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D3.1.2. Framework for measuring the DGC transformation capacity of the EEs

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Executive summary

This document presents a **comprehensive, competence-based framework for assessing the transformation capacity of Entrepreneurial Enviroment (EEs) in the context of the EU's digital, green, and entrepreneurial transitions**. Grounded in established European frameworks—DigComp, GreenComp, and EntreComp, the model moves beyond individual skills to understand how enviroment as a whole can build the capacity to adapt, innovate, and transform. Developed within the **Capacity2Transform** project (Interreg Central Europe, 2023–2026), the framework provides a unified, research-informed tool for supporting regional innovation actors, particularly in the cultural, creative, and sustainable tourism sectors, in designing, measuring, and advancing enviroment transformation. In the case of cultural and creative industries, the framework helps to capture how digital, green, and entrepreneurial competences can be leveraged to create not only economic, but also social and cultural value.

At the heart of the framework is a three-layer theoretical model that captures the interplay between competence domains, transformation functions, and enviroment actors. Competences are seen not just as individual traits but as systemic enablers of change, activated through functions like visioning, collaboration, experimentation, resource mobilization, and institutional anchoring. The model highlights dynamic feedback loops, illustrating how competences and actors co-evolve to generate sustainable transformation within Entrepreneurial Enviroment. The accompanying measurement method includes a modular, adaptable questionnaire that integrates items from the three EU competence frameworks. This tool is designed for flexible application across stakeholder groups, including entrepreneurs, educators, policymakers, intermediaries, and funders. The aim is to assess not only current competence levels but also identify development gaps and track progress over time. A five-step implementation protocol ensures consistent and effective use of the tool. Data ethics and validity are foundational. Accordingly, the protocol mandates informed consent, anonymity, and GDPR compliance, along with rigorous psychometric validation. Ongoing sustainability of the tool is ensured through version control and alignment with evolving EU policy standards. To support transferability and long-term sustainability, the framework is accompanied by concrete actions for uptake and scaling. **This framework provides a scalable, policy-relevant, and empirically validated instrument for tracking and supporting digital, green and creative (DGC), competence-driven, transformation across Europe's entrepreneurial enviroment**. It is both a diagnostic and strategic tool—supporting education, funding, and policy decisions that build readiness for a sustainable, digital, and entrepreneurial future.

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1. Introduction

In this document we present a **comprehensive framework that provides a structured, research-based approach to measuring the transformation capacity of Entrepreneurial Enviroment**. It is designed to assess the transformation capacity and serve as unified tool composed of four core elements: a foundation of scientific articles, a theoretical model, a competence measurement method and implementation guidelines.

The purpose is to equip policymakers, researchers, and ecosystem stakeholders with a instrument for assessing the readiness of EEs to transform in response to digital, green, and entrepreneurial challenges.

The transition toward a more resilient, digital, and sustainable economy calls for a fundamental transformation of Entrepreneurial Enviroment. This transformation depends not only on technological infrastructure or regulatory change but also on the systemic development of competences that enable individuals and institutions to act, adapt, and innovate. In this context, competence-based frameworks offer a powerful foundation for designing, implementing, and evaluating transformation strategies.The development of this framework is embedded within the ***Capacity2Transform*** **project** (Interreg Central Europe, 2023–2026), which aims to strengthen the ability of regional ecosystems, especially those in the cultural, creative, and sustainable tourism sectors, to navigate Europe's green and digital transitions. The project addresses a key challenge faced by many regions: while policies increasingly call for transformation, there remains a lack of structured tools to assess whether entrepreneurial ecosystems are actually equipped to lead and sustain that change. This framework responds to that gap by providing a scientifically grounded, competence-based method for understanding and tracking transformation readiness across ecosystem actors.

In addition, the framework takes into account the relevance of cultural and creative industries (CCIs), highlighting how digital, green, and entrepreneurial competences can be understood in these sectors and how they hold potential to generate social, cultural, and economic value.

The foundation for this work lies in the previous deliverable D1.2.2 DGC Competence Measurement Toolkit (available here: https://capacitytotransform.eu/tool/dgc-competence-measurement-toolkit/), which outlined a project-specific approach to assessing digital, green, and entrepreneurial skills using a tailored questionnaire derived from the DigComp, GreenComp, and EntreComp EU frameworks. In this framework, we introduce the concept of **DGC competences**—a project-specific integration of the **Digital (D)**, **Green (G)**, and **Entrepreneurial (E)** competence frameworks**.** The proposed competence-based approach operationalizes digital, green, and creative (DGC) transformation capacity by translating creativity into measurable competences reflected in the EU frameworks (DigComp, GreenComp, and EntreComp). While we draw directly from the DigComp, GreenComp, and EntreComp frameworks, the DGC label reflects our focus on how these domains interact not just as isolated skill sets, but as systemic enablers of ecosystem transformation. In this sense, **DGC refers to the integrated and applied competence logic** that underpins our model. That toolkit addressed a key gap in the literature: while many studies examine these frameworks individually, few offer integrated, actionable instruments aligned with EE transformation objectives. Building on this foundation, the current framework takes a holistic step forward—proposing a consolidated model for understanding how these three competence domains interact to foster change, and offering a structured method for measuring progress across different EE stakeholders.

While D1.2.2 DGC Competence Measurement Toolkit focused primarily on competence definition and measurement planning, this framework provides a deeper conceptual foundation by

introducing a theoretical model of transformation capacity. Drawing from recent academic research, the model highlights how competences act not merely as individual traits, but as ecosystem-wide enablers of transformation processes such as visioning, collaboration, learning, and institutional alignment. Competence acquisition is therefore positioned not as an end goal, but as a lever for systemic change. This framework also includes clear methodological guidance and tool usage protocols for applying the competence measurement instruments in practice.

Accordingly, the proposed framework for measuring the DGC transformation capacity of the EEs seeks to operationalize transformation through a competence-based lens. In this way suggested DigComp, GreenComp and EntreComp frameworks are more accessible, measurable, and strategically deployable within Entrepreneurial Enviroment to foster and include culture-based and creativity-driven innovation.

2. Theoretical Model for EE Transformation Capacity

The transformation of Entrepreneurial Enviroment toward digitalisation, sustainability, and innovation is increasingly driven by the development of key transversal competences. As digital and green transitions accelerate, so does the need for ecosystems to adapt and evolve, not only through technological change but through the distributed acquisition and application of relevant competences across ecosystem actors. In this context, creativity (understood as the ability to generate, refine, and apply novel ideas) acts as a foundational competence that enables ecosystems to explore options, learn iteratively, and translate opportunities into value.

This theoretical model positions transformation capacty as a function of embedded competences within the Entrepreneurial Enviroment, structured around three EU-level frameworks: EntreComp (entrepreneurial competence), DigComp (digital competence), and GreenComp (sustainability-related competence). These frameworks represent a comprehensive and policy-aligned approach to defining the competences required for forward-looking ecosystem development, with creativity explicitly acknowledged.. Hence, competence-based transformation capacity serves as the operational expression of creative transformation within the entrepreneurial ecosystem context.

Competences as Enablers of Transformation

Research suggests that entrepreneurial competences act as mediators in the relationship between education and action. Singh et al. (2024) demonstrate that entrepreneurial competences mediate the influence of digital entrepreneurial education on entrepreneurial intentions, reinforcing the value of integrated learning models. Similarly, Fabregá et al. (2020) argue that developing entrepreneurial competences such as self-awareness and environmental commitment can positively contribute to sustainable development.

These insights reinforce the model's premise that competences are not only discrete learning outcomes but also critical mechanisms for transformation at the system level—enabling individuals, organisations, and institutions to collaborate, adapt, and innovate.

Framework Integration and Theoretical Synergy

The integration of EntreComp, DigComp, and GreenComp provides a multi-dimensional lens to understand and assess transformation readiness:

EntreComp offers a structure for understanding the entrepreneurial mindset and action orientation, but its operationalisation remains challenging. Joensuu-Salo et al. (2022) treat it as a unidimensional predictor of start-up behaviour, while Bacigalupo (2022) acknowledges the complexity in measuring entrepreneurial competences in educational settings. Seikkula-Leino et al. (2021) call for further policy support in implementation, suggesting a need for ecosystem-level clarity and coherence.

DigComp provides a structured digital competence model (Vuorikari et al., 2022), yet actual adoption remains inconsistent, especially in education. Fleaca et al. (2022) identify persistent challenges in higher education institutions' digital readiness, while Berniak-Woźny et al. (2023) stress that stakeholder engagement is key to widespread DigComp integration. Baah-Acheamfuor et al. (2023) further demonstrate that attitudes moderate the relationship between digital competence and employability.

GreenComp, though relatively new, offers the potential to bridge values, knowledge, and action around sustainability. Sourgiadaki and Karkalakos (2023) highlight its flexibility for diverse applications, while Planck et al. (2024) identify overlap and interdependence between GreenComp and EntreComp, suggesting their combined use as essential for transitioning from systems thinking to practical sustainable action.

Together, these frameworks form a complementary and mutually reinforcing structure. Their integration allows this model to capture the competence interplay necessary for transformation—an approach that is increasingly endorsed in the literature (Planck et al., 2024; Rehnam et al., 2023).

A Holistic, Systemic Perspective

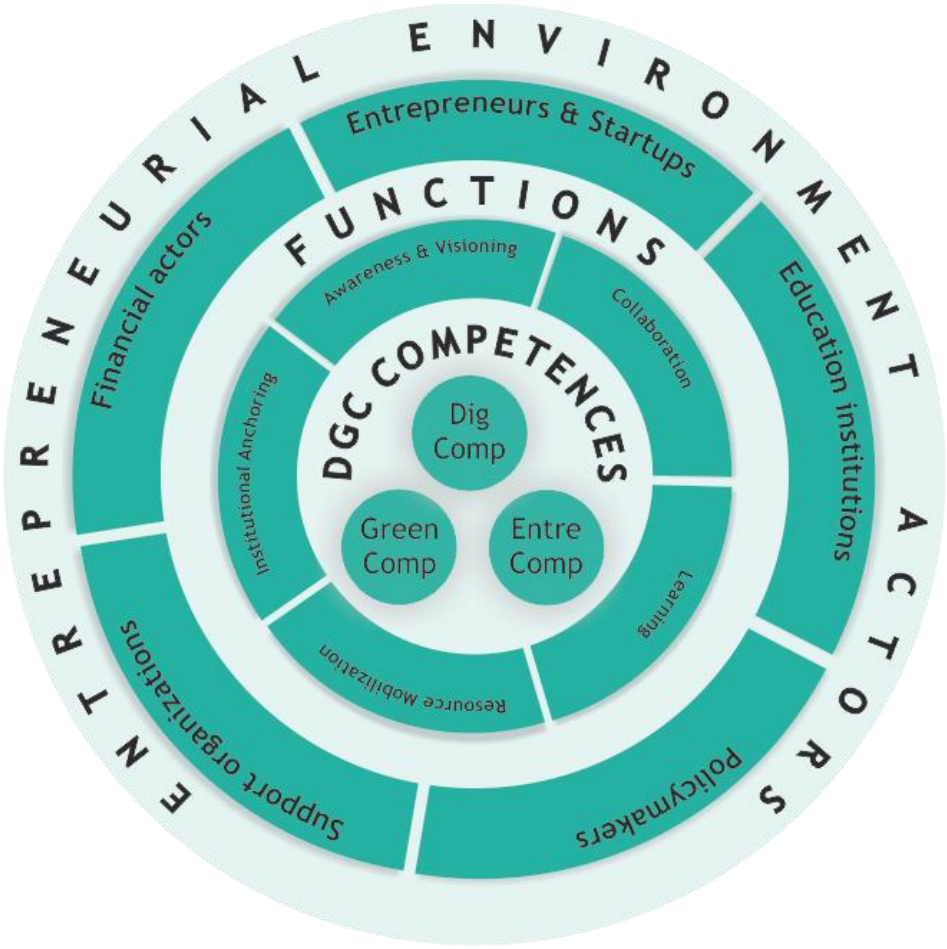
Despite a growing consensus on the need for an integrated approach, most studies address these frameworks in isolation. As Corres et al. (2020) argue, the complexity of competence frameworks lies in their inclusion of not only knowledge and skills but also attitudes, values, emotional management, and uncertainty tolerance. They call for a "learning to be" perspective, which supports a holistic and reflexive transformation model. This is especially relevant in the context of Entrepreneurial Ecosystems, where learning happens collectively and adaptively.

Thus, this model does not view competences as static traits but as dynamic, ecosystem-embedded capabilities. These competences manifest through interactions, institutional alignment, and shared transformation functions (e.g., networking, experimentation, visioning).

Model of EE Transformation Capacity

The theoretical model (Figure 1) visualises transformation capacity as a layered structure, with competence domains at the core, transformation functions in the middle, and ecosystem actors in the outer ring. These layers are dynamically interlinked, representing how competences enable transformation processes, which are enacted by various EE actors.

Figure 1. Theoretical Model of EE Transformation Capacity



Source: Own compilation, FEBT team

The model builds on the understanding that competence development is not isolated or linear—it is embedded within complex interactions between people, institutions, and systems. Three interconnected layers explain how competences influence, and are influenced by, the wider transformation of Entrepreneurial Enviroment. These layers (Competence Frameworks, Transformation Functions, and Environment Actors) operate in dynamic, recursive loops that reflect the nature of real-world change processes.

Inner Layer: Competence Frameworks

At the core of the model are the **three established EU competence frameworks**:

- DigComp: Digital Competence Framework
- GreenComp: Sustainability Competence Framework
- EntreComp: Entrepreneurial Competence Framework

These frameworks define the knowledge, skills, and attitudes needed for individuals and organisations to thrive in an evolving socio-economic context. By combining them, the model acknowledges that transformation toward sustainable and digital entrepreneurship requires a

fusion of digital literacy, sustainable thinking, and entrepreneurial capacity. These competences are not treated as parallel silos, but as a unified foundation for change. In the context of cultural and creative industries (CCI), the inner layer is particularly valuable as it links digital, green, and entrepreneurial competences with creativity and cultural expression. This integration supports the translation of competences into social, cultural, and economic value, reinforcing the role of CCIs as drivers of culture-based and creativity-driven innovation within entrepreneurial environments.

Accordingly, Digital, Green, and Creative (DGC) transformation is conceived as a competence-based process, where digital fluency, sustainable orientation, and creative capacity interact dynamically to enable innovation, resilience, and inclusive growth across entrepreneurial ecosystems.

Middle Layer: Transformation Functions

Surrounding the competence layer are **five transformation functions—core mechanisms** that channel competences into ecosystem-level change:

- Awareness & Visioning: Developing a shared understanding of future direction
- Collaboration & Networking: Building collective capacity through connection
- Experimentation & Learning: Testing and evolving new ideas in practice
- Resource Mobilization: Acquiring and leveraging knowledge, talent, and capital
- Institutional Anchoring: Embedding change in policies, norms, and structures

These functions are action-oriented processes that translate competences into outcomes. For example, the digital competence of data literacy (from DigComp) might support better decision-making in resource mobilization. Similarly, the GreenComp dimension of systems thinking enhances visioning and strategic alignment in sustainability efforts. Competences gain practical meaning and value when they are enacted through these transformative activities. It should be noted that in CCI sectors, competences such as creativity and value co-creation play an important role in linking transformation functions with cultural and social innovation. Culture-based innovation can serve as input and output: competences inform creative processes, while creative practices generate new forms of value that reinforce the EE's capacity to adapt, innovate, and sustain transformation.

Outer Layer: Environment Actors

The outermost layer includes the **primary actors responsible for initiating and sustaining transformation**:

- Entrepreneurs & Startups: Innovators and early adopters who experiment with new ideas
- Education & Training Institutions: Providers of knowledge and competence development
- Public Authorities & Policymakers: Enablers through governance and regulation
- Intermediaries & Support Organizations: Bridges across sectors and knowledge domains
- Financial Actors: Investors and funders shaping access to resources

These actors operate in diverse contexts, but they are all shaped by, and in turn shape, the competences and functions within the environment. Their interactions generate feedback loops—for example, a policymaker informed by competence measurement results might create incentives

that encourage learning, which then influences curriculum design in education institutions or resource access for startups. In the CCI sector, the role of environment actors is of great importance, as creative professionals, cultural institutions, and intermediaries often act as both innovators and enablers of transformation. Their capacity to mobilize cultural resources, foster cross-sectoral collaboration, and embed creativity into economic and social structures makes them key drivers of culture-based and creativity-driven innovation within entrepreneurial environments.

Interactions Across Layers

The strength of this model lies in its **multi-directional interactions**: Competences influence how transformation functions are carried out. Transformation functions, in turn, reveal which competences are most needed or underdeveloped. Actors perform transformation functions using these competences and feed insights back into the system.

This dynamic produces a continuous learning cycle: competences are enacted, tested, reflected upon, and redefined in practice. Importantly, each element is both a cause and consequence of change. For instance:

- An entrepreneur's entrepreneurial competence drives experimentation.
- That experimentation produces outcomes that inform institutional anchoring.
- The success (or failure) of anchoring feeds back into competence development needs.

By visualizing this recursive process, the model provides a structured and flexible lens to understand transformation not as a one-time intervention, but as an evolving, competence-driven process involving multiple actors and feedback pathways (see Table 1).

Table 1: Typology of Interactions Between Model Layers

Interaction Type	Direction	Description	Example
Competence Activation	Inner → Middle	Competences from DigComp, GreenComp, and EntreComp are applied through transformation functions.	Digital collaboration skills (DigComp) enable more effective Networking & Collaboration.
Function Implementation	Middle → Outer	Transformation functions are carried out by actors in context-specific ways.	Resource Mobilization is led by Financial Actors through funding calls or grants.
Feedback to Competence Development	Outer → Inner	Actor experience reveals new competence needs or validates existing ones.	Public authorities identify the need for systems thinking (GreenComp) after failed sustainability initiatives.
Function Reinforcement	Middle ↔ Middle	Transformation functions reinforce or depend on each other.	Effective Collaboration supports Experimentation by combining diverse knowledge.
Competence Synergy	Inner ↔ Inner	Overlap or reinforcement between competence frameworks.	Combining GreenComp's values thinking with EntreComp's ethical thinking enhances sustainable entrepreneurship.

Actor Collaboration	Outer ↔ Outer	Actors co-create change through joint initiatives and knowledge sharing.	Startups, companies and entrepreneurs partner with universities to co-develop sustainability-focused curricula.
Institutional Feedback Loops	Outer → Middle → Inner	Institutional change leads to adjustments in transformation logic and competence focus.	New policy on digital upskilling influences institutional anchoring and digital training strategies.
Iterative Learning Cycle	All Layers	Combined effect of acting, reflecting, adjusting across all levels of the system.	Competence gaps observed during learning cycles trigger program redesign and new institutional support.

This typology can guide stakeholders in identifying leverage points for intervention; practitioners in tracking how competences manifest in different contexts and researchers in analyzing systemic patterns and feedback loops.

3. Competence measurement method

The competence measurement method operationalizes the theoretical model through a structured questionnaire. This method builds directly on the work done in D1.2.2 DGC Competence Measurement Toolkit, which identified the lack of integrated tools capable of capturing digital, green, and entrepreneurial competences in a way suited to EE-level assessment.

D1.2.2 DGC Competence Measurement Toolkit laid the foundation by designing a tailored questionnaire based on the European Commission's DigComp, GreenComp, and EntreComp frameworks. While D1.2.2 DGC Competence Measurement Toolkit focused on creating the measurement instrument and piloting it at the individual level, **this framework extends its application to the system level, with refined indicators and analysis strategies that reflect systemic transformation capacity**.

The measurement method is designed to capture not only competence levels but also patterns of distribution and potential gaps across stakeholder groups within the system.

Digital competence framework

DigComp framework establishes a common understanding of what digital competence entails. The most recent version, DigComp 2.2, further develops the framework by outlining five core competence areas, ensuring it stays relevant in today's rapidly changing digital environment:

1. Information and Data Literacy
2. Communication and Collaboration
3. Digital Content Creation
4. Safety
5. Problem Solving

Green Competence Framework

The GreenComp framework, introduced in 2022, defines sustainability as a holistic competence structured around 12 key competences, grouped into four interrelated areas:

1. Embodying sustainability values
2. Embracing complexity in sustainability
3. Envisioning sustainable futures
4. Acting for sustainability

Entrepreneurship Competence Framework

EntreComp framework, introduced in 2016, defines and promotes an entrepreneurial mindset. The framework is built around three main areas and 15 specific competences, providing a structured approach to entrepreneurship education:

1. Ideas and opportunities
2. Resources
3. Into action

4. Measurement tool guidelines

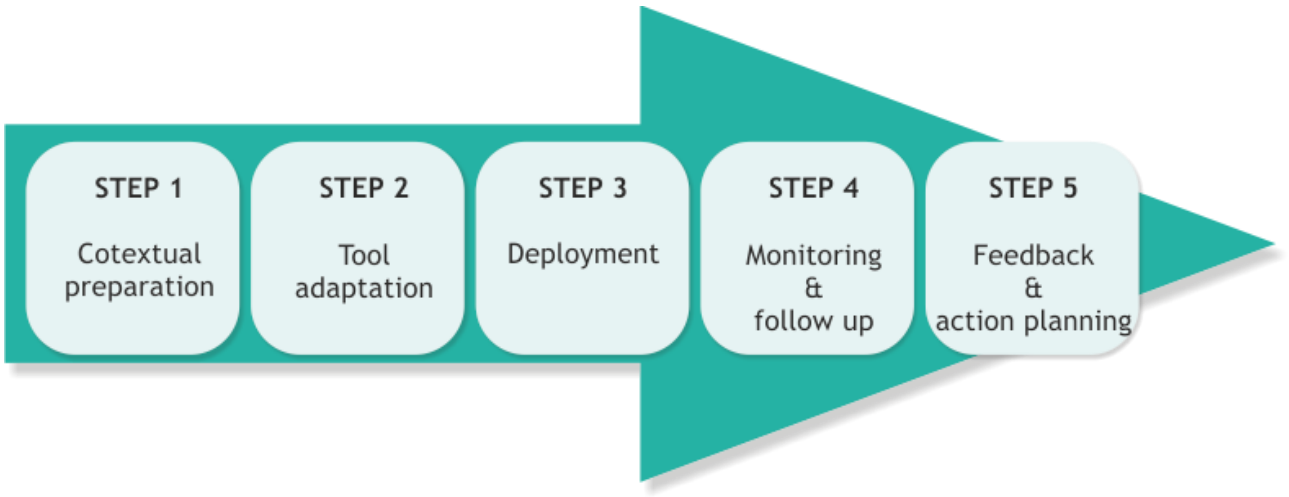
The accompanying guidelines ensure consistent and meaningful application of the tool across different regional or thematic contexts. They clarify why DigComp, GreenComp, and EntreComp were selected as they offer comprehensive and standardized structures for competences that are central to future-fit ecosystems. DigComp covers essential digital skills needed for innovation and adaptation. GreenComp ensures basic awareness and capacity related to sustainability transitions, without requiring deep environmental expertise. EntreComp addresses the entrepreneurial mindset and collaborative skills that underpin dynamic nature of Entrepreneurial Environment.

The tool is designed to be modular, allowing for self-assessment, expert evaluation, or group facilitation. It is adaptable to different stakeholder groups including public agencies, education institutions, entrepreneurs, and support organizations. The framework is primarily designed for policymakers, business support organizations' management, and educators who need to assess readiness for transformation on various levels, from broader (regional) to targeted (organizational). Secondary users include individuals such as entrepreneurs, scholars, intermediaries, funders and others who can apply results for capacity-building and investment decisions. Rather than focusing on environmental impact per se, the tool captures competences relevant to enabling and supporting green and digital transitions, reflecting readiness and potential rather than outcomes.

Implementation Protocols

To ensure consistent, valid, and meaningful application of the proposed competence measurement model across diverse Entrepreneurial Environments, the following implementation protocol is recommended. It is structured in five steps, (as presented in Figure 2) aligning with the three-layer theoretical model and enabling dynamic feedback loops between competences, transformation functions, and actors.

Figure 2. Implementation protocol flowchart



Source: Own compilation, FEBT team

To ensure consistent and meaningful application of the proposed competence measurement model across various Entrepreneurial Environments, this chapter introduces a five-step implementation protocol. This structure aligns with the three-layer theoretical model and supports dynamic feedback loops among competences, transformation functions, and actors. Each step builds upon the previous, offering a practical pathway from preparation to informed action planning (see Table 2).

Step 1: Contextual Preparation

The first phase of implementation is critical for ensuring that the competence measurement tool aligns with the characteristics and needs of the specific Entrepreneurial Environment. This involves identifying the target group, which may range from a small-scale pilot cohort to an institutional or regional-level initiative. To ensure relevance, a stakeholder mapping process should be conducted, clarifying the roles and engagement of entrepreneurs, educators, policymakers, intermediaries, and financial actors. In the CCI context, stakeholder mapping should explicitly include creative professionals, cultural institutions, and intermediaries, as their roles in cultural value creation and innovation differ from those of purely economic actors.

The next task is to define the primary goals and specific use cases for the tool. For example, the tool might be used for baseline assessments prior to training, for evaluating impact after programs conclude, or for tracking competence development over time through annual or periodic assessments. These goals should be clearly linked to ecosystem transformation functions such as experimentation, learning, or institutional anchoring.

Ethical and operational foundations must also be laid at this stage. All participants should be informed of the voluntary nature of the study, data anonymization practices, and how their data will be used. Transparency in these areas is vital for building trust and ensuring ethical compliance.

Step 2: Tool Adaptation

Once the context has been defined, the next step is to adapt the competence assessment tool to ensure cultural, linguistic, and contextual relevance while preserving methodological consistency. This process starts by selecting the most appropriate indicators from the full pool of items derived from DigComp, GreenComp, and EntreComp frameworks. The goal is to achieve a balanced representation across all five transformation functions, ensuring that the selected items reflect the ecosystem's strategic goals.

Localization involves translating and adapting items for the local language, sectoral terminology, and cultural context. Special care should be taken to avoid ambiguity or misinterpretation. A cognitive pre-test or focus group is recommended to verify clarity and relevance among the intended respondents.

For CCI actors, the tool can be adapted to capture competences such as cultural value creation, creative problem-solving, and the translation of cultural knowledge into sustainable economic opportunities.

Lastly, the tool's formatting must be standardized. A consistent Likert-type scale should be used (e.g., 1 to 5 or 1 to 7), and clear instructions with optional examples should be provided to improve usability and respondent understanding.

Step 3: Deployment

The third step involves the practical administration of the tool and collection of data. A survey platform must be selected based on the scale and complexity of the implementation. Open-source tools like LimeSurvey are suitable for customization, while platforms like Qualtrics provide advanced logic features. For lighter or smaller-scale use, Google Forms may be sufficient. It is important that the platform supports multiple languages and is mobile-friendly where necessary.

Survey design must consider the respondent's experience. The total completion time should ideally not exceed 20 minutes. Optional questions on demographics and role classifications should be included to support more detailed analysis. If certain actor groups require specific items, branching logic can be applied to present relevant content. In CCIs, deployment should consider the diverse working realities of creative actors, ensuring flexibility in survey access (e.g., mobile-friendly formats) and sensitivity to freelance or project-based employment structures.

Before full deployment, a small-scale pilot test is strongly recommended. This helps to assess timing, clarity of items, and overall data quality, allowing for final adjustments before large-scale rollout.

Step 4: Monitoring and Follow-Up

After data collection, the focus shifts to ensuring that results are analyzed and transformed into actionable insights. Participation rates should be tracked across the different actor categories to ensure balanced representation. Broad participation across layers—such as entrepreneurs, educators, and intermediaries—is essential for meaningful cross-layer analysis.For CCI ecosystems, monitoring should highlight not only economic but also cultural and social dimensions of competence application, such as collaboration across artistic disciplines or the co-creation of community value.

Basic statistical techniques, including means, frequencies, and cross-tabulations, can be used to identify patterns in competence levels. Gaps, strengths, and differences between actor groups can then be visualized and interpreted.

For those seeking a summary metric, a Competence Transformation Index (CTI) can be optionally calculated. This index aggregates performance across the three competence domains (digital, green, and entrepreneurial) and can serve as a composite indicator for benchmarking, internal reporting, or policy monitoring.

Step 5: Feedback and Action Planning

The final step is to translate findings into strategy, learning, and systemic improvement. Data should be visualized in user-friendly formats such as dashboards, radar charts, or heatmaps. These visualizations help make the results easily understandable and actionable by different stakeholder groups. Data can be clustered by actor type, transformation function, or competence domain to pinpoint areas for intervention.

Insights should be used to inform the design or adaptation of support mechanisms such as training programs, mentoring, or policy interventions. For instance, if a low level of digital readiness is identified among educators, a targeted capacity-building initiative can be introduced. In CCI-focused environments, feedback loops should emphasize how competences can be leveraged to foster culture-based and creativity-driven innovation, supporting strategies that link creativity with sustainable entrepreneurship and regional development.

Where feasible, individual feedback can also be provided. Personalized reports may suggest learning paths, training modules, or mentoring opportunities tailored to the individual's competence profile. These assessments can serve as inputs into development plans or performance evaluations.

Data Ethics and Methodological Integrity

Throughout all stages of implementation, ethical and methodological standards must be maintained to ensure data validity and participant trust. All participation should be voluntary and anonymous, with full compliance to GDPR or equivalent local privacy regulations. Clear informed consent must be obtained from all respondents.

From a psychometric standpoint, all items should undergo validation through expert review and reliability testing, including techniques such as Cronbach's alpha. If the tool is expanded or customized, exploratory factor analysis should be considered. Pilot testing across multiple ecosystems is recommended to ensure generalizability.

To ensure the tool remains relevant and sustainable, periodic updates should be performed to reflect changes in the EU competence frameworks (e.g. updates to DigComp, GreenComp). Version control and full documentation of any revisions must be maintained.

Table 2. Implementation Guidelines and Key Actions

Step	Key Actions
1. Contextual Preparation	*Identify target group and scope (pilot, institutional, EE-level)*
Define use-case (baseline, impact, tracking)	
Map stakeholders (entrepreneurs, educators, etc.)	
Clarify ethical terms and informed consent	
2. Tool Adaptation	*Select balanced indicators across frameworks (DigComp, GreenComp, EntreComp)*
Translate and localize items	
Conduct pre-test (cognitive interviews or focus groups)	
Format scales and instructions clearly	
3. Deployment	*Choose appropriate platform (LimeSurvey, Qualtrics, Google Forms)*
Design survey for usability (max 20 mins)	
Add demographic and role questions	
Pilot test and adjust before full launch	
4. Monitoring & Follow-Up	*Track participation by actor category*
Use descriptive statistics for analysis	
Identify competence gaps or strengths	
Optionally compute Competence Transformation Index (CTI)	
5. Feedback & Action	*Visualize data (dashboards, heatmaps)*
Use results to design or refine programs	
Provide personalized feedback if feasible	
Align action plans with identified needs	

Actions for Uptake and Scaling

To ensure that the measurement framework moves beyond pilot testing and becomes a transferable solution, a set of actions is required to support its broader uptake and long-term sustainability. These actions are aimed at embedding the tool into existing structures, facilitating its use by diverse stakeholders, and ensuring continuous alignment with evolving EU policy priorities. A set of actions includes:

Integration into existing structures – project partners should encourage embedding the tool into regional innovation strategies, training programs, and policy reporting cycles.

Capacity-building support – project partners should promote and/or provide training sessions, user manuals, and workshops for stakeholders on how to apply the tool.

Digital access – project partners will enable digital access by hosting the tool, questionnaire templates, and competence maps on the Capacity2Transform Knowledge Factory for open reuse.

Partnership model – project partners will promote cross-regional exchange to adapt and benchmark results.

5. Suggested Output Formats: Explanation and Recommendations

To transform data into actionable insights, the use of well-designed and standardized output formats is essential. These outputs serve various functions, from individual learning and reflection to system-wide evaluation and policy development. The following output formats (shown in table 3) are recommended, each tailored to specific users and purposes within Entrepreneurial environments:

1. Standard Competence Reports

Purpose: Standard reports should provide a synthesized overview of competence assessment results at the group, program, country or institutional level. These outputs are ideal for internal reporting, program evaluation, funding accountability, and sharing results with stakeholders.

Primary Users: Program coordinators, trainers, project managers, institutional leaders, evaluators, funding bodies.

Recommended Features:

- A brief overview outlining the objective of the assessment, the target group, and the timeframe in which data was collected.
- Description of the measurement tool used, including its alignment with EU frameworks (DigComp, GreenComp, EntreComp), the selection of competences, and how scales or indexes were interpreted.
- A table or summary chart showing average scores across competence domains (digital, green, entrepreneurial). Optional: include standard deviations or confidence intervals for more analytical depth.
- Results disaggregated by actor groups or roles (e.g., entrepreneurs, educators, public officials) or countries.

- Conclusions and Recommendations: Identification of key strengths and weaknesses across the competence areas. Providing clear, actionable suggestions for capacity building, program improvement, or policy adjustments (e.g., targeted training where “Institutional Anchoring” scores are low).
- Annexes (Optional): Sample questionnaire or list of measured items and/or technical appendix on sample composition, demographic breakdown, and completion rates.

2. EE Competence Maps

Purpose: Competence maps offer an **aggregated visual overview of Entrepreneurial Environment strengths, gaps, and alignment** across different actor categories (e.g., entrepreneurs, educators, public agencies). They are especially useful for program design, diagnosis, and multi-actor coordination.

Primary Users: Policymakers, innovation program managers, public agencies.

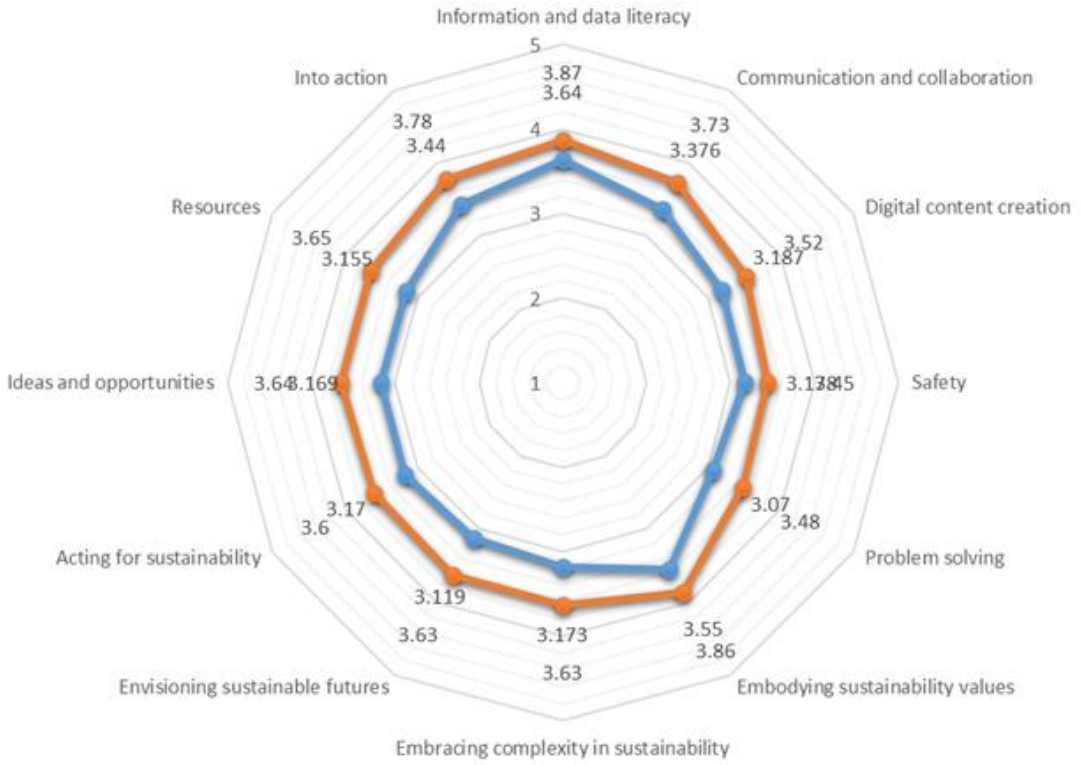
Recommended Features:

- Heatmaps or radar charts segmented by actor type, transformation function, or competence domain.
- Ability to filter by sector (e.g., tech, green energy), geography (e.g., regional clusters), or institutional affiliation.
- Clear labeling of underdeveloped transformation functions (e.g., weak scores in “Institutional Anchoring”) to inform intervention planning.
- Comparison across actor types (e.g., "entrepreneurs score high in experimentation but low in digital safety").

Implementation Tip:
Integrate maps into periodic Entrepreneurial Environment reviews, strategy workshops, or capacity-building roadmaps. Use maps to guide investment allocation, training needs, and partnership development.

Example: Figure 3 illustrates a radar chart comparing participants’ self-assessed competence levels before and after the upskilling intervention across 12 key areas spanning digital, green, and entrepreneurial domains. As part of the Interreg CE Capacity2Transform project, all participants completed the DGC competence questionnaire both before and after the intervention, allowing us to capture perceived competence development and assess the effectiveness of the capacity-building activities. The blue line represents the average pre-assessment scores, while the orange line reflects post-assessment results.

Figure 3. Changes in Digital, Green, and Entrepreneurial Competences After Upskilling[1]



Source: FEBT's Research on Capacity2Transform project

This visual snapshot clearly highlights consistent improvement across all competence areas, with particularly notable gains in "Problem Solving," "Resources," and "Envisioning Sustainable Futures." The outward shift of the orange line indicates strengthened capacities, supporting the quantitative findings detailed in the tables above. Detailed results will be presented in D3.1.3 Reports on statistical analysis and peer exchange activities due in the reporting period 6 (the summary of findings will be published on Knowledge factory). Such standardized competence maps are useful for identifying areas of high impact as well as potential gaps requiring further attention in future capacity-building efforts.

3. Individual Feedback Reports (Optional)

Purpose: These reports provide participants with a personalized summary of their assessed competences across digital (DigComp), green (GreenComp), and entrepreneurial (EntreComp) domains. The goal is to support **self-awareness, reflection, and personal learning path development**.

Primary Users: Participants, mentors, trainers, HR officers in innovation hubs or incubators.

Recommended Features:

- Simple visualizations (e.g., radar charts, bar graphs) showing competence scores per domain and function.
- Descriptive feedback for each competence area, highlighting **strengths and opportunities for development**.
- Suggested **learning resources, courses, or mentoring actions** aligned with weaker competences.
- Option to benchmark against average scores of peer groups (e.g., "entrepreneurs in your sector" or "policy actors in your region").

Implementation Tip:
Make these reports downloadable directly after completing the self-assessment survey or provide them via email. Ensure confidentiality and GDPR compliance when sharing individualized feedback.

4. Longitudinal Dashboards (Optional)

Purpose: These dashboards allow for **tracking competence evolution over time**, supporting both evaluation and strategic foresight. They help institutions and funders monitor change, benchmark progress, and compare outcomes across programs, cohorts, or territories.

Primary Users: Funders, institutions, researchers, regional innovation agencies.

Recommended Features:

- Time-series graphs showing shifts in key competences or CTI (Competence Transformation index of digital, green and entrepreneurial competences) across months or years.
- Comparison widgets for evaluating performance across regions, sectors, or demographics.
- Exportable datasets and reports to support research, policy reporting, or compliance documentation.
- Alerts or flags for significant changes (e.g., post-intervention improvements or emerging competence gaps).

Implementation Tip:
Ensure dashboards should be built with **open APIs (Application Programming Interface) or modular data architecture** to allow integration with other data systems (e.g., education platforms, innovation portals). It is reccomended to apply clear data governance rules, and to ensure longitudinal datasets are well-documented for reuse and comparative studies.

Recommendations for Successful Use

- **Standardize visual formats** across all outputs to build recognition and ease of use.
- **Use accessible language and iconography** to engage non-technical audiences.
- Ensure all formats are **digitally accessible** (WCAG-compliant) and mobile-friendly.

- Provide **training or toolkits** to stakeholders (especially system managers and trainers) on how to interpret and apply results effectively.
- Where possible, **embed outputs into existing feedback cycles**, such as accelerator program reviews, regional innovation reporting, or educational assessments.

By combining individual and collective outputs, framework supports both **micro-level development** (personal and organizational learning) and **macro-level insights** (Entrepreneurial Environment governance and policy design) becoming a valuable instrument for sustainable, digital, and entrepreneurial transformation.

Table 3: Suggested Output Formats

Output Type	Purpose	Users
Standard Competence Reports	overview of competence assessment results at the group, program, country or institutional level	Program coordinators, trainers, project managers, institutional leaders, evaluators, funding bodies
EE Competence Maps	Provides a visual snapshot of strengths/weaknesses across environments	Policymakers, program managers
Individual Feedback Reports (optional)	Supports reflection and learning path design	Participants, mentors, trainers
Longitudinal Dashboards (optional)	Enables tracking of change over time, comparison across groups or regions	Institutions, funders, researchers

6. Conclusion

The unified competence measurement framework developed in this document demonstrates both conceptual coherence and practical effectiveness in tracking transformation capacity across Entrepreneurial Eenvironments. Grounded in the integration of the **DigComp**, **GreenComp**, and **EntreComp** EU competence frameworks, this approach addresses key gaps in previous tools by offering a methodologically sound, context-sensitive, and actionable instrument.

The implementation of the self-assessment tool across diverse stakeholder groups should result in **concrete, positive outcomes**. Analysis of Capacity2Transform Pilot Actions indicate a **notable increase in perceived competence** across all three competence domains (digital, green, and entrepreneurial) after targeted interventions. These gains suggest that the measurement instrument not only captures relevant aspects of individual and organizational competence, but also **effectively reflects progress over time**, when used in conjunction with training, mentoring, and Entrepreneurial Environment support.

The observed increase in self-assessed competences also reinforces the **validity** of proposed instrument. When a measurement tool reflects change in response to intentional upskilling actions, it meets a core requirement of both formative and summative evaluation. In this context, the tool proves useful for diagnosis and benchmarking, and for **monitoring transformation trajectories** as a starting point for future interventions. The alignment between competence growth and proposed theoretical model strengthens the claim that the selected constructs and indicators represent meaningful components of Entrepreneurial Environment transformation capacity.

While this conclusion presents the high-level finding of competence increases, more detailed **descriptive statistics, item-level analysis, and subgroup comparisons** will be provided in D3.1.3. Reports on statistical analysis and peer exchange activities document due in the reporting period 6.

The development and successful deployment lof this measurement framework offers a significant step forward in operationalizing digital, green and creative (DGC) competence-driven transformation in Entrepreneurial Enviroment. Developed within the context of the Interreg Central Europe ***Capacity2Transform*** project, the framework has been empirically tested through pilot activities and stakeholder engagement across Central Europe. By validating this instrument through empirical use and aligning it with EU-level strategic frameworks, we offer a useful and adaptable solution for building sustainable, digital, and entrepreneurial capacity across Europe and beyond.

FInally, for cultural and creative industries (CCI), the framework underscores how creative competences can generate social, cultural, and economic value. By explicitly integrating creativity-driven innovation and transformation processes, the model strengthens the role of CCI actors as active contributors to regional resilience and as enablers of green, digital, and entrepreneurial transitions.

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APPENDIX

DGC Competence Measurement Toolkit is a separate project deliverable and is also available here: https://capacitytotransform.eu/tool/dgc-competence-measurement-toolkit/ For comprehensiveness it is also enclosed here as an appendix.

C2T - (Pre) self-assessment for participants

Survey Flow

Block: Default Question Block (10 Questions)

Standard: DIGITAL COMPETENCIES (6 Questions)

Standard: GREEN COMPETENCES (5 Questions)

Standard: ENTREPRENEURSHIP COMPETENCES (4 Questions)

You are invited to participate in the skills self-assessment exercise with an aim to assess your digital, green and entrepreneurial competences before the upskilling actions taking place. Please take your time and estimate your proficiency levels in different competence areas.

At the end of the project, a follow up self-assessment will be conducted. Please estimate the level of your proficiency in the following skills, where

1 - no skills means you have no skills or don't know how to perform the related task;
2 – basic skills means you can perform a simple task with autonomy and appropriate guidance when needed;
3 - intermediate skills means you can perform the task of your own and solving straightforward problems;
4 – advanced skills means you can perform the task at an advanced level according to your own needs and those of others in the complex context;
5 – expert skills means you can perform the task at a highly specialized level in the complex context while guiding others.

Thank you for participating in Central Europe - Capacity to Transform (C2T) project!
Your C2T team

In accordance with GDPR Article 28, Section 3, this data processing agreement includes assurances that 1) Faculty of Economics, Business and Tourism in Split (FEBT) agrees to process data collected by this questionnaire only for the purposes of the pre- and post- self-assessment of competences of participants in the upskilling programs within the Interreg Capacity2Transform project. 2) Everyone who comes into contact with data at FEBT is sworn to confidentiality. 3) FEBT uses appropriate technical and organisational measures to protect the security of the data. 4) FEBT will not subcontract to another processor unless instructed

to do so in writing by the lead partner Primorska Tehnološki Park from Slovenia, in which case another Data Processing Agreement will need to be signed with the sub-processor (pursuant to Sections 2 and 4 of Article 28). 5) FEBT will uphold its obligations under the GDPR, particularly concerning data subjects' rights. 6) FEBT will maintain GDPR compliance with regard to Article 32 (security of processing) and Article 36 (consulting with the data protection authority before undertaking high-risk processing).
Responses to this survey are voluntary and completely confidential. The data will only be reported in group form and never for an individual. The reports are aggregated in a manner neither allowing for the identification of individual respondents nor for the attribution of individual responses to a respondent. Recipients of the survey results will be dedicated staff members from the Interreg Capacity2Transform project team. The aggregated data will be kept for a maximum period of two years after the closure of the survey to comply with the project guidance. If you have questions regarding the survey details, please contact the responsible person at FEBT by sending an e-mail to mcukusic@efst.hr

Q1 Name and surname

_____

Q2
Work position

_____

Q3 Organization name

_____

Q4 Country of residence

▼ Afghanistan (1) ... Zimbabwe (251)

Q5 Your e-mail address

_____

Q6 Please indicate your gender

Female

Male

Other

Prefer not to respond

Q7 Please indicate your age

Less than 20

21-25

26-30

31-35

36-40

41-50

51-55

56-60

61-65

More than 65

Q8 What is the highest level of education / highest degree you have completed / obtained

High school (secondary school)

Bachelor's degree

Master's degree

Post-graduate degree (e.g. doctorate degree)

Q9
Rubric code
Please create a rubric code that will be used for follow up self-assessment at the end of the project. For example you can use the following: last three letters of your mother's first name and your two favorite numbers (e.g. ABC37)?

_____

DIGITAL COMPETENCES

Information and data literacy
Please estimate the level of your proficiency in the following skills:

	1 - no skills (don't know how to perform a task)	2 - basic skills	3 - intermediate skills	4 - advanced skills	5 - expert skills
D1.1. I can browse, search and filter data, information and digital content.					

D1.2. I can evaluate (analyze, compare and critically evaluate) data, information and digital content. D1.3. I can manage (organize, store and retrieve in a structured environment) data, information and digital content.	

Communication and collaboration
Please estimate the level of your proficiency in the following skills:

	1 – no skills (don't know how to perform a task)	2 - basic skills	3 - intermediate skills	4 - advanced skills	5 - expert skills
D2.1. I can interact through a variety of digital technologies and understand appropriate digital communication means for a given context. D2.2. I can share data, information and digital content with others through appropriate digital technologies following referencing and attribution practices. D2.3. I can participate in society through the use of public and private digital services, seeking opportunities for self-empowerment and participatory citizenship. D2.4. I can use digital tools and technologies for collaborative processes and for co-construction and co-creation of resources and knowledge. D2.5. I am aware of behavioural norms and know-how while using digital technologies and interacting in digital environments, including cultural and generational diversity. D2.6. I can create and manage one or multiple digital identities, protect own					

reputation and deal with the data that I produce.	

Digital content creation
Please estimate the level of your proficiency in the following skills:

	1 - no skills (don't know how to perform a task)	2 - basic skills	3 - intermediate skills	4 - advanced skills	5 - expert skills
D3.1. I can create and edit digital content in different formats and express myself through digital means.					
D3.2. I can modify, refine, improve and integrate information and content into an existing body of knowledge to create new, original and relevant content and knowledge.					
D3.3. I understand how copyright and licences apply to data, information and digital content.					
D3.4. I can plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.					

Safety
Please estimate the level of your proficiency in the following skills:

	1 - no skills (don't know how to perform a task)	2 - basic skills	3 - intermediate skills	4 - advanced skills	5 - expert skills
D4.1. I can protect devices and digital content and I understand risks and threats in digital environments, including safety and security measures, reliability and privacy.					
D4.2. I can protect personal data and privacy in digital environments and understand how to use and share					

personally identifiable information while being able to protect myself and others from damages. D4.3. I can avoid health risks and threats to physical and psychological well-being while using digital technologies and protect myself and others from possible dangers in digital environments. D4.4. I am aware of the environmental impact of digital technologies and their use.	

Problem solving
Please estimate the level of your proficiency in the following skills:

	1 - no skills (don't know how to perform a task)	2 - basic skills	3 - intermediate skills	4 - advanced skills	5 - expert skills
D5.1. I can identify technical problems when operating devices and using digital environments, and to solve them. D5.2a. I can assess needs and identify, evaluate, select and use digital tools and possible technological responses to solve them. D5.2b. I can adjust and customize digital environments to personal needs (e.g. accessibility). D5.3. I can use digital tools and technologies to create knowledge and to innovate processes and products, as well as resolve conceptual problems and problem situations in digital environments. D5.4. I understand where my digital competence needs to be improved or updated, seek opportunities for self-development, and keep up-to-date with the digital evolution.					

GREEN COMPETENCES

Embodying sustainability values
Please estimate the level of your proficiency in the following skills:

	1 - no skills (don't know how to perform a task)	2 - basic skills	3 - intermediate skills	4 - advanced skills	5 - expert skills
G1.1. I can reflect on personal values; identify and explain how values vary among people and over time and how they align with sustainability values.					
G1.2. I can support equity and justice for current and future generations and learn from previous generations for sustainability.					
G1.3. I can acknowledge that humans are part of nature and respect the needs and rights of other species and of nature itself in order to restore and regenerate healthy and resilient ecosystems.					

Embracing complexity in sustainability
Please estimate the level of your proficiency in the following skills:

	1 - no skills (don't know how to perform a task)	2 - basic skills	3 - intermediate skills	4 - advanced skills	5 - expert skills
G2.1. I can approach sustainability problem from all sides, considering time, space and context in order to understand how elements interact within and between systems.					
G2.2. I can assess information and arguments, identify assumptions, challenge the status quo, and reflect on how personal, social and cultural backgrounds influence thinking and conclusions.					
G2.3. I can formulate current or potential challenges as a sustainability					

problem in terms of difficulty, people involved, time and geographical scope.	

Envisioning sustainable futures

Please estimate the level of your proficiency in the following skills:

	1 - no skills (don't know how to perform a task)	2 - basic skills	3 - intermediate skills	4 - advanced skills	5 - expert skills
G3.1. I can envision alternative sustainable futures by imagining and developing alternative scenarios and identifying the steps needed to achieve a preferred sustainable future.					
G3.2. I can manage transitions and challenges in complex sustainability situations and make decisions related to the future in the face of uncertainty, ambiguity and risk.					
G3.3. I can adopt a relational way of thinking by exploring and linking different disciplines, using creativity and experimentation with novel ideas or methods.					

Acting for sustainability

Please estimate the level of your proficiency in the following skills:

	1 - no skills (don't know how to perform a task)	2 - basic skills	3 - intermediate skills	4 - advanced skills	5 - expert skills
G4.1. I can navigate the political system, identify political responsibility and accountability for unsustainable behaviour, and demand effective policies for sustainability.					
G4.2. I can act for change in collaboration with others.					

G4.3. I can identify own potential for sustainability and actively contribute to improving prospects for the community and the planet.	

ENTREPRENEURSHIP COMPETENCES

Ideas and opportunities
Please estimate the level of your proficiency in the following skills:

	1 – no skills (don't know how to perform a task)	2 – basic skills	3 – intermediate skills	4 – advanced skills	5 – expert skills
E1.1. I can identify and seize opportunities to create value (needs to be met) by exploring the social, cultural and economic landscape.					
E1.2. I can develop several ideas and opportunities to create value, including better solutions to existing and new challenges, combining knowledge and resources to achieve valuable effects.					
E1.3. I can develop a vision to turn ideas into action and visualize future scenarios to help guide effort and action.					
E1.4. I can judge what value is in social, cultural and economic terms and recognise the potential an idea has for creating value and identify suitable ways of making the most out of it.					
E1.5a. I can assess the consequences of ideas that bring value and the effect of entrepreneurial action on the target community, the market, society and the environment and act responsibly.					
E1.5b. I can reflect on how sustainable long-term social, cultural and economic goals are, and the course of action chosen.					

Resources

Please estimate the level of your proficiency in the following skills:

	1 - no skills (don't know how to perform a task)	2 - basic skills	3 - intermediate skills	4 - advanced skills	5 - expert skills
E2.1. I can reflect on own needs, aspirations and wants in the short, medium and long term to strengthen belief in own ability to influence the course of events, despite uncertainty, setbacks and temporary failures.					
E2.2. I am determined to turn ideas into action and satisfy own needs to achieve while simultaneously being patient and resilient under pressure, adversity, and temporary failure.					
E2.3. I can get and manage, often limited, material, non-material and digital resources as well as needed competencies at any stage to turn ideas into action.					
E2.4. I can estimate the cost of turning an idea into a value-creating activity and manage financing to make sure value-creating activity can last over the long term.					
E2.5. I inspire and enthuse relevant stakeholders to get support needed to achieve valuable outcomes by effective communication, persuasion, negotiation and leadership.					

Into action

Please estimate the level of your proficiency in the following skills:

	1 - no skills (don't know how to perform a task)	2 - basic skills	3 - intermediate skills	4 - advanced skills	5 - expert skills
E3.1. I can act and work independently to achieve goals, stick to intentions and					

carry out planned tasks in order to initiate processes that create value.

E3.2. I can set long-, medium- and short-term goals, define priorities and action plans and adapt to unforeseen changes.

E3.3a. I can make decisions when the result of that decision is uncertain, when the information available is partial or ambiguous, or when there is a risk of unintended outcomes.

E3.3b. Within the value-creating process, I can include structured ways of testing ideas and prototypes from the early stages, to reduce risks of failing.

E3.4. I can work together and cooperate with others to develop ideas, turn them into action, solve conflicts, and face up to competition positively when necessary.

E3.5. I can use any initiative for value creation as a learning opportunity, learning with others and from both success and failure (own and other people's).