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INVEST FOR EXCELLENCE IN REGIONAL SUSTAINABILITY
INVEST4EXCELLENCE

RDI COMPETENCE MATRIX

Deliverable D4.1

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PROJECT PARTNERS

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UARD	University of Agribusiness and Rural Development, Bulgaria
UTH	University of Thessaly, Greece
KARELIA UAS	Karelia University of Applied Sciences, Finland
VHL	Van Hall Larenstein University of Applied Sciences, The Netherlands

ABBREVIATIONS

FGI Focus Group Interview
HEI Higher Education Institution
JBI Joanna Briggs Institute (Australia)
PCC Population, Concept and Context
RDI Research, Development and Innovation (or R&D&I or RD&I)
SCC Sustainable Supply Chains
NGO Non-Governmental Organization
GRI Global Reporting Initiative
ICT Information and Communication Technology
SDG Sustainable Development Goal (United Nations)
AI Artificial Intelligence
XR Extended Reality; AR (Augmented Reality) and VR (Virtual Reality)
LARGs Lean; Agile; Resilient; Green and Sustainable paradigms
SMEs Small and Medium Enterprises
CSR Corporate Social Responsibility
SEM Structural Equation Modelling
TBL Triple Bottom Line
PI Physical Internet
LCA Life Cycle Assessment
HESD Higher Education for Sustainable Development

PUBLISHABLE SUMMARY

The aim of the INVEST4EXCELLENCE Work Package 4: Capacity Building Tools is to strengthen the human capital by developing Research, Development and Innovation (RDI) sustainability competences and skills of the INVEST alliance RDI staff and students. This specific ***Deliverable 4.1: RDI Competence Matrix*** summarizes the baseline of the key competences found in a three-step research process: (1) Scoping Review, (2) Case Study, and (3) Focus Group Interviews.

The objective of the ***Scoping Review*** step was to identify and describe the key competences, skills and knowledge, which are relevant in Research, Development and Innovation (RDI) in relation to Sustainable Supply Chains (SSC). The scoping review was conducted in the form of a systematic literature review on RDI competences, skills and knowledge.

The scoping review provided a structured and purpose-base selected current state analysis revealing key findings of the reviewed literature. Structured ***Case Study*** in its turn has a task to reveal the current practises at INVEST alliance partner organisations to enable identification of the mismatches and gaps. Enriched with the ***Focus Group Interviews***, it was possible to build understanding on the phenomena and to co-create joint knowledge combining the theoretical background and current practices into one descriptive entity shedding light into the capacity building needs and potential. The process was iterative and participatory.

As a result, RDI Competence Matrix has been collated (Table 4). The results have been grouped at several levels in terms of Sustainable Supply Chain Management (SSCM) sub-sections, the perspective (working life or Higher Educational Institution), or the generality or specificity of the competence. Some competences were clear to categorize, but many of the competences could have belonged to several categories. Similarly, the division into general and specific competences was wavering.

The Focus Group Interviews emphasized some competences, which were not so much highlighted in the earlier steps but, in general, the characteristics of the key competences were found in every step of the research.

This study creates the baseline, on which the next steps of the INVEST4EXCELLENCE WP4: Capacity Building Tools can be implemented. The resulted RDI Competence Matrix will be further discussed in the partnership and the key competences selected for training. As the data received was vast, it gives also possibilities to deepen the study. It has been planned that a joint scientific article will be published based on the results during the course of the I4E project.

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1. INTRODUCTION

The aim of the INVEST4EXCELLENCE Work Package 4: Capacity Building Tools is to strengthen the human capital enabling brain circulation and gender balance by developing research competences and skills of the INVEST alliance RDI staff and students. The specific objective is to identify and describe the key competences and skills that are needed to share research resources within INVEST consortium.

In this study, RDI (or R&D&I or RD&I) is an abbreviation for ***Research, Development and Innovation***, based on the definition of the European Commission (European Commission, 2022). ***Competence*** is generally defined as a possession of sufficient knowledge, judgment, skill or strength for a particular duty. In organizations, competences can be used to define work roles i.e. knowledge in circular economy.

The research process for I4E Deliverable 4.1 (Task 4.1) included the following three steps:

1. **Scoping review** for mapping the key concepts, revealing the extent of the literature available in research, development and innovation (RDI) competences and identifying the knowledge and evidence gaps.
2. **Case study** for revealing the current practices at INVEST alliance organisations and regions, implemented in a structured frame.
3. **Focus group interviews** for enriching the data acquired from the previous steps.

The study was implemented as a logical and consecutive process, where knowledge and understanding grew gradually. As an output, the data is presented in a tabular form (***RDI Competence Matrix***) in this Deliverable 4.1 document (Table 4). The matrix is supported by the background documentation of the research method and process (Chapters 1–4).

The workflow, indicative schedule and responsibilities to complete the Task 4.1 are described in a visual form (Picture 1). Task/Deliverable 4.1. leader Karelia UAS has coordinated the study, created the study protocol and bore the main responsibility for implementing, analysing and reporting the study. Other project partners have contributed the study according to the following steps:

- Agreeing jointly on the study protocol.
- Providing support in institutional data collection
    - ***Scoping review***: Literature data search and extraction in national languages.
    - ***Case study***: Filling the structured case study template regionally.
    - ***Focus Group Interviews***: Implementing 2-3 focus group interviews regionally (2-5 informants in each group, length of the interviews max. 60 min. each) and transcribing the results in English.
- Commenting the data analysis and the final deliverable.

Picture 1. The workflow, indicative schedule and responsibilities for the INVEST4EXCELLENCE Deliverable 4.1 RDI Competence Matrix (due date 31st March 2022).

2. SCOPING REVIEW PROTOCOL

The Scoping Review protocol used in this study is based on and applied from the Joanna Briggs Institute JBI Scoping Review Protocol Template (Joanna Briggs Institute, 2022). The aim was to complete the scoping review data searches and extraction in each region prior to implementing the case study and focus group interviews.

2.1. Objectives and research questions

2.1.1. Objectives

The objective of this scoping review was to ***identify and describe the key competences***, ***skills and knowledge***, which are relevant and essential in research, development and innovation (RDI) in relation to sustainable supply chains (SSC). The scoping review was conducted in the form of a systematic literature review on:

1. General research, development and innovation (RDI) competences and skills

2. Specific research, development and innovation (RDI) competences and skills ...in relation to the Sustainable Supply Chains (SSC).

In the data extraction phase, the RDI competences, skills and knowledge were collected into a data pool, which Karelia UAS analysed and divided into general and specific competences, when applicable (Table 4).

2.1.2. Population

The target group in this study a.k.a. the study population for the literature review included the research, development and innovation (RDI) professionals /practitioners or researchers /students in Higher Education Institutions (HEI) or in industry, who are involved in the sustainable supply chains (Table 2).

2.1.3. Research Questions

1. What are the ***general*** research, development and innovation competences and skills in relation to sustainable supply chains (SSC)?
2. What are the ***specific*** research, development and innovation competences and skills in relation to sustainable supply chains (SSC)?

2.2. Methods

2.2.1 Inclusion Criteria

The inclusion criteria was based on and applied from PCC (population /concept /context framework) (University of South Australia 2022) as follows, and described in more details in Table 1.

1. **Participants/population:** Research, Development and Innovation (RDI) professionals, who are involved in activities related to Sustainable Supply Chains (SSC) and are expected to have knowledge to implement the sustainability skills in their research, development and innovation actitivies.
2. **Concept:** Research, Development and Innovation (RDI) competences, skills and knowledge.
3. **Context:** Sustainable Supply Chains (SSC) (as a term, entails both social and environmental aspects).

Table 1 - Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
• Theoretical or empirical studies. • Any reliable study designs in the selected databases including review/synthesis articles. • In addition to the selected databases with peer-reviewed articles, relevant grey literature will be included (Google Scholar search). • Studies must report on competences or skills or knowledge or a term with corresponding meaning, AND must be relevant to the sustainable supply chains (SSC) as a concept. • In empirical studies, populations or samples must be professionals (or university students) working in research, development and innovation (RDI) activities either in HEIs or industry. • In theoretical/conceptual studies, the concepts referring to competences, skills or knowledge in RDI must be relevant in the area of sustainable supply chains (SSC). • Max. 150 articles together from all the database searches (per language), ***based on relevance.*** • Published after 1st January 2010, prioritizing recent research.	• Study does not report on sustainability/responsibility related to research, development and innovation (RDI) competences (e.g. study reports on research, development and innovation (RDI) competences ***but not*** related to sustainability; ***or*** study reports on sustainability competences ***but not*** related to research, development and innovation (RDI) work). • Publications in a language other than English, Finnish, Dutch, Slovakian, Greek, or Bulgarian. • Grey literature other than Google Scholar.

2.2.2 Search Strategy

The search terms were defined according to the PCC framework (chapter 2.2.1) and presented in detail in the Table 2.

The search aimed to include the studies published in INVEST4EXCELLENCE partner native languages i.e. English, Finnish, Dutch, Slovak, Greek and Bulgarian. The reviewers of respective languages were expected to have native-level fluency in the respective languages. The search terms (Table 2) were translated in applicable parts into relevant Finnish, Dutch, Slovak, Greek and Bulgarian terms.

As the field of the sustainability has been developed quickly in the past years, and the I4E project outputs should have a future orientation, only the studies published after 1st of January 2010 were included to the data searches, prioritizing recent research.

Table 2 – Search strategy

Details	Free Text Terms [Title/Abstract] and Thesauri terms
1. Population: research, development and innovation professionals	professional* OR practition* OR research professional* OR researcher* OR "higher education institution*" OR HEI* OR student* *ti, ab*
2. Concept: research, development and innovation competences and skills	competenc* AND (research OR development OR innovation) *ti, ab* skill* AND (research OR development OR innovation) *ti, ab* knowledge AND (research OR development OR innovation) *ti, ab*
3. Context: sustainable supply chains (SSC)	sustainab* AND supply chain* *ti, ab* responsib* AND supply chain* *ti, ab*
Combination	1 AND 2 AND 3
Limit/Filters	English, Finnish, Dutch, Slovakian, Greek, Bulgarian (native-level competency required) Published after 1st of January 2010

Key: *, truncation; *ti, ab*, title and abstract searches; " ", exact phrase

In this study, the articles were screened mainly for the ***titles and abstracts*** and the data extraction was conducted based on the inclusion/exclusion criteria (Table 1). When relevant, also the full-text screening was done to deepen the study, but not thoroughly. Data management software were used to help the selection of studies and the data extraction, when relevant.

Both ***research databases*** and ***grey literature*** were used for the data search. Each participating university chose 2-5 databases, which gave the best results in terms of national language articles. Google scholar was used as grey literature database in each language.

The search strategy was to locate ***electronically published studies***. An initial limited pilot search of EBSCO was undertaken to identify articles on the topic. The text words contained in the titles and abstracts of relevant articles, and the index terms used to describe the articles, were used to develop a full search strategy for all databases. The search strategy, including all identified keywords and index terms, was adapted for each included database, information source and/or language.

The more detailed instructions of applying the search strategy can be found in Appendix I of this document.

2.3. Study/Source of Evidence selection

Each organisation decided independently, if they preferred to use a citation management software (e.g. Covidence or RefWorks) for sorting out the citations, or did they implement the screening manually.

Following the database search, all identified citations were collated and the relevant full-text articles retrieved. Then duplicates were removed. Titles, abstracts (and relevant full-text articles) were screened by for assessment against the inclusion criteria for the review (Table 1).

2.4. Data extraction

The data was extracted from the articles included in the scoping review by reviewer(s) using a ***data extraction sheet*** (excel template) developed and provided by the Task/Deliverable leader Karelia UAS (Picture 2). The data extraction sheets included the relevant data categories about the population/participants (HEI staff, HEI students, industry/business, other), study discipline (Environmental sciences /Engineering /IT /Social sciences /Business /Entrepreneurship /Other), and key findings (= RDI competences /skills /knowledge) in relation to the research questions (section 2.1.3).

Data gathered and extracted in INVEST partner national languages were translated into English to the extraction sheet (Picture 2). Separate files were used for different languages, which guarantees the traceability of the data. The data extracted to the excel sheets formed the basis for the next steps of the RDI competence study, thus the Case Study and Focus Group Interviews. The latter activities deepened the knowledge about the research, development and innovation (RDI) competences, skills and knowledge related to the sustainable supply chains (SSC).

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Literature review (Task/Deliverable 4.1) /Data extraction sheet for Scoping Review
Name of Institution:
Name of Reviewer:
E-mail:

	Population (type of professionals) (x)				Scientific disipline (x)							Research, development or innovation competence or skill		
Article ID	HEI staff	HEI students	Industry /business	Other (name it)	Environmental sciencies	Engineering	IT	Social sciences	Business	Entrepreneurship	Other (name it)	Competence 1	Competence 2	Competence 3

Picture 2. The excel template for the Scoping Review data extraction sheet. The excel template contains also the guidance to fill in the sheet.

2.5. Data Analysis and Presentation

Karelia UAS as the Task/Deliverable leader bore the main responsibility of analysing the Scoping Review data and providing the key findings to the next steps of the study (Case Study and Focus Group Interviews). Proper analysis required the partner input in terms of the literature review in national languages as described in earlier chapters.

The evidence presented responds to the research objective and questions and the data is presented in ***tabular form*** (Table 4).

3. CASE STUDIES

Case study may be interpreted with a two-fold meaning in INVEST4EXCELLENCE RDI Competence Matrix elaboration: first, the whole research process relies on a case study methodology with different data collection steps (1. scoping review, 2. structured case study, and 3. focus group interview). Second, *case study is used as a structured data collection and analysis tool* to describe the existing regional practises and qualities of RDI actions to give the context, and competences related to sustainable supply chains. Following the nature of the case study method, the researchers explore and build understanding on the phenomena as a holistic and interpretive study in the INVEST partner HEIs and their RDI ecosystems in as naturistic form as possible (Cohen *et al.* 2008, pp. 253-263; Patton 2002, pp. 447- 452).

In the data collecting process, the scoping review provided a structured and purpose-base selected current state analysis revealing key findings of the reviewed literature. Key findings gave a reasonable solid theoretical background for the capacity building of the project latter tasks. Structured case study in its turn has a task *to* ***reveal the current practises at INVEST alliance partner organisations*** to enable identification of the mismatches and gaps.

Enriched with the focus group interviews, we explored and built understanding on the phenomena and co-created joint knowledge combining the theoretical background and current practices into one descriptive entity shedding light into the capacity building needs and potential. The process was iterative and participatory. The development forms a hermeneutical circle where understanding and commitment grow throughout the reflective process where the experienced reality is constructed into learning outcomes that form the base for INVEST4EXCELLENCE RDI Comptence Matrix.

The Case Study frame was structured and the INVEST4EXCELLENCE Task/Deliverable 4.1 leader Karelia UAS provided a template (Table 3) for the case study.

3.1. Case Study Template

The case study template is shown in Table 3. The table was to be filled by each INVEST alliance member HEI. The table includes the basic background information related to the research, development and innovation (RDI) activities, staff and the key competences at the I4E partner organisation.

Table 3. A structured template for the regional Case Studies.

Name of the HEI		
Theme	**Topics**	**Data**
Background information	Names of the researchers filling this template	
	Date and place	
	Sources of data	
Research, development and innovation indicators of the INVEST partner organisation	Overall research, development and innovation (RDI) budget volume (in Euros)	
	Research, development and innovation (RDI) budget volume from ***national*** funding sources divided in the main programmes/sources (e.g. ERDF, ESF+, others)	
	Research, development and innovation (RDI) budget volume from ***international*** funding sources divided in the main programmes/sources (e.g. Horizon, Erasmus+, others)	
Research, development and innovation focus areas of the INVEST partner organisation	Thematic titles of the (strategic) focus areas	
	Specific topics under the focus areas (related to sustainable supply chains)	
Ecosystem Indicators of the INVEST partner organisation	Number of ***regional*** working life partners in research, development and innovation (RDI)	
	Number of ***national*** partners in research, development and innovation (RDI)	
	Number of ***international*** partners in research, development and innovation (RDI)	
	Types of the partner organisations in research, development and innovation (RDI) ***in percentages*** (in quadruple-helix manner a.k.a. academia, business, administration, civil society)	

Research, development and innovation staff and competences of the INVEST partner organisation (HEI)	Number of research, development and innovation (RDI) staff (include also gender and age ratios, if available)	
	Educational background of the research, development and innovation (RDI) staff (level of education and %)	
	Titles of the positions of research, development and innovation (RDI) staff and % of staff in each	
	Required ***general*** RDI competences for the research, development and innovation (RDI) staff (especially in relation to sustainable supply chains)	*Fill this after the scoping review analysis completed by the Task/Deliverable leader thus, when the competences found from literature are divided into general & specific competences*
	Required ***specific*** RDI competences for the research, development and innovation (RDI) staff (especially in relation to sustainable supply chains)	*Fill this after the scoping review analysis completed by the Task/Deliverable leader thus, when the competences found from literature are divided into general & specific competences*
	Existing competence development methods at the INVEST partner organisation	

4. FOCUS GROUP INTERVIEWS

To ensure relevant understanding of the phenomena and support coherent capacity building actions, the data for all the tasks was enriched more in depth with focus group interviews in each of the INVEST partner regions.

The informants were selected based on purposive sampling and ***the main aim was to receive insights and supportive data for the INVEST4EXCELLENCE capacity building tool development***. In practice, the informants were relevant regional stakeholders related to the sustainable supply chains in a quadruple-helix manner. Thus, the informants represented academy, business, administration or civil society.

The informants of the focus groups included internal staff of partner organisations and some relevant stakeholders as external informants. The internal informants represent the staff members working in RDI. The staff positions that the internal informants hold are project manager, professor, associate professor and lecturer. The competence areas that these informants represent comprise logistics, regional and rural development, tourism, administration and management, agribusiness management, construction engineering, energy and environmental engineering, health care, social services, ecological and social

aspects of sustainability, various fields in economics (e.g. international and macro economics), finance, marketing, investments and risk management.

The external informants are relevant regional stakeholders involved in the RDI actions of INVEST partners. These informants were selected by the partner organisation and include governmental regional development agencies, consulting companies with a focus on sustainable development, firms specialised in various kinds of sustainable solutions and production, e.g. private agricultural and rural business development companies, national commodity exchange and renewal energy. Moreover, the informants included stakeholders specialised in food quality and safety, food and nutrition management, organic farming and rural development.

The goal of focus group interviews was that each INVEST alliance organisation implements 2-3 Focus Group Interviews including 2-5 informants per group. One of the groups could consist of the research, development and innovation (RDI) personnel of the particular INVEST organisation. The focus group interviews should have taken maximum of 60 minutes each. Task/Deliverable leader Karelia UAS provided a ***semi-structured interview protocol*** based on the results of the earlier study phases. The interviews took place in English or in national languages, and the discussion outcome was provided for the Task/Deliverable leader in English, preferably as an anonymized transcript including also a short description of informants.

The focus group interview results were analysed by the inductive ***content analysis*** and combined with the earlier competence results to the matrix (Table 4).

5. RESULTS AND DISCUSSION

The aim of this research was to identify and describe the Sustainable Supply Chain (SSC) related competences, skills and knowledge that are relevant and essential in Research, Development and Innovation (RDI) of the participating INVEST alliance HEIs' staff, students and working-life partners. The results of the three-step gradual research (scoping review, case studies and focus group interviews) are represented in tabular form as a competence matrix in Table 4.

The research process was iterative and participatory. As the data received was vast, it gives possibilities to deepen the study further in the coming months. It has been planned that a joint scientific article will be published based on the results during the course of the I4E project.

5.1. RDI Competence Matrix

The results collated in the RDI competence matrix (Table 4) have been grouped at several levels. Based on the Scoping Review, the extracted competence data was grouped in three main categories: (1) Competences related to the Sustainable Supply Chain Management (SSCM), (2) competences related to the interaction between the Higher Education Institutions (HEIs) and Industry/Business, and (3) competences related mainly to Higher Education Institutions internally.

Further, the competences related to the Sustainable Supply Chain Management (SSCM) were grouped into four categories, based on loosely the general sub-division of SSCM sections:

1. Evaluation, Planning, and Innovation
2. Product and Process Design
3. Supplier Management & Operations
4. Sustainable Logistics.

Competences were also sub-grouped based on the division to *general* and *specific* RDI competences (Chapter 2.1.1).

Table 4. The RDI Competence Matrix (Deliverable 4.1)

Category	Subcategory	Competence and Description
Sustainable Supply Chain Management (SSCM) (based on scoping review and external interview results)	**Planning; Evaluation & Innovation: General Competences**	**Sustainability management and leadership competences**; management plays a major role in the sustainability of supply chains; strategic thinking and planning; objective-setting; concept creation; holistic thinking; visionary leadership; Knowledge management; green supply chain management; Leadership by values; Trust management; Quality management and assurance; Models for sustainable supply chain management (e.g. LARGS = Lean; Agile; Resilient; Green & Sustainable paradigms; SEM = Structural Equation Modelling); Understanding of sustainable supply chain performance measurements (SSCPM) and indicators; knowledge and ability to evaluate sustainable, green and circular business models; identify opportunities for promoting sustainable and responsible governance; optimisation methods (e.g. multi-objective programming); optimal production planning and decision-making
		Knowledge of the concept and practices of corporate social responsibility (CSR); phenomena of transparency; stakeholder dialogue and sustainability reporting (standards e.i. GRI =global reporting initiative); traceability
		Knowledge of sustainability goals; regulatory harmonisation (instruments); regulations and standards (UN, EU and global); environmental and social taxonomies; due diligence processes (likely to become obligatory); global regulation of supply chains; ecological taxation; national legislation
		Sustainable supply chain innovation (SSCI)
		Stakeholder collaboration; knowledge of sustainability benchmarking tools; open innovation practices; innovation ecosystems
		Organizational transformation and change management towards sustainability; re-shaping of organisations; sustainable designs in achieving triple bottom line (TBL; TBL= planet; profit and people)
		Energy-water-environment sustainability nexus (i.e. emissions; renewable energy; water resources and distribution); matching availability of resources (materials,water,energy) with the requirements of the supply chain; land use planning; green energy
		Knowledge of customer interface and customer communications i.e. customer feedback systems in customer-centered development work; customer sustainability awareness effects on buying behavior; consumer informing; motivations affecting consumer behaviour; consumer attitudes

		Close collaboration with scientific research; Knowledge of industry-specific sustainability research practices (including applied research)
		Practical experience is an asset in planning and innovation (combined with theoretical information)
		Digital and technological skills; supply chain management using digital technologies; Knowledge of big data/predictive analytics (BDPA); Artificial intelligence; machine learning; blockchain-based quality management architecture; Internet of Things (IoT) as a contributor to sustainability; measuring and monitoring the effects of IoT on sustainability efforts
		Global collaboration in research, development and innovation; Global and multicultural collaboration skills; knowledge of local and foreign (work) cultures; openness to influences; new values in a multicultural environment
		Collaboration skills in sustainability development networks; building a common understanding of the terms and dimensions related to sustainability and responsibility; dialogue (constructive conversation) skills; ability to discriminate and prioritize the most influential and realistic sustainable development goals from the low-impact and unessential development work
		Sustainability practices in small and medium enterprises (SMEs); Understanding the business-size context in sustainability (SMEs vs. corporations); Knowledge sharing and assistance on sustainable quality management for smaller enterprises (i.e. public agencies, quality systems, funding options, reporting, regulations, laws, taxation, trustee organizations, knowledge hubs); Influencing the development of public policies; advocacy strategies; networking skills (i.e. political decision-makers) and strategies in influencing legislative drafting
		Risk and crisis management; Risk management models and practices; Risk management in the face of fluctuations of global economy and trends i.e. ability to anticipate and prepare for risks (i.e) and react fast to changing business environment (i.e. World Economic Forum's global risk map); understanding the impact of uncertainty; creating supply chain resilience; Understanding the unfavorable effect of global phenomena (e.g. pandemics) on SC and developing solutions to overcome them on a global and local scale; such as climate change; overpopulation; forest fires; and loss of biodiversity and natural resources
		Green business
	Planning; Evaluation & Innovation: Specific Competences	**Food supply chains;** design and operate food distribution systems; supply and marketing of food; fostering competitiveness of food supply chains; managing quality throughout the supply chain; Local energy-food self-sufficiency; Local production and development of food supply chains; active probing in policy formulation; restructuring and consolidating the agricultural sector; encouraging the creation of producer organisations; innovative and effective cultivation and processing techniques; saline agriculture; precision agriculture practices; hydroponic crops; Food system dynamics; sustainable agricultural management; nutritional analysis; analysing success factors in reducing consumer-related food waste
		Circular economy & bioeconomy; the possession of molecules (material) is crucial in sustainable development; critical raw materials; nature-inclusive practices; conservation on nature and biodiversity
		Smart solutions; Smart cities; smart branches e.g. agriculture and tourism; energy effectiveness/transition; urban energy; sustainable urban mobility;
		Social-ecological systems
		Peace economics
		Sustainable tourism
	Product & Process Design: General	**Sustainability design;** Design for sustainability (DFS) techniques for economics; ecology and social equity; Models for sustainable supply chain design; agile approach to design and development; redesigning existing supply chains;
		Understanding a dynamic product line
		Technology and IT; e.g. blockchain
		Sustainability certifications
		Reverse supply chain management
		Patenting skills
	Product & Process Design: Specific Competences	**Life cycle assessments (LCAs)** according to standards)
		Circular economy; configuration of closed-loop supply chains
		Design of eco-efficient biomass supply chains;

	Supplier Management & Operations: General Competences	**Understanding the models for sustainability supplier assessment;** multi-tier sustainable supply chain modeling; supplier selection models; Supply Chain Network Design (SCND) models for sustainability implementation; Social sustainability practices in multi-tier supply chains; double agency role of leading firms (first tier suppliers) in multi-tier sustainable supply chains
		Cooperation planning between suppliers; connecting companies in the supply chain; aligning the objectives of the different supply chain actors; allocating economic gain between partners
		Purchasing practices in supply chain management; corporate responsibility in purchasing/procurement
		Collaboration skills in sustainability supply networks
		Ability to manage and improve human resources; Green human resource management; Human rights risk management; Behavioral factors in implementing SSCM practices; Organization culture
		Talent and competence management; competence/knowledge mapping (i.e. CV databases); Customer-centric competence development; development discussions (yearly); competence development (i.e. continuing education and further training; collaborative and digitized education, transfer of experience, internal theme-based groups for competence development planning, curated knowledge packages for internal/external training); outsourcing (i.e. collaborative networks); longer-term recruitment strategies (i.e. targeting novel/missing competences) in growth planning; Demand and supply of SCM knowledge/talent
		Understanding of innovation implementation in practice
		Big data and data analytics
	Logistics: General/specific	**Green logistics;** environmental standards
		Reverse logistics
		Digital interoperability in logistics and supply chain management
		Physical Internet (PI) as a worldwide logistic paradigm interconnecting and coordinating logistics and supply networks
		Sustainable express transport services
		Investment in eco-solutions in logistics
		Smart urban logistics
		Awareness of the need for sustainability-related knowledge development and training in staff
Higher Education and Industry interaction	**Competences based on scoping review**	**Understanding the concept and practices of smart specialization**
		ICT and technology skills; technology development; digital competence; ICT skills; technology transfer
		Participatory approaches and partnerships; building upon commonalities and differences
		Interdisciplinary knowledge and skills
		Learning environments
		Knowledge of sustainable development; Understanding the sustainable development goals (SDGs) and sustainability challenges
		Creating project-based initiatives for sustainability
		Competence management; Competence models; Knowledge management; Employability skills
		Innovation-related competences; Innovation process; Innovation management; Innovation funding; Innovation potential; knowledge and innovation transfer; Leadership in innovation; Innovation partnership; Innovation networks; Innovation commercialization; Innovation risks; Ecological aspects of innovation and sustainable development; Eco-innovation; Transitions and innovation; Clusters of knowledge and innovation; Innovation Competitiveness; Innovations in EU and SMEs; Innovative decision-making; facilitation of open approach in innovation
		Social innovation understanding: Social economy; Sustainable and inclusive growth; Social inclusion; Social capital
		Sustainable organizational change; Change Management; Community change
		Entrepreneurship skills; Academic entrepreneurship
		Intellectual property management; Academic scientific research and Intellectual property
		Commercialization and marketing knowledge and skills; Consumer demand; commercialization; Product and innovation commercialization; Marketing and business models; Competitiveness management skills; customer orientation; active consumer participation
		Thinking skills; Creative thinking; Problem-solving
	Competences based on external interviews	**Commercialization and marketing skills**; ability to commercialize and market new technological innovations to the agents with high purchasing power; ability to self-market one's expertise; ability to work directly with customers; green marketing skills
		Producer-consumer relations development
		Qualification and requalification; life-long learning

	(industry and public sector)	**Multidisciplinary/interdisciplinary/transdisciplinary approaches and knowledge;** knowledge that cuts across many disciplines; i.e. understanding of both water and electrical engineering
		Identification of digitalization opportunities
		Attitude towards RDI-work; self-oriented and solution-focused thinking
		Self-leadership skills
		Project management skills; branch-specific project management skills; interdisciplinary teamwork e.g. in industrial business administration
		Knowledge exchange in bilateral collaboration; continuing education opportunities for companies in HEIs; targeted outsourcing of educational services to companies (i.e. courses); New HEI-based funding models (i.e. scholarships) for students' practical training periods in companies; Concrete ways of interacting i.e. internships and students' research activities in companies (i.e. theses); practice case studies (based on real-life examples from companies) as learning tasks; communication of yearly occurring educational activities (i.e. courses) in HEIs well in advance; HEI teachers' working life networking competence (i.e. accumulation of ideas; innovations and case study tasks) and enough time allotted for visiting companies; Open days; Piloting activities; expertise provision; publications
		Understanding of (public) stakeholders' role in the sustainable development of companies i.e. functions of regional administrative agencies; boundary conditions set by different agencies
		Benchmarking practices; cross-benchmarking;
		Utilizing disruptions in the sustainable development work
		Knowledge acquisition skills; ability to react swiftly to different knowledge needs; acquire knowledge (from different fields of knowledge) and apply it to practice
		Slow food and slow tourism
		Interaction and listening skills; ability to adapt and one's behavior to different situations depending on customers' needs
	Competences based on internal interviews (HEI)	**Co-operation in specialist networks**; Ability to integrate one's knowledge into a vast variety of contexts in society and co-operate with other specialists from different backgrounds
		Knowledge of communities and groups; e.g. sustainable energy communities; group-based work and management;
		Co-creation skills
		Knowledge of sustainability regulations and standards
		Continuing education and lifelong learning skills; Constant development and learning
		Digital skills and tools; general skills e.g. extended reality (XR) (i.e. AR and VR technologies); branch-specific skills e.g. cybersecurity and data protection in construction and construction engineering
		Competences in curriculum development; cooperation with work-life stakeholders; work-life-based curriculum planning; developing new structures for HEI-working life interaction
		Knowledge of the shortage of workforce in different fields of work (i.e. in construction and construction engineering; social and health services) and the ability to create solutions for overcoming it
		Attitude towards learning and development; ability to work autonomously and acquire knowledge independently; open-mindedness; boldness; optimism
		Self-leadership skills
		Business-driven development skills; Ability to recognize concrete development needs in companies and create joint projects that are cost-effective for stakeholders
		Integration of technical knowledge and ecosocial approach; the combination of environmental and social perspectives on sustainability; social innovations; social and cultural knowledge e.g. business culture; cultural sensitivity
		Innovation skills; problem-solving
		Project management skills
		Organizational change management; organizational transformation towards sustainability requires strong change management competence
		Eco-design; taking a circular-economy perspective into account in each stage of product design (i.e. energy solutions; resources)
		Stakeholder (i.e. advocate) organizations as sustainability information providers; branch-specific knowledge needs on sustainable development i.e. associations of engineering and technology
		Forms of industry-HEI co-operation; theses; project-based tasks; (multidisciplinary) hackathons; studification skills; curriculum co-development models; business and science forums; events and sharing good practices; living labs; making use of learning communities
		Future research competences; megatrends; weak signals
		Sustainable management skills; hybrid management; knowledge management; technologies in management (e.g. AI)
		Globalization and glocalization processes
		Flexible implementation of curriculum; dynamic integration of new
		Innovative forms of travel services i.e. AI-assisted travel experiences

		Pedagogical approaches; inclusive education; Ability to rethink pedagogy in the emergence of new technologies e.g. extended reality
		Ethical thinking skills
		Coaching skills
		Marketing approach in business and co-operation
		Co-operatives development
		Geography
		Finances in RDI; investing in RDI; Focus on financial aspects of innovation; financial risk management; evaluation of innovation and investment; risk management in innovation; financial planning in innovation; risk assessment for new products; start-ups development
		Entrepreneurial university; concentration on research activities that have practical and everyday focus
Sustainability in Higher Education	**Competences based on scoping review and internal interviews**	**HEI management competences;** Institutional change /transformation; Organization management; Strategic management; Crisis management and critical infrastructure protection; Risk management; Funding and strategic management of HEIs supporting sustainable practices; value chain management
		HEI competence management; Career management; Professional development; Knowledge triangle; Competence management; Professional competences development; Competence approach and innovations in education; competence development methods (e.g. staff training, workshops); Specialised competences for university employers (specialized expertise simultaneously in multiple areas hard to attain e.g. researcher/business/etc)
		Social responsibility in HEIs; Principles of responsible education and research; Good practices in CSR in the context of education; research and social innovation; Social audit
		Knowledge of International dimensions of HEIs; Globalization; Intercultural competences; Language competences
		Knowledge-based economy and Smart growth
		Cooperation between science; education and business; Stakeholder engagement; Quadruple helix; Academic interaction; supply chain collaboration for sustainability; transfer of knowledge; co-creation; action research
		Developing a curriculum with a transdisciplinary approach involving expertise from both HEIs and corporate organizations
		Sustainable start-up development support
		Higher Education for Sustainable Development (HESD) practices
		Open innovation in HEIs; development of open innovation environments in universities (additional elaborating info to the entry Open innovation in HEIs);
		Innovation audit skills e.g. (survey-based) mapping of available competences and information regarding innovation activities in the area R&D for e.g. monitoring and competence development purposes
		Technology and IT; ICT competences; Transfer of technology
		Inclusive education
		Project management
		Fields of research; Operations research; Future research (Future of education and Future of societies);
		transversal skills
		soft skills; e.g. conflict resolution
		Pedagogical approaches; authentic learning; experiential learning
		Systems approach; systems thinking; analysis of systems
		Educative contents on sustainable supply chains; raising students' sensitivity to the impact of supply chain disruptions
		Thinking skills; critical thinking; forward thinking

5.2. Results and discussion

The Scoping Review created the baseline for the results, thus the key Research, Development and Innovation (RDI) competences in Sustainable Supply Chains. Both, the case studies and focus group interviews supported the findings from the literature. It was

expected and experienced that the latter steps will not give totally differing results but rather deepen the preliminary findings; the scoping review results provide a set of more general level competences, whereas the focus group interview results represent a more practical and individual-level viewpoint on competences.

Some competences were clear to categorize in the matrix (Table 4), such as *energy-water-environment sustainability nexus* or *reverse logistics*. On the other hand, many of the competences could have belonged to several categories. Similarly, with respect to many categories the division into ***general*** and ***specific*** competences is wavering as e.g. *purchasing skills* can be referred as a general competence but *purchasing practices in supply chain management* is definitely a specific competence.

The Focus Group Interviews emphasized some competences, which were not so much highlighted in the earlier steps. Such competences included especially *business-driven development skills* (ability to commercialize and market new technological innovations), *food and energy security skills*, and *knowledge acquisition, interaction and listening skills* as general competences. In the Focus Group Interviews, the general competences, such as *continuing education and lifelong learning skills*, were emphasized more frequently over the specific ones, especially by the working-life stakeholders.

All top-level categories include both similarities and overlapping themes. Based on the data, collaboration, project management and ICT- skills and sustainability and responsibility competences, for example, seem to have general relevance as competences in the RDI work related to sustainable supply chains (SSC). Moreover, the main categories of competence matrix reveals that a large part of detected competences, such as thinking skills (critical thinking, transversal thinking, problem solving) communication and ICT-skills, seem to fall into the recent categorizations of 21-century skills (see e.g. Partnership for 21st Century Skills, 2009; González-Salamanca, Agudelo & Salinas 2020).

5.3. Conclusions

The main aim of this specific research was to identify the key RDI competences to be developed during the INVEST4EXCELLENCE project. This study creates the baseline, on which the next steps can be implemented. The RDI competence matrix (Table 4) will be further discussed in the partnership and the key competences to be selected for ***training*** *(Deliverables 4.2 – 4.4)*. Thus, further grouping and selection must be done, as this study provided a very wide perspective to the phenomena. On the other hand, the baseline is explored thoroughly, which means that the most relevant Research, Development and Innovation (RDI) competences related to the Sustainable Supply Chains (SSC) are definitely described in the matrix.

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APPENDIX I: Instructions for applying the search strategy

1. First, make sure that you have proper translations of the Free Text Terms found in Table 2. Note that the truncated terms i.e. sustainab* intend to search for all the terms that involve the root "sustainab" i.e. sustainability, sustainable.

2. Adapt the search strategy to work on your ***own language***, chosen (national) databases and their search syntax.

3. For each of your queries, opt for advanced search if it is available for your chosen database to specify the following search options:
    1. **Date range**: 2010-2022
    2. **Article citation field**: title & abstract
    3. **Language**: your own national language

4. Each of your search queries involves three parts: 1) Population 2) Concept and 3) Context that are presented in the following Table 2 (copied below):

Details	Free Text Terms [Title/Abstract] and Thesauri terms
2. Population: research, development and innovation professionals	professional* OR practition* OR research professional* OR researcher* OR "higher education institution*" OR HEI* OR student* *ti, ab*
3. Concept: research, development and innovation competences and skills	competenc* AND (research OR development OR innovation) *ti, ab* skill* AND (research OR development OR innovation) *ti, ab* knowledge AND (research OR development OR innovation) *ti, ab*
4. Context: sustainable supply chains (SSC)	sustainab* AND supply chain* *ti, ab* responsib* AND supply chain* *ti, ab*
Combination	1 AND 2 AND 3
Limit/Filters	English, Finnish, Dutch, Slovakian, Greek, Bulgarian (native-level competency required) Published after 1st of January 2010

Here is an example of a query entered in EBSCO Academic Search Premier (search engine) by using advanced search option:

- In a search engine, which has only basic search option available, a query may look like this: professional* OR Practition* OR "Research professional" OR Researcher OR "Higher institution" OR HEI OR “university student*” competence research sustainable "supply chain" (the search strategy above is applied to SpringerLink database’s search syntax).

- In each database, try out all the possible search word combinations, which involve one search unit from each PCC category (population, concept and context), until you have covered all the search combinations and attained relevant results that satisfy the inclusion and exclusion criteria.

- Based on your searches from all databases, select for data extraction ***based on relevance*** altogether ***max. 150 articles***, which satisfy the inclusion and exclusion criteria. Use the data extraction sheet (excel template provided) for data extraction and translated your findings into English.

APPENDIX II: Results of the literature review, case studies and focus groups interviews

This annex summarizes the findings obtained from (1) **scoping reviews** (literature available in English and national languages), (2) **case studies** and (3) internal (universities) and external (stakeholders) **focus group interviews.**

1) Results of scoping reviews

The scoping reviews were conducted by each INVEST4EXCELLENCE partner regionally and, thus, cover literature from national databases in local languages. In addition, KARELIA UAS conducted a scoping review on academic databases available in English. This section presents the summarized key results of each of these scoping reviews organized into thematic groups. This section includes the results of the following scoping reviews: (a) English (KARELIA UAS); (b) Finnish (KARELIA UAS); (c) Bulgarian (UARD); (d) Slovak (SUA); and (e) Greek/English (UTH).

a) Scoping review (English)

1. **Sustainable Supply Chain Management (SSCM) Principles and Strategies**: This category would include competences like Purchasing Supply Management (PSM) in SSCM, reverse supply chain management, Sustainable Supply Chain Risk Management (SSCRM), Multi-tier Sustainable Supply Chain Modelling, and Sustainable Supply Chain Performance Measurement (SSCPM).
2. **Innovation and Technology in SSCM**: Here, we can place competences related to Sustainable Supply Chain Innovation (SSCI), Data Envelopment Analysis (DEA) for sustainable supplier selection, Digital Interoperability in Logistics and Supply Chain Management, and the application of machine learning technology in SSC.
3. **Educational and HR Strategies for Sustainability**: This includes Higher Education for Sustainable Development (HESD) practices, green human resource management practices, and Sustainability training for engineering students in HEIs.
4. **Sustainability Assessment and Measurement**: This category can include competences like Carbon Management Accounting, Green Supply Chain Management (GSCM) and green information (GIS) system synergy, and Sustainability maturity models, i.e., TBL, in the assessment of SSC.
5. **Sustainability in Specific Industries**: This category would include competences such as Food Supply Chain Sustainability Practices, Green Supply Chain Management in Construction, and Process systems engineering (PSE) skills in sustainability in the chemical industry.
6. **Policy and Regulation in SSCM**: This includes competences like regulatory and market pressures as drivers of SSCM and cap-and-trade regulation.
7. **Social and Environmental Dimensions of SSCM**: This includes competences such as pro-environmental behaviour, a conceptual framework of social sustainability, stakeholder pressure as a social and environmental sustainability driver in SSCM decision making, and social SSC indicators.
8. **Big Data and Analytics in SSCM**: This includes competences related to Big Data Analytics as a mediator in Lean, Agile, Resilient, and Green (LARG) practices and big data-driven sustainable supply chains.

9. **Knowledge Management in SSCM**: This includes competences like Knowledge management (KM) processes facilitating strategic or operational development of SSCs and knowledge transfer between supply chain partners.

10. **Circular Economy and Lifecycle Management**: Here we can place competences related to circularity in supply chain configurations supporting restorative and regenerative processes and Circular economy (CE) strategies for design, manufacturing, construction, and operation and maintenance phases in the construction industry.

b) Scoping review (Finnish: KARELIA UAS)

It is a comprehensive list of competencies relevant to sustainable supply chains obtained from Finnish literature. These competencies cover various aspects, including regulations, strategies, operations, technological applications, monitoring, and reporting, among others. Here is a summary of the main findings categorized into key thematic groups:

1. **Regulatory and Compliance**:
   - Global regulation of supply chains
   - Governmental sustainability criteria and regulation
   - Due diligence laws
   - Sustainable statutory objectives
2. **Corporate Social Responsibility and Reporting**:
   - Corporate Social Responsibility (CSR)
   - CSR reporting and greenwashing
   - Transparency of corporate social responsibility
   - Corporate responsibility reporting
3. **Strategic Integration and Management**:
   - Integration of business and environmental strategies
   - Managerial involvement in enhancing sustainability
   - Integrating strategic sustainability objectives in year plans of supply chains
4. **Sustainable Operations and Logistics**:
   - Green logistics
   - Sustainable express transport services
   - Environmental systems in logistics
5. **Sustainable Procurement and Supplier Relations**:
   - Corporate responsibility in purchasing
   - Procurement responsibility
   - Responsible procurement of materials and services
   - Sustainable supplier selection process and monitoring
6. **Innovation and Technology Application**:
   - Blockchain-based procurement
   - Life cycle assessments of food supply chains
   - Big data in sustainable business
   - Digitalization in enhancing sustainable development
7. **Stakeholder Engagement and Cooperation**:
   - Co-operation between supply chain stakeholders
   - Stakeholder interaction in CSR functions
   - Customer-oriented business development

8. **Sustainability Awareness and Education**:
   - Sustainability awareness in customer service selection
   - Sustainability-related knowledge development and training in staff
   - Digital learning platforms in developing sustainability, responsibility, and circular economy training in companies
9. **Risk Management and Monitoring**:
   - Human rights risk management
   - Risk-based categorization of suppliers
   - Monitoring responsibility in a long supply chain
10. **Sustainable Product Development**:
    - Life cycle assessment (LCA)
    - Component model for IT product development
11. **Sector-Specific Innovation**:
    - Internationally competitive innovation business ecosystems in Finland
    - Innovation in agricultural sector, forest industry, and healthcare

c) Scoping review (Bulgarian: UARD)

1. **Scientific Research and Publishing**:
   - Scientific research
   - Knowledge management
   - Crisis management and critical infrastructure protection
   - Ethics in scientific research
   - Scientific publishing
   - Ethics in publishing
   - Fighting academic misconduct
2. **Innovation Management and Strategy**:
   - Innovation management
   - Smart specialization
   - Research and development
   - Innovation strategy
   - Innovation activity
   - Competitiveness management
   - Innovation development / types of innovation
   - Open innovation
   - Social innovation
   - Financial innovation
3. **Knowledge Transfer and Commercialization**:
   - Knowledge and innovation transfer
   - Technology transfer
   - Intellectual property management
   - Innovation commercialization
4. **Cooperation and Partnerships**:
   - Business and universities cooperation
   - Project based initiatives
   - Academic entrepreneurship
   - Innovation partnership

- Innovation networks
- Innovation clusters
- Knowledge, research and development
- Business-science partnerships
- Organization management

5. **Funding and Financial Management**:
   - Project financing
   - Innovation projects
   - Innovation funding
   - Venture capital
   - European funds
   - Financial aspects in innovation management
   - Financial sustainability
6. **Sustainability and Environmental Management**:
   - Sustainable development
   - Environmental management
   - Sustainable and inclusive growth
   - Quality of environment and life
   - Ecological aspects of innovation and sustainable development
   - Sustainability challenges
   - Sustainable design
7. **Education, Training, and Competence Management**:
   - Competence management
   - Competence models
   - Intelligence
   - Open education
   - Professional and practical training
   - Digital competence
   - Professional competences development
   - ICT competences
   - Methods of teaching and learning
8. **Entrepreneurship and Start-up Development**:
   - Entrepreneurship behaviour
   - Start-up development
   - Entrepreneurship and economic growth
   - Academic entrepreneurship
9. **Risk and Crisis Management**:
   - Risk management at HEIs
   - Global risks
   - Sustainable supply chains
   - Global supply chains
10. **CSR and Social Responsibility**:
    - Corporate social responsibility
    - Socially responsible initiatives
    - Social responsibility in HEIs
    - Principles of responsible education and research

- Good practices in CSR in the context of education, research, and social innovation
- Social audit

11. **Supply Chain and Logistics Management**:
    - Supply chain management
    - Logistics chains, models, and good practices
    - Short Food Supply Chains
    - Logistics and supply chain management
12. **Technology and ICT**:
    - ICT and information management
    - Knowledge-based economy and ICT
    - Technological audit
    - Technology development

d) Scoping review (Slovak: SUA)

1. **Education, Training and Research**:
    - Sustainable education
    - Collaborative and digitized education
    - More applied research
    - Innovation implementation
    - IT training
    - Continuing education and further training
    - Occupational retraining and re-education
2. **Communication and Cooperation**:
    - Flexibility
    - Information sharing
    - Communication
    - Transparent and credible sustainability reporting
3. **Technology and Innovation**:
    - Setting up of logistic processes
    - Effective technological collaboration
    - Technological, social, environmental innovations
    - Patents, a dynamic product line
4. **Sustainability Practices and Governance**:
    - Certifications
    - Corporate governance guidelines
    - Ethical politics
    - Efficient use of materials and energy
    - Investment in eco solutions in logistics
5. **Strategic Planning and Leadership**:
    - Decision maker's strategic planning
    - Leadership with vision
    - Transfer of experience
    - Building relationships with suppliers
    - Building relationships with stakeholders

e) Scoping review (Greek/English: UTH)

1. **Scientific Research and Innovation**
    - Agricultural research and innovation
    - Business and economic research
    - Water resources planning
    - Environmental research
    - Bio-economy and agri-production
2. **Sustainability in Various Sectors**
    - Transportation and urban mobility
    - Sustainable logistics
    - Urban energy and big data analytics
    - Bio-fuel and biomass production
    - Sustainable Additive Manufacturing
    - Resilience and well-being in healthcare
    - Environmental management and contamination assessment
3. **Technological Innovation and Data Analysis**
    - Smart cities and pandemics management
    - Bibliometrics and big data analytics
    - Blockchain
    - Information-Seeking Behaviour
    - Wireless Communications
    - AI and machine learning
4. **Natural Resource Management**
    - Water management and hydrology
    - Soil analysis and contamination assessment
    - Rainfed cultivation and irrigation
    - Pest control management in farming
5. **Environmental Sustainability and Conservation**
    - Urban and environmental planning
    - Land-sea interaction and land planning
    - Energy-water-food nexus
    - Forestry and Social-Ecological Systems
6. **Innovation Management and Business Innovation**
    - Innovation in tourism and hospitality
    - Innovation in supply chains
    - Innovation in agriculture (precision-agricultural practices, greenhouse cultivation, etc.)
    - Sustainable business models and practices
7. **Economic Welfare and Sustainable Development**
    - Environmental economics and policy
    - Sustainable development in fisheries
    - Waste Generation Efficiency
    - Economic aspects of innovation
    - Peace economics
8. **Education and Social Development**
    - Accessible and inclusive education
    - Environmental behaviour and public perception

- Participatory modelling
- Awareness and sustainability in education

2) Case studies

This section is describing the existing situation at partner organizations, based on the key results acquired from INVEST partner organizations; summarizing shortly the needed competences for RDI staff and the existing competence development methods at the INVEST partner organizations. Competences for RDI staff were completed during the focus group interviews when the results of literature review were available.

Needed competences found to be relevant for RDI staff, in addition to or from those mentioned in the literature review:

- Project management
- Self-management and leadership
- Digitalization, intelligent solutions
- Holistic global understanding of the operational environment, society and environment – sustainable development (incl. resource efficiency)
- innovation management
- resilience management, preparedness (incl. cyber security), foreshadowing
- social – economic understanding
- trans-disciplinary thinking

Existing competence development methods at the INVEST partner organizations:

- Project manager coaching
- Mentoring
- Job shadowing
- Field work
- Design ateliers
- Role play
- Team building activities
- Internships
- Different on-site and online training, e.g. scientific writing, interview techniques; also participating trainings outside the organization
- Periodical trainings for work safety
- Workshops, webinars and seminars (also with stakeholders)
- Work in scientific networks
- Research path (doctoral studies)
- INTRO for newcomers

3) Focus Group Interviews

This section includes the summaries of the results acquired from (a) internal (university) and (b) external (stakeholders) focus group interviews arranged by INVEST partners. The summaries include the key results organized in thematic categories.

a) Internal Interviews (Universities)

1. Strategic Planning & Management:
- Evaluation, planning, and innovation
- Monitoring
- Project management
- Business orientation
- Competence identification and development
- Specialization

2. Research & Development:
- Product and process design
- Practical research
- Open innovation

3. Sustainability & Environmental Stewardship:
- Sustainable supply chain management
- Responsible consumption
- Infrastructure management
- Sustainability and systems competences
- Environmental and social sustainability competences

4. Globalization & International Relations:
- Internationalization
- Language competences

5. Soft Skills & Communication:
- Soft skills (networking, teamwork, conflict resolution)

6. Competence Development Strategies:
- Staff trainings
- Workshops
- Support from educationalists
- Students' involvement in RDI
- Curricula development
- Competence-based approach
- Systems thinking
- Forward thinking

7. Future Competences:
- Data collection and analysis
- Sustainable value chain
- Sustainable business models
- Green energy
- New value chains
- Economic innovations
- Artificial intelligence

8. Problem Solving Competences:

- Problem definition and analysis
- Multiple problem solving directions
- Wicked problems handling

9. Flexibility and Adaptability:

- Coping with uncertainties
- Adaptability to changing plans and situations
- Willingness for long-term projects

10. Technical Competences:

- Building technology and construction
- Legislation and standards
- Digital tools and systems
- Cybersecurity
- Energy and environmental engineering
- Ecological design (in the context of circular economy)
- Digitalization, including robotics, VR, AR, and XR
- Data-driven decision making

11. Collaboration & Management:

- Collaboration across different fields
- Inclusive and culture-sensitive approach
- Group and community skills
- Hybrid management
- Change management

12. Innovation & Future Orientation:

- Innovation skills
- Future Research competences
- Self-directed learning and attitude towards learning

13. Sustainability & Responsibility:

- Understanding the concept of sustainability
- Socio-cultural knowledge
- Environmental and business sustainability skills
- Understanding of global ecological crises
- Responsible business practices

b) External Interviews (Stakeholders)

1. **Understanding Sustainable Development:**
    - Interpretation of sustainability and responsibility terms
    - Understanding dimensions of sustainability
    - Knowledge of sustainable development definitions and concepts
    - Awareness of global sustainability goals (e.g., UN Sustainable Development Goals)
2. **Communication and Collaboration:**
    - Effective communication skills at various levels and with multiple stakeholders
    - Stakeholder collaboration and ability to work with different actors
    - Constructive dialogue and discussion skills
    - Ability to consider and incorporate multiple perspectives

3. **Evaluation, Innovation, and Planning:**
    - Competence in evaluation processes
    - Ability to innovate and think creatively
    - Strategic planning skills
4. **Knowledge of Legislation and Regulations:**
    - Understanding and keeping up with relevant laws and regulations
    - Knowledge of legal requirements and their impact on business operations
5. **Quality Systems and Standards:**
    - Challenges and knowledge related to quality systems, especially in smaller companies
    - Knowledge of standards and certifications relevant to sustainability
6. **Environmental and Social Sustainability:**
    - Understanding environmental impacts and considerations
    - Knowledge of social sustainability and its dimensions
    - Awareness of global and local environmental issues and their implications
7. **Policy and Political Engagement:**
    - Ability to engage in policy-making processes
    - Understanding the political landscape and decision-making mechanisms
    - Knowledge of lobbying and advocacy strategies
8. **Education and Training:**
    - Identifying and addressing competency needs through development discussions
    - Providing training and education opportunities
    - Collaboration between academia and the industry for research, development, and innovation activities
9. **Applied Sciences and Practical Application:**
    - Applying theoretical knowledge to practical situations
    - Understanding the practical aspects of societal functioning
    - Knowledge of business operations and their relationship to societal aspects
    - Applying theoretical knowledge to real-life business contexts
    - Case studies and practical assignments to enhance understanding and problem-solving skills

10. **Adaptability and Change Management:**
    - Ability to adapt to changing legal and regulatory environments
    - Capacity to respond to emerging global trends and challenges
    - Skills in managing and implementing changes within organizations
11. **Reporting and Verification:**
    - Knowledge of reporting standards and frameworks (e.g., GRI)
    - Ability to verify and authenticate sustainability claims
    - Understanding the requirements and challenges of sustainability reporting
12. **Business Management and Strategy:**
    - Understanding the business context and operational constraints
    - Strategic management skills for integrating sustainability into business practices
    - Competence in supply chain management and value chain optimization
13. **International Cooperation and Collaboration:**
    - Ability to work as part of international collaborations
    - Knowledge of global sustainability initiatives and networks
    - Collaboration with international partners for mutual benefits

14. Research and Development:

- Competence in research methodologies and practices
- Innovation skills for developing new solutions and approaches
- Ability to apply research findings to real-world contexts

15. Tailored Approach and Customer Orientation:

- Ability to tailor and target actions to support customer needs
- Effective communication and listening skills
- Understanding the customer's situation and challenges

16. Knowledge of Supportive Institutions and Resources:

- Awareness of institutions and organizations that can support business development
- Knowledge of existing models and frameworks for sustainable development

17. Risk Management and Adaptability:

- Ability to anticipate and manage risks in a rapidly changing environment
- Quick response and adaptability to global trends and challenges
- Utilization of global risk assessments and trend analysis tools

18. Supporting Small and Medium-sized Enterprises (SMEs):

- Providing support and guidance specifically tailored for SMEs