CIRCULAR ECONOMY COMPETENCES AND CURRICULUM DEVELOPMENT **– AN OVERVIEW**

REFLOW - Wp6 – Capacity Building and Knowledge transfer
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INTRODUCTION

Circular economy can be defined as an economy that is restorative and regenerative by design, and aims to keep products, components, and materials at their highest utility and value at all times. In a circular economy the value of products and materials is maintained for as long as possible. Waste and resource use are minimized, and when a product reaches the end of its life, it is used again to create further value.

To move into a circular model, both society and business as well as individuals need to adopt new behaviors. The importance of education in this process is paramount: the future implementers of the circular model are in our schools and universities now. It is therefore essential for them to gain a complete understanding of circularity and equip them with the skills they need to lead projects and work together in multidisciplinary teams.

The development and adoption of recognized competence frameworks specifically designed for circular economy is at an early stage. Yet, several universities and colleges in the world are currently developing new curricula and offering a set of different courses centered around circularity.

This document introduces preliminary insights on existing competence frameworks related to circularity, offers an overview of the current circular economy teaching landscape and provides a set of examples of existing courses developed at university level to teach circular economy.

As several REFLOW pilots are interacting with educational institutes to develop circular economy-oriented trainings, this document offers a baseline to start conversations around curriculum content. It may also support other training institutions in selecting relevant learning outcomes and pedagogical objectives when developing circularity trainings.

1 CIRCULAR ECONOMY COMPETENCE FRAMEWORKS

Several research projects have set up to develop competence frameworks associated with circular economy. We highlight in this section the most relevant ones.

Frameworks are organized per scope (general or linked to specific disciplines or target groups), and the level of implementation (theoretical /practical).

1.1. CIRCULAR LITERACY FRAMEWORK

Scope:	General
Level of implementation:	Theoretical

The transition to a Circular Society needs an immense boosting of transformative capabilities and particularly: Circular Literacy.

"Circular Literacy refers to the ability to understand and respect natural cycles and material flows. This includes holistic, systemic thinking, the ability to penetrate complexity and deal with it and the capability to co-create and cooperate inter- and transdisciplinary and across cultures and 'social borders'[1]."

Circular literacy is based on three forms of knowledge (figure 1):

- **System knowledge**: about how the current metabolism of consumption and production within natural systems functions or dysfunctions.
- **Target knowledge** about what the transformation is aiming at, this means visions, narratives and scenarios for future developments.
- **Transformation knowledge** about how the journey from the current state to the desirable future can be undertaken.

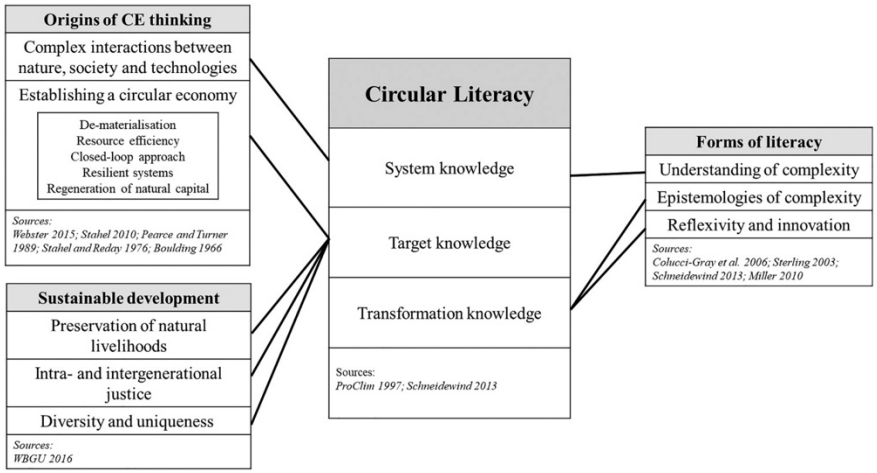

Figure 1: Circular literacy framework

[1] Zwiers, Jacob, Jaeger-Erben Melanie & Hofmann Florian (2020) Circular literacy. A knowledge-based approach to the circular economy, Culture and Organization, 26:2, 121-141, DOI: 10.1080/14759551.2019.1709065

Table 1:Circular literacy dimensions and indicators

Type of knowledge	Dimensions	Indicators
System knowledge	Understanding of complexity	• Consideration of the interconnections between diverse components in biosphere, technosphere and sociosphere (or natural, social and technological systems) • Consideration of the self-organising properties of systems
Target knowledge	Establishing the circular economy	• Consideration of de-materialisation and resource efficiency of economic and consumption practices • Consideration of a closed-loop approach and feedback systems • Consideration of resilience and regeneration of natural capital
	Preservation of natural livelihoods	• Consideration of planetary boundaries • Consideration of impacts throughout the lifecycle
	Intra- and intergenerational justice	• Consideration of social justice • Consideration of substantive, economic, political inclusion
	Diversity and uniqueness	• Consideration of diversity, local/cultural uniqueness • Consideration of the creation of local capacities
Transformation knowledge	Epistemologies of complexity	• Integration and adoption of different knowledge and various perspectives • Addressing multiple means and actors
	Reflexivity and innovation	• Relational and (self-)reflective knowledge • Anticipation of unpredictable developments • Creativity and innovativeness

1.2 CYCLECC FRAMEWORK

Scope:	Adult learning
Level of implementation:	Competence definition

CycleCC, a European project focusing on circular competences in adult learning, highlight three different fields when we talk about circular economy skills:

1. **Technical competences**, that is those competences related to specific tasks in each occupation.
2. **Generic interdisciplinary competences**, that is those related to some transversal areas of knowledge needed to support any occupation.
3. **Normative competences**, that is, those (also) transversal skills related to vision and values needed to support the transition to circular economy model.

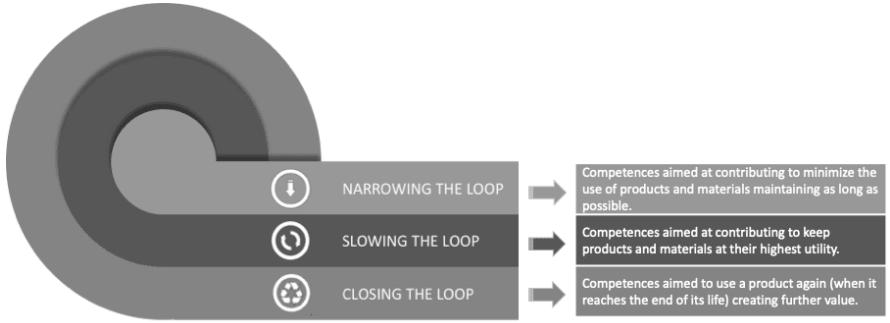

Figure 2: Cycle competence framework

Based on a circular approach, there are three types of competences:

1. Competences aimed at contributing to minimize the use of products and materials maintaining value as long as possible (preserving) – **NARROWING THE LOOP.**
2. Competences aimed at contributing to maintaining products and materials at their highest utility (optimising) – **SLOWING THE LOOP**.
3. Competences aiming to use a product again (when it reaches the end of its life), creating further value (fostering effectiveness) – **CLOSING THE LOOP**.

Transversal and personal competences that support the main concepts are described in the following competence scheme:

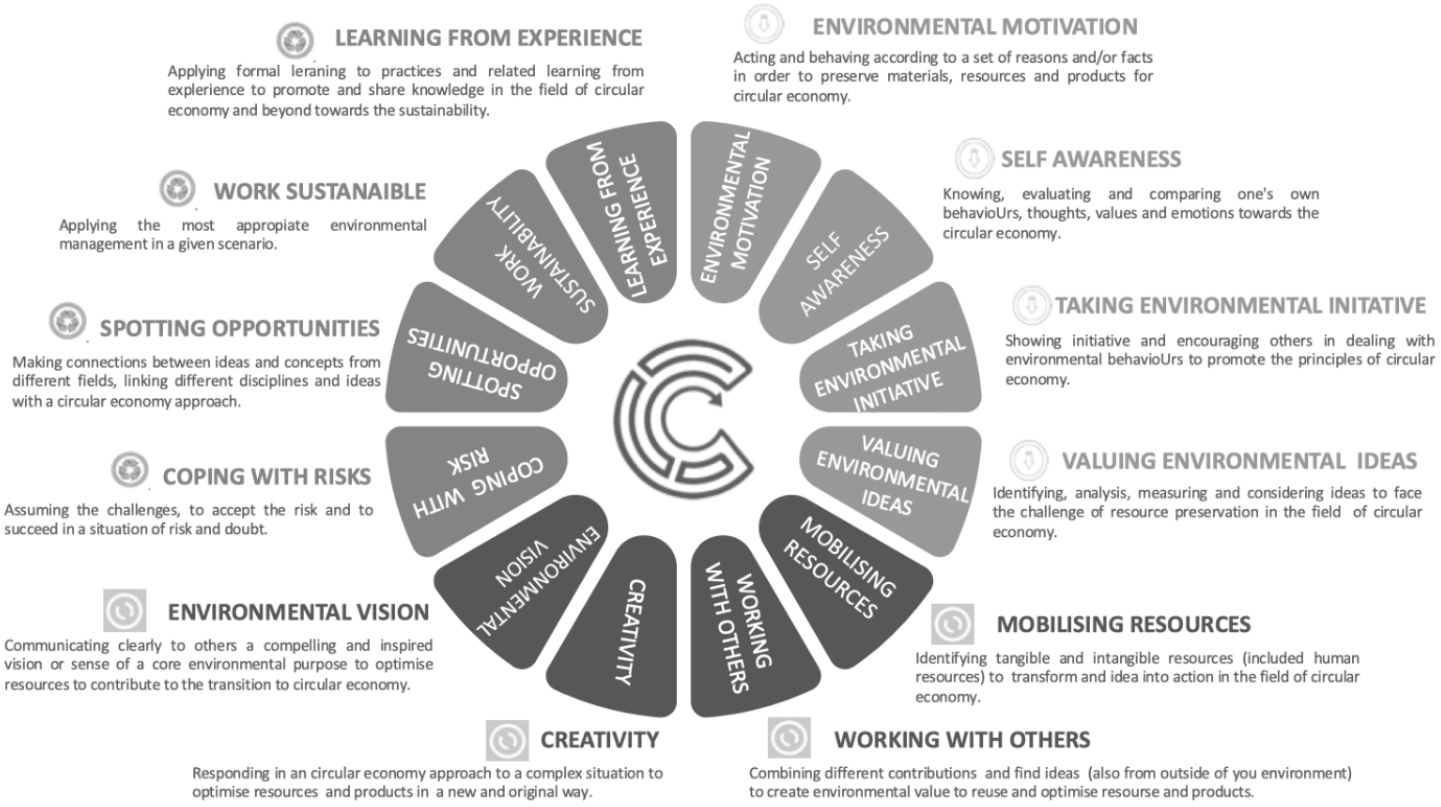

Figure 3: CycleCC competence framework

1.3 THREE C: COMPETENCE MATRIX FOR CIRCULAR ECONOMY REDESIGNING

Scope:	School education
Level of implementation:	Theoretical

In the project **Three C**, a competence matrix for Circular Economy Redesigning was developed. The matrix consists of five learning levels, comparable with the Bloom taxonomy. In the LEVEL5 approach, three dimensions of learning are integrated in one framework: knowing, doing and feeling. Within the competence matrix for Circular Economy Redesigning, systems thinking is used for the knowing and doing dimension, systems designing is used for the doing dimension and multiperspective thinking is used for the feeling dimension.

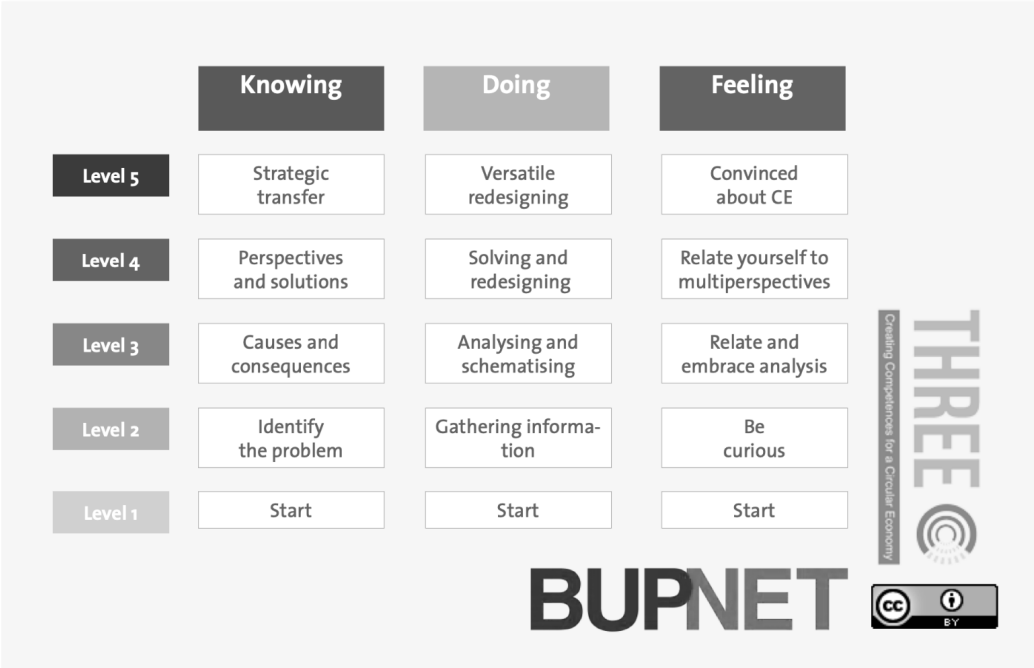

Figure 4: Three C Circular Competences Framework

1.4 BS8001:2017

Scope:	Business oriented
Level of implementation:	Theoretical

The key circular principles described in the norm BS8001:2017 highlight a set of interconnected principles that can form a coherent structure to inspire the development of a circular competence framework in the business context.

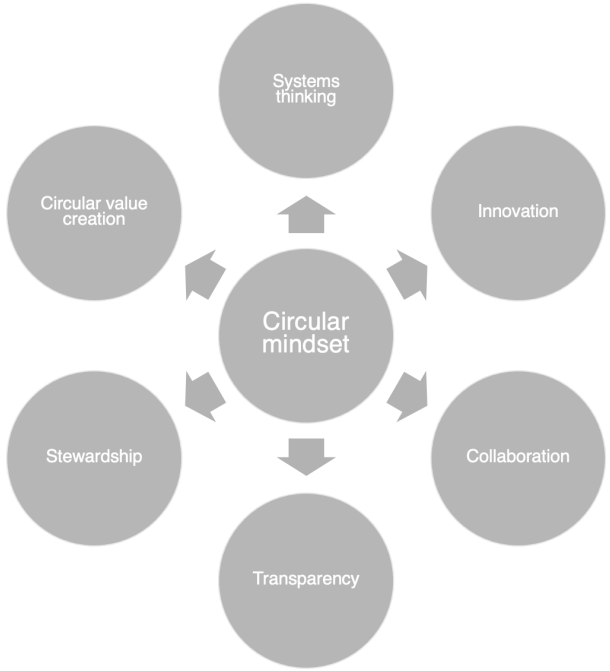

Figure 5: circular economy principles (BS8001:2017)

1. Systems thinking: Understanding the system-wide impacts of your activity- *Organisations adopt a holistic approach to understand how individual decisions and activities interact within the wider system they are part of.*

2. Innovation: Rethinking resource management as a lens for value creation. *Organisations continually innovate to create value by enabling the sustainable management of resources through the design of processes, products/services and business models.*

3. Stewardship: Taking responsibility for the ripple-effect impacts resulting from your decisions and activities. *Organisations manage the direct and indirect impact of their decisions and activities within the wider system they are part of.*

4. Collaboration: Securing systemwide benefits by cooperating with others. *Organisations collaborate internally and externally through formal and/or informal arrangements to create mutual value.*

5. Value optimization: Keeping materials at their highest value and function. *Organisations maintain all products, components and materials at their highest value and utility at all times.*

6. Transparency: Being open and honest about circular barriers and benefits. *Organisations are open about decisions and activities that affect their capacity for transition towards a more circular and sustainable mode of operation and are willing to communicate these in a clear, accurate, timely, honest and complete manner.*

1.5 METHODS FOR CIRCULAR ECONOMY TEACHING METHOD GUIDE

Scope:	School education
Level of implementation:	Learning goal definitions

In its *Methods for Circular Economy Teaching – Method Guide and Tool Kit*[2] developed in 2019, Turku University of Applied Sciences highlight the following conceptual and generic learning goals to be mastered by students taking part in a circular economy course:

Conceptual learning goals:

- Mastering the basic concepts of circular economy and understanding limited resources
- Being able to apply the business models of circular economy
- Being able to apply systemic thinking in problem solving.
- Being aware of management tools related to circular economy
- Identifying a project and the technological-economical possibilities and limits concerning a particular field

Generic learning goals:

- Identifying the needs companies have concerning circular economy and finding information and solutions
- Developing team working skills
- Networking and seeing its importance
- Resourcing the tasks at hand with the given aims in mind
- Pitching and presentation skills.

[2] http://julkaisut.turkuamk.fi/isbn9789522167330.pdf

1.6 REFLOW COMPETENCE FRAMEWORK

Scope:	City oriented
Level of implementation:	Competences definitions

Making the transition to circular and regenerative cities relies on a different set of skills, competences and approaches. These competences can be drawn from generic skills sets associated to *sustainability competences* such as systems thinking, value thinking or futures thinking competences, in combination with *contextual competences* directly connected to the phenomenon of circular and regenerative cities, and *interpersonal competences* which create the necessary conditions to develop and strengthen other competences

Figure 4 (next page) describes the overall competence framework developed in the context of the REFLOW project. Generic competences "packages" are described below.

1. Systems Thinking Competence:
Ability to analyze sustainability problems and solutions cutting across different domains and scales; considering agents, cause -effect structures, cascading effects, inertia, feedback loops, etc.

2. Values Thinking Competence:
Ability to collectively map, specify, apply, reconcile, and negotiate sustainability values, principles, goals, and targets

3. Futures Thinking Competence:
Ability to anticipate how sustainability problems and solutions might evolve over time, considering alternative development pathways for current systems and crafting coherent and plausible pictures of the future

4. Strategic Thinking Competence:
Ability to design and implement transformational (systemic) intervention and transition strategies toward sustainability

5. Technical level competence:

Level 1: Technical level 1 sets out the general knowledge, skills and competences needed to develop circular and regenerative cities

Level 2: At this level, the requisite skill sets are focused and tailored to particular roles of target groups

6. Interpersonal Competence:
Ability to work in teams, and understand, embrace, and facilitate diversity among cultures and social groups. Interpersonal competence is a basic ingredient in each of the other competencies.

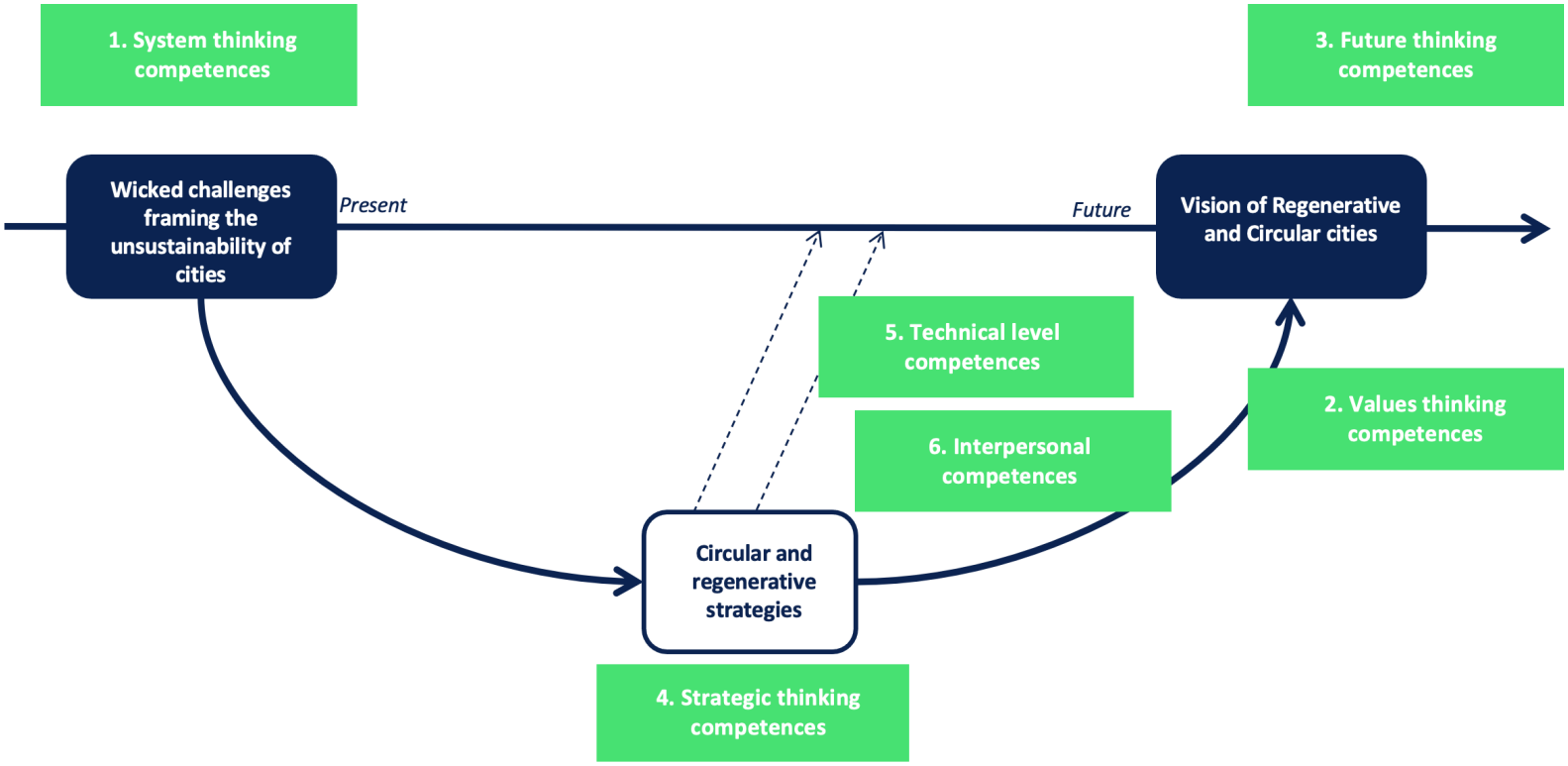

Figure 6:Reflow Circular Competence Framework

1.7 CIRCULAR ECONOMY BUSINESS COMPETENCES

Scope:	Business-oriented
Level of implementation:	Competence definitions

The **co.project**[3] a project by Ellen MacArthur Foundation, in collaboration with TUDelft and University of Exceter set out to identify key knowledge and skills needed for certain business functions to bring circular economy ideas into their line of work. The co.project convened the participants from five organisations in three chosen business functions (Marketing & Sales, Procurement & Supply Chain, and Product Creation & Design) and distilled a list of missing knowledge and skills needed for all functions and specifically for each area to accelerate the transition to a circular economy.

Circular economy understanding

- Having a clear understanding of the circular economy concept
- Having a shared circular economy vocabulary and taxonomy in place, so
  that the language and understanding of concepts is streamlined among employees
- For employees of a specific company, having a clear understanding of how circular economy aligns with their company's strategy and goals

Communicating circular economy

- Being able to translate what circular economy means for different business functions and for the company
- Being able to communicate and sell
  its benefits to internal and external stakeholders (e.g. Customers, suppliers, partners, etc.)

Assessing the circularity of a product, its materials, and components

- Being able to define circular requirements for a product and assess and compare the materials and components needed against each other according to a set of circular criteria

Calculating the cost, benefits, and risk of extended product life

- Being able to make a total overview of the extended use cycle costs and benefits
- The cost and benefit calculation includes looking at multiple use cycles as opposed to a one use cycle to assess the real value the company will get over time, including the assessment of any risks involved

Design for multiple life cycles

- Being able to design product-service systems that can serve multiple use cycles and/or users

Linking customer demand with reverse logistics

- Being able to connect customer demand and willingness to bring back the products with the implication for reverse logistics

[3] https://www.ellenmacarthurfoundation.org/assets/downloads/ce100/Phillips-Co.project-Findings-Final.pdf

Managing changing relationships with the suppliers

- Being able to define and map out the changing ecosystem of suppliers
- Being able to negotiate new type of contracts to reflect the expanding role of suppliers in procurement where they move between supplier and customer roles

Understanding circular economy supply chain

- Being able to define the circular supply chain and identify opportunities where the current linear supply chain could be transformed into a circular one

Selling a circular economy solution in a story

- Being able to move from transactional sales approach beyond selling the 'product', to providing a service that offers better economic, environmental and social outcomes

Data modelling

- Being able to analyse the data harnessed by a variety of digital tools (ai, blockchain, etc.) And translate them into actionable insights to inform changes in services/ products, sales approach, messaging, etc.

Consultative selling skills helping clients transform

- Working with customers to translate the principles and concepts of the circular economy into meaningful value propositions
- The range of circular economy value creation opportunities involves disrupting the one-way relationship with the client and finding new forms for two-way relationships

Managing changing customer relationships

- Being able to map out the expanded landscape of customer stakeholders, understand and address their needs, and engage them in conversations concerning their different role in the sales process

2. LANDSCAPE: CIRCULAR ECONOMY LEARNING OFFERINGS IN UNIVERSITIES

In 2018, the Ellen MacArthur Foundation published a scoping study[4] to identify the current CE learning offerings available in universities. Focusing on 51 learning offerings which explicitly mentioned circular economy in the title, the foundation highlighted the key themes part of the course description (figure 1).

The following topics were highlighted:

- **Environmental aspects :**Most of the 39 mentions are general, and the examples given are largely confined to resource scarcity, whereas other examples of environmental impact are mostly left out, e.g. climate change, water and biodiversity, the derived impact on the social sphere and human health, and also the role of renewables.
- **Social aspects :** Of the 32 mentions of social aspects, seven are directed at behavioural change. The impact on equality and social cohesion is another angle that stands out. 11 of the course descriptions display an evaluative, questioning stance, whereas eight focus only on the positive impact the circular economy can have on social systems.
- **Policy levers:** 28 course descriptions bring up policy. Few go into any level of detail. Only seven highlight market-based instruments, while another lever – public procurement – is absent.
- **Digital technology :** Only 14 course descriptions bring up any connection to the role of digital technology, e.g. IoT, big data, 3D printing, automation, Industry 4.0, or blockchain.
- **Design :** Design features in 35 course descriptions, oftentimes in general terms. There are a few mentions of ecodesign, modular design, and six mentions of biomimicry. Moreover, LCA (life-cycle assessment) is often discussed in relation to design.
- **Servitisation:** 22 descriptions discuss product-service systems (PSS) and shifting from goods to services.
- **Circular business models :** 28 course descriptions address the role of circular business models.
- **Systems thinking :** Although it appears in 22 of the descriptions, there is a large degree of uncertainty around how systems thinking is understood. Some imply that systems thinking mainly consists of collaboration or LCA, both of which are highlighted in close to half the course descriptions.

[4] https://www.ellenmacarthurfoundation.org/assets/downloads/Global-Snapshot-19.10.18-1.pdf

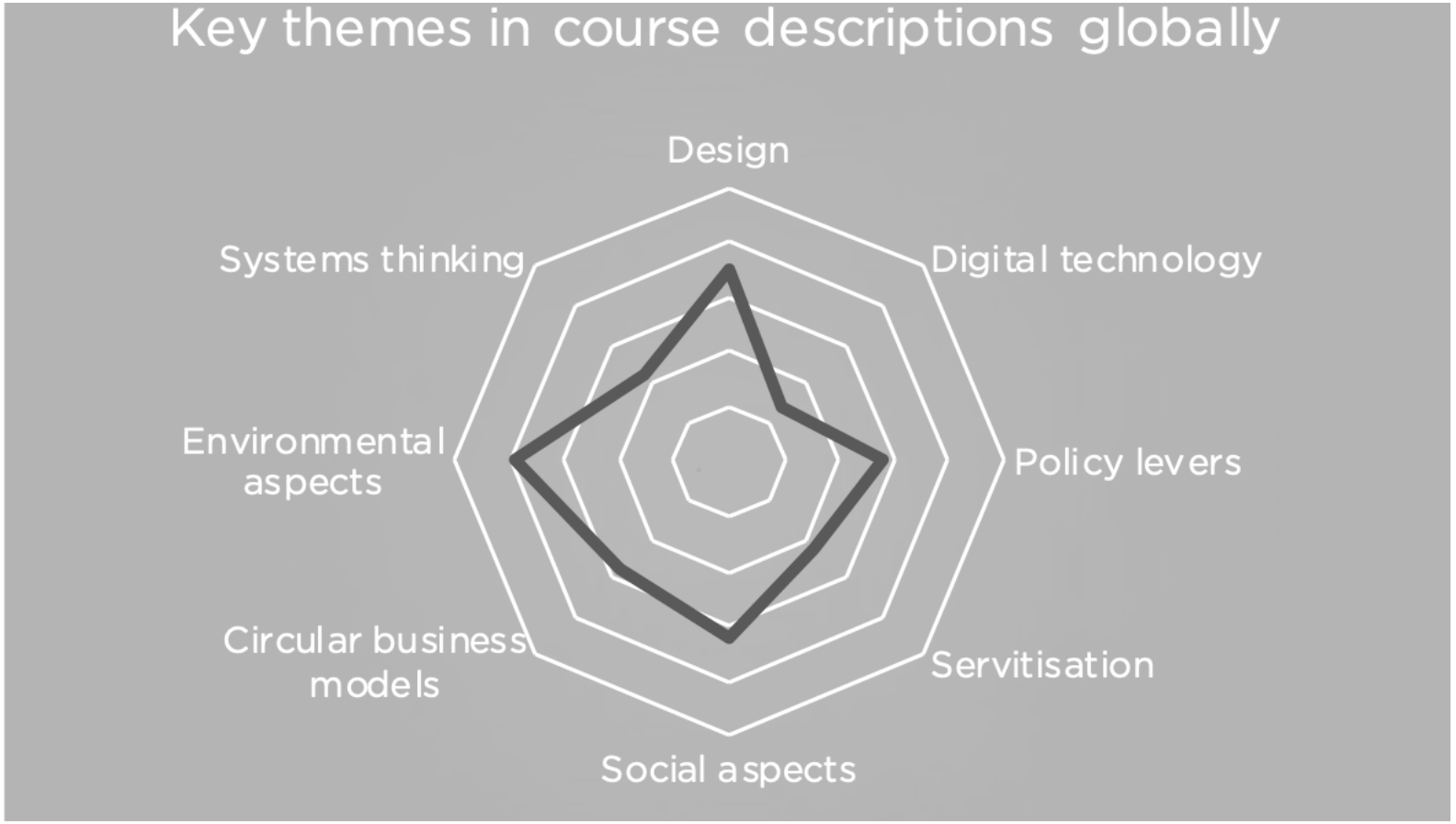

Figure 7: key themes in CE courses (Source: EMF,2018)

3. EXAMPLES OF EXISTING TRAINING CURRICULUM OF CE COURSES

COURSE TITLE	CIRCULAR ECONOMY
UNIVERSITY	Chalmers University of Technology.
DESCRIPTION	Circular economy (TEK680) is a 7.5 credit course given in study period 1 by the division of Environmental Systems Analysis (ESA) at Chalmers University of Technology.
OBJECTIVES	The course aims to provide students with a rich understanding of the merits and challenges of transitioning to a more resource-efficient and circular economy. Drawing from multiple disciplines, including engineering, management and sustainability sciences, students gain knowledge on underlying principles and visions as well as theory and tools that support the formulation and assessment of resource-efficient and circular measures. By exploring real-world examples, students synthesize and apply the knowledge gained.
LEARNING OUTCOMES	• Describe historic and future projections of natural resource use and associated sustainability challenges • Describe visions and underlying principles of various approaches to resource-efficiency and circular economy • Critically discuss the implications of increased resource-efficiency and circularity for sustainable development • Account for actors, their options, barriers and drivers for transitioning to a more resource-efficient and circular economy. • Account for resource-efficient and circular physical measures, their potential benefits and limitations • Formulate strategies towards increased resource-efficiency and circularity based on relevant theories, methods and tools from multiple disciplines. • Assess strategies towards increased resource-efficiency and circularity based on relevant theories, methods and tools from multiple disciplines. • Communicate orally and in writing the knowledge and skills acquired.
TEACHING APPROACH	The course is comprised by a series of lectures given by lecturers from various disciplines and by invited guests from industry and authorities. There are five major stand-alone exercises while shorter ones are integrated in the lectures. A project will be conducted in multi-disciplinary groups. Lectures, literature, exercises and project instructions are published at the course website.
SOURCE AND INFO	https://chalmers.instructure.com/courses/7432/assignments/syllabus

COURSE TITLE	INTRODUCTION TO CIRCULAR ECONOMY
UNIVERSITY	LUT School of Energy Systems
DESCRIPTION	.
OBJECTIVES	Students get an introduction about the following topics: Introduction to circular economy: circular economy aspects related to food systems, forest systems, product design, transportation sector and sharing economy.
LEARNING OUTCOMES	Upon completion of the 3 ECTS cr course the student is expected to be able to 1. explain the targets of circular economy and understand possibilities to implement circular economy in different sectors, Upon completion of the 5 ECTS cr course the student is expected to be able to (in addition to the previous) 2. analyse capability of the selected products, production systems and servicesto fulfil the requirements of circular economy, 3. implement assessments to reveal development needs of selected products,production systems and services to fulfill the requirements of circular economy,and 4. compare different alternative ways to work towards circular economy targets.
TEACHING APPROACH	This course includes 3 ECTS cr web course and 2 ECTS cr blended learning
SOURCE AND INFO	https://uni.lut.fi/documents/10304/401721/MSc+Circular+Economy.pdf

COURSE TITLE	**UNDERSTAND AND ANALYSE THE CIRCULAR ECONOMY**
UNIVERSITY	Cranfield, UK
DESCRIPTION	**Circular Economy Context** – Introduction to dynamic systems and metaphors including complex adaptive systems, learning through metaphors, valuing stocks as well as flows within a Circular Economy and the true 'value' of waste. Systems of feedback including linear vs circular feedback systems, formats of feedback and their value (e.g. materials, data, and information), analysis of feedback rich case studies and the consideration of feedback related to the different strands of the course. Tools and methods for considering and analysing micro and macro scale change and their system level impacts including system enablers (e.g. social, political, cultural, and geographic). FLO: 1) Compare and explain different philosophies associated with a circular economy; 2) Analyse the system level impacts of transformational change from social, political, environmental, economic and cultural stances. **Biological Systems** – Introduction to properties of waste biomass and methods for critical appraisal and how to use them to design closed loop processing systems. Organic waste to compost and anaerobic digestion. Case studies on emissions of closed loop industrial systems of waste. Waste bio refinery: novel technologies and public perceptions. FLO: 1) Demonstrate a critical appraisal of the waste biomass properties and how to use them to apply concepts and principles of the circular economy to design closed loop processing systems; 2) Demonstrate a in-depth knowledge of the waste materials that are currently processed into closed processing loops aligned with biological cycles (for example: composting and anaerobic digestion) **Renewable Energy Systems** – Introduction to fundamental renewable energy technology and how it works (Intermittency, storage and smart grids). Availability of required resources and methods of comparative analysis (solar coverage, wind speed, biomass availability). Matching needs, resources and available technology including methods for calculating energy supply and demand and multi-criteria decision analysis. FLO: 1) Demonstrate a critical appraisal of the available renewable energy technologies, state-of-the-art and development requirements; 2) Use of appropriate multi-criteria decision analysis tools to be able to assess available resources, stakeholder requirements and technology scales to determine the most appropriate technology options for a specific scenario; 3)Apply an understanding of renewable energy technologies to critically discuss the role in, and the importance of, a circular economy.

	Materials Innovation – Introduction to the different types of materials currently used across industrial sectors including critical materials, their properties and methods used for assessment. Government targets and strategies for a circular economy and impact on materials. Principles and properties of circular materials and methods of circular assessment for new materials. Materials manufacturing processes. FLO: 1) Identify and describe Circular Economy principles related to materials evaluation and management as well as governmental targets, principles and strategies; 2) Describe the different types of materials used in different industries, their key properties and terminologies used to assess them. **Circular Manufacturing** - Energy: Embodied and process, ancillary processes. Materials conversion processes as the underpinning of all physical products, Sankey diagrams for materials' and energy flows, Materials as an energy carrier leading to philosophy of dematerialisation, Manufacturing from a systems approach, Redistributed manufacturing – infrastructure and social implications,Remanufacturing – what is it? Impact on design and business models, Whole life cycle analysis. FLO: Critically analyse materials and energy flows for a given production process and identify the drivers and barriers to transformational change within manufacturing of the future. **Circular Design** – History of design for sustainability and the transition from 'green' to 'circular'. Skills, principles and practices of designing for a circular economy. Systems thinking and circular design including critical analysis of system rebound effects. Tools and methods for applying a design thinking approach for circular design including service design, whole system design and design for behaviour change. FLO: Take a justified approach to the selection of appropriate design tools and methods for a given circular strategy **Circular Value Chains** – Introduction to recognised approaches and models to support the development of knowledge and systematic understanding of the major principles and concepts of supply chain design and will continue to examine and evaluate circular economy principles in relation to the key supply chain operating processes within the SCOR framework (namely: Supply chain planning and design; Procurement and Sourcing; Manufacturing; Distribution and logistics). A key element will be the management of reverse logistics systems. The strand will continue by evaluating the implications of circular economy principles on supply chain design and equip students with analytical and management tools to provide students with a critical awareness leading to a capability to synthesise supply chain design and circular principles. FLO: 1) Discuss the principles and concepts underpinning supply chain design and analyse their implications for a circular economy.
OBJECTIVES	Within this module learners will develop the knowledge and skills to demonstrate a systematic understanding of the key principles, benefits, challenges and underlying the philosophy associated with a circular economic model. They will be taught,

	and have the opportunity to use, state of the art tools, methods and approaches, being used within industry across sectors to critically analyse the economic, environmental, social and organisational impact of implementing aspects of the circular economy both within a specific business and across different industrial sectors.
LEARNING OUTCOMES	Demonstrate a systematic understanding of the key principles, benefits, challenges and underlying philosophy associated with a circular economy model and critically evaluate the economic, environmental, social and organisational impact of implementing aspects of the circular economy within your own business and across industrial sectors
TEACHING APPROACH	Taught modules 40%, Group projects 20%, Individual project 40%
SOURCE AND INFO	https://www.cranfield.ac.uk/courses/taught/technology-innovation-and-management-for-a-circular-economy

COURSE TITLE	SUSTAINABLE DEVELOPMENT AND CIRCULAR ECONOMY
UNIVERSITY	VAMK, finland
DESCRIPTION	Bachleor level course on sustainable development and circular economy
OBJECTIVES	The course introduces students to the following themes: Resource scarcity. The sectors of Sustainable Development. Circular Economy and its business models. Sustainable Development and Circular Economy in businesses.
LEARNING OUTCOMES	The student knows the principles of Sustainable Development and Circular Economy. He understands the targets of Sustainable Development and Circular Economy in today's and future societys and global causes for Sustainable Development and Circular Economy. The student is familiar with the business models of Circular Economy and the sectors of Sustainable Development. The student is able to apply Sustainable Development and Circular Economy concepts into businesses
TEACHING APPROACH	Lectures, project work, project management, self evaluation, group evaluation
SOURCE AND INFO	http://www.puv.fi/opsweb/?code=IEYX1004&lang=en

COURSE TITLE	CIRCULAR ECONOMY.NOW
UNIVERSITY	University of Helsinki
DESCRIPTION	. Circular Economy.now is a 3 to 5-credit module that focuses on learning and teaching the principles of the circular economy. The module can be utilised as either a three-credit e-learning course, or as a broader five-credit hybrid course managed by a responsible teacher as part of a university's own curriculum. The module does not feature any prerequisites and is suited for students in all disciplines, and can also be used for other training purposes, such as within organisations or companies. The online teaching materials are accessible to all.
OBJECTIVES	• Develop an overall image of the circular economy and understand its basic principles. • Understand the problems related to the way we consume resources today and how the circular economy can help in solving these problems. • Familiarise yourself with the methods that could promote the circular economy. • Form a vision of the practical actions that could be utilised in different sectors to promote the circular economy.
LEARNING OUTCOMES	Using good ideas to promote sustainable development – research, ponder, discuss, exchange opinions.
TEACHING APPROACH	Online learning – free platform
SOURCE AND INFO	https://circularnow.fi

COURSE TITLE	**INNOVATE EVALUATE AND MANAGE THE CIRCULAR ECONOMY**
UNIVERSITY	Cranfield, Uk
DESCRIPTION	The following topics are introduced: **Disruptive Innovation** – A history of innovation including an analysis of innovations of the past and how they have resulted in radical change. Innovation theory. Introduction to, comparative evaluation and application of tools, techniques and approaches for achieving disruptive change including the latest advances in digital technologies. Discussion and debate on the application of disruptive innovation and technologies for a circular economy. FLO: Critically evaluate disruptive innovation of the past and discuss how lessons learned can be applied to the transition towards a circular economy; 2) Compare current and future technologies and analyse their potential for achieving circular system level change. **Circular Business Models** – Changing models of innovation including; traditional vs emerging models of innovation, rational for changing models, challenges for new innovation models, outcomes and impacts of traditional vs new business models. Learners will explore the nature of 'value creation' as a processual concept including: the value creation process, embedded value, use value and nature and forms of different types of value created. Business model innovation – learners will explore different types of business model associated with the circular economy (e.g. product as a service, sharing economy, product life extension) and be taught how to develop a business plan for the implementation of a particular value proposition for a company. FLO: 1) Demonstrate an understanding of changing models of innovation over history and discuss how they are being shaped by today's globally challenged business context; 2) Analyse and evaluate different methods of circular value creation for businesses of varying sizes across sectors; 3) Design an outline circular business plan demonstrating a particular value proposition for your organisation. **Managing the Transition to a Circular Economy** – Future sustainability challenges of scaling and transition: learners will explore the factors hindering companies and sectors from transitioning towards a regenerative, restorative and net positive economy. This will include: issues relating to scaling and transition, institutional and policy context, system innovation and change. Typologies of change including the nature of change, learning and innovating, incremental vs transformative change and challenges of managing change. Determinants of change for a circular economy including: leadership for sustainability issues (e.g. ethics, authenticity, skills), accounting and economics, pro-social marketing and corporate political behaviour. FLO: 1) Identify and discuss the challenges of transitioning towards a circular economy including scaling, policy and system innovation; 2) Analyse and evaluate different typologies of change and select the most appropriate typology for a given context; 3) Apply appropriate tools and methods to design a change management plan for your organisation in the transition towards a circular economy.

	Materials Innovation – Materials selection properties and software. Analysis of materials flows throughout the technosphere and biosphere. Materials biodegradability and innovations for a circular economy. Materials product life cycle assessment and analysis of circular approaches e.g. maintenance, repair, refurbishement and recycling on material properties and value. FLO: 1) Examine and analyse how product materials degrade to design "closing loops" materials strategies; 2) Describe and evaluate the approaches to product/material maintenance, life cycle assessment and prediction, repair, refurbishment. **Circular Manufacturing** – Sustainable Manufacturing Business Tools, sustainable value creation in production, Value mapping tools and techniques, Business transformation tools. FLO: Apply sustainable manufacturing business tools to build a circular business model for a given company and evaluate its lifecycle impacts. **Circular Design** – Circular design strategies and the influence of new / circular business models on design. Information communication technologies, additive manufacturing and implications for circular design. Application and evaluation of circular design tools and methods. Methods and indicators of assessment for circular design including use of the 'Circularity Indicators' tool. FLO: Apply the most appropriate tools and methods to design a circular product, service or system and evaluate its circularity. **Circular Value Chains** – Learners will be introduced to tools and methods to evaluate novel solutions of circular activity through the use of case study examples and research undertaken within CLSCM. It will explore and systematically appraise the value chain elements and business case requirements to facilitate the transition towards a Circular Economy. A key aspect will be an appraisal of the role of reverse logistics as an agent for change. FLO: Apply appropriate tools and methods to design a reverse logistics system and evaluate its impacts across the supply.
OBJECTIVES	Within this module learners will develop the knowledge and skills to design and evaluate novel solutions of circular activity within the context of an organisation and demonstrate understanding of its impact across the wider ecosystem. They will be introduced to the tools and approaches necessary to construct a comprehensive business case and implementation strategy for the application of their own ideas. Learners will be able to systematically appraise methods by which the transition towards circular economy an be effectively managed and reflect on their own role as a change maker within that process.
LEARNING OUTCOMES	Design and evaluate novel solutions of circular activity, within a business context and wider ecosystem, and construct a comprehensive business case and implementation strategy for application. Systematically appraise methods by which the transition towards a circular economy can be effectively managed and reflect on your role as a change maker within that process.

TEACHING APPROACH	Taught modules 40%, Group projects 20%, Individual project 40%
SOURCE AND INFO	https://www.cranfield.ac.uk/courses/taught/technology-innovation-and-management-for-a-circular-economy

COURSE TITLE	CIRCULAR ECONOMY AND MARKETS OF TOMORROW
UNIVERSITY	Aalto university, Finland
DESCRIPTION	The bachelor course integrates and utilizes a broad range of theoretical concepts, frameworks, and topics on a practical level. Key areas include circular economy models and other eco-innovations, sustainable marketing tied to triple bottom line, sustainable consumption and attitude-behavior gap
OBJECTIVES	This course introduces and elaborates on the importance of Circular Economy and sustainability for marketing theory and practice.
LEARNING OUTCOMES	Students will gain: 1. Understanding of the importance and challenges of Circular Economy and retaining sustainability in marketing 2. Skills in designing and building circularity and sustainability through rigorous research 3. An understanding of how to create and assess economically, environmentally and socially sustainable marketing process 4. Understanding of circularity and sustainability as a source of competitive advantage 5. Applied knowledge on circular economy and sustainability through case studies and managerial problems 6. Understanding of consumer's role in the circular economy
TEACHING APPROACH	During the course, students work in multidisciplinary teams on various business cases and challenges. The outcomes are presented for sparring, comments and critique from the other teams, course staff and visiting industry experts. Grading: The course grade will consist of the following components: - Group work and written reports - Group presentations - Individual home assignments - Active class participation and class preparation
SOURCE AND INFO	https://studyinfo.fi/app/#!/koulutus/1.2.246.562.17.63283585733

4 REFERENCES AND ADDITIONAL RESOURCES

REFERENCES

CYCLE CC (2019) - Pedagogical model to include circular economy competences in adult education
http://cyclecc.eu/spanish/wp-content/uploads/sites/4/2019/06/Result-1.-CYCLE_final.pdf

Ellen MacArthur foundation (2019) Gaps in business function-specific knowledge and skills for a circular economy co.project findings
https://www.ellenmacarthurfoundation.org/assets/downloads/ce100/Phillips-Co.project-Findings-Final.pdf

Ellen MacArthur foundation (2018) A global snapshot of circular economy learning offerings in higher education
https://www.ellenmacarthurfoundation.org/assets/downloads/Global-Snapshot-19.10.18-1.pdf

Three C (2016) - Circular Economy and Education, conference report 2016
https://greeen-eu.net/wp-content/uploads/2014/02/threeC-report-Porto-event.pdf

Turku University of Applied Sciences (2019) - Methods for Circular Economy Teaching
http://julkaisut.turkuamk.fi/isbn9789522167330.pdf

Zwiers, Jacob, Jaeger-Erben Melanie & Hofmann Florian (2020) Circular literacy. A knowledge-based approach to the circular economy, Culture and Organization, 26:2, 121-141, DOI: 10.1080/14759551.2019.1709065

ADDITIONAL RESOURCES

REFLOW: on the community section of the REFLOW project, a set of free online courses around circular economy are curated. The Forum section of the website also offers additional resources in the circular learning resources section.

Kirchherr, J., & Piscicelli, L. (2019). Towards an education for the circular economy (ECE): five teaching principles and a case study. Resources, Conservation and Recycling : a detail description of an "introduction to circular economy course" content.

The Circular classroom: A set of teaching resources for educators https://circularclassroom.com/educators/

Circula game: A serious game to use in training environment. In the game, the players develop circular economy business ideas, learn to understand the circular economy from the perspective of business activities and consumption, and gain teamwork skills and capabilities for developing their own business ideas and entrepreneurship.

For design-oriented courses related to circular economy, Circular Design Europe has released a comprehensive handbook to support trainers in developing CE courses.

For more resources
on CIRCULAR ECONOMY
https://reflowproject.eu