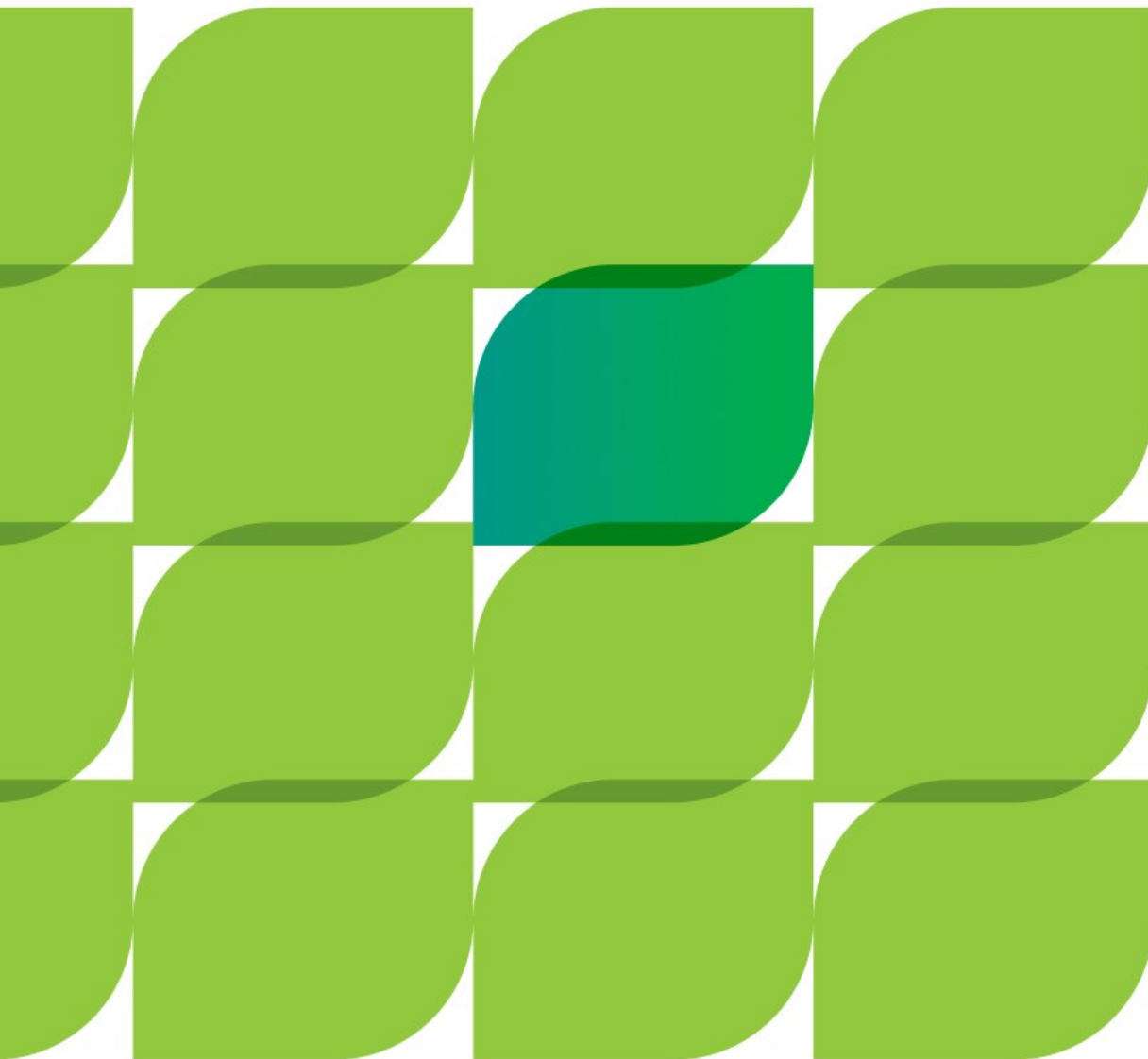


# D2.1 Roles and Skills Needs Analysis Report

**The roles and skills for digital professionals providing  
sustainability solutions**



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## About the Digital4Sustainability project

Digital4Sustainability is a pioneering initiative aimed at accelerating Europe's twin transition by equipping the workforce with the essential skills needed to drive sustainability-focused innovation. In response to the pressing need to achieve climate neutrality and meet the Sustainable Development Goals (SDGs), the project will develop a forward-thinking Digital Sustainability Skills Strategy as well as cutting-edge learning programmes. These efforts will address the urgent and emerging skills needs of the European industry, empowering the workforce to develop sustainable technologies that support Environmental, Social, and Governance (ESG) practices. By aligning closely with industry needs throughout the project, Digital4Sustainability will help European companies, particularly small and medium-sized enterprises (SMEs), achieve long-term competitiveness and growth through digital and sustainable transformation.

Funded by the Erasmus+ Programme of the European Union, this 4-year project unites 29 members of the Digital Large-Scale Partnership (Digital LSP) under the Pact for Skills, spanning 13 EU countries. The consortium includes digital and sustainability experts, business associations, universities, and Vocational Education and Training (VET) providers.

# The Digital4Sustainability Project Consortium

The Digital4Sustainability project consortium is an Erasmus+ Alliance for Sectoral Cooperation on Skills, bringing together 29 partners and Associated partners from 13 EU countries.

	Partners	Acronym	Country
1	Adecco Formazione Srl	Adecco Training	Italy
2	Adecco Italia Holding Spa	Adecco Holding	Italy
3	As Bcs Koolitus	BCS KOOLITUS	Estonia
4	Asociatia Cluj IT	CLUJ IT CLUSTER	Romania
5	Badgebox Srl	BadgeBox	Italy
6	CEFRIEL Societa Consortile A Responsabilita Limitata	CEFRIEL	Italy
7	Cooperatie Eduserpro U.A.	Eduserpro	Netherlands
8	Digital Technology Skills Limited	DTSL	Ireland
9	DIGITALEUROPE AISBL	DIGITALEUROPE	Belgium
10	European DIGITAL SME Alliance	DIGITAL SME	Belgium
11	Fast Lane Institute For Knowledge Transfer GmbH	FAST LANE	Germany
12	Gospodarska Zbornica Slovenije	GZS CCIS	Slovenia
13	Gospodarska Zbornica Slovenije Center Za Poslovno Usposabljanje	GZS CPU	Slovenia
14	IVSZ – Digitalis Vallalkozasok Szovetsege	IVSZ	Hungary
15	Matrix Internet Applications Limited	MATRIX INTERNET	Ireland
16	National College of Ireland	NCI	Ireland
17	Profil Klett D.O.O.	PK	Croatia
18	Sdruzenie Bulgarska Asociacia Na Softuernite Kompanii – Basscom	BASSCOM	Bulgaria
19	Stichting Hogeschool Utrecht	HU	Netherlands
20	Tekenable Limited	TEKenable	Ireland
21	Universidad De Alcala	UNI ALCALA	Spain
22	Universidad Internacional De La Rioja SA	UNIR	Spain
23	Universität Koblenz	UNI KO	Germany

**24** National University of Science and Technology Politehnica Bucharest POLITEHNICA Bucharest Romania

	<b>Associated partners</b>	<b>Acronym</b>	<b>Country</b>
<b>1</b>	Asociacija Infobalt	INFOBALT	Lithuania
<b>2</b>	SKILLNET IRELAND Company Limited By Guarantee	SKILLNET IRELAND	Ireland
<b>3</b>	The Council of European Professional Informatics Societies	CEPIS	Belgium
<b>4</b>	Universidad Complutense De Madrid	UCM	Spain

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## List of abbreviations and acronyms

Abbreviation	Term
<b>CEDEFOP</b>	Centre Européen pour le Développement de la Formation Professionnelle
<b>CEN</b>	Comité Européen de Normalisation
<b>CODES</b>	Coalition for Digital Environmental Sustainability
<b>CSR</b>	Corporate social responsibility
<b>CSRD</b>	Corporate Sustainability Reporting Directive
<b>e-CF</b>	European e-Competence Framework (EN 16234-1)
<b>EQF</b>	European Qualifications Framework
<b>ESCO</b>	European Skills, Competences, Qualifications and Occupations
<b>ESG</b>	Environmental, social, and governance
<b>HE</b>	Higher Education
<b>SDGs</b>	Sustainable Development Goals
<b>SMEs</b>	Small and Medium-sized Enterprises
<b>STEM</b>	Science, Technology, Engineering, and Mathematics
<b>VET</b>	Vocational Education and Training
<b>WP2</b>	Work Package 2 "Needs Analysis & Digital Sustainability Skills Strategy for Europe"



# 1. Scope of the needs analysis

A needs analysis is a first step in a Blueprint project to determine the needs that must be addressed in the project. Therefore, it is the first task in Work Package 2 “Needs Analysis & Digital Sustainability Skills Strategy for Europe” (WP2). The end result is this deliverable “D2.1 Needs Analysis Report”.

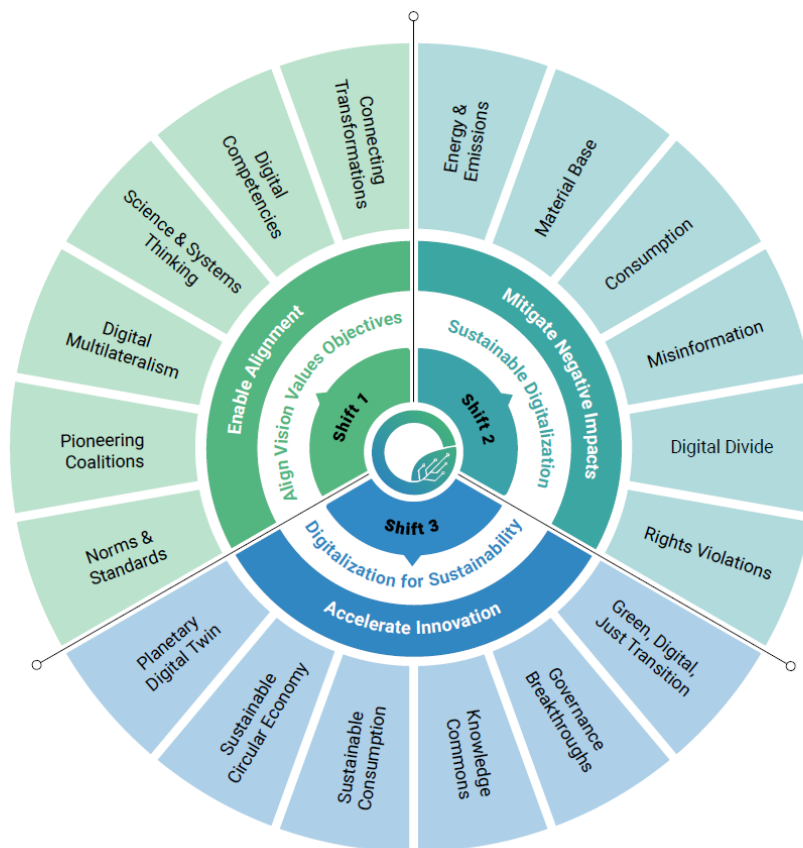
This deliverable will be input for the next phase of WP2, the Digital Sustainability Skills Strategy (D2.2 European Digital Sustainability Skills Strategy). Also, this deliverable stands as a pillar for the activities in the rest of the project. It forms the foundation for the developing the learning-outcome-based curricula and learning programmes.

## 1.1 The CODES framework

The first thing that needed to be determined was the focus within the field of the twin transition. A good starting point for this demarcation is the CODES framework<sup>1</sup>. This framework defines digital sustainability as the design, development, deployment and regulation of digital technologies to secure sustainable economic, environmental and social development. Sustainability is clearly defined as covering all the Sustainable Development Goals (SDGs), and not just focusing on environmental goals.

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<sup>1</sup> Coalition for Digital Environmental Sustainability (CODES). (2022). Action Plan for a Sustainable Planet in the Digital Age. <https://doi.org/10.5281/zenodo.6573509>



**Figure 1 The CODES Framework**

The framework distinguishes three shifts in digital sustainability:

**1. Align vision, values, and objectives**

The first shift is to align the vision, values, and objectives of the digital age with sustainable development. This convergence of digitalisation and sustainability is the prerequisite for accelerating environmentally, socially and economically sustainable development.

**2. Sustainable digitalisation**

The second shift entails that digital infrastructures, software and applications are socially responsible, ethical and environmentally sustainable throughout their lifecycle. Its aim is to reduce the negative environmental and social impacts of digitalisation.

**3. Digitalisation for sustainability**

This final shift is about digital innovation that seeks to proactively enable, accelerate and scale environmentally and socially sustainable development. It focuses on digital solutions to reach sustainability goals on organisational and societal level.

The first shift is important, but not the main focus of the project. Elements of this shift, such as building pioneering coalitions, connecting communities and transformations, and adopting norms and standards, will be part of the project but mainly as a prerequisite for the other shifts.

The second shift of sustainable digitalisation is also important, but would entail a focus on the ICT/ digital sector itself, as it concerns digital infrastructures, software, and applications. It does not focus on how digitalisation could support organisations and society to become more sustainable, which is the name and the aim of the project. This shift is a prerequisite for a successful third shift, so attention to aspects of this shift is still needed, but will not be the main focus.

The focus on the third shift “digitalisation for sustainability”, is therefore unavoidable. The examples of the framework already provide starting points for relevant topics like digital twins, the sustainable circular economy, and sustainable consumption. It is about how the ICT/ digital sector is able to design, develop and deploy the tools that help society in general and organisations of all sectors specifically, become more sustainable. Of course, this includes also the ICT sector itself, as digital solutions should be sustainable themselves as well.

**Digital4sustainability focuses on the digitalisation for sustainability shift.**

## 1.2 Target groups for education and training

Skills development can be aimed at different target groups. The figure shows the four levels of potential target groups for education and training of skills related to digital for sustainability.



**Figure 2 Potential target groups for education & training**

One of the main goals of Blueprint projects, including this one, is to educate and train people to become professionals in the sector. This means that the education and training should focus mainly on the highest level of specialisation being the digital for sustainability professionals, including future professionals in this field.

It can be argued that professionals dealing with digital for sustainability issues, like SME owners, organisational decision makers, and governmental policy makers, are important for guiding the twin transition, and especially the digital for sustainability shift, in the right direction. This level will therefore also be included in the initial needs analysis. The levels of working people in general and of the general public, will not be targets in this project.

**Digital4sustainability focuses on current and future digital for sustainability professionals and on professionals directly involved with digital for sustainability topics, in terms of education and training.**

### 1.3 Relevant roles

The ICT/ digital sector has already developed occupational and role profiles, but profiles specifically focused on how the ICT/digital sector can contribute to sustainability, have not yet been developed. Initial desk research was conducted to determine which roles are already defined as important and should be studied further. The role profiles were defined in more detail during the needs analysis. The starting point for formulating role profiles was the e-CF<sup>2</sup> (the EU standard for ICT professionals), the CEN ICT professionals role profiles<sup>3</sup>, and relevant occupations defined in ESCO<sup>4</sup>. The role profiles will include relevant competences and related skills.

A distinction was made between the two levels of target groups: the (future) digital for sustainability professionals and professionals dealing with digital for sustainability issues. On the

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<sup>2</sup> CEN/ TC428. (2019). EN 16234-1: e-Competence Framework (e-CF) – A common European Framework for ICT Professionals in all sectors. Part 1: Framework.

[https://standards.cencenelec.eu/dyn/www/f?p=205:110:0:::FSP\\_PROJECT:67073&cs=15E62ED24D608A5F10D6BEE8E6D50FA10](https://standards.cencenelec.eu/dyn/www/f?p=205:110:0:::FSP_PROJECT:67073&cs=15E62ED24D608A5F10D6BEE8E6D50FA10)

<sup>3</sup> CEN Workshop Agreement. (2018). CWA 16458-1: European ICT professionals role profiles – Part 1: 30 ICT profiles. [https://www.cencenelec.eu/media/CEN-CENELEC/AreasOfWork/CEN%20sectors/Digital%20Society/CWA%20Download%20Area/ICT\\_SkillsWS/16458-1.pdf](https://www.cencenelec.eu/media/CEN-CENELEC/AreasOfWork/CEN%20sectors/Digital%20Society/CWA%20Download%20Area/ICT_SkillsWS/16458-1.pdf)

<sup>4</sup> European Commission. (n.d.). European Skills, Competences, and Occupations classification (ESCO) Retrieved October 11, 2024, from <https://esco.ec.europa.eu/en>

one hand roles like digital sustainability consultant, sustainability data analyst, and software developer for sustainability. On the other hand, there are roles like organisational decisionmakers like CEOs, SME owners, and department heads, and roles like policymakers on local, regional, national, and European level.

Complete role profiles will be defined for the digital for sustainability professionals, since these professionals should be able to fulfil a role in the digital for sustainability field.

For professionals dealing with digital for sustainability issues, role profiles will not be defined, since digital for sustainability is just a (small) part of their role. Instead, only the groups of roles will be identified to allocate relevant digital for sustainability related skills to different target groups.

**Digital4sustainability defines role profiles for digital for sustainability professionals.**

## 1.4 Relevant skills

It is important to understand the roles needed in connection with digital for sustainability, but equally important is information about the skills needs. This information is important, for example, to determine where upskilling and reskilling learning programmes should focus. Based on the initial general desk research a set of digital for sustainability-related skills was selected for further study in the rest of this skills needs analysis. The skills for digital for sustainability professionals will become part of the role profiles. The most important skills for professionals directly dealing with digital for sustainability topics, will be identified, so they can be included in upskilling and reskilling programmes.

**Digital4sustainability identifies the digital for sustainability related skillsets needed by digital for sustainability professionals and professionals directly dealing with digital for sustainability topics.**

## 1.5 Level of analysis

The Skills Needs Analysis provides essential input for the Digital Sustainability Skills Strategy. The need for digital for sustainability roles and skills is not bounded by borders, so the need is international, and people can find opportunities throughout Europe. The most important level will therefore be the aggregated European level. At regional and national levels, specific needs may differ, although they are part of this bigger picture. This will be relevant when specific

curricula are designed based on the specific, local situation. Therefore, needs will also be analysed at the national level, but this is not the main target of this needs analysis.

**Digital4sustainability has a focus on the European level and take into consideration local, specific situations when relevant.**

## 1.6 About this document

The rest of this document describes the results of the needs analysis. The first section presents the main takeaways arising from this needs analysis, offering clear actionable insights based on the triangulation of the results of the individual methods used in this study. The following section explains the approach, setup, and execution of this multi-method study. The section after that presents the results of the data collection for each of the methods.

The main findings section that follows presents the main conclusions drawn from each individual method used in the study. In this section, references have been omitted to enhance readability. Naturally, all statements are underpinned by sources, and those references can be found in the annexes. Each annex provides a detailed description of the complete outcomes of each method used in the study.

The final sections of the document contain the glossary, references of the main document, and an overview of the annexes.





## 2. Key takeaways

### 2.1 Awareness should be raised on digital for sustainability

The twin transition narrative also brought new terminology and inevitably this led to misunderstandings and different interpretations. The digital for sustainability shift is one of the three shifts of the twin transition, and the focus of this project. To achieve this shift, a multi-level transformation is needed. On an instrumental level, it is about how digital solutions can support reaching sustainability goals. The contribution of the digital sector to sustainability is something that needs attention and elaboration.

#### 2.1.1 Managers and business owners need to know the possibilities of digital solutions to support sustainability

Managers mainly in medium and large organisations and business owners mainly of small organisations need to make decisions on sustainability. They need to know how digital solutions can assist them in making and implementing those decisions. This translates into raising awareness and in a need for use cases and business models. Besides this, knowledge and skills on topics like the possibilities of digital solutions, the role of data, laws, regulations & standards, Sustainable Development Goals (SDGs), CSR policy, and ESG reporting, is also needed.

#### 2.1.2 There should be specific attention to digital for sustainability

Overall, sectoral, regional, national, and European digital strategy documents, sustainability strategy documents and other sources like for example labour market reports don't pay attention to digital for sustainability. In most cases, it concerns information on the digital sector

and information on sustainability activities, but hardly ever they are presented as interrelated or as a coherent interconnected approach. This is somewhat strange because this is the essence of the twin transition narrative. The few reports that address the topics together do so with a narrow focus, like for example carbon footprint or the energy efficiency of IT. It is needed that the field of digital for sustainability gets attention in these kinds of relevant reports to showcase the important contribution it has on the sustainable digital society.

## 2.2 It is about roles, not occupations

An occupation is the job a person fulfils, and this can consist of multiple roles. Especially in many SMEs, a digital for sustainability role often is just one of the several roles a person may have. For example, a SME owner is the digital sustainability lead for their organisation, but that is of course not the only role this owner has. Also, in other organisations the focus is shifting from occupations to roles with specific skillsets. Looking at mobility, it is also becoming more relevant what kinds of roles somebody fulfilled than the specific occupation or job title. Therefore, it is not about occupations but about roles. These roles in the field of digital for sustainability are emerging, but are not yet well established.

### 2.2.1 10 digital for sustainability roles

Digital for sustainability professionals are professionals who can contribute to sustainability using digital solutions. These are emerging digital/ ICT-related roles in a specific area. This is why the starting point in defining these roles are the CEN European ICT professional role profiles. These standard roles can be specified for different specialisations, in this case digital for sustainability. There are ten roles defined and confirmed as relevant by this study. Roles in the area of management and consultancy are digital sustainability lead, manager, and consultant. Looking at data processing and analysis, the roles are sustainability business analyst, data scientist, data analyst, and data engineer. Finally, the application development and operations related roles are sustainable solution designer, software developer for sustainability, and sustainability technical specialist. More information on these roles can be found in annex.A.

### 2.2.2 M-shaped professionals are needed

Digital for sustainability professionals should be specialised in multiple fields. Traditionally, people were specialised in one field without being able to look beyond their field (I-shaped). It became clear that people need to be able to communicate with other specialisations (T-

shaped) and preferably are specialists themselves in two fields ( $\pi$ -shaped). Nowadays there is a need for professionals that have specialist competences in even more fields. This is the case for digital for sustainability. Somebody should be specialised in digital, in sustainability, and thirdly in the field of application, for example agriculture, energy, or finance. These professionals with three specialisations are called M-shaped professionals. This is a minimal requirement for people working as real digital for sustainability professionals. Professionals with even more specialisations can be useful as well and are referred to as comb-shaped professionals.

### 2.2.3 Digital sustainability leads and managers are needed within organisations

The digital sustainability lead is the person, or are the persons, in an organisation that drives digital for sustainability forward. They are essential in making sure that organisations use the potential of digital solutions to achieve sustainability goals to the fullest. Digital for sustainability managers are responsible for driving this forward on a structural, ongoing basis. Especially the digital sustainability lead is already present in organisations, but also a lot of organisations want to have one now or in the near future by upskilling people in the organisation or hiring new staff.

### 2.2.4 Consultants are needed to advise

There is too little knowledge and skills in a lot of organisations to implement digital solutions to achieve the sustainability goals. Also, it is not feasible for a lot of organisations to hire the right people that can advise on this matter. This opens a need for digital for sustainability consultants. This need has already been recognised by consulting firms who are looking to hire these digital sustainability consultants to advise their clients. Organisations are indicating they need these consultants to advise them, especially on topics related to laws, regulations, and standards. The organisations that indicate this consultancy need are mainly SMEs.

### 2.2.5 Data related roles will increase in importance

There will be a significant demand for all data related roles put together. Data analysis is important to determine factors like environmental impact and evaluate the efficiency of sustainability initiatives within business processes. This type of analysis is only possible if reliable data is generated and captured. Most digital solutions for sustainability depend for a large part on reliable data and the analysis of that, and this leads to a dependence on people who can execute these analyses.

## 2.3 Digital professionals need sustainability skills and sustainability professionals need digital professional skills

Upskilling digital professionals with sustainability knowledge and skills is the quickest way to fulfil the need for digital for sustainability professionals. It is also possible to upskill sustainability professionals with the skills needed for digital professionals. Since the core of the digital for sustainability shift is digital solutions, it is logical that this takes more effort, since digital professional skills are more dominantly important in these roles. Reskilling people from other fields is also an option, which will require even more effort, but is needed given the shortage especially in the digital sector. The emergent nature of the field complicates this upskilling because it is not crystallised yet what skills are exactly needed in different roles and contexts, like regional circumstances, different sectors, and company size. Having said this, there are some clear indications that are good starting points.

### 2.3.1 Digital professionals all need basic sustainability skills

A starting point for upskilling digital professionals to digital for sustainability professionals is that all digital professionals have basic sustainability knowledge and skills. This includes general knowledge on laws, regulations, and standards, but also skills on digital professional specific topics like sustainable IT operations and development, and ICT energy consumption and carbon footprint. After this first step, a smaller group of digital professionals can be upskilled further to become real digital for sustainability specialists.

### 2.3.2 It is more than ESG reporting or carbon footprint

A lot of the current need for skills is concentrated on topics like ESG reporting and carbon footprint. Looking at ESG, it is primarily focused on the environmental element and less on the social and governance aspects. Also, in the environmental element, the focus is on topics like carbon footprint at the expense of other, equally stringent environmental topics. This narrows the scope too much and undervalues important Sustainable Development Goals. Topics like for example ICT for development, the digital divide, and social inclusion & gender equality should not be overlooked when skilling digital for sustainability professionals. On the contrary, it is helpful to highlight these topics to raise awareness about the broadness of digital for sustainability.

### 2.3.3 Legislation related skills remain important

Laws, regulations, and standards on sustainability are still increasing, and are a very important driver for organisations. It is of course vital that digital solutions are always in line with the latest developments on this. Therefore, both digital professionals and professionals dealing directly with digital for sustainability topics should be regularly upskilled on these developments.

### 2.3.4 Data related skills are important for analysis and reporting on sustainability

It is evident that for analysing and reporting on sustainability, there is a need for data related skills. This is especially important in areas like impact measurement or a more specialised topic like carbon data modelling & scenario planning. Additionally, these skills are important for other topics related to sustainability like social inclusion, smart cities, waste minimisation, and energy efficiency.

### 2.3.5 Working in teams and communication are key transversal skills

Although it's important to have professionals who are skilled in all aspects of the solution they design, develop and/or implement, it is inevitable that given the complexity of these solutions, people have to work in teams with people with different specialisms and different strong point in their skillsets. Teamwork and more general communication skills are therefore key to achieving sustainability goals with digital solutions.

### 2.3.6 A holistic view and willingness to learn are essential for the digital for sustainability shift

Leaders of the digital for sustainability shift, such as digital sustainability leads, need a holistic, overarching view connecting the dots between different topics and fields. All digital for sustainability professionals and others dealing with these topics, need to have a willingness to learn and embrace continuous learning. It is essential to keep up with the latest developments, and to unlearn the old and learn the new.

## 2.4 Sustainability should be integrated in the education of digital professionals

Sustainability should not be treated like any other topic. It is of the greatest essence for our future. It should become an integral part of any education, especially when educating and training future digital professionals. It should be integrated in all learning units of a digital professional education. This lays the groundwork for digital professionals who want to contribute to sustainability goals, and make it their field of expertise.

### 2.4.1 Develop sustainability elements as soon as possible

In many cases, it is not possible to completely change a learning programme quickly. Therefore, the fastest way to introduce more sustainability topics into the education of digital professionals is to develop add-ons like courses on important sustainability topics, and incorporating sustainability into examples, case studies, and assignments as a main topic. Also from the other perspective, in sustainability education there should be courses on the possibilities of digital solutions. This could bring the two fields closer together to really make it a twin transition.

### 2.4.2 Make sustainability the topic of cases and assignments in as many as possible learning units

The integration of sustainability in the education of digital professionals can be facilitated by making sustainability the topic of practical projects and hands-on learning activities. For example, using case studies on digital sustainability solutions instead of other fields like finance or marketing, or developing a simple digital sustainability solution as an assignment instead of one for retail or e-commerce.

### 2.4.3 Cooperation between education and organisations is key

Organisations need more people with digital for sustainability skills, and educational institutes are important partners in fulfilling these needs. Collaboration between education and organisations is key equipping people with the right skills. Education should constantly be aware of what skills are needed, and organisations should provide opportunities to develop and practise these skills in real life situations. This should be supported by networks that also include research institutes, policy makers, and trade organisations.

## 2.5 Training should be modular and short

A complaint in a fair share of organisations is that employees just don't have time for upskilling. Also, organisations don't have time to organise, and people don't feel like having a lot of training. Besides this, everybody has different backgrounds and experiences, so the kind and amount training will vary from person to person. Upskilling should therefore be modular and short. The preferred approach is through internal training or by on-the-job coaching, but time constraints and the fact this requires the organisational coaches to be skilled first, makes this challenging. This creates opportunities for innovative approaches offered by learning providers.

### 2.5.1 All digital professionals need to be trained on sustainability as quickly as possible

The urgency to become more sustainable is high. For society in general, for organisations, for professionals in general, and for digital professionals. The sooner digital professionals become more aware of the importance of sustainability, and are upskilled in this area, the better. This starts with the basic sustainability skills that all digital professionals should have.

### 2.5.2 Certifications are the preferred way to prove digital for sustainability skills

It is important to organisations that people can prove they possess digital for sustainability skills. The preferred method to do that is through certifications, for example in the form of micro-credentials. Therefore, assessment as confirmation of acquired learning outcomes, is vital to professionalise the field of digital for sustainability.

## 2.6 An emerging field requires updating

The final takeaway is that this field of digital for sustainability is clearly a new, emerging field. This requires updating of the needs on a regular basis, since they could already be shifting as you read this. The key skills are identified and the prediction is they will remain relatively stable, but some new will be added and some will become less relevant. The roles are expected to be less stable especially on the specific tasks and competences needed in specific roles. Both roles and skills should be monitored, and the needs analysis should be updated regularly, to be sure that the right, most relevant upskilling and reskilling learning programmes are designed, developed and delivered.



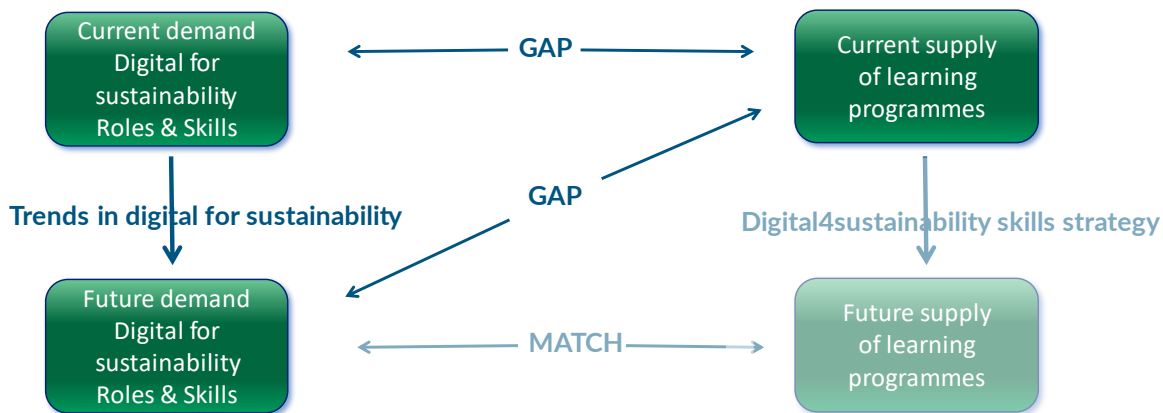
### 3. Methodological approach

The skills needs analysis focuses on the current and the future requirements for digital for sustainability roles and skills and the nature of the skills shortage that need to be addressed.

This consists of the following steps:

1. Firstly, establishing the current demand for digital for sustainability roles, competences, skills and knowledge.
2. Secondly, forecast the future demand for digital for sustainability roles, competences, skills and knowledge. Due to factors like European goals of achieving climate neutrality by 2050 and seizing the opportunities of the digital decade, along with the increasing importance of sustainability and digital on both political agendas and public opinion, it is expected that this demand will continue to increase and also evolve in the coming years, but this needs to be underpinned.
3. The third step of the analysis is to identify the existing supply of learning programmes to determine to what extent current education and training meets the demand.
4. By mapping the existing supply and triangulating between methods, the gap between current and future demand can be determined. This triangulation forms the final part of the needs analysis and leads to the main takeaways. This is a crucial starting point in determining how the Digital Sustainability Skills Strategy can successfully match future supply with future demand.





**Figure 3 Elements of the skills needs analysis**

The three elements that function as input for the gap analysis (current demand, future demand and current supply) all need different data to provide an overview of the situation, so a gap analysis can be conducted. Therefore, a methodology has been developed that includes different data collection techniques and different target groups.

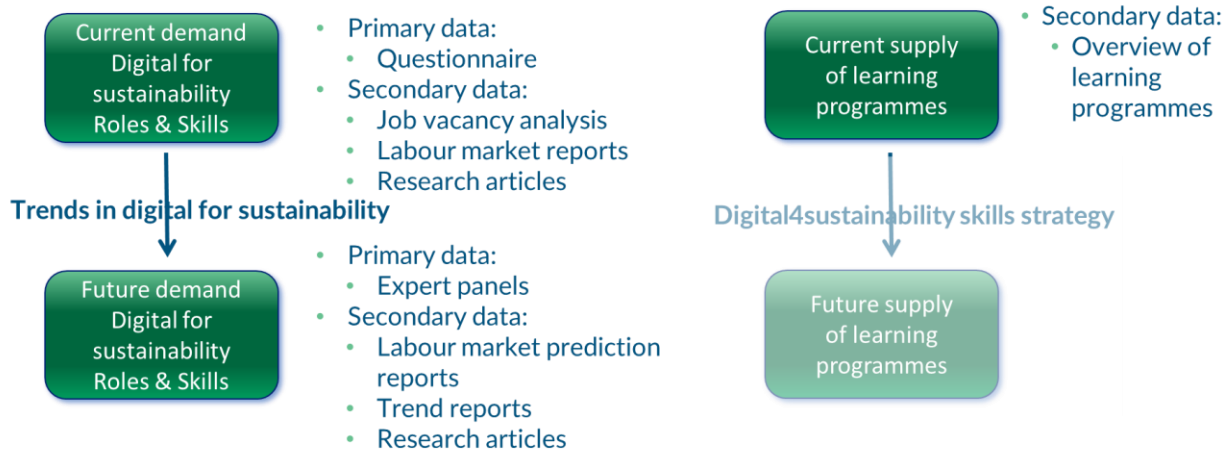
Trends in digital for sustainability themselves are not an object of study in this needs analysis. They are of interest only in so far as they act as drivers for the future demand. The focus is on the future need for digital for sustainability roles, competences, skills and knowledge resulting from these trends, so an analysis of the potential future skills gap can be made. However, key trends are identified, as they could indicate specific current or future demand.

## 3.1 Multi-method approach

A multi-method approach as the name suggests, involves using more than one method of research to reach conclusions. This can include both quantitative and qualitative methods. The approach allows the use of methods that best suit the kind of data you want to collect and analyse. The analysed data from each method is brought together by method triangulation. This involves analysing whether the results of different methods support or contradict each other. Following this, conclusions on the needs analysis as a whole can be drawn leading to key takeaways.

### 3.1.1 Data collection methods

By applying standard multi-method methodology and considering such as collecting data at the appropriate level and triangulation, it is possible to specify which data collection techniques are most appropriate for each element of the skills needs analysis.



**Figure 4 Data collection methods**

The overview shows that secondary data collected via desk research is an important part of the data collection in every element of the analysis. There is some data about the current and future market demand, and the project could benefit from this research by investigating these sources.

Current and future demand can also be studied through a questionnaire, while future demand can be further studied using a method suited for investigating predictions involving expert opinions. Current supply can be fully studied through desk research supplemented where necessary by questions to specific suppliers. This leads to the following data collection techniques used in this analysis. The methods will be discussed in greater detail later in this document, but in short, it is about:

1. Desk research on current and future demand

The desk research consisted first of all of studying scientific articles on twin transition-related, and more specific digital for sustainability roles, skills, and competences. The second part of the desk research involved the collection and analyses of job market reports and trends reports. The articles and reports should be focused on the current needs and/or future needs.

2. Job vacancy analysis

The analysis of job vacancies provides insights on the current demand for digital for sustainability-related roles and skills. The choice was not to be this through crawling/scraping, since there are methodological limitations to the automated approach (like for example most of these tools can only process English job vacancies and the rest still

needs to be done manually). An extra consideration is that the field of digital for sustainability is not crystallised yet, and therefore there is no unity in terminology which makes it very hard for automated tools to find and select all the relevant vacancies. Therefore, the job vacancy analysis was done based on manual collection of job vacancies.

### 3. Questionnaire

A questionnaire was distributed to organisations with digital for sustainability skills needs in order to ask them about their current and predicted future demand for digital for sustainability roles, competences and skills.

### 4. Desk research on current supply

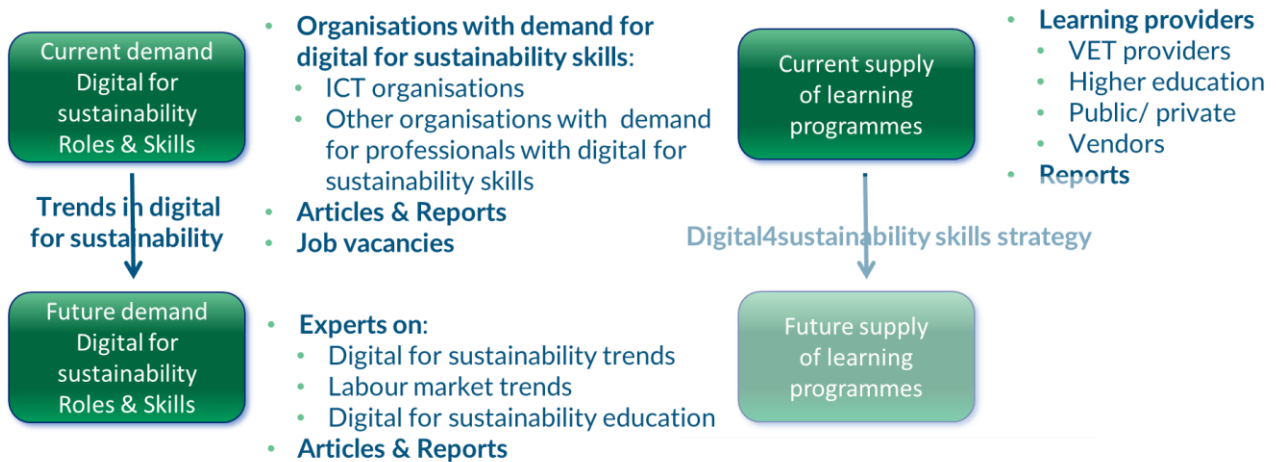
The current supply consists of a number of different learning programmes on different levels (EQF 4 to 8) and by different kinds of providers (public and private HE institutes, public and private VET providers, in-company providers like corporate academies, vendors of digital sustainability solutions etc.). Desk research is used to get an overview of this supply on a national level.

### 5. Expert panels

There are several effective methods for making qualitative predictions and utilizing an expert panel stands out as a time-efficient approach that yields rich, high-quality data. Furthermore, well-organised expert panels can serve as valuable tools for fostering collaboration in this domain, both nationally and at the European level.

## 3.1.2 Data sources

In a multi-method approach, multiple groups of data sources are used, and samples of these groups can be selected in different ways. The details will be presented later when each method is described in more detail, but in brief these are the data sources:



**Figure 5 Data sources**

1. Articles and reports

The focus is on articles and reports on the need for digital for sustainability professionals, roles and skills on a national level. Also, articles and reports that focus on the broader field of (ICT) labour market can be relevant if they touch upon the field of sustainability.

2. Organisations with demand for digital for sustainability skills

These are first of all IT organisations operating in the field of sustainability (selling ICT solutions that support sustainability), but also other organisations that have a need for their own digital for sustainability professionals.

3. Experts

Experts can come from organisations that need skills for digital for sustainability, as well as highly respected ICT, twin transition, and more specific digital for sustainability trend watchers and academics. Experts on more general labour market trends and experts on education and training can also add value.

4. Learning providers

The population on the supply side consists of suppliers of training and education in digital for sustainability skills, ranging from EQF levels 4 to 8. This supply is offered by both public and private sector learning providers like universities, VET providers, training providers, vendors and suppliers of internal staff training.

## 3.2 Literature review

The academic literature was reviewed to assess the state of the art and triangulate this with the other methods to distil starting points for the development of the skills strategy. The focus was broad and multidisciplinary, with seeking articles that discuss the following topics (in isolation or in combination):

1. the twin transition and the way it develops (for which a range of alternative search terms were used as twin transformation, dual transformation, digitainability, sustainable development and digitalization, green jobs and technology);
2. a focus on skills, competences, abilities or capabilities, both on an individual and organisational level in relation to the twin transition;
3. the job market in relation to the twin transition;
4. education in relation to the twin transition.

All academic partners added to a shared database, which helped to prevent regional and disciplinary biases. Articles came from the members' databases and networks, were found through Google Scholar, and through snowballing with tools like 'Research Rabbit'.

In terms of quality of the sources, the preference was to include peer-reviewed articles, (academic) book chapters, and PhD-theses only. However, due to the nascency of the field, it was deemed essential to include conference proceedings in the scope. As a measure of quality, we did solely include those conference papers that have a permanent digital identifier like DOI, ISBN or arXiv.

## 3.3 Labour market reports

It was expected that up-to-date labour market reports with relevant information are not readily available, if at all, given the emerging nature of the field compared to other fields. To address this, initial general desk research was conducted to determine available sources mainly at the European level. Similarly, at the national level, partners were asked to search for labour market reports on digital for sustainability, but if these were not available, they were asked to write a short report on at least the current state of the digital sector and the field of sustainability in general.

The initial desk research focused on pre-existing information on skills, mostly at the European level, and on delineating the roles and skills that are most relevant and worth studying in the rest

of this skills needs analysis. Previous projects and studies were examined to avoid duplication and determine the most efficient approach.

European and more specific national labour market reports were studied to gain insights into the current labour market. The twin transition labour market was analysed in as much detail as possible. If there was any doubt whether an item should be included in the study, the basic rule was to include it. In most cases, labour market reports were too general to identify specific job and skill needs related to digital for sustainability. In that case, or if no reports had been distilled from data, partners were asked to find European, but especially national databases on their labour market and more specifically the labour market of the twin transition. No such databases on twin transition were found in any of the countries.

### 3.4 Questionnaire

Besides desk research, the questionnaire was the other main technique to gather input on current demand. In addition, the questionnaire was also used to understand the expectations about what the future demand will be. Therefore, the main question to be answered by the questionnaire was: "What are the current and future roles and skill needs for digital for sustainability professionals in organisations that have a need for these professionals?". The questionnaire consisted mainly of multi-select questions, as well as ranking questions, questions with a Likert scale and some open questions. The implementation of the questionnaire basically consisted of three steps: selecting the sample, collecting the data and analysing the data.

The population of the questionnaire consisted of organisations in need of skilled digital for sustainability professionals. This is the starting point finding and selecting organisations for the sample. Given the generally low response rate to questionnaires, it was advised to add as many organisations as possible to the sample. The questionnaire was distributed using social media channels and the networks of the contributing partners of the consortium. The questionnaire was provided in English, and EU Survey was the online tool used to collect the data. The questionnaire can be found in the annex questionnaire.

Contributing partners were asked to aim for at least 30 respondents each. While this is not a large enough sample to draw statistical conclusions at the national level, it is large enough to give indications, while the sample size will be large enough at the European level.

The data were analysed using several techniques. In addition to descriptive statistics, to describe the characteristics of the sample, it was checked whether moderating variables (such as type of organisation, organisation size, etc.) affect the results of the questionnaire. Other inferential tests, such as correlation tests and regression tests, were not considered relevant given the nature and purpose of the questionnaire as part of a multi-method approach. The questionnaire served as one of the inputs for determining the current and future skills demand for digital sustainability professionals, and no hypothesis testing was intended.

### 3.5 Job vacancies

The analysis of vacancies provided insight into the current demand for digital for sustainability roles and skills. The vacancy analysis was carried out on the basis of manually collecting vacancies. There were a number of reasons for this. Most importantly, there are several major methodological limitations to the automated approach, such as the fact that most of these tools can only process English-language job ads. Moreover, the project does not provide budget to hire an external organisation to do this via crawling/ scraping.

The main focus was on the roles that resulted from the initial desk research. Additionally, any other role directly related to a digital solution for a sustainability challenge was considered relevant. The data were collected using a qualitative approach that involved manually checking whether a vacancy was really about digital for sustainability and what skills were actually relevant in those vacancies. This ensured that the right vacancies were analysed and that vacancies in the national language could be included in the study. A template was used to collect the data. The analysis of the data provided an overview of the most commonly found roles and skills in terms of descriptive statistics.

### 3.6 Supply of education & training

The supply side consisted of educational offerings on digital for sustainability skills. The first focus was that the learning programmes are at VET (EQF 4/5) or higher VET (EQF 6/7) level. These learning programmes can be offered by public and private universities, VET providers, training providers, vendors or in-house training departments.

To gain an overview, the current supply was mapped. This was done by extracting information from websites, brochures etc. A template was used to provide the necessary information needed for the analysis of every offering. If the information about an offering could not be

completed with the available documentation, the provider was approached and asked about the missing information.

The analysis consisted of an overview of the offerings with relevant clustering to provide insight in the supply.

### 3.7 Expert panels

Expert panels are a widely used method to gain insight into future situations. With this method, experts synchronously discuss possible future scenarios on a specific topic during meetings. The aim is to reach a consensus, but it is also possible that the outcome consists of two or more scenarios. In each country of the consortium, national panels of experts were organised by the partner(s) in that country. In addition to the national expert panels, a European expert panel was also held to validate and generalise the results of the national expert panels and the other data collected and analysed.

The invited experts were experts on digital for sustainability in general or on labour market and/or education trends. These were for example questionnaire respondents that have a good insight into future developments, but also other experts from the marketplace, governmental institutions, NGOs, or academia.

Per country, partners were asked to organise at least one expert panel meeting with 8 to 15 participants.

The expert panel meetings followed the format of a relatively open questioning of experts, where experts were given the opportunity to share their thoughts on the current demand, to express their expectations regarding future demand, and engage in discussion about it. The panel moderator(s) steered the discussion in the right direction by asking open-ended questions related to current and future digital sustainability roles, skills and education/training needs. To achieve consistency among the expert panels, a protocol was used for moderating an expert panel meeting, including preliminary guiding questions. The meetings were held in the local language. A format was used for reporting the results of the national expert panel meetings, with a description of the discussion, key findings and relevant quotes. The reporting format was accompanied by a guideline to ensure as much consistency between the panel reports as possible. The reports were written in English.

The analysis of the expert panels provides an overview of the opinions of experts on the future demand of digital for sustainability roles, competences, skills and knowledge.





## 4. Results of data collection

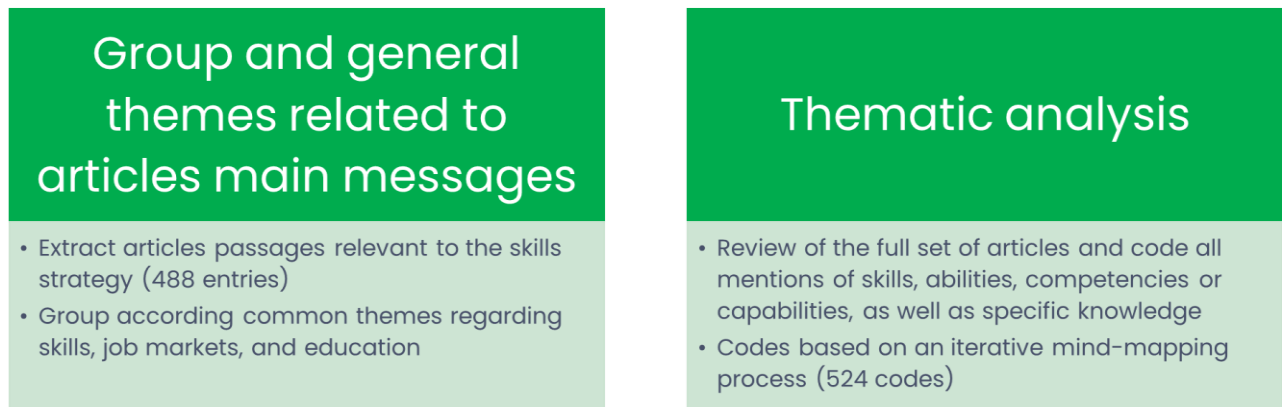
In this section, the results of the data collection of the individual methods will be presented. The overview below briefly shows all the results after which for each method the details are presented.

Method	Data collected
<b>Literature review</b>	70 scientific articles analysed (+ 6 articles on frameworks)
<b>Labour market reports</b>	42 reports analysed in detail (of 98 initial sources)
<b>Questionnaire</b>	181 responses in dataset (of total of 242 respondents)
<b>Job vacancies</b>	117 vacancies analysed in detail (of 164 initial vacancies)
<b>Supply of education &amp; training</b>	157 learning programmes analysed
<b>Expert panels</b>	90 experts in 12 national expert panels + 15 experts EU panel

Figure 6 Overview collected data

### 4.1 Literature review

The final database consisted of 70 articles, covering a wide range of sectors and countries. The oldest article was written in 2019, with the majority being published in 2023 or 2024. An overview can be found in Appendix A. In addition, 6 articles have been included in the review, which share frameworks on either sustainability or digital skills. As the separate fields have evolved further than the literature on skills for twin transition (or digital sustainability skills), these frameworks have been used as reference materials during the analysis of the 70 core articles. The analysis of the database was conducted in two different, complementary ways.



**Figure 7 Two steps approach of the literature analysis**

Firstly, (i) all articles have been read in full and any passages that could be relevant to the skills strategy have been copied to an Excel file. The file consisted of 488 entries. As a next step, the main messages were grouped together, to distil common themes in the literature regarding skills, job markets, and education.

Secondly, (ii) a thematic analysis was conducted by reviewing the full set of articles to code all mentions of skills, abilities, competencies or capabilities, as well as specific knowledge that was necessary. In coding only those pieces of text that were based on original empirical or conceptual work were included (which means not part of a general introduction or literature review section). This limitation resulted in only 42 articles providing input for the thematic analysis. For each specific piece of information on skills or knowledge that was based on original work, a quote was recorded in an Excel spreadsheet. A code was attached to capture the focus of the quote, staying close to the original wording. Where possible several quotes were merged into a similar quote, but only when this did not illude the specificity of each of the codes. A total number of 524 codes were developed in this process. And for each code, the region, sector, and unit of analysis were noted in the Excel file.

Next, a process of categorizing started. The original codes were grouped and organised in an iterative process. To make sense of the data, multiple hierarchical layers were created to catch different levels of abstraction. A data structure of 6 levels was established, with level 1 referring to the basic code 2 resulting in hierarchical layers. During this process, six levels of abstraction were established, with level 1 representing the original codes representing the specific quotes, and level 6 being the highest-level group of 'twin transformation competences' capturing all the codes together.

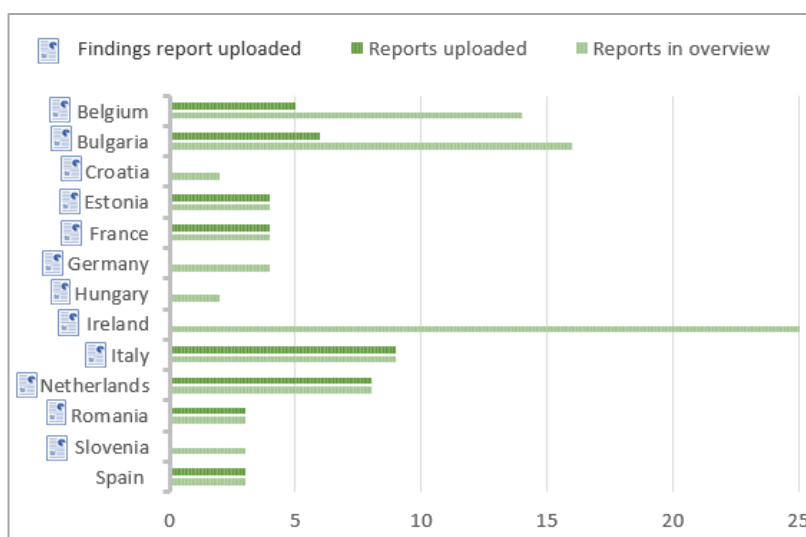
To smoothen the analysis process of the large dataset, first a subset of 18 random articles has been analysed through the process described above. In developing the codes and different hierarchical levels and naming them, the 6 articles addressing either sustainability or digital skills were used as reference. As a next step, the remaining articles were coded with the preliminary coding scheme, while finetuning and adding onto the scheme when necessary.

The initial plan was to, as a last step of the thematic analysis, compare the results on the different units of analysis, region, and sector. However, considering a skewed distribution of codes of the different categories and specification information lacking in part of the articles, this comparison was not feasible with the current dataset. Also, given the variety of contexts and roles the articles focus on, counting the different mentions of specific skills was not meaningful. The result of the analysis is hence a mapping of all the twin transition skills as mentioned in the reviewed database resulting from earlier research.

## 4.2 Labour market reports

Beforehand the expectation was that this would be the most difficult data-collection method, since the field of digital for sustainability is not a separate part of the labour market. Also, the twin transition is mainly just covered by information from the digital sector and the sustainability sector put next to each other. This expectation turned out to come true.

In total 98 sources were found that were related to the national labour market situations in the consortium countries. There were no reports dedicated to the labour market situation of the twin transition, but some included information on both digital and sustainability jobs. In some cases, only information from national digital and national sustainability strategies was available.



In total 42 sources were considered relevant and were used for more detailed analysis. For twelve of the consortium countries an initial findings report was drafted, in which the situation in the country was sketched based on the available sources.

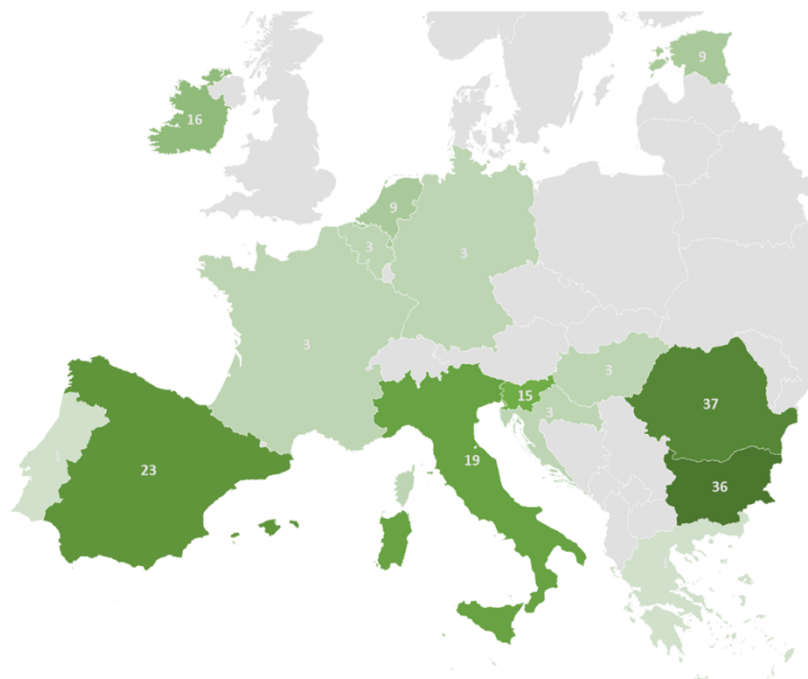
Figure 8 The input for the labour market analysis

### 4.3 Questionnaire

The questionnaire was distributed by consortium partners via social media, emails, and personal contact between 16 June 2024 and 12 July 2024.

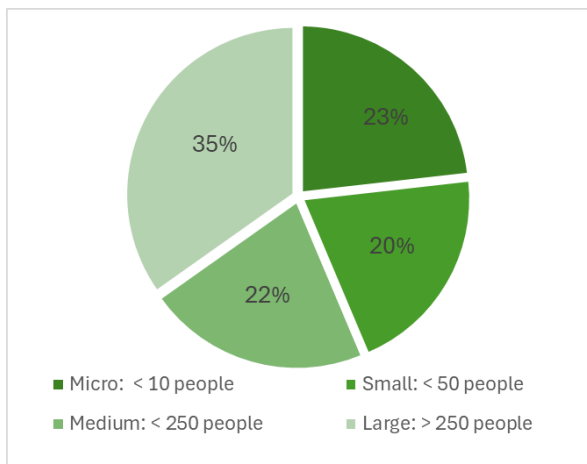
This resulted in over 1000 people clicking on the link or scanning the QR-code. There were 936 engagements using the official bit.ly link and an unknown amount using the original EU-survey link. There were 242 respondents of which 61 did not finish the complete questionnaire. This means that the final dataset contains 181 responses. On a 95% confidence level, this leads to a 7.3% margin of error.

The most responses came from Bulgaria and Romania, followed by Italy and Spain. There are fewer responses from smaller countries like Slovenia, Ireland, and Estonia, which could be explained by their population size. Unfortunately, it turned out to be difficult to get responses from the large countries France and Germany. Although it is not a perfect distribution across the countries of the consortium partners, there is still input from



— **Figure 9 Respondents distribution across consortium countries** —

all consortium countries. This in combination with the fact that the country of the organisation is not the most important characteristic for this study, makes that this does not hinder drawing conclusions from this analysis

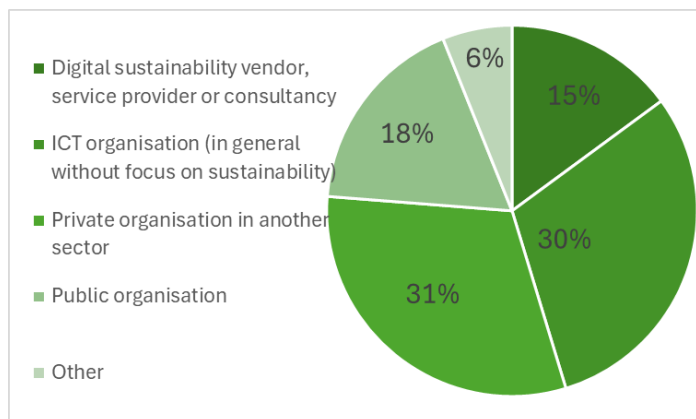


**Figure 10 Number of employees in respondents organisation**

Another characteristic of the respondents is the size of the organisation they work in. In total 65% of the respondents are representing SMEs, being organisations with less than 250 employees. This almost evenly spread between micro (< 10 people), small (<50 people) and medium (<250 people) size organisations. The fact that 35% of the organisations are large organisations means that they are overrepresented in this study, since only 0,2% of the organisations in the EU are large organisations<sup>5</sup>. A possible explanation could be

that large organisations have more interest in this topic given for example that they have to comply with CSRD rules which (unlisted) SMEs don't<sup>6</sup>. In any case, this is something to take into account when analysing this data since it is very well possible that SMEs and large organisations have different needs for digital4sustainability roles, skills and education & training.

It is also relevant to have a brief look at the kinds of organisations that responded. Looking at relevant categories of organisations most responses were from general ICT organisations and private organisations in other sectors with still also 15% organisations that specifically focus on digital sustainability as a vendor, service provider or consultancy. With also almost 20% of the respondents from public organisations, it is a good mix of sorts of organisations with no direct concerns about the influence this might have on findings.



**Figure 11 Types of organisations**

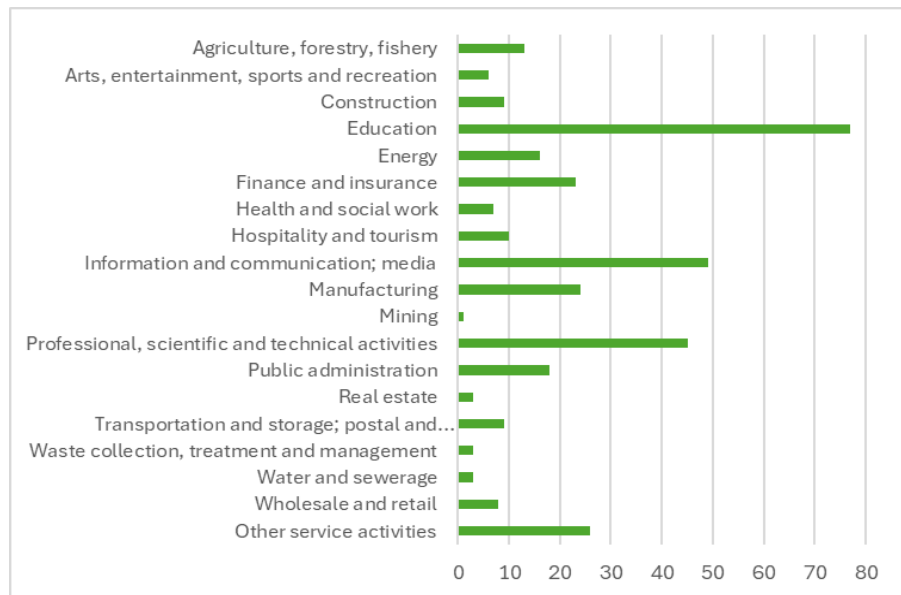
<sup>5</sup> Eurostat. (2023, December 12). Large businesses generated half of EU's net turnover.

<https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20231212-1>

<sup>6</sup> European Commission. (n.d.). Corporate sustainability reporting. Retrieved October 11, 2024, from

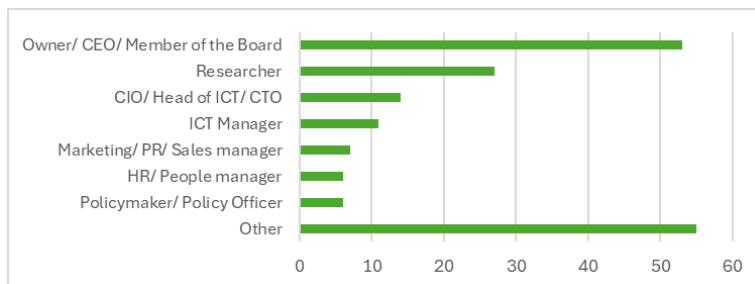
[https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting\\_en?prefLang=en](https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en?prefLang=en)

The respondents also indicated the sector or sectors<sup>7</sup> their organisation is active in. The sector most mentioned is education, which indicates an over-representation of educational institutes. This also seems to be the case for the ICT sector, but that is logical given the fact this



**Figure 12 Sectors in which organisations are active**

study is about the digital field. Other sectors that are represented well are agriculture, energy, finance and insurance, manufacturing, and public administration. Besides the over-representation of the education sector, there are no other points of attention for the analysis.



**Figure 13 Roles of respondents in their organisation**

Looking at the last interesting aspect of the respondents, being the roles the respondents have within their organisations, there are a lot of owners and CEOs that

respond themselves potentially indicating the importance of the topic.

It is also good to see that people responsible for digital within their organisation like CIOs and ICT managers have responded. Finally, it is clear that researcher are overrepresented in this study, which is consistent with the fact that the education sector is overrepresented.

<sup>7</sup> Eurostat. (2008). NACE Rev. 2. Statistical Classification of Economic Activities in the European Union. Office for Official Publications of the European Communities, Luxembourg.

<https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF>

## 4.4 Job vacancies

It was discussed in the methodology that the job vacancy scraping should be done manually, so just looking for job postings by searching job portals. This process led to 164 job vacancies in twelve countries.

Besides this, an experiment was conducted in one country whether it was possible to scrape the job vacancies automatically using tools that are also used and proven valid for established fields. This led to 146 potential vacancies of which after first screening only 19 turned out to be potentially relevant. After further screening this was reduced to two vacancies directly related to digital for sustainability and seven others that are potentially or partly related to it. This confirmed the correctness of our starting point that in an emerging field like this, it is not (yet) possible to successfully implement automated AI powered scraping tools.

The original list of job vacancies was again analysed on relevance which again led to a reduction of the dataset ending up with 117 job vacancies to be analysed in depth. These vacancies were published between 20 May and 23 July in the thirteen consortium countries.

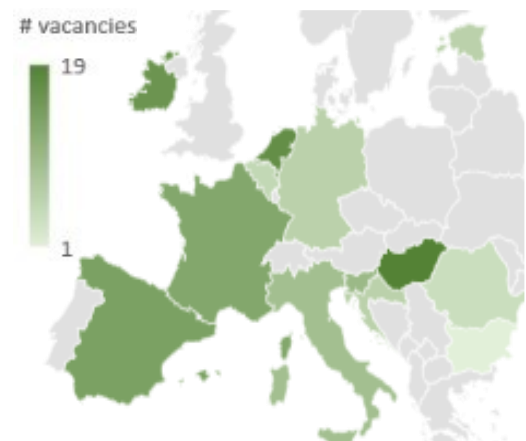


Figure 14 Job vacancies in countries

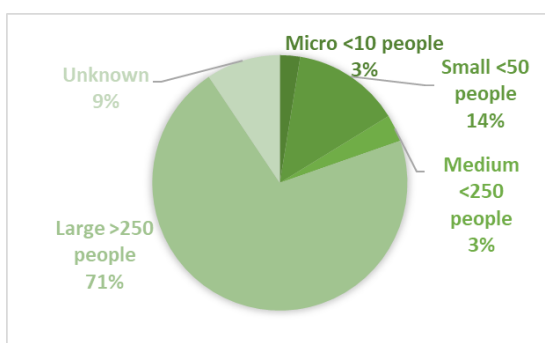


Figure 15 Organisation sizes of job vacancies

A more important statistic in this context is that 71% of the job vacancies are positions in large organisations. This is a disproportional amount of job vacancies, since only since only 0,2% of the organisations in the EU are large organisations<sup>8</sup>. This can be explained by the fact that job vacancies are per definition for jobs which is different from roles. A role can be fulfilled by a person in an organisation

who also has other roles, which will logically be more the case in smaller organisations. To have a specific job for a digital for sustainability role, will sooner be in the case in larger organisations.

<sup>8</sup> Eurostat. (2023, December 12). Large businesses generated half of EU's net turnover.

<https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20231212-1>



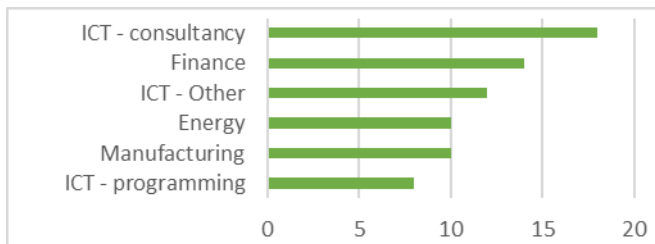


Figure 16 Job vacancies by sector

Most of the job vacancies are in ICT organisations (32%) when looking at the sectors that the organisations are in. Besides ICT also the financial, energy, and the

manufacturing sector are represented well.

All other sectors only had a few, one, or even

no vacancies. For example, the healthcare sector, but also the water and the waste sector did not have any digital for sustainability vacancies in the time frame of this study.

## 4.5 Supply of education & training

A total of 157 learning programmes were collected and analysed, spread across the consortium countries. Most of these programmes are offered by public institutes (81%), followed by private providers (18%), and only one percent of the analysed programmes being in company programmes. This can be explained by the fact that information of in company learning programmes is less available. The analysed learning programmes are mainly at master level (66%) with another 23% at bachelor level.

Given the nature of the programmes, it is logical that most of them result in a degree (79%) and only some of them with a certificate (15%).

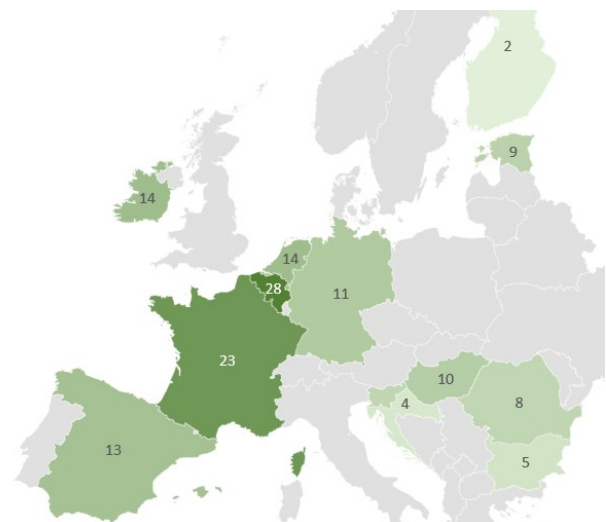


Figure 17 Distribution of analysed learning programmes across countries

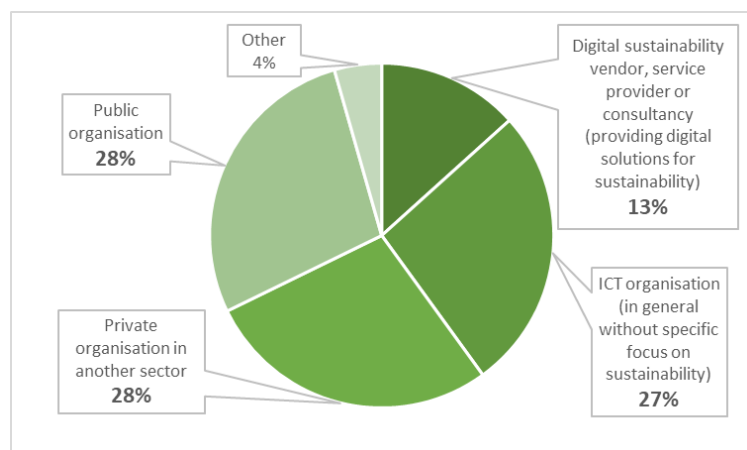
## 4.6 Expert panels

There are national experts panels held in every country in which the consortium has at least one partner. This resulted in 90 experts participating in 12 national expert panels. Although the methodology prescribes that it should be panel meetings in some cases this was (partly) replaced with individual interviews. This leads to slightly different results because of the different dynamics between researcher and respondent but given the choice between no input from an



expert or a slightly different way of data collection, the choice was made to get their input using individual interviews.

A portion of the experts are active in a specialised digital sustainability vendor, service provider, or consultancy.



**Figure 18 Types of organisations experts are active in**

A larger group works at a general ICT organisation, which does not mean that they themselves are not specialising in digital for sustainability. Others are active in a private organisation in another sector or at a public organisation of which most are in education. In total 27% of the respondents work in education, which also explains why 21% of the experts are researchers. The other

roles experts have within their organisation vary from CEO or owner (29%) to more specific digital sustainability roles (36%) like ESG director, project manager sustainable IT, and sustainability expert. The owners are mostly owners of micro-organisations which make up 20% of the organisations in which the experts are active in. Overall, 38% of the experts are part of a large organisation, so 62% in SMEs. The sectors the organisations are active in, besides education, are mainly ICT (19%) or in the sector "other service activities" (38%) which consist of digital sustainability service providers, amongst other services.

The EU expert panel consists of 15 experts from 12 countries. It is a mix of professors, CEOs, and other professionals that all are active in the combination of the fields of digital and sustainability.



## 5. Main findings

The main findings section will first present a summary of the findings of each of the methods. The more extensive analysis of each of the methods can be found in the annexes. The section will end with the triangulation of the methods leading to overall findings which are the underpinning of the key takeaways

### 5.1 Literature review

The literature clearly indicates that the **twin transition is expected to fundamentally change institutions, companies, and labour markets**. At the same time, the twin transition is still in an **early stage**. Only few companies are on a fundamental level embracing and synchronizing a digital and sustainability transformation. **Awareness, use cases and business models are called for to inspire action**.

On the other hand, **companies are already experiencing skills shortages in the field of digital and sustainability transformation**. Working on the twin transition requires more and a larger variety of skills, as the literature shows. This is associated with higher education levels. As the digital transformation at the same time is expected to lead to a reduction of low-skilled labour, which requires limited creativity, an urgent skill gap is apparent. Institutes of higher education need to alter curricula and ways of teaching but cannot keep up with the fast pace of technological development. Also, re- and upskilling of the existing workforce would not be achieved by only altering formal education. Therefore, **collaborative efforts between educational institutes, companies, trade organisations, and other local partners are necessary to tackle this challenge**.

The thematic analysis has delivered an overview of **an enormous number of different skills** mentioned in the literature. Looking at the overall data structure, it seems obvious that it is **impossible to expect the full skill set in a single employee**. Also, not all skills will be necessary in every role, for example consider technological skills which cover a range of specific applications, or skills like virtual product design or governance. It is noted furthermore that part of the skills needs have been identified on an organisational level ('organisational capabilities'), and others on the level of individual employees, which calls for specification in developing skill profiles. A complicating factor is, however, that research into the twin transition is far from satisfactory to a level that clear differentiations per sector, or type of company can be made. Also, it is not clear at this point which new roles or jobs will arise. This establishes which skills are needed for which job profiles cannot be established based on the current knowledge base. It is even indicated that companies also do not exactly know which skills they need, and hence are not able to assess possible skill gaps. This highlights the need to increase the insights in this field.

On a positive note, there is **clear overlap with both digital transformation and sustainability skills, which means that companies can build on an existing set of skills**. On the other hand, it is yet unclear what is needed to create synergy out of a combination of skills, or what changes when existing skills are applied in a different domain. This again requires additional research.

In terms of recommendations this literature review therefore firstly calls for **active cooperation between multiple stakeholders, including research institutes, trade organisations, policymakers, and companies to build the knowledge necessary for tailored roles and associated skill sets**. This could for instance be done starting with reviewing the current European e-CF profiles. Considering the swiftly evolving field of the twin transition (both in practice and academia) new developments should furthermore be actively monitored and integrated into a skills strategy.

What is convincingly argued in the literature, is that **transversal and soft skills, and (ecosystem) cooperation skills** are needed for many workers in the twin transition. On the other hand, **basic digital skills are also likely to be essential in any twin transition role**. It is therefore suggested that a skills strategy taps into this need, in order to reduce the anticipated skills gap proactively. Companies that already need a specific set of job-related skills can currently provide on-the-job training to build on a general skills foundation.

Also, there is a clear call for the role of leadership, entrepreneurship and development of use cases. While developing use cases and business models is outside of the direct scope of the

Digital4Sustainability project, searching after cooperation with other twin transition initiatives or educational institutes can be beneficial. Furthermore, raising awareness, sharing inspiring examples, and the identified knowledge needs can be seemingly integrated in a skills strategy.

A final message that clearly speaks from the literature is that there **cannot be a 'one-size-fits-all' in re- and upskilling for the twin transition**. This has to do with different regional circumstances, different engagement in the twin transition of sectors, company size, and the maturity level of an organisation or existing organisational capabilities. In a skills strategy it would be wise to take these differences into account

## 5.2 Labour market reports

As for the labour market in the field of digital sustainability, the demand for skilled workers in this field is expected to grow strongly in the coming years.

If the trend continues, it is expected that for some sectors the demand will even be so high that it cannot be met. Demand is already disproportionately distributed across different sectors and will continue to be so, with some sectors experiencing less to no demand. While some job losses are anticipated, overall the impact is expected to be positive.

Exactly how big the demand for digital sustainability will be is difficult to say based on currently available data. In general, data is available on labour market developments in ICT and data is available on the growing demand for 'green occupations', but exact data on digital and sustainability is lacking. For all countries, the demand for both skilled ICT staff and staff skilled in sustainability is expected to continue to grow.

There will be a particular demand for skilled staff in sustainability in relation to the **circular economy** (especially focused on **supply chain** and **waste management**), **energy and utilities** (**solar, wind and climate technology**), **logistics and transport** and **construction**, and to a lesser extent in **agriculture** and **manufacturing**. **Sector-specific sustainability skills** will increasingly be in demand.

Overall, the service sector is expected to be little affected by the green transition, with the exception of **finance, law, architecture, science, engineering** and **ICT**.

There are emerging professions in this area, such as **environmental consultants (ESG)**, **carbon auditors**, **responsible digital educators** and **responsible digital managers**. **Data managers**, **middle managers** and **HR managers** will be particularly affected. In the ICT field, greater demand is expected for professionals skilled in **developing environmentally sustainable**

**solutions** and **refining existing systems for greater sustainability and efficiency**, with positions such as **software analysts, ICT systems analysts, cyber security specialists, testers** and **data analysts**. Also, skills in **green marketing** and **sustainable supply chains** are emphasised.

This is strongly linked to European laws and regulations such as the EU Corporate Sustainability Reporting Directive (CSRD), the EU Corporate Sustainability Due Diligence Directive (CSDDD), the EU Packaging and Packaging Waste Regulation (PPWR), the Ecodesign for Sustainable Products Regulation (ESPR), and the EU Emissions Trading System (EU ETS), to name a few (details can be found in for example the overview of [initiatives included in Europe's Green Deal](#)<sup>9</sup> and Deloitte's [Sustainability Regulation Outlook](#)<sup>10</sup>).

Overall, the demand for STEM skills in general is expected to increase, along with professional, transversal and lifelong learning skills. And also, that a combination of more traditional skills with new skills and soft skills will be needed. In many countries, the retirement of the current workforce plays a role in the growing labour shortage.

Several reports also highlight the need to upskill and reskill the current workforce in digital and sustainable skills. Many countries have introduced incentives.

For example, manuals are provided on (upcoming) workforce development. In a number of countries, reasonably standardised role descriptions are available and sometimes teaching and training materials. Role descriptions can serve as a basis for HR policies and for curriculum design by education and training providers. In some cases, teaching materials are already available for primary education. It also happens in some countries that there is even already a legal requirement to include the topic of sustainability in all curricula of formal education. There are also other measures, such as vouchers and subsidies.

Every country has formulated both a digital strategy and a strategy focused on sustainability. These documents have generally been developed by different government departments and sometimes appear to be completely separate. However, the more recent the versions of these

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<sup>9</sup> Council of the European Union. (n.d.). European Green Deal. Retrieved October 13, 2024, from <https://www.consilium.europa.eu/en/policies/green-deal/>

<sup>10</sup> Brennan, S. et al. (2024). Sustainability regulation outlook 2024. Deloitte Insights. <https://www2.deloitte.com/us/en/insights/environmental-social-governance/sustainability-regulation-outlook.html>

strategies are, the more the overlap between the two areas is addressed in these strategies, i.e. a discussion of sustainability aspects in the digital strategy and vice versa.

When digital and sustainability are discussed together, the recommendations still mainly focus on the carbon footprint and energy savings; broader aspects with themes such as ethics, privacy and inclusiveness are often left out, with a few exceptions. A 'just' transition that does more justice to the broad scope of the SDGs is on the digital sustainability agenda in only a limited number of countries.

Recommendations on digital, in particular, vary widely between countries, due to large differences between the extent to which a country is digitally developed. There is also variation in the approach to sustainability. This is where the nature of business activities and sector organisation come into play, e.g. certain sectors are more represented in one country than another and one country has more SMEs than another. This means that issues and challenges, and thus recommendations and actions, may differ to a greater or lesser extent from country to country and often from region to region.

### 5.3 Questionnaire

The findings of the questionnaire are organised according to the three main elements of the needs analysis: digital for sustainability roles, skills, and education & training.

#### 5.3.1 Roles

Currently, the digital sustainability lead is the role of all roles studied that is already most present in organisations (see figure). This is followed by other organisation-oriented roles

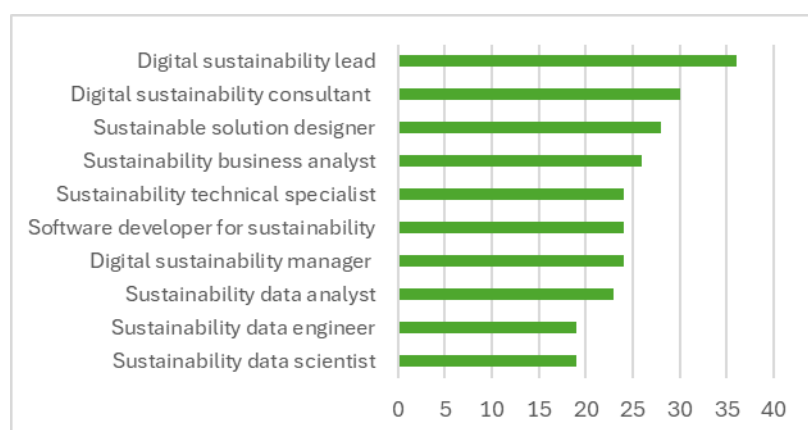


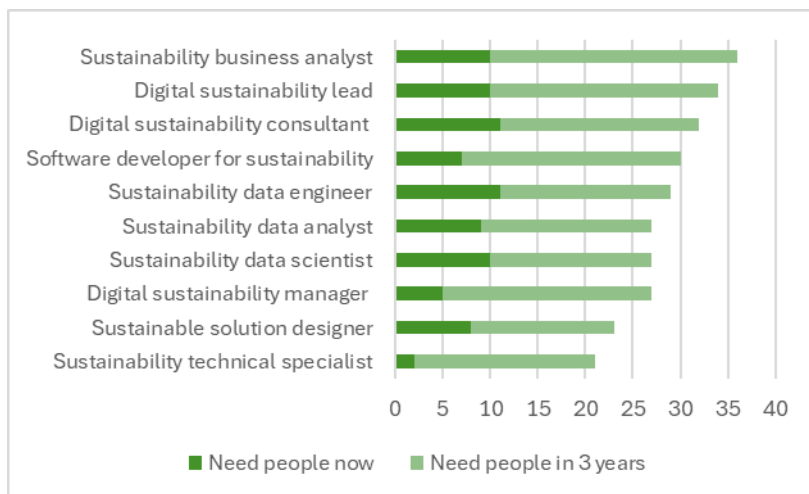
Figure 19 Roles already present in organisations

digital sustainability consultant and sustainability business

analyst. The more technical roles like sustainable technical specialist and software developer for sustainability are somewhat less present at the moment. Sustainability data roles, being

sustainability data analysts, engineers, and scientists, are the least present at organisations at the moment.

This picture only changes slightly looking at the current need and the need in the near future

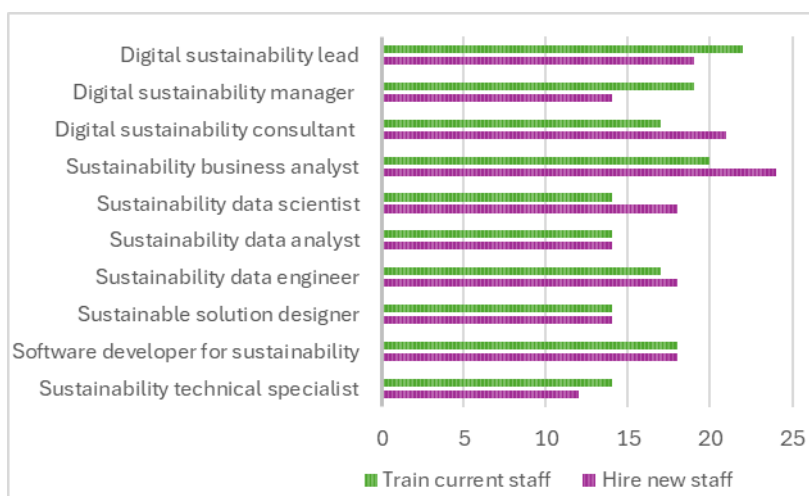


**Figure 20 Needs for people in roles now and in three years**

(see figure). The sustainability business analyst, digital sustainability lead and consultant are needed by the most organisations now and in the next three years. What is different is that quite a few organisations are searching now for sustainability data engineers,

analysts, and scientists. This indicates there could also be an urgent need for people that can fulfil these roles, since they are already present in only a few organisations in comparison, but organisations are looking for these kinds of specialists. There is a less urgent need for specific technical specialists and software developers, although it is expected that the demand for software developers for sustainability will pick up in the coming

years.



**Figure 21 Train or hire new staff**

Analysing how organisations are planning to cover the need for these roles, it shows that it is both popular to train current staff and to hire new staff (see figure). On the one hand internal upskilling is in comparison considered more important for roles like digital sustainability lead and manager, while on the other hand roles like sustainability business analyst

and data scientist are more likely to be hired externally. It seems logical that this is also the case for consultants.

### 5.3.2 Skills

The next step of the analysis is to identify what are the most important sustainability related skills and knowledge that are needed in these digital sustainability roles (see figure). This can be divided into specific sustainability topics and more transversal skills needed in the area of

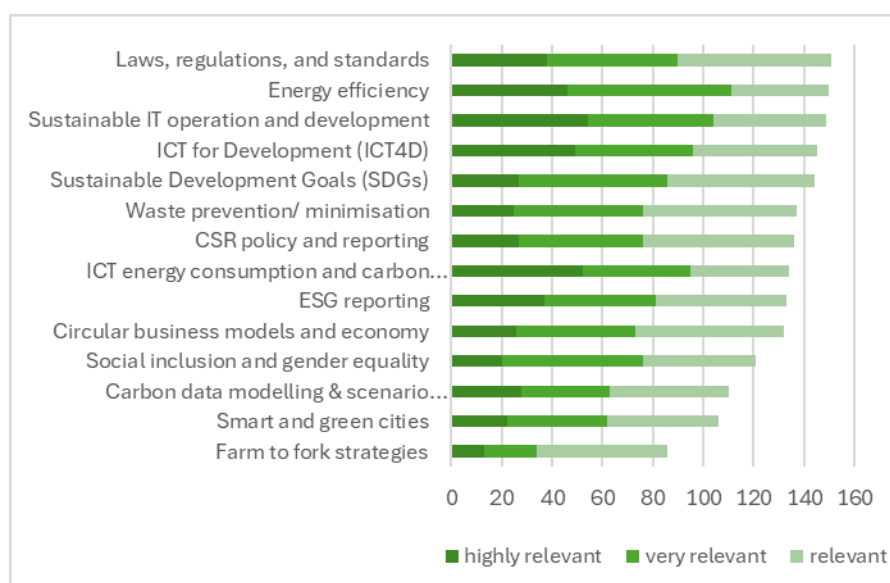


Figure 22 Relevant sustainability-related skills and knowledge

digital for sustainability.

The first set of specific sustainability skills and knowledge shows that when talking about more overall, general topics, laws, regulations, and standards, are considered to be relevant for the largest number of organisations. Other

related topics like Sustainable Development

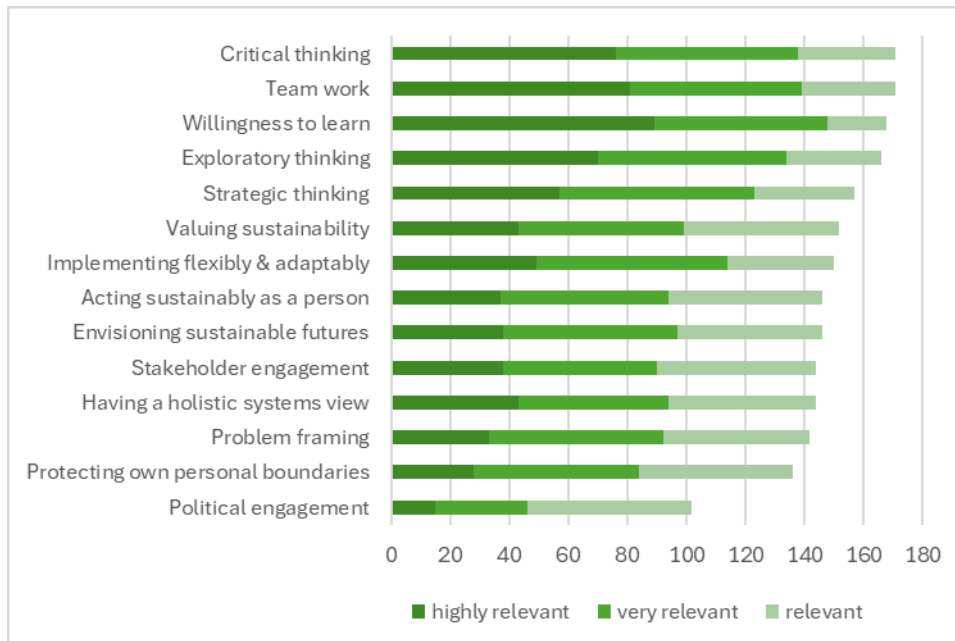
Goals, CSR policy and reporting, and ESG reporting are also considered relevant, but none of these topics are often mentioned as being highly relevant. This suggests these topics are relevant as basics but are not specifically at the core of what is needed.

Looking at sustainability areas energy efficiency and ICT for development score the highest. Areas like social inclusion and gender equality are rated somewhat less relevant, but specific areas like smart cities and farm to fork strategies are even less relevant. This can be explained by the fact that not every organisation is involved in these kinds of areas and therefore not many organisations consider them to be relevant.

The ICT-industry-related topics of sustainable IT operations & development, and ICT energy consumption, & carbon footprint are considered highly relevant by many respondents.



The transversal skills and attitudes show that especially the very general skills that don't have a direct relationship to sustainability are considered the most relevant (see figure). These are skills like critical thinking, teamwork, willingness to learn, exploratory thinking, and strategic thinking.



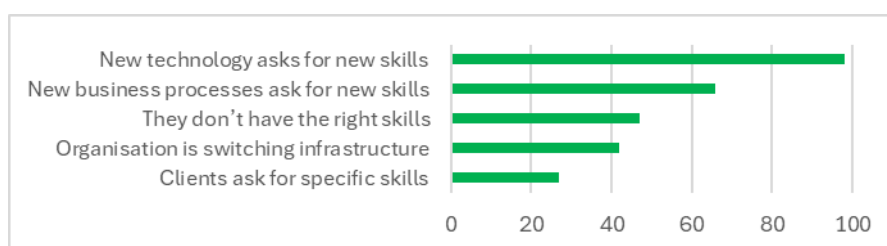
**Figure 23 Transversal skills needed in the area of digital for sustainability**

Looking at the sustainability related transversal skills and attitudes, valuing sustainability is the most important. Acting on that and show sustainable behaviour, is considered less important, while having a vision on sustainable futures is considered as

relevant as acting sustainable. The aspect that is considered way less important is having political engagement to support sustainable action. Although well over 90% of the respondents think that the more general skills are relevant, still over 80% of the respondents think that specific sustainability related skills and attitudes are needed for people that are working in digital for sustainability.

### 5.3.3 Education and training

The final main topic of the questionnaire is the views of the respondents on education and training of skills to professionals working or aspiring to work in the field of digital for sustainability.



**Figure 24 Reasons for having to train people**

The first topic is about why people in organisations need to be upskilled (see figure). The most popular reaction is that simply new

technology asks for new skills. Besides other reasons it is also important to notice that over 40 respondents indicate that people don't have the right skills when starting a job. This indicates that in a lot of cases it is not possible to find people that are already skilled sufficiently, which suggests a shortage of skilled professionals in the field. This could mean that people are not equipped with the right skills after formal education in some cases.

Almost of a quarter of the respondents state that their organisation has a backlog in training. Mainly this is because of a lack of time. Equally, organisations don't have time to organise training and most importantly people have no time to do it. A smaller group even reports resistance towards training. Other issues are that organisations have no people to train others, and also that there is no (external) training available for the required skills, while a smaller number of respondents indicate that training is too expensive. These last points suggest there should be training available in an accessible way for the important sustainability related skills. The first points add to the fact that training should be flexible, short, modular learning, so that it can fit into the schedules of learners.

The next question was who you are going to train the right skills to be able to fulfil the digital for sustainability roles? (see figure)

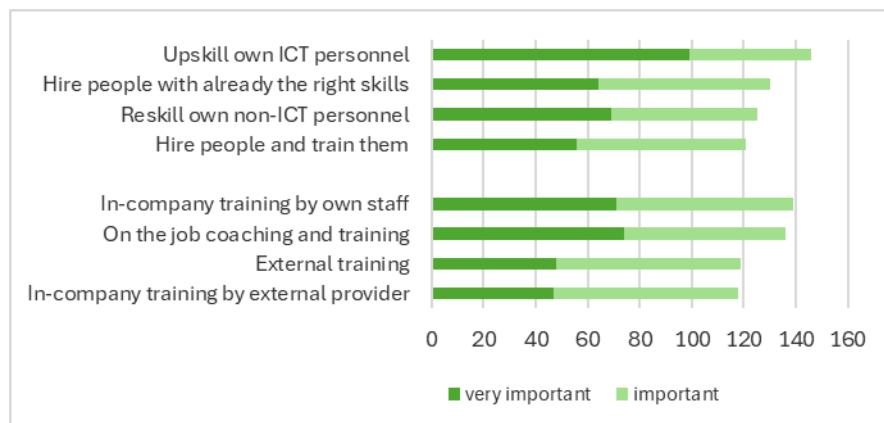


Figure 25 Who to train and how?

Most respondents indicate that upskilling own ICT personnel is the most important target group for training. Also, reskilling own non-ICT personnel is an option less preferred than ICT personnel, but still considered an important

option. It is somewhat remarkable that there is hardly any difference between hiring new people with the right skills and hiring people who need to be trained.

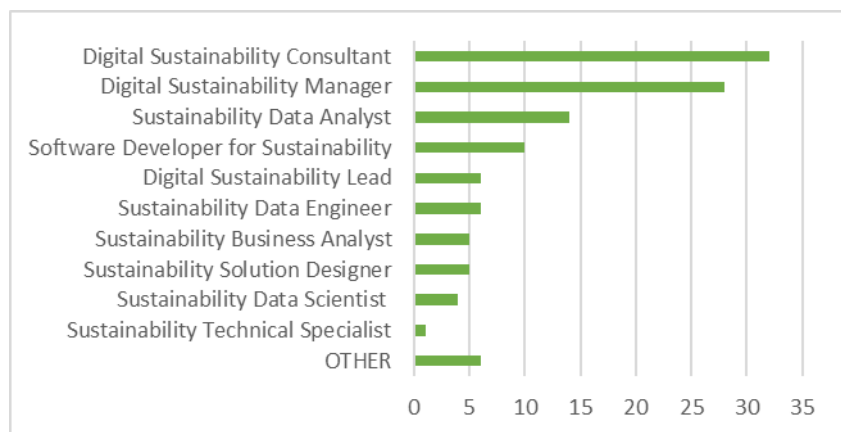
Concerning who is important for providing the training, organisations prefer internal training by their own staff. This can be done either by internal training or by on the job coaching and learning. External training or in-company training by external providers is considered to be less important. This raises questions for example on how internal staff gets skilled on these new topics in the first place. The most logical explanation is that first a certain group of an

organisation is trained and that they in return train the rest of the organisation. This would require a train-the-trainer model.

## 5.4 Job vacancies

Most of the analysed digital for sustainability job vacancies are in the main area of management consultancy (59%) while jobs in the areas of data processing & analysis (25%) and development & operations (16%) are less advertised. This is also visible in the specific roles that the vacancies are related to (see figure). The digital sustainability consultant and manager

are by far the roles most asked for in job vacancies. From the other areas, the sustainability data analyst and the software developer for sustainability are the roles that appear the most in job vacancies. Other roles appear less often, but each role is still asked for in about 4 to 5% of the vacancies, except for the



**Figure 26 Roles asked for in job vacancies**

sustainability technical expert that could only be linked to one vacancy. There are only five vacancies that could not be categorised in the predefined roles, of which three being general supporting internships. This confirms that the preselected roles are covering the current market demand represented in job vacancies.

The job vacancies are distributed rather evenly when it comes to the job level, with around twenty percent on entry/ junior level and on senior level. The intermediate level is responsible for almost thirty percent of vacancies, with almost a third of the vacancies for which it is not clear. Looking at the requested amount of experience in only three cases more than 10 years is needed. The other vacancies are more or less equally distributed between less than 3 years and 3 to 10 years of required experience. The most dominant requested educational level is by far bachelor level (59%) followed by master level (22%).

The analysis of the content of the job vacancy shows first of all that at the moment ESG is the most important topic. It is the top-mentioned word in the job title (22%), and the top

sustainability skills are the skills related to ESG. Also, it is one of the top requested knowledge areas (16%) and the one most mentioned tasks (27%).

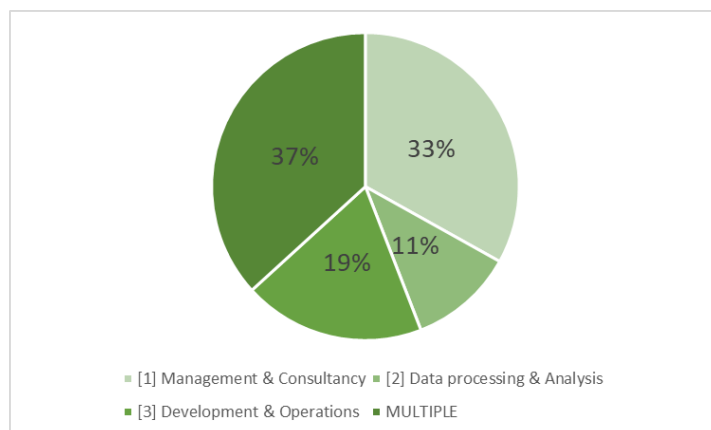
The second important topic is anything to do with data. 13% of the job titles include the word “data” and in the category digital/ ICT skills data related skills are the most present (37%). Also, it tops the knowledge areas mentioned in job vacancies (19%).

It is also interesting to mention that a lot of the job vacancies are about management (27% of the job titles included “manager” or “management”) and managing was mentioned the most as task (38%). Related to that, also consultant is mentioned often (21%) in the job title, which means that at least 50% of the roles are directly management & consultancy roles.

Finally, the transversal (soft) professional skills that are asked for are mainly communication (50%) and (working in a) team (35%).

## 5.5 Supply of education & training

The current supply of learning programmes is for a large part focused on digital for



**Figure 27 Learning programme focus across role areas**

sustainability management & consultancy roles (33%). There is an even larger percentage of learning programmes that does not specifically focus but covers two or all three of the role areas.

The largest issue at the moment though is that most of the learning programmes are not explicitly about digital for sustainability or the twin transition in

general. They are mainly programmes that have a focus on one aspect and then have the other as a kind of add-on in some parts of the programme. Also, programmes are sometimes very specialised, which means that they cover some very specific elements of sustainability, and it is unclear whether it is covered more broadly.

There are programmes aimed at educating digital professionals with some attention for sustainability without being explicit about it, like making it part of the title or description of the programme. Also, there are hardly any dedicated learning units in the programmes dedicated

to sustainability. These digital professional programmes are in some cases focused on a certain field, like for example agriculture or geoinformatics which are fields that unavoidably should cover aspects of sustainability, but it is not explicitly integrated in the programmes yet.

The other way around there are environmental science programmes that contain implicitly attention to the possibilities of digital solutions like for example a course on geographic information systems, but without having courses on designing, developing, and deploying digital solutions for sustainability goals. The conclusion is that skilling digital sustainability professionals is difficult when somebody wants to do that in one learning programme. It requires at least two programmes with one having the focus on digital and the other on sustainability. This of course limits the potential synergies between both fields, which is going against the twin transition narrative.

Upskilling existing sustainability professionals entails they have to have thorough digital training. The limitation this training usually has is that it does not cover digital for sustainability solutions in particular, which means that professionals should find this out themselves.

There are some specialised, specific programmes that cover digital for sustainability solutions, like for example ICTs in sustainable cities and territories or twin innovation by SMEs in the construction sector. These, mainly short, programmes are very relevant but have the limitation that it only focuses on one specific aspect of sustainability and related digital solutions.

Finally, there are some courses that help to upskill professionals that deal with digital for sustainability topics, like SME owners. These are courses like ICT tools for sustainability for entrepreneurs.

## 5.6 Expert panels

The Main findings of the national expert panels are organised in line with the three main topics defined in the methodology, namely the digital for sustainability roles, skills, and education & training. All these three topics are discussed with regard to the current needs and the future needs.

## 5.6.1 Roles needed now



**Figure 28 Word cloud of roles needed now**

Currently, **ESG reporting** is dictating the digital sustainability landscape. Organisations are figuring out how to comply to the CSR Directive in the most efficient way. Because there is uncertainty about how the concept of digital sustainability will evolve and because the topic is considered unclear, complex and abstract, with directly measurable results difficult to see, organisations face major challenges in making it clear and actionable. This is also well reflected in the demand for digital sustainability roles in the short term. Particularly, **SMEs** are struggling to find resources in this area. They cannot hire a full time (digital) sustainability expert, so they opt for **reskilling current staff or hire a consultant** to guide the way in the regulatory landscape. For **larger organisations, data related roles** are important in relation to **collecting and organising data and impact measurement** in the light of the ESG reporting.

*“The demand for in-house experts will mainly arrive from big companies.”*

*“Small and medium-sized companies will need external consultants to guide them on certain aspects.”*

Opinions differ among the panels about who exactly needs to possess sustainability skills, ranging from **top management**, to **line management**, via **certain people from IT staff** to **all of the IT staff**. Expert panels also differ on the point to **the extent to which IT specialists**, like the data analysts and the software developers **must be skilled** in this topic versus their managers. Several panels state a **sustainability software developer or engineer** is absolutely needed and also digital sustainability roles related to **solution design and process optimisation**. In a couple of panels, the **centrality** of the digital sustainability role is stressed, with **boundary-spanning**,

**inter- and multidisciplinary characteristics**, mastering multiple disciplines, a **Pi- or M-shaped professional**, together with the importance of **a transversal and behavioural skillset**.

*“This is not a mandatory new role or position but a transversal job that needs to be done.”*

In some panels, the wish and need **to broaden the current scope of sustainability** is expressed, beyond ESG reporting obligations and minimising the carbon footprint. Taking into account **broader climate aspects** is relevant in the case of **smart cities** and **social and ethical aspects** are mentioned in relation to AI but also to IT in a general sense.

In general, roles for which the demand is expected to rise are the ones **focused on ESG reporting**, like **environmental/ sustainability/ESG reporting managers** and the associated **data-related roles**, such as **data architects, data engineers, data managers and data analysts**, besides roles in **ESG consultancy**. There is also a need for a person who can develop a digital sustainability strategy, so **a digital sustainability leader**. Besides these roles, other roles mentioned are **a (digital) sustainability champion**, someone responsible for the communication regarding the concept of sustainability, **a sustainability change management role** to support the transition, **a digital sustainability tester** and **a digital sustainability teacher**. There is also demand expected for **jobs in the area of smart cities**, covering topics like water management, IoT, material flow management and data security.

## 5.6.2 Roles needed in the future



**Figure 29** Word cloud of roles needed in the future

In the long run, experts predict an integration of sustainability into all organisational functions and almost all expert panels expect an increase in demand for digital sustainability roles, although some are uncertain about the demand for specific roles. It is even expected that



sustainability has become 'business as usual'. The roles that are mentioned are mainly based on current trends and a few mention new roles that do not yet exist.

***"The convergence of digital and sustainability will not just lead to the creation of new roles but will also redefine existing positions."***

Experts expect a rise in demand for **digital sustainability consultants**, especially in relation to SMEs and for **(business) sustainability analysts**, especially related to sustainable service providers and larger companies, due to legal obligations, focusing on analysing the relative benefits of sustainable solutions. An increase is also foreseen in the demand for technical roles like ICT **sustainable software developers/administrators/architects, systems administrators, intelligent energy systems architects**, and **roles related to smart cities**. A need is also reported for **digital sustainability leaders** and **digital sustainability managers**. In general, digital sustainability roles are expected to be **multidisciplinary**, combining expertise from different fields.

It is also expected that there will be **a central key managerial role**, possibly a **new C-Level role, a Chief of Execution (CoE)**, a person without deep expertise but who can connect the dots and who oversees transformation and cross-departmental or even cross-organisational alignment changes. Roles are expected to be **multidisciplinary**, combining expertise in environmental sciences and sustainability with knowledge and skills in other fields, for example, HR, accounting, legal and or management skills.

***"I think the level of knowledge required for these roles is so diverse, and you need to have somebody in the organisation who can see through the different elements of sustainability, it requires complex knowledge."***

In addition, **someone with deep knowledge of environmental and social impact factors** will be needed, taking into account geopolitical aspects. Only this awareness of the analogue infrastructure behind the digital level will lead to a change of focus and of **business models to take account of the analogue**: resilience, proximity, circular economy; thus, realising a truly sustainable digital transformation.



### 5.6.3 Skills needed now



Figure 30 Word cloud of skills needed now

Regarding the digital sustainability skills needed in the short term, experts note that these depend on the stage of the digital sustainability transformation a country or organisation is currently in. The experts outline two scenarios, a country-level scenario from awareness to skills development through education and training and an organisation-level scenario from developing a strategy to implementing it.

In most panels, the discussion is about sustainable systems rather than systems that support sustainability. This is attributed to a **lack of understanding of the term sustainability**, that is often equated with only environmental protection, leaving out big social themes, big resilience themes and big economic themes. This goes hand in hand with a **lack of understanding of the impact** of digital technology, with the negative impact little or not understood and the positive impact almost never exploited. This means that a relatively large proportion of the skills mentioned by experts are related to the development of energy-efficient systems and focus on carbon neutrality.

*“We forget about the other aspect of sustainability - the social aspect. All the companies that want to compete in the market will need someone who has a holistic view of sustainability, not just one in a specific area.”*

**ESG reporting skills** and an **understanding of (environmental) legislation** are considered very important. These are skills discussed by the majority of panels. Panels differ on who should possess this legislative expertise and to what extent. Having a **multidisciplinary and/or interdisciplinary skillset** is also considered important for all digital sustainability professionals.

This skillset is a mix of **management skills** with **skills in different categories (technical, strategic and intercultural)** and **fields** (sustainability, legislation, and fields like e.g., marketing, communication, innovation). Technical skills focus on **energy-efficient technologies**, but also listed are **IoT, programming languages, cloud platforms, Edge/Fog Computing, and AR/VR development**. **Data skills** are also often mentioned as important.

When it comes to more sustainability skills and competences, experts mention **understanding sustainability frameworks and being familiar with sustainable practices**; like life-cycle analysis and circular economy models, the importance of the value chain, circular systems and electronic waste management; having an **understanding of sustainability impacts** and the principles behind that, such as **cause-and-effect relationships** and the capacity to **measure and valorise impacts**, also related to the broader environmental, social and economic impacts. This should be combined with a **holistic and interdisciplinary design approach** in order to translate those principles into digital solutions.

*“No one knows which direction everything will go, but we need to be aware that we must strategically invest in changing the mindset of employees, management, and ultimately the entire company.”*

**Management skills** and **soft skills** in general, and particularly communication and **collaboration** are listed in several panel reports. Other skills/ competences mentioned are **innovation skills, problem-solving skills, critical thinking, strategic thinking, adaptability, learning ability, intercultural skills, organisational awareness, situational awareness** and **understanding of interdependencies**.

Personal attributes that are highlighted are: **empathy, engagement, personal commitment, taking responsibility, sensitivity** and **credibility**. Some striking skills mentioned are **anticipatory skills, ability to think horizontally** and the **ability to unlearn**.

#### 5.6.4 Skills needed in the future



**Figure 31** Word cloud of skills needed in the future

Overall, the experts outline an **extrapolation of current trends and skills** for the long term. They expect an increase in demand for digital skills in sustainability, fuelled by legislation and an increasing awareness among society and consumers. Sustainability in general **will be more integrated** in organisational strategies and activities and companies are expected to be actively working on implementation. It is not only about management of sustainability projects, but **organisational processes will change** and adhere more and more to sustainability principles, such as sustainable IT project management, sustainable change management and sustainable procurement management.

These trends, and in particular also the mandatory ESG reporting, are increasing the importance of **impact measurement** of measures taken and thus **data collection and analysis, with AI and ML** in the background. Experts see a further professionalisation in the field of impact measurement and evaluation.

Just like the short-term, **the focus is largely on climate and energy-efficiency**, so **rather on sustainable IT instead of IT for sustainability**. In some panels, though, other expected trends mentioned relate to broadening the scope of the current mainstream sustainability practices and discourse. Organisations are expected to look more and more across their organisation boundaries and **take the entire supply chain and their procurement processes** into account, which will be reviewed in the light of (digital) sustainability principles. There is also already **a movement from carbon measurement to a more global measurement with changing impact factors**, along with the development of digital solutions that have **a net positive impact** on sustainability, in line with the principles of the **regenerative economy**. **Social sustainability** is explicitly mentioned, as well as the importance of developing a corporate culture that supports **humanity**.

*“Most of the environmental and social impacts are in the supply chain and manufacturing. I think it is necessary in the coming years to develop skills on sustainable digital purchasing.”*

An increasing focus on implementation is reflected in the long term expected need for interpersonal soft/transversal skills such as **communication**, especially **storytelling, collaboration, management, change management** and **leadership**; particularly **value-oriented leadership** skills with **social engagement** as departments and teams need to work together and employees need to be convinced. A sustainability champion is a suggested role in this respect.

*“At the leadership level, personal commitment is very important, and credibility. If you are not committed to sustainability, you will not be credible, and you will not be able to carry these efforts through the company properly.”*

The most important skill on a personal level is clearly **adaptability**, mentioned by many expert panels. Other personal skills relate to **empathy, continuous learning, creativity, curiosity, high tolerance, critical thinking, visionary thinking, strategic foresight** and **having a systemic vision** of the organisation.

On organisational level needed skills relate to the **management of sustainability projects**, but also to **sustainable IT project management**, and **sustainable change management**. Besides this, **an understanding of the market, incentives**, and **consumer behaviour** together with **risk analysis** and management are not only essential to **prepare for changes**, but also valuable for **evaluating the impact of digital sustainability solutions**. All this goes hand in hand with **(strategic) innovation**. Also, knowledge of **the regulatory framework and all related updates** are mentioned, partly related to **sustainability/ESG reporting**.

The most needed skills in the area of sustainability relate to **principles of the circular economy**. Other digital sustainability skills listed by the experts are **life-cycle assessment, green IT practices, the ability to design for sustainability from the ground up, advanced energy-efficient technologies, integrate sustainability into software development life cycles** and **develop methodologies to continuously improve the environmental performance of digital solutions**.

Both **impact measurement** and **processing data** are mentioned in half of the panel reports. It is considered crucial to the long-term success of digital sustainability initiatives that professionals are able to **use data and metrics to measure the impact of their actions and make informed decisions**. Additionally, skills in **AI and ML** are needed for **improving predictive analytics** and **enabling automated decision-making** in sustainability efforts.

*"A sustainability officer needs to have a background in environmental information, as well as technical know-how about data management."*

There is a slight difference between some panels in relating skills to certain roles. In two panels the experts relate a deep understanding of emerging sustainability trends and the changing regulatory landscape only to executive positions such as digital sustainability leaders and managers, while in another panel the experts see regulatory understanding rather as a more transversal skill, applicable to a range of roles.

For a digital sustainability transformation to be successful in the long term, experts advise that organisations need to take a holistic approach, adapt their business models, create a supportive culture, collaborate across departments, be aware of EU funding in this area and find a common ground between business staff and environmental scientists.

### 5.6.5 Education & training needs now

Many panels start the discussion with **a call for action on the side of formal education**. They should reform their curricula; with **full integration** of sustainability in traditional courses across all subjects, create **interdisciplinary curricula** merging technology, environmental science and business strategy, **introduce separate courses/modules** or **transform existing modules** and **integrate real-world applications and case studies** into educational programmes to provide a full understanding of how digital tools can be applied to sustainability challenges.

Alongside this call for action on formal education, experts on many panels stress the **urgent need to reskill** and **upskill the existing workforce**. Experts suggest that this should take the form of **short training courses** with **certifications** or **micro-credentials**.

*"Results cannot be achieved in a short period, but that does not mean we should stop or not begin something new and innovative. It is necessary to raise awareness among people about what they are doing and how it contributes to sustainability and sustainable business, and how digital skills can help with this."*

In many panels, experts distinguish between **different types of training**. Mentioned are: **(short) awareness-raising training, basic training on fundamentals** and **more advanced training for experienced professionals**. Some panels express the need for **basic sustainability and climate change training for all employees** to build a culture of sustainability within organisations. Awareness-raising training should be followed up on the practical implications in the workplace.

There is a need for **tailored training** in digital sustainability **for specific, already existing roles** to equip professionals with the skills they need to incorporate sustainability into their daily responsibilities. Mentioned are training for **leaders, managers** and **HR executives**, to get these people involved in the topic and explain what it means specifically for them. Also mentioned are training for **data engineers** and **other IT professionals** and **specialised technical profiles** to explain best practices in digital sustainability.

*“Training data specialists is an important step, but there must also be a real focus on strategic change. Data analysts are usually not in a position to put sustainability on the agenda. So, if there is no demand from companies, it makes little sense to train people.”*

Additionally, training should have a **multidisciplinary approach** to bridge different disciplines and could be delivered by a **dedicated in-house trainer** or through **shared roles between departments**. **Support from senior management** is seen as a prerequisite for success.

**Key skills that should be included** in training programmes are **understanding environmental regulations, sustainability reporting, data analytics, systems thinking, sustainable design principles** and the **use of advanced technologies** such as **AI, IoT, and AR/VR**. Courses and certification preparation in **IoT, Cloud Computing, Edge/Fog Computing** and **AR/VR** are essential for *software developers and engineers*. Provision of training is especially important in the fields of **data analysis, sustainability consulting** and **operations management**.

Many panels indicate **a need for some form of cooperation between education, industry and government**. **The business sector could provide valuable insights** into the skills and knowledge that are most in demand so that the education offer matches the needs of the labour market. **Government support** is considered crucial to **encourage companies and educational institutions to invest** in sustainability education and training initiatives.

In the coming years, **more clarity is needed on what sustainability means** and how it can be implemented. Meanwhile, it is crucial to **foster a mindset in which ethical considerations play a role when deploying technology.**

*“Sustainability terms must be clarified as they are not clear for IT people, as well as IT concepts are not clear for pure sustainability roles.”*

### 5.6.6 Education & training needs in the future

In the long term, many experts expect there will be **a demand for tailored training for various functions in specialised areas**, such as **human resources, procurement, C-level executives, management and technical functions.**

*“This is a combination of business leaders, technologists and administrators needing new skills – consider persona-based training.”*

Experts mention a range of business, technical and sustainability topics for these specialised training courses, such as sustainability consulting, sustainable IT procurement, sustainable supply chain management, sustainable cloud computing strategies and sustainable finance in the area of business; sustainable infrastructure design, sustainable application development, data management and analytics and cloud performance optimisation for technical functions; and fundamentals of ecology, EU policies and regulations, understanding sustainability data, energy efficiency and waste management in the field of sustainability.

Besides specialised training, there is a need for a **general sustainability training for all employees.**

**Continuous learning and professional development** (CPD) are considered highly important. It is even argued that this should be mandatory for all professionals, regardless of sector, to keep their skills up-to-date and relevant.

Regarding formal education, experts expect a strong call for formal education pathways and comprehensive degree programmes in digital sustainability, with development of **dedicated BSc and MSc programmes and dual masters**, that combine sustainability with any other expertise. Additionally, it is also argued that the **basics for (digital) sustainability skills and principles should be present in any education and professional training at all levels**, including secondary education. This is considered a prerequisite for students from all disciplines to develop a sustainability mindset and consider the environmental, social, and economic



impacts of their future professional activities. **Practical experience** during education and training is also considered very important, e.g. through internships, apprenticeships, mentoring and situational learning.

*“As the trainings must be oriented towards the needs of the entities that will actually open positions for people with those competencies, those needs must be well understood (at least on some level) and a contact between the educational institutions and these entities must be facilitated.”*

Experts also point to the **importance of effective collaboration between industry and education and training institutes** which will ensure that curricula are aligned with the evolving needs of the labour market.

In the end it is stated that it all comes down to the essential question: Are people willing to change their behaviour? This determines whether we will end up with a sustainability debt or with truly sustainable practices that elevate our collective well-being.

*“World is changing with or without us. We can only choose if we want to be a part of the change or not.”*

### 5.6.7 European expert panel

At the European level, the debate evolved around a series of statements containing some of the key findings of the national expert panels. These statements served to stimulate discussion, with as much free space as possible for the experts to express their personal opinions, including comments using virtual post-its.

#### 5.6.7.1 ESG role

Overall, the experts agree that **ESG** is just one small area and is **not the main focus** in many organisations, and also should not be the main focus. In a small organisation, the scope may be narrower, and tasks related to reporting and ESG may be assigned to one person and the CEO must be involved, while in larger organisations there could be a dedicated administrative specialist, knowledgeable in legislation and responsible for ESG reporting.

*“I don't think ESG is the main job role, it's just one area. We actually just spent the last two days [...] having a sustainability forum, bringing all the different parts together. [...] We had the sustainability office, we had software, we had research,*



*we had supply chain, we had infrastructure, we had global real estate, we had corporate social responsibility, we had ESG, so that's lots of different roles."*

However, it is a hard task for one person to be aware of how to be more sustainable in many areas. Many **SMEs** are focused on the operational level and everyday business, so regarding sustainability they will focus on practical skills, which can bring added value to everyday business, like sustainable procurement and automation together with some reporting obligations.

#### 5.6.7.2 Many roles

Sustainability is about behaviour change, business change and product development change, even a paradigm change, and involves **integration into the full governance structure** of an organisation.

*"Sustainability in depth is a lot more than calculating emissions. It's also behavioural change, economy of the core activities inside the company, economy of the products [...]. And this is a role that is more into business development and product development, rather than an ESG role."*

When starting a sustainability project, particularly in a large organisation, **many different roles and departments are involved** across the whole organisation, e.g. sustainability office, CSR, research, lifecycle assessment specialists, product designers, software developers, infrastructure, supply chain, real estate, HR, finance, marketing and communication etc. And also, the **impact on all the parts of the whole organisation** must be taken into account.

"Actually we need **sustainability as part of the DNA**. So, when you are creating new products or new software, the developers are thinking about it how do you do a responsible computing framework that the HR teams can pick up, the CSR teams can pick up, the developers can pick up, [...] and go: 'Right, I've got a project. How does that affect my data centre? How does it affect my infrastructure? How does it affect the developers, the data governance, the systems and the impact?'"

#### 5.6.7.3 Teams, leadership role or transversal role?

There must be a central key manager or C-level role in a larger organisation. A person that needs to have technical skills, knowledge about ESG and sustainability and some business skills to lead the way and raise awareness. This role does not exist yet. At the same time, sustainability

cannot be the responsibility of just one person. Given its complex and broad nature, a systemic view is needed and it should be addressed by teams.

**“I’m gonna be a bit sceptical about just putting all the all the burden in just a specific professional. For me it is a very complex problem. So maybe I would prefer to talk about, instead of specific professionals, talk about teams.”**

Currently, organisations invest in **a transversal role** which works together with different departments, having a sustainability background, but also involving IT.

There is a need for such a role that can communicate with both the technical people and the people responsible for sustainability and ESG etc. A solid starting point could be **skills related to ‘electricity’**. Having these will help demystifying ‘magical’ sustainability solutions and drive correct conclusions. On the other hand, energy consumption is just one indicator when addressing sustainability.

#### 5.6.7.4 Data

The **most difficult role to fill is the one that relates to data and sustainability**. It is crucial that **data is available and can be trusted**. Especially in larger, dispersed companies, it is essential that at all locations, the same data dictionaries, assets and terminologies are used. In general, **one needs to think about how IT and emerging technologies** (blockchain, IoT, robotics etc.) **could help** to automate, simplify and enable informed decision making. **Data is needed to reach sustainability goals**, and this should be an aspect when educating for sustainability.

#### 5.6.7.5 Legislation vs scope

In general, **companies are very pragmatic** and need incentives to act, like **labels or legislation**. At the same time, legislation and standards **can impact innovation, both in a negative and in a positive way**, as organisations need to find ways to comply. Probably, **SME's will need to cooperate**, if they want to invest and implement innovative solutions.

Experts agree that although these incentives are needed, sustainability involves a change in mindset, so compliance with regulations should not become the aim. Sustainability cannot be reached simply through business as usual and considering sustainability as an add-on. The **current focus on output, environmental sustainability, energy consumption and negative impact is far too limited**.

*“Basically, we need a systemic change here and I personally do not think we'll manage to reach that with business as usual. And I'm really wondering why I see so little the idea of having specialists in sustainability, and as long as you don't have this basic knowledge and you're here with your IT knowledge and really IT problems, you'll just consider sustainability being an add-on.”*

The broader scope of the concept of sustainability must be taken into account, addressing its positive impact and the broader set of stakeholders; creating value in the three dimensions: society, economy and the environment. The skills needed for this also depend on the **maturity level of the organisation** in relation to managing sustainability in these three dimensions. An option would be **to skill people who are already knowledgeable in the complex field of sustainability, instead of the other way around.**

#### 5.6.7.6 Frameworks

At the European level, there are **frameworks and also standardised methodologies**. For example, federations make life cycle assessment models available for their members, including SME's. To many organisations, these resources are a **black box**. There is also very **little information on how to implement** these frameworks, for example how can the GreenComp framework be translated into curricula or applied in a company? It must also be clear if the focus is on digital skills for sustainability jobs or on green skills for IT jobs.

*“The green competence framework that is the European sustainability competence framework, is not easy to read, is not easy to prepare a curriculum even for VET. [...] So we have to make this framework easily to be adopted by teachers or by trainers, by SMEs. There is a gap there.”*

**Being able to connect the dots** is important in this respect. For example, how do the different sustainability legislations relate to each other and how can different sustainability tools be connected and aligned with the specific needs of a particular organisation?

*“So, I think, from a sustainability point of view [...] people need to think about how IT and emerging technologies can help automate, simplify and allow them to make more informed decisions to get energy levels down quicker [...] or any social sides,*

*they need the data and I think that's what's important that we need to get across in any education."*

#### 5.6.7.7 The new normal after the twin transition?

The situation after a successful twin transition will involve **bioeconomy** and the **creation of local and regional supply chains**. Currently, the tendency is to think dematerialised, so not taking into account the analogue world. **Behind every digital application, there is an analogue infrastructure, that should be taken into account** when it comes to sustainability. Both the impact of the digital solution and the impact of the analogue infrastructure must be considered, to analyse whether a solution is globally positive or globally negative. The current discourse does not include these topics. **It is important to address these, especially when educating tomorrow's workforce.**



## 6. Glossary

Term	Definition/ Description
<b>Accreditation of an education or training programme</b>	Process of quality assurance through which a programme of education or training is officially recognised and approved by the relevant legislative or professional authorities following assessment against predetermined standards. (Cedefop, 2024)
<b>Accreditation of an education or training provider</b>	Process of quality assurance through which an education or training provider is officially recognised and approved by the relevant legislative or professional authorities following assessment against predetermined standards. (Cedefop, 2024)
<b>Assessment (of learning outcomes)</b>	Process of appraising knowledge, know-how, information, values, skills and competences – acquired in formal, nonformal or informal settings – against relevant standards (learning outcomes, validation) . Assessment of learning outcomes typically leads to certification. (Cedefop, 2024)
<b>Associate degree</b>	Qualification awarded after successful completion of the so-called short cycle in the Qualifications Framework of the European Higher Education Area (EQF). The short cycle fits within or is linked to the first cycle (or bachelor's level). The degree requires approximately 120 ECTS credits. (European Consortium for Accreditation, 2021)
<b>Bachelor's degree EQF level 6</b>	Qualification awarded after successful completion of the first cycle in the Qualifications Framework of the European Higher Education Area (EQF). The degree usually requires a minimum of 180 and a maximum of 240 ECTS. (European Consortium for Accreditation, 2021)
<b>Certification (of learning outcomes)</b>	Process of issuing a certificate, diploma or title formally attesting that a set of learning outcomes (knowledge, knowhow, information, values, skills and/or competences) acquired by an individual have been assessed by a competent body against a predefined standard. Certification may validate the outcomes of learning acquired in formal, non-formal or informal settings. (Cedefop, 2024)
<b>Comb-shaped professionals</b>	Professionals who have a depth of knowledge and skills in many specific domains of expertise or fields (all the vertical bars of the comb-shape) and have broad knowledge and skills across multiple fields or disciplines (the horizontal bar of the comb-shape). This allows them to cross collaborate and effectively leverage someone else's expertise in that area. (Adapted from Friedlein, 2013; Grupman, J., 2021)
<b>Competence</b>	Demonstrated ability to apply knowledge, skills, and attitudes for achieving observable results. (CEN/TC 428, EN 16234-1 (2019)

<b>Curriculum</b>	Inventory of activities related to the design, organisation and planning of an education or training action, including definition of learning objectives, content of programmes, methods (including assessment of learners and evaluation of programmes) and material, as well as arrangements for training teachers and trainers. The term 'curriculum' refers to the design, organisation and planning of learning activities; the term 'programme' refers to the implementation of these activities. (Cedefop, 2024)
<b>Digital badge</b>	Validated graphical visualisation of a learning experience – e.g. participation in a course, seminar or workshop, or acquisition of knowledge, skills and competences – with or without certification. Digital badges are issued in a variety of formal or nonformal settings. (Cedefop, 2024)
<b>Digital credential</b>	In education and training, electronic, secured and verifiable statement issued by a competent authority (education or training provider, awarding body, professional organisation) describing a learning action. (Cedefop, 2024)
<b>Digital sector</b>	Combination of manufacturing and service industries whose primary purpose is to both create and sell digital technology products, services or solutions. (CODES, 2022)
<b>Digital sustainability</b>	The design, development, deployment and regulation of digital technologies to secure sustainable economic, environmental and social development. In the CODES Action Plan, this refers to an overarching aim, embodying all 3 shifts of the Action Plan. (CODES, 2022)
<b>Digital sustainability roles</b>	The roles in an organisation that require substantial digital sustainability skills, meaning these skills are central to the job. These are people with at least partial responsibility for digital innovation that seeks to proactively enable, accelerate and scale environmentally and socially sustainable development digitalisation for sustainability. (D4S Consortium, 2024; based on CODES, 2022)
<b>Digital sustainability skills</b>	Skills related to designing, developing, deploying and regulating digital technologies to secure sustainable economic, environmental and social development. (D4S Consortium, 2024; based on CODES, 2022)
<b>Digital transformation</b>	Systems-level economic, societal and environmental transformations triggered as a result of digitalization. (CODES, 2022)
<b>Digitalisation</b>	Use of digital technologies to turn products and services into a digital format to drive efficiency and innovation. (CODES, 2022)
<b>Digitalisation for sustainability</b>	Digital innovation that seeks to proactively enable, accelerate and scale environmentally and socially sustainable development. In the CODES Action Plan, this refers to shift 3 and the 6 related strategic priorities. (CODES, 2022)
<b>Doctorate degree</b>	Qualification awarded after successful completion of the third cycle in the Qualifications Framework of the European Higher Education Area (EQF). The degree usually requires a three to four years of study, mostly as a period of research. (European Consortium for Accreditation, 2021)
<b>e-Competence Framework (e-CF)</b>	Standard established as a tool to support mutual understanding and provide transparency of language through the articulation of competences, skills, knowledge and proficiency levels as required and deployed by Information and Communication Technology (ICT) professionals. (CEN/TC 428, EN 16234, 2019)

<b>Educational credential</b>	Documented statement that acknowledges a person's learning outcomes. (European Micro-Credential Terminology, 2022)
<b>Educational profile</b>	Structure that enables a competence-oriented learning programme design and development, thus providing a link between competences needed in a professional environment and learning outcomes of education and training. It assists planning education and professional accomplishment at individual and institutional levels. (CEN/TC 428, TS 17699, 2021)
<b>E-shaped professionals</b>	Professionals who have a depth of knowledge and skills in a specific domain or field (expertise) and also have broad knowledge and skills across multiple fields or disciplines (experience), which enables them to collaborate across disciplines with experts in other areas. Besides expertise and experience these professionals also possess knowledge and skills related to the tangible (execution) and intangible (exploration), implying having both a big-picture outlook and an attention to detail from being a practitioner. (Adapted from DaVanzo, 2010)
<b>European Qualification Framework (EQF)</b>	Overarching framework that makes transparent the relationship between European national (higher) education frameworks of qualifications and the qualifications they contain. It is an articulation mechanism between national frameworks. (Bologna Working Group on Qualifications Frameworks, 2005)
<b>European Skills, Competences, Qualifications and Occupations (ESCO)</b>	The multilingual ESCO classification identifies and categorises skills, competences, qualifications, and occupations relevant for the EU labour market and education and training. It systematically shows the relationships between the different concepts. (ESCO, 2022)
<b>Formal education</b>	Education that is institutionalised, intentional and planned through public organizations and recognised private bodies [...] Formal education programmes are thus recognised as such by the relevant national education or equivalent authorities Institutionalised education occurs when an organization provides structured educational arrangements, such as student-teacher relationships and/or interactions, that are specially designed for education and learning. [...] Formal education consists mostly of initial education. Vocational education, special needs education and some parts of adult education are often recognised as being part of the formal education system. [...] Programmes that take place partly in the workplace may also be considered formal education if they lead to a qualification that is recognised by national education authorities (or equivalent). These programmes are often provided in cooperation between educational institutions and employers (e.g. apprenticeships). (UNESCO, 2011)
<b>Formal learning</b>	Acquisition of knowledge, know-how, information, values, skills and competences in an organised and structured environment in terms of learning objectives, time or resources (e.g. an education or training institution or a company). Formal learning is intentional from the learner's point of view. It typically leads to certification. (Cedefop, 2024)
<b>Formal recognition (of learning outcomes)</b>	Process of granting official status to learning outcomes knowledge, skills and competences either through: <ul style="list-style-type: none"> <li>• validation of non-formal and informal learning;</li> <li>• grant of equivalence, credit units or waivers;</li> <li>• award of qualifications (certificates, diploma or titles). (Cedefop, 2014)</li> </ul>
<b>Higher or upper VET</b>	Composed of: a) post-secondary level VET, offered outside higher education; b) higher-level continuing VET (CVET) offered within or outside the formal education system (usually after entry into working life); qualification here often gives access to nationally recognised qualifications but the target is adult learners; qualifications are often based on professional experience and examinations (competence tests); c) higher-level CVET provided outside the formal education system (by adult education centres, public employment services or private companies), which do not fall into the above categories. Higher

	VET relates to EQF levels 5 to 8. (Cedefop, 2019)
<b>ICT Body of Knowledge (ICT BoK)</b>	Structured set of information including, terminology, concepts, models, and theories which represent the accepted and agreed upon core knowledge base required by the ICT profession. (CEN/TC 428, EN 17748-1, 2022)
<b>ICT Professional Role Profiles</b>	A generic set of typical roles performed by ICT Professionals in any organisation, covering the full range of ICT business processes, and using the European e-Competence Framework (e-CF) as the basis for competence identification. The 30 ICT Profiles give a sound basis and starting point for any organisation to develop more context-specific ICT profiles according to specific needs. The profiles can be used from multiple perspectives and for a broad range of purposes. These include HR planning, recruitment, digital transformation process support, curriculum design and qualification promotion. (CWA 16458 ICT Profiles, 2018)
<b>ICT sector</b>	Combination of manufacturing and services industries whose products primarily fulfil or enable the function of information processing and communication by electronic means, including transmission and display. (OECD, 2022)
<b>Informal learning</b>	Acquisition of knowledge, know-how, information, values, skills and competences in the framework of daily activities – work, family or leisure – which are not explicitly designated as learning activities in terms of objectives, time or learning support. Informal learning may be unintentional from the learner's perspective; its outcomes may be validated and certified. (Cedefop, 2024)
<b>Information and Communication Technology (ICT)</b>	Diverse set of technological tools and resources used to transmit, store, create, share or exchange information. (UNESCO, 2009).  From a technical point of view ICT relates to digital computers/ devices and internet (communication) systems, including software, hardware and networks. From an economic and political standpoint, ICT relates to a cross sector of enterprises, including manufacturers, product suppliers or service providers relating to the ICT field. (ENI6234-1 e-CF)
<b>Initial education</b>	Formal education of individuals before their first entrance to the labour market, i.e., when they will normally be in full-time education. It thus targets individuals who are regarded as children, youth, and young adults by the society to which they belong. It is typically provided by educational institutions in a continuous educational pathway. (UNESCO, 2012)
<b>International Standard Classification of Education (ISCED)</b>	Global reference classification for education systems and it provides a comprehensive framework for organising education programmes and qualification by applying uniform and internationally agreed definitions to facilitate comparisons of education systems across countries. (ISCED, 2022)
<b>Job profile</b>	A context-specific and detailed description of what an employee does to assure that the job holder has no doubts about their tasks, duties, responsibilities and often those to whom they report. It usually contains precise information about the competences, skills and knowledge required and practical information about health and safety and remuneration. (ECSF, 2022 / CEN CWA16458, 2018)
<b>Knowledge</b>	Theoretical or practical understanding and awareness of phenomena such as facts, terminology,



	concepts, models, or theories that are related to a field of work or study. Knowledge is the outcome of the assimilation of information through learning and is theoretical and/or factual. (CEN/TC 428 EN 17748-1, 2022; Council of the European Union, 2017)
<b>Learning</b>	Process by which an individual assimilates information, ideas and values and thus acquires knowledge, know-how, skills and competences. Learning occurs through personal reflection, reconstruction and social interaction. It may take place in formal, non-formal or informal settings. (Cedefop, 2024)
<b>Learning environment</b>	Any environment that allows a person to learn in providing certain conditions or procedures to do so; this can be an educational institute, a training facility or a workplace, as well as a face-to-face, hybrid or a virtual environment. (CEN/TC 428, TS 17699, 2022)
<b>Learning outcome</b>	Statements of what a learner knows, understands and is able to do on completion of learning process, which are defined in terms of knowledge, skills and competence. (Cedefop, 2014)
<b>Learning programme</b>	Inventory of activities, content and/or methods implemented to education or training achieve education or training objectives (acquiring knowledge, skills and/or competences), organised in a logical sequence over a specified period of time. (Cedefop, 2014)
<b>Learning path</b>	Specific route that reflects a person's subsequent learning activities undertaken in a specific learning environment throughout his/her life, career or study. (CEN/TC 428, TS 17699, 2022)
<b>Lifelong learning</b>	All learning activity undertaken throughout life, with the aim of improving knowledge, skills/competences and/or qualifications for personal, social and/or professional reasons. (Cedefop, 2014)
<b>Master's degree</b>	Qualification awarded after successful completion of the second cycle in the Qualifications Framework of the European Higher Education Area (EQF). The degree usually requires a minimum of 90 ECTS, of which at least 60 ECTS at master's level. (European Consortium for Accreditation, 2021)
<b>Micro-credential</b>	The record of the learning outcomes that a learner has acquired following a small volume of learning. These learning outcomes will have been assessed against transparent and clearly defined criteria. Learning experiences leading to microcredentials are designed to provide the learner with specific knowledge, skills and competences that respond to societal, personal, cultural or labour market needs. Microcredentials are owned by the learner, can be shared and are portable. They may be stand-alone or combined into larger credentials. They are underpinned by quality assurance following agreed standards in the relevant sector or area of activity. (Council of the European Union, 2022)
<b>Modular programmes</b>	Programmes that are composed of small discrete modules or learning units that are virtually self-contained, independent, nonsequential, and typically short in duration. Modular programmes allow students to compose the content of their education in a flexible way by combining different courses or modules. (French, 2015; UNESCO, 2011)
<b>M-shaped professionals</b>	Professionals who have a depth of knowledge and skills in three specific domains of expertise or fields (the vertical bars of the M) and have broad knowledge and skills across multiple fields or disciplines (the horizontal bar of the M-shape). that allows them to cross collaborate and effectively leverage someone else's expertise in that area. (Adapted from Friedlein, 2013; Grupman, J., 2021)
<b>Non-formal</b>	Education that is institutionalised, intentional and planned by an education provider. [...] It is an addition,

<b>education</b>	alternative and/or complement to formal education within the process of lifelong learning of individuals. [...] It caters to people of all ages but does not necessarily apply a continuous pathway structure; it may be short in duration and/or low-intensity; and it is typically provided in the form of short courses, workshops or seminars. Non-formal education mostly leads to qualifications that are not recognised as formal or equivalent to formal qualifications by the relevant national or sub-national education authorities or to no qualifications at all. Nevertheless, formal, recognised qualifications may be obtained through exclusive participation in specific non-formal education programmes; this often happens when the non-formal programme completes the competences obtained in another context. (UNESCO, 2011)
<b>Non-formal learning</b>	Learning which is embedded in planned activities not explicitly designated as learning (in terms of learning objectives, learning time or learning support), but which contain an important learning element. Non-formal learning is intentional from the learner's point of view. It typically does not lead to certification. (Cedefop, 2014)
<b>Post-secondary, non-tertiary education</b>	Encompasses qualifications that are considered to be beyond secondary education but are not included in the tertiary sector. Post-secondary non-tertiary education provides learning experiences building on secondary education, preparing for labour market entry as well as tertiary education. Students entering will have usually completed upper secondary education. Programmes usually have a full-time equivalent duration of between 6 months and 2 years. Post-secondary, non-tertiary education relates to EQF levels 4 and 5 and ISCED level 4. (UNESCO, 2011)
<b>Prior learning</b>	The knowledge, know-how and/or competences acquired through previously unrecognised training or experience. (Cedefop, 2014)
<b>Professional development</b>	Any action of education or training undertaken by an individual after entering working life, to update her/ his skills and qualifications – or acquire new ones –, improve her/ his performance and progress in career. Professional development: <ul style="list-style-type: none"> <li>• encompasses job-related and generic skills and competences (team or time management, negotiation skills, conflict management, communication, etc.);</li> <li>• may take the form of self-directed learning, formal training, certifications, consultation, conferences, coaching or mentoring, communities of practice and technical assistance. (Cedefop, 2014)</li> </ul>
<b>Proficiency level</b>	Level indicating the degree of mastery that allows an ICT professional to meet requirements in the performance of a competence; proficiency levels in the e-CF are characterised by a combination of levels of influence within a community, context complexity, autonomy, and typical behaviour expressed by examples of action verbs; this standard incorporates proficiency levels e-1 through to e-5. (ENI6234-1 e-CF, 2019)
<b>Qualification</b>	An official record (certificate, diploma) of achievement which recognises successful completion of education or training, or satisfactory performance in a test or examination; and/or the requirements for an individual to enter, or progress within an occupation. (UNESCO, 1984)
<b>Qualification system</b>	All activities related to the recognition of learning outcomes and other mechanisms that link education and training to the labour market and civil society. These activities include: <ul style="list-style-type: none"> <li>• definition of qualification policy, training design and implementation, institutional arrangements, funding, quality assurance;</li> </ul>

	<ul style="list-style-type: none"> <li>• assessment and certification of learning outcomes.</li> </ul> <p>Comment: a national qualifications system may be composed of several subsystems and may include a national qualifications framework. (Cedefop, 2014)</p>
<b>Reskilling</b>	Training enabling individuals to acquire new skills and knowledge giving access either to a new occupation or to new professional activities. (Cedefop, 2014)
<b>Role Profile</b>	An outline or general document that demonstrates the relationship between specific activities or tasks in a role and the individual skills, competences and knowledge required to undertake them. Unlike a particular job, a role derives from an organisational need to do something. Assigned employees can meet organisational requirements by carrying out all or part of the tasks required to ensure their role. (ENISA, 2022 / CEN CWA16458 2018)
<b>Short cycle tertiary education</b>	Programmes at this level are often designed to provide participants with professional knowledge, skills, and competences. Typically, they are practically based, occupational-specific and prepare students to enter the labour market. However, these programmes may also provide a pathway to other tertiary education. programmes. Short cycle tertiary education relates to EQF level 5 and ISCED level 5. (UNESCO, 2011).
<b>Skilling</b>	Training enabling individuals to acquire new skills and knowledge giving access either to an occupation or to professional activities. (Cedefop, 2014).
<b>Skills</b>	Ability to apply knowledge and use know-how to complete tasks and solve problems. Skills can be cognitive (involving the use of logical, intuitive, and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments). (Council of the European Union, 2017)
<b>Skill gap</b>	Situation where an individual does not have the kind and/or level of skills required to perform their job adequately. (Cedefop, 2014).
<b>Skill mismatch</b>	Situation of imbalance in which the level or type of skills available does not correspond to labour market needs. (Cedefop, 2014).
<b>Skill needs</b>	Demand for particular types of knowledge and skills on the labour market (total demand within a country or region, economic sector, etc.). (Cedefop, 2014).
<b>Skill shortage</b>	Situation where skills supply (type of abilities and number of people available on the labour market) is not sufficient to meet labour market demand. (Cedefop, 2014).
<b>Soft skills</b>	Patterns of thought, feelings and behaviours that are socially determined and can be developed throughout the lifetime to produce value. These are cross-cutting skills across jobs roles and sectors that relate to personal competences (confidence, discipline, self-management) and social competences (teamwork, communication, emotional intelligence). (Borghans, 2008; Dall'Amico, E. & Verona, S., 2015).
<b>Software</b>	Computer programs, procedures, and possibly associated documentation and data pertaining to the operation of a computer system (IEEE 828, 2012).
<b>Sustainability</b>	Meeting the needs of the present whilst ensuring future generations can meet their own needs. It has

	three pillars: economic, environmental and social. To achieve sustainable development, policies in these three areas have to work together and support each other. (European Commission, 2024; based on UN, 1987).
<b>Sustainability competence</b>	Empowers learners to embody sustainability values, and embrace complex systems, in order to take or request action that restores and maintains ecosystem health and enhances justice, generating visions for sustainable futures. (Bianchi e.a., 2022).
<b>Sustainability education</b>	Education that aims to provide learners with sustainability competences in order to reflect and embrace sustainability in their daily lives as students, consumers, producers, professionals, activists, policymakers, neighbours, employees, teachers and trainers, organisations, communities, and society at large. (Bianchi e.a., 2022).
<b>Sustainable Development Goals</b>	The Sustainable Development Goals are a universal call to action to end poverty, protect the planet and improve the lives and prospects of everyone, everywhere. The Goals were adopted by all United Nations Member States in September 2015 as part of the 2030 Agenda for Sustainable Development which sets out a 15-year plan to achieve the Goals and their related targets. (UN, 2015)
<b>Sustainable digitalisation</b>	Digital infrastructures, software and applications that are socially responsible, ethical and environmentally sustainable throughout their lifecycle. In the CODES Action Plan, this refers to shift 2 and the 6 related strategic priorities. (CODES, 2022)
<b>T-shaped professionals</b>	Professionals who have a depth of knowledge and skills in a specific domain or field (the vertical bar on the letter T) and also have broad knowledge and skills across multiple fields or disciplines (the horizontal bar on the letter T), which enables them to collaborate across disciplines with experts in other areas. (Adapted from Gardner, 2017; Brown, 2009).
<b>Tertiary education</b>	Third level education that encompasses bachelor, master and doctorates or equivalents. Vocationally oriented education and training at tertiary qualifications level means education and training that can contain aspects of both academic and vocational areas typically with the majority of vocational aspects (e.g., Universities of applied sciences, Polytechnic institutes). It is usually located at levels equivalent to EQF levels 6 to 8 and ISCED levels 6 to 8. (Cedefop, 2011)
<b>Transversal skills and competences</b>	Learned and proven abilities which are commonly seen as necessary or valuable for effective action in virtually any kind of work, learning or life activity. They are “transversal” because they are not exclusively related to any particular context (job, occupation, academic discipline, civic or community engagement, occupational sector, group of occupational sectors, etc.). (ESCO/EQF expert group, 2021)
<b>Upper-secondary education</b>	Encompasses educational institutions that focus on general or vocational education. Programmes at this level are typically designed to complete secondary education in preparation for tertiary education, or to provide skills relevant to employment, or both. Pupils enter this level typically between ages 14 and 16. Upper secondary education relates to EQF levels 3 to 5 and ISCED level 3. (Cedefop, 2014;2020).
<b>Upskilling</b>	Short-term targeted training typically provided following initial education or training, and aimed at supplementing, improving or updating knowledge, skills and/or competences acquired during previous training. (Cedefop, 2014).
<b>Validation (of learning)</b>	Confirmation by a competent body that learning outcomes (knowledge, skills and/or competences) acquired by an individual in a formal, non-formal or informal setting have been assessed against

<b>outcomes)</b>	predefined criteria and are compliant with the requirements of a validation standard. Validation typically leads to certification. (Cedefop, 2014).
<b>Vocational Education and Training (VET)</b>	Education and training which aims to equip people with knowledge, know-hows, skills and/or competences required in particular occupations or more broadly on the labour market. Vocational Education and Training covers upper-secondary, post-secondary, non-tertiary, and tertiary levels of education. (Cedefop, 2008; Erasmus+ Programme Guide, 2019).
<b>Work-based learning</b>	Learning that takes place through some combination of observing, undertaking, and reflecting on productive work in real workplaces. It may be paid or unpaid and includes a diversity of arrangements like apprenticeships, dual programmes, traineeships, internships, job shadowing, and other work placements used as part of school-based VET programmes. (OECD, 2016; UNESCO, 2015).
<b><math>\pi</math>-shaped professionals</b>	Professionals who have a depth of knowledge and skills in two specific domains or fields (the two vertical bars of the $\pi$ -shape) and have broad knowledge and skills across multiple fields or disciplines (the horizontal bar of the $\pi$ -shape), which enables them to bridge the gap between the two domains or fields and also to collaborate with experts in other areas. (Adapted from Friedlein, 2013).



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**Note:**

These are the references of this main document. References used in the different methods to come to these main findings, are part of the respective annexes.



## 8. Annexes

The annexes are presented as a separate document due to the extensive size. The annexes can be consulted here: <https://cloud.digital4sustainability.eu/s/KCwwkWdtQpjGEas>.

An overview of the annexes:

- D2.1.Annex.A Digital for sustainability role profiles
- D2.1.Annex.B Literature review
- D2.1.Annex.C Analysis of the labour market reports
- D2.1.Annex.D. Analysis of the questionnaire
- D2.1.Annex.E Analysis of the job vacancies
- D2.1.Annex.F Analysis of the supply of education & training
- D2.1.Annex.G Analysis of the expert panels

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