2.1.9 Module development M08 Life Cycle Thinking and Sustainable Management

Module Specification:

Life Cycle Thinking and Sustainable Management

Within the Erasmus+ KA2 Capacity Building Project (CBHE)

WORK4CE – Cross-domain competences for healthy and safe work in the 21st century

619034-EPP-1-2020-1-UA-EPPKA2-CBHE-JP

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Version 1.0, 20.05.2021

Version 2.0, 30.03.2023

Version 3.0 19.09.2023

1. Summary

Overall Learning Outcome:

At the end of the course the student will be able to understand the importance of considering the triple bottom line - People, Planet and Profit - in the management of their projects. The student will be able to apply tools Ecodesign and Life Cycle Thinking tools.

Target Group Analysis:

- Master level student with bachelor degree in technology domains (IT, Engineering)
- Professionals with bachelor degree in technology domains (IT, Engineering)

Competences & Learning Outcomes:

It is expected that following knowledge, Skills and competences being delivered to students:

- **Knowledge**
  - Student becomes familiar with basic concept of Sustainability
  - The student defines the concept of ecodesign and becomes aware of the environmental economic and social and is aware of the environmental, economic and social implications of product design.
  - The student lists the advantages of integrating environmental criteria into the product development process.
  - The student knows and understands the different regulations and technical specifications for ecodesign within an European framework.
  - The student understands the origin and need of Life Cycle thinking.
- **Skills**
  - Define or select a suitable tool to assess the sustainability of a project.
  - Tailor or develop the Sustainability Assessment model.
  - Apply the Sustainability models to projects.
  - The student applies the ecodesign methodology and manages the available tools for ecodesign .
  - The student positions ecodesign within the business organization in the framework of the product development process.
  - The student reports the current environmental problems associated with products and services.
  - The student defines the life cycle concept and identify the phases of the life cycle of a product.
  - The student describes the fundamentals and regulations of the Life Cycle Analysis.
  - The student applies evaluation methodologies and software tools for product life cycle analysis.
- **Competence – ability & attitude**
  - The student evaluates the life cycle analysis developed by others.

Selection of Content:

Course content is outlined at:

- What is Sustainability?
- How can we assess the impact of a product in more detail: LCA

- Minimizing impact of a new product: ecodesign
- Towards a circular economy.

Activities and Teaching/Learning Methods:

The module is thought as a tutorized online version and includes:

- Participation of students in the online live stream lectures.
- Individual study of available materials.
- Development of individual and team assignments.

Competence Assessment:

competence assessment is composed of

- Individual assignment
- Team assignment
- Peer review
- Written exam

Curricula Integration:

This module is targeted to be included in curriculum of Master in Project Management.

Quality Evaluation:

The module will undergo a pilot teaching and will be evaluated by students, professors and IT/media specialists to get feedback for improvement. This iteration countinus during 3 years in diferent universities and publishable release will be produced in each iteration.

Change History & Ownership:

Revision	Product Owner	Date of Release	Remarks
1	Jose Ramon Otegi (UPV /EHU)	20 May 2021	First Revision of document with regard to developers of Open Cop prepared for review of project quality board. This revision describes the basic parts and will be improved in further iterations.
2		30 Mar 2023	

Table of Content

2. Introduction to the module

In 2015, the United Nations adopted the 2030 Agenda for Sustainable Development. It is a declaration and a plan of action for people, planet, and prosperity. The agenda identifies 17 Sustainable Development Goals (SDGs) and 169 targets. It is a plan to improve life on the planet, and it is to be developed before 2030. This highlights the importance of focusing on both people and the planet.

For engineers and project managers, these SDGs are a lighthouse that should guide all projects.

The consortium running the Work4ce project (Cross-domain competences for healthy and safe work in the 21st century) has developed several educational modules around issues that impact workplace performance and health. This module, from a broader perspective, explores the effects on all stakeholders, including the environment.

The module starts by discussing the reasons why sustainability is critical today. Climate change and material scarcity are already affecting the economy and wellbeing.

The design phase of new products and processes is impacted by current and anticipated material scarcity and should also consider the effects that these products will have on climate change. Furthermore, the design phase is no longer the start of a linear process but an entry point to a circular one. The Cradle to Grave paradigm has been replaced by the Cradle to Cradle model. In March 2020, the European Union adopted the Circular Economy Action Plan, another institutional effort to promote growth while reducing pressure on resources.

To tackle these challenges, engineers and project managers need effective tools. Among them, Digital Sustainability Canvas (DSC), Life Cycle Analysis, and Ecodesign stand out.

In this module, all these tools will be presented and embedded into the circular economy design-production-recovery process.

The module is designed for autonomous students to collaboratively develop knowledge through online materials, teacher guidance, and peer collaboration.

3. Module Description

3.1 Overall Learning Outcomes

At the end of this module, the student will be able to:

- Recognize the importance of sustainability and the circular economy in the development of products and processes.
- Apply tools and techniques (Ecodesign, Life Cycle Thinking, Digital Sustainability Canvas) to design products and processes, taking into consideration the Triple Bottom Line.
- Combine his/her knowledge/skills/competencies with those of others to design sustainable processes and products.
- Evaluate the work of others in the introduction of sustainability principles into product and process design.

3.2 Target Group Analysis

Level	Prerequisite	Current position	Needs	Prospective Job Field
Master level student	Bachelor in technology domains (IT, Engineering)	Student	Monitoring and Control of the learning process.	Master level position in engineering or design sectors.
Long life learning student	Bachelor in technology domains (IT, Engineering)	Professional	Flexible - daily and weekly - dedication to the learning process. External motivation to keep on learning (motivation to dedicate to the module may be hindered by other factors such as work deadlines, family tasks...).	Improvement of position in current or new organisation.

3.3 Competences & Learning Outcomes

LO 1	The student defines the concept of ecodesign and become aware of the environmental economic and social and is aware of the environmental, economic and social implications of product design.
LO 2	The student lists the advantages of integrating environmental criteria into the product development process.
LO 3	The student knows and understands the different regulations and technical specifications for ecodesign within an European framework.
LO 4	The student applies the ecodesign methodology and manages the available tools for ecodesign .
LO 5	The student positions ecodesign within the business organization in the framework of the product development process.
LO 6	The student understands the potential of ecodesign as a new business model in the company.
LO 7	The student understands the origin and need of Life Cycle Thinking.
LO 8	The student understands the current environmental problems associated with products and services.
LO 9	The student defines the life cycle concept and identify the phases of the life cycle of a product.
LO 10	The student describes the fundamentals and regulations of the Life Cycle Analysis.
LO 11	The student applies evaluation methodologies and software tools for product life cycle analysis.
LO 12	The student evaluates the life cycle analysis developed by others.
LO 13	The student understands the concepts and how to fill the Digital Sustainability Canvas.
LO 14	The student applies the Digital Sustainability Canvas to visualize the sustainability impacts of projects.

3.4 Content

What is Sustainability?

- Sustainability definition.
- What are the drivers behind our increasing material and energy consumption?
- The Triple Bottom Line. Sustainable Development Objectives. Circular Economy. Company Reporting Initiatives
- The product life cycle: Global view

Digital Sustainability Canvas (DSC)

- Basic Principles
  - Define the DSC for visualizing sustainability in Digital Transformation Projects (DTPs).
  - Align projects with the Triple Bottom Line (people, planet, profit).
- Framework Components
  - Use 11 key placeholders for DTP assessment.
  - Apply methodology to fill and analyze sustainability data
- Evaluating Impacts
  - Apply the RAG method (+, -, N) to assess impacts, considering both direct and indirect effects.
  - Refer to the UN-SDGs for standards and categorize impacts for a comprehensive sustainability view.
- Case Study Application
  - Use the DSC in a real Digital Transformation Project case study to guide decision-making and improve sustainability outcomes.

How can we assess the impact of a product in more detail: LCA

- Product life cycle: contextualization and concept
  - Definitions and principles.
  - Historical evolution and current situation. From consumerism to programmed obsolescence. The environmental problems associated with the products.
  - Points of attention: input data, system boundaries, functional unit
  - Life cycle and extended responsibility of the producer.
  - Introduction to the concept of the Life Cycle Thinking. Implications for the product designer.
- Life cycle analysis: methodology and tools for calculation
  - Life cycle analysis. Methodology for the quantification of the environmental impact of products.
  - Methodological principles of Life Cycle Analysis based on international standards UNE-EN ISO 14040 and UNE-EN ISO 14044.
  - Introduction to software tools for the development of Life Cycle Analysis: Open LCA.

Minimizing impact of a new product ecodesign

- Basic principles and implications of ecodesign.
  - Introduction to the concept of design and ecodesign. Basic principles and implications for the design of products and services. Product life cycle. Benefits of Ecodesign. Energy saving / durability. Product trends and implications.
- Ecodesign regulations and technical specifications.
  - Regulations to be considered in Ecodesign. Global vision of the map of directives by sectors: European Directive 2009/125 / CE that establishes a framework for the establishment of ecodesign requirements applicable to energy-related products; end of life vehicles (ELVs); waste electrical and electronic equipment (RAEEs); waste plastic food packaging. New measures such as M/543. Patents.
- Ecodesign Methodology.
  - Ecodesign integration in business management systems. Application of the principles of the international standard ISO 14006: 2020 “Environmental management systems. Guidelines for the incorporation of ecodesign”. Introduction to Life Cycle Analysis (LCA). Consumer communication mechanisms: Environmental Product Declarations (EPD), Product Environmental Footprint (PEF), Organization Environmental Footprint (OEF), Monovector footprints (carbon, water, ...). The ecodesign process.
- Ecodesign and company.
  - Servitization. Implementation of new business models based on product-service systems, as a strategy to promote the Circular Economy. Types of services. Sustainability / environmental impact.

Towards a circular economy.

- Goals and definition of circularity. Product sharing. Product lifetime extension. Reuse and refurbish. Recycling

3.5 Teaching & Learning Activity Plan

A) Teaching/learning methods per competence

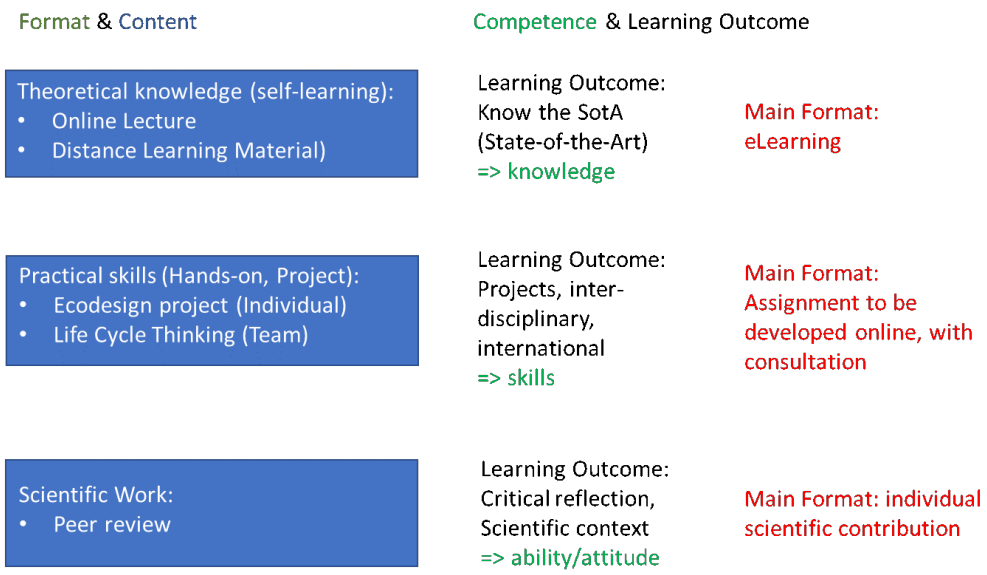

Figure 1: Mapping of Didactic Formats to Competence Areas [own source]

B) Didactic concept:

The module is thought as a tutorized online version where the student will receive an introduction to the basic knowledge which she/he will have to apply to specific assignments.

It will require:

- Participation of students in the online live lecturing
- Individual study of available materials
- Development of individual and team assignments

C) Activity Plan

The module is organized around individual and team activities. The optimum size of the group is 30 with 6 teams of five people each.

As an introduction, the students will answer to an online test to assess the level of knowledge regarding Circular Economy, Sustainability and Life Cycle Thinking.

- ***Phase 1*:**

  In a first phase, the professor will lecture on the basic concepts of the module. Lectures will happen online. Professors will describe the assignments.

- ***Phase 2*:**

  In a second phase, students will perform individual knowledge acquisition tasks, with a specific orientation to the assignments. This stage could happen simultaneously with phases three and four.

- ***Phase 3*:**

  Phases three and four will run in parallel, with students developing the assignments.

- ***Phase 4*:**

  Along these, tutorials will be offered and organized. A minimum time for student and team has to be dedicated to tutorials.

- ***Phase 5*:**

  In Phase five, the teams will present their results, both as a written report and orally. Students will have to deliver a review of the work of other students.

Finally, they will sit an exam.

Type of activity	Activities	Remarks	9 ECTS module		
			Hours Student	Hours Professor per Group /Team/Student	Hours Professor Total

Group	Online Lecture	Students have to attend. (But it may be recorded).	15	15	15
Group	Recorded Lecture		6	15	15
Group	External video		10	0	0
Team	Team Tutorial		4	2	12
Team	Team Assignment Report	It may include the use of SW tools or other applications	70	1.5	9
Team	Team Assignment Oral Presentation		0.1	0.1	0.6
Individual	Individual Learning (reading, small exercises)		90	0	0
Individual	Individual Learning (Tutorial)		1	1	22
Individual	Individual Assignment Report	It may include the use of SW tools or other applications	20	0.5	15
Group	Exam	Different types of exam may be designed (test, essay…)	2.5	15	15
		TOTAL HOURS	**218.6**	**33.1**	**103.6**

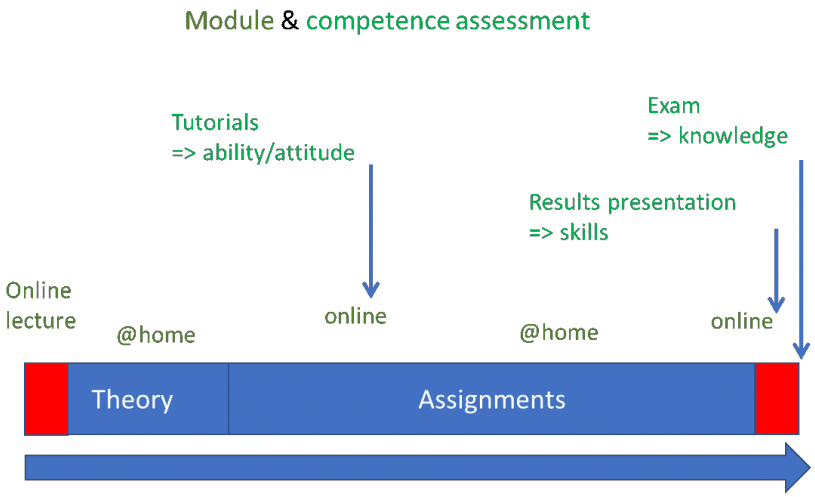

Figure 2: Scheduling Example of Didactic Formats during Semester [own source]

3.6 Teaching & Learning Resources

Materials to be used by students will be available in the online supporting tool.

It is expected that students have available online connectivity to allow search for scientific literature.

Besides, students are required to have videoconferencing tools (webcam, audio).

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3.7 Assessment Methods

FORM of Assessment	%	REMARK
Written exam	20	Based on theory classes

Individual assignment	30	Based on report provided by individual work of each student on a specified topic
Team assignment	40	Based on Writen Report of team work of a group of students
Peer review	10	Based on peer review of other's team oral presentation or reports

3.8 Curricula Integration

This module will be implemented in pilot version in the first semester of 2021-2022 in the University Master in Project Management.

It will be imparted by professors from Bilbao.

Students are expected from University of the Basque Country and FH Dortmund. Students from other partner universities are also welcome.

4. Syllabus/Module Handbook

Entry for the Syllabus/Module Handbook

Life Cycle Thinking and Sustainable Management					
Module Owner UPV/EHU	**Workload** 180 h	**Credits** 9 ECTS	**Semester**	**Frequency**	**Duration** 1 Semester

1	**Course Title** Life Cycle Thinking and Sustainable Management	**Contact hours** 30 h in total	**Self-Study** 150 h	**Planned Group Size** 30 students

2	**Course Description** The module begins by introducing the key reasons for discussing sustainability. Climate change and material scarcity are already impacting the economy and overall wellbeing. The design phase of new products and processes is influenced by both current and future material scarcity and must also consider the impact these products will have on climate change. Furthermore, the design phase should not be viewed as the beginning of a linear process, but as an entry point into a circular one. The traditional Cradle to Grave paradigm has now shifted to a circular Cradle to Cradle model. In March 2020, the European Union adopted the Circular Economy Action Plan, an institutional effort aimed at fostering growth while reducing the pressure on natural resources. To tackle these challenges, engineers and project managers require effective tools. Among them, Life Cycle Analysis (LCA), Ecodesign, and the Digital Sustainability Canvas (DSC) stand out. The DSC provides a practical framework for assessing the sustainability impacts of Digital Transformation Projects, focusing on people, planet, and profit. In this module, all of these tools will be presented and embedded within the circular economy design, production, and recovery process.

3 **Course Structure**

- **What is Sustainability?**
  - Sustainability definition.
  - What are the drivers behind our increasing materials and energy consumption?
  - The Triple Bottom Line. Sustainable Development Objectives. Circular Economy. Company Reporting Initiatives
  - The product life cycle: Global view
- **Digital Sustainability Canvas (DSC)**
  - Basic Principles
    - Define the DSC for visualizing sustainability in Digital Transformation Projects (DTPs).
    - Align projects with the Triple Bottom Line (people, planet, profit).
  - Framework Components
    - Use 11 key placeholders for DTP assessment.
    - Apply methodology to fill and analyze sustainability data
  - Evaluating Impacts
    - Apply the RAG method (+, -, N) to assess impacts, considering both direct and indirect effects.
    - Refer to the UN-SDGs for standards and categorize impacts for a comprehensive sustainability view.
  - Case Study Application
    - Use the DSC in a real Digital Transformation Project case study to guide decision-making and improve sustainability outcomes.
- **How can we assess the impact of a product in more detail: LCA**
  - Product life cycle: contextualization and concept
    - Definitions and principles.
    - Historical evolution and current situation. From consumerism to programmed obsolescence. The environmental problems associated with the products.
    - Points of attention: input data, system boundaries, functional unit
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  - Life cycle analysis: methodology and tools for calculation
    - Life cycle analysis. Methodology for the quantification of the environmental impact of products.
    - Methodological principles of Life Cycle Analysis based on international standards UNE-EN ISO 14040 and UNE-EN ISO 14044.
    - Introduction to software tools for the development of Life Cycle Analysis: Open LCA.
- **Minimizing impact of a new product ecodesign**
  - Basic principles and implications of ecodesign.
    - Introduction to the concept of design and ecodesign. Basic principles and implications for the design of products and services. Product life cycle. Benefits of Ecodesign. Energy saving / durability. Product trends and implications.
  - Ecodesign regulations and technical specifications.
    - Regulations to be considered in Ecodesign. Global vision of the map of directives by sectors: European Directive 2009/125 / CE that establishes a framework for the establishment of ecodesign requirements applicable to energy-related products; end of life vehicles (ELVs); waste electrical and electronic equipment (RAEEs); waste plastic food packaging. New measures such as M/543. Patents.
  - Ecodesign Methodology.
    - Ecodesign integration in business management systems. Application of the principles of the international standard ISO 14006: 2020 “Environmental management systems. Guidelines for the incorporation of ecodesign”. Introduction to Life Cycle Analysis (LCA). Consumer communication mechanisms: Environmental Product Declarations (EPD), Product Environmental Footprint (PEF), Organization Environmental Footprint (OEF), Monovector footprints (carbon, water, ...). The ecodesign process.
  - Ecodesign and company.
    - Servitization. Implementation of new business models based on product-service systems, as a strategy to promote the Circular Economy. Types of services. Sustainability / environmental impact.
- **Towards a circular economy.**
  1. Goals and definition of circularity. Product sharing. Product lifetime extension. Reuse and refurbish. Recycling

4 **Application Focus**

Engineers and project managers need tools to address to new challenges. Among them, Life Cycle Analysis, Digital Sustainability Canvas and Ecodesign, which will be studied and applied.

In this module both tools will be presented and embedded into the circular economy design - production - recovery process.

5 **Scientific Focus**
Literature review and analysis. Deductive own research based on the literature. Scientific reflection and discussion in the teams.

6 **Parameters**

- ECTS: 9
- Hours of study in total: 180
- Weekly hours per semester: It will depend on the calendar organisation

- Contact hours: 30

- Self-Study hours: 150

- Course characteristics:
- Course frequency: every year - summer semester
- Maximal capacity: 30 students
- Course admittance prerequisites: bachelor degree
- Skills trained in this course: theoretical, practical and scientific skills and competences
- Assessment of the course: continuous evaluation, including exam
- Teaching staff: to be determined.

7	**Learning outcomes** 7.1 Knowledge • The student defines the concept of ecodesign and becomes aware of the environmental economic and social and is aware of the environmental, economic and social implications of product design. • The student lists the advantages of integrating environmental criteria into the product development process. • The student knows and understands the different regulations and technical specifications for ecodesign within an European framework. • The student understands the origin and need of Life Cycle thinking. • The student understands the environmental, social, and economic impacts of Digital Transformation Projects (DTPs). • The student uses the the Digital Sustainability Canvas (DSC) to align projects with sustainability goals and assess impacts. 7.2 Skills • The student applies the ecodesign methodology and manages the available tools for ecodesign . • The student positions ecodesign within the business organization in the framework of the product development process. • The student reports the current environmental problems associated with products and services. • The student defines the life cycle concept and identify the phases of the life cycle of a product. • The student describes the fundamentals and regulations of the Life Cycle Analysis. • The student applies evaluation methodologies and software tools for product life cycle analysis. • The student analyzes and interprets sustainability data to solve challenges effectively. • The student collaborates with interdisciplinary teams to achieve sustainability objectives. 7.3 Competence – ability & attitude • The student evaluates the Digital Sustainability Canvas and the Life Cycle analysis developed by others.
8	**Teaching and training methods** The module is organized around individual and team activities. The optimum size of the Group is 30 with 6 teams of five people each. As an introduction, the students will answer to an online test to assess the level of knowledge regarding Digital Sustainability Canvas, Circular Economy, Sustainability and Life Cycle Thinking. • ***Phase 1*:** In a first phase, the professor will lecture on the basic concepts of the module. Lectures will happen online. Professors will describe the assignments. • ***Phase 2*:** In a second phase, students will perform individual knowledge acquisition tasks, with a specific orientation to the assignments. This stage could happen simultaneously with phases three and four. • ***Phase 3*:** Phases three and four will run in parallel, with students developing the assignments. • ***Phase 4*:** Along these, tutorials will be offered and organized. A minimum time for student and team has to be dedicated to tutorials. • ***Phase 5*:** In Phase five, the teams will present their results, both as a written report and orally. Students will have to deliver a review of the work of other students. Finally, they will sit an exam.
9	**Curricula Integration** Integration into curricula of Project Management Master Course.
10	**References** • Basic bibliography • In-depth bibliography • Journals • Websites

5. References

Basic bibliography

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- Journal of Life Cycle Assessment
- Journal of Management and Sustainability
- International Journal of Sustainable Design
- Journal of Cleaner Production
- Journal of Industrial Ecology
- Resources, Conservation and Recycling
- Sustainability
- ACS Sustainable Chemistry and Engineering
- Nature Sustainability

Websites

- https://www.ellenmacarthurfoundation.org
- The Circular Economy Foundation: http://economiacircular.org/EN/?page_id=62
- AENOR Gestión del Ecodiseño ISO 14006: https://www.aenor.com/certificacion/medio-ambiente/ecodiseno
- Ihobe: https://www.ihobe.eus/inicio
- Basque Ecodesign Center: http://www.basqueecodesigncenter.net/Default.aspx?IdMenu=20552758-7739-4933-b86f-8a063bb65abc&Idioma=es-ES
- European Commission > Internal Market, Industry, Entrepreneurship and SMEs > Industry > Sustainability and circular economy > Ecodesign: https://ec.europa.eu/growth/industry/sustainability/ecodesign_en

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