This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776503
- CIRC4Life-H2020-IND-CE-2016-2017/CIRC-2017/TwoStage

A circular economy approach for lifecycles of products and services

ICT Platform specifications

D4.1

PROJECT INFORMATION	
Type of Project	European Commission Horizon 2020
Call	CIRC-01-2016-2017 Systemic, eco-innovative approaches for the circular economy: large-scale demonstration projects
Grant Agreement No.	776503
Project Duration	01/05/2018 – 31/04/2021 (36 months)
Project Coordinator	Nottingham Trent University (NTU)
Project Partners	Enviro Data (ENV), Jonathan Michael Smith (JS), Kosnic Lighting Limited (KOS), Centre of Research for Energy Resources and Consumption (CIR), European EPC Competence Center GmbH (EECC), The Institute for Ecology of Industrial Areas (IETU), SWEREA IVF AB (SWE), Make Mothers Matter (MMM), ONA PRODUCT (ONA), INDUMETAL Recycling (IND), GS1 Germany GMBH (GS1G), Laurea University of Applied Science (LAU), Center for European Policy Studies (CEPS), Institute of Communication and Computer Systems (ICCS), Recyclia (REC), S.A.T. Alia (ALIA)

DOCUMENT INFORMATION	
Title	ICT Platform specifications
Version	Draft 0.1
Release Date	09.10.2018
Work Package	WP4
Dissemination Level	PU

DOCUMENT AUTHORS AND AUTHORISATION	
Document Responsible	Georgios Tsimiklis , ICCS
Contributors	Wenjie Peng, NTU Sten-Erik Bjorling, ENV Nicole Bongartz, GS1 Tim Bartram, GS1 Nicolas Becker, EECC Sebastian Schmitter, EECC Miltos Koutsokeras , ICCS Alicia Valero Delgado, CIR
Reviewed by	Athanasia Tsertou, ICCS Alicia Valero Delgado, CIR Abel Ortego Bielsa, CIR Sten-Erik Bjorling, ENV
Approved by	Athanasia Tsertou, ICCS

DOCUMENT HISTORY			
Version	Date (dd.mm.yy)	Description	Implemented by
1.00	09.10.18	First draft	ICCS with the contribution of all stakeholders
2.00	29.10.2018	Final Version	ICCS with the comments/review of CIR and ENV
3.00	24.03.20	After revision	ICCS based on the reviewer's comments

Summary

This deliverable provides an overview of the ICT platform, covering the user requirements, the mapping between user requirements to system requirements and finally the system specifications.

This deliverable includes the system requirements and specifications for each of the subcomponents of the ICT platform (functional as well as non- after reviewing and refining the user requirements in the CEBMs. The specifications are mapped to user requirements through a traceability matrix. The deliverable is the result of Task 4.1.

It is the result of the task 4.1 which is described as:

This task will define the overall system architecture for the core ICT platform of the CIRC4Life effort. The task will involve the definition of the main components of the core ICT platform, its main internal processes and standardized access points for external and internal interoperability. This task comprises the following specific steps:

- *Review and potential refinement of user requirements stemming from the CEBMs definition from an ICT viewpoint*
- *Creation of a reference user vs system requirements traceability matrix for both target and demonstration systems*
- *High-level definition and specification for internal interfaces between all ICT platform functional components*
- *Developing a self-contained architecture document and a traceability matrix for functional components vs. requirements*

Table of Contents

Table of Figures

List of Tables

Acronyms and abbreviations

Abbreviation	Description
App	Application
CE	Circular Economy
CEBM	Circular Economy Business Model
DoW	Description of Work
EC	European Commission
EoL	End of Life
ICT	Information Communication Technology
ID	Identity
JSON	JavaScript Object Notation
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
P2P	Peer to Peer
PEF	Products Environmental Footprint
QR	Quick Response
RFID	Radio Frequency Identification
SoA	Service Oriented Architecture
UI	User Interface
UK	United Kingdom
WP	Work Package

1 Introduction

This project aims to develop and implement a circular economy approach in order to create new sustainable products and services through their value and supply chains.

It will be demonstrated at a large scale in 4 sectors: electrical and electronic products (tablets, domestic and industrial LED lightning) and farming and agri-foods sectors (meat product supply chain and organic vegetables). Demonstrators will be held in the UK (Cornwall and Berkshire Counties) and Spain (Regions of Murcia, Basque Country and Valencia).

Three new circular economy business models will be developed during the project:

(i) co-creation of products and services,
(ii) sustainable consumption
(iii) collaborative recycling and reuse

The Co-creation of Products and Services model will bring end-users closer to the design and manufacturing phases by identifying consumer preferences via Big-data online mining product reviews and evaluating product specifications and prototypes via Living Lab to customise end-user requirements.

The Sustainable Consumption model will develop a method to calculate the eco-points of products based on the outcome of the EU funded project myEcoCost by:

- assessing product environmental footprints (PEF)
- providing a traceability solution to monitor product's sustainability along the value chain
- supporting end-users and stakeholders to actively implement the circular economy via awareness raising and knowledge sharing activities

The Collaborative Recycling/Reuse model will develop a system for stakeholders to interact with each other in order to facilitate the use or reuse of end-of-life products and reduce waste and implement the eco-credits award scheme encouraging people to recycle or reuse.

An ICT platform will be developed to support the development, implementation, demonstration, and communication activities.

For more information: www.circ4life.eu

1.1 Purpose of the document

The purpose of this document is to describe each of the subcomponents of the ICT platform, the system requirements and specifications for each of the subcomponents of the ICT platform after reviewing and refining the user requirements in the CEBMs. Each of the subcomponents of the ICT platform, and subsequently the specifications are mapped to user requirements through a traceability matrix.

This deliverable provides an overview of the ICT platform, covering the user requirements, the mapping between user requirements to system requirements and finally the system specifications.

The user requirements are collected in a dedicated table through a simplified method in order to include as much as possible the feedback of the CEBM in this early stage of the project. The methodology used for the user requirements is described in the Section2 . In the section 3, all the user requirements are collected in a table and then mapped to one or more subcomponents of the ICT platform. Section 4 subsequently describes the system requirements of the ICT platform for each of the user requirements of the section2. Then the architecture of the ICT platform is described in the section 5, where the system as a whole is explained. Finally, the specifications of the ICT components are found in the section 6.

1.2 Intended readership

The work presented in this report addresses the need of the following groups:

- The CIRC4Life consortium including the technical and the non-technical partners. The non-technical partners will have a reference on how the CEBM will be supported through the ICT platform whereas the technical partners will have a view of the system as a whole which will be the reference of the development for the system subcomponents.

- Researchers, scientists and organizations who are interested in Circular Economy and especially on how the ICT technology could support newly created CEBMs.

1.3 Relation with other CIRC4Life Work Packages/Deliverables

This deliverable is the core of the ICT platform that will be created in the context of CIRC4Life. It describes the architecture of the ICT platform, the components to be developed within the scope of WP4 as well as the interactions/components of ICT systems of other Work Packages.

In this context, this document includes an overview of:

- the Impact Assessment Tool (WP1, WP2)
- the ECO-shopping and ECO Account tools (WP3)
- the Traceability Module (WP5)
- the Recycling Module (WP2)
- the B2B for stakeholder interaction (WP7)
- All the subsystems of WP4

In addition this deliverable is setting the basis for all the other deliverable of WP4, and will be the starting point for the subsequent tasks of the WP4.

2 Requirement Analysis

This section describes the methodology used for the extraction of the user requirements and the mapping to system requirements.

2.1 User requirements Methodology

The main purpose of the collection of the end user requirements is to satisfy the user needs by introducing the appropriate system specifications in the design of the CIRC4Life architecture. Taking into consideration this principle, the system architecture is designed towards this direction. The figure 2 visualises the followed iterative procedure that starts from the identification of the end-user requirements, proceeds with the definition of the system/technical requirement and finishes with the system architecture of CIRC4Life. Considering that the user requirements are mainly based on the DoA and an initial feedback of the users, the CIRC4Life ICT platform is designed with a flexible architecture in order to retrofit in a circular approach any additional user requirement or functionalities as much as possible.
The exact technical approach that is considered in this direction is described with details in the section 5 and section 6 of this document.

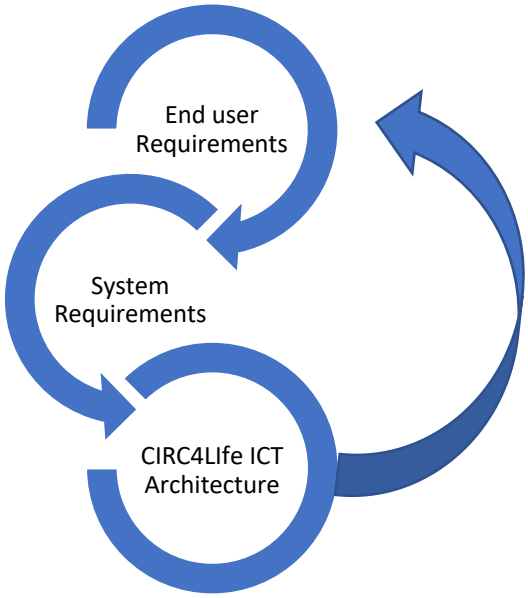

Figure 2-1 *Methodology for the collection of user requirements, system requirements and definition of the system architecture*

The first step of the methodology described above is the collection of the user requirements which is very important for any ICT system. A general process comprising of four steps as described by [Maguire, 2002] and seen in the figure 2.2 was used for the user requirement collection.

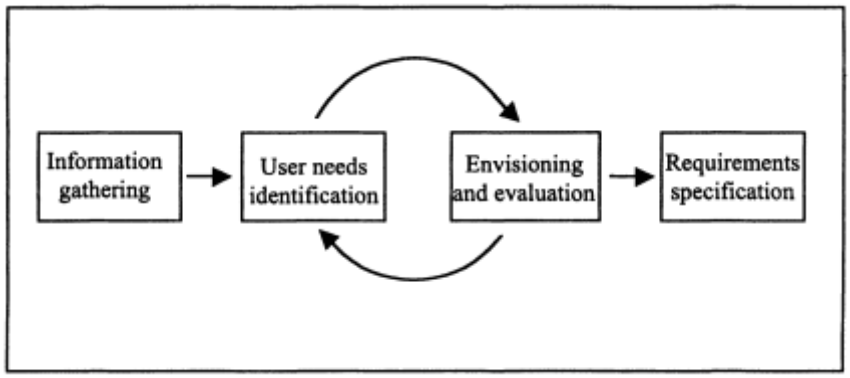

Figure 2-2 Process for user requirement Analysis

Information Gathering: The first step of the user requirements analysis is to gather information about the users and stakeholders and the processes that need to be supported by the ICT platform. The DoA was mainly used for this step as well as feedback from the WPs that were initiated during the first 5 months of the project.

User needs Identification: Then the user needs identification was conducted by analysing scenarios and use cases that could be served by the system. Use cases of the system are included in the DoA and also retrofitted by initiated tasks of the project.

Envisioning and evaluation: At this phase the general architecture of the ICT platform was used as a base of comparison with the user needs.

Requirements Specification: Finally, the user requirements were formulated considering a generic definition in order to accommodate as much as possible future requirements that could derive from the TO BE created Circular Economy Business Models.

2.2 User requirements Format

The format that is used for the user requirements is presented in the table 2.1.

Attribute	Description
User Requirement Unique ID	E.g. USER_01
Functional or Non-Functional	F or NF
Classification of requirement	Design, Use, recycle/reuse, generic
Title	
Description (3-4 lines)	
Prioritization	Must, should, could, out of scope
Work Package	Cross-WP
Related ICT System	The CIRC4LIfe ICT system to which the requirement applies. In case it is applicable to more than one system these should be referenced. The overview of the systems can be found in the figure 5-2 *Overall ICT system architecture*.

Table 2–1 Format of CIRC4Life User Requirements

The first field is a unique identifier of the requirement that consists of the string User, the classification to a CEBM and an enumeration of each category.

The user requirements are classified in the following categories:

1. **Design:** Aspects relevant to the CEBM of The Co-creation of Products and Services model
2. **Use:** Aspects relevant to The Sustainable Consumption model
3. **Recycle/Reuse:** Aspects relevant to The Collaborative Recycling and Reuse model
4. **Generic:** Aspects that are generic and relevant to the whole project scope or other non-functional requirements.

Finally, a link to the related ICT system to which the requirement applies is added in the end of each user requirement. This part was retrofitted after the completion of all the user requirements and the initial system design, being the link to the section 4 of the system requirements as well as the base of the section 5 and the whole architecture of the system.

2.3 List of user Requirements

2.3.1 Design

Attribute	Description
User Requirement Unique ID	USER_D_01a
Functional or Non-Functional	F
Classification of requirement	Design
Title	Consumer-Supply chain interactions.
Description (3-4 lines)	Support different user roles (designer, producer, distributor, retailer, end user) within an CIRC4Life account
Prioritization	Must
Work Package	WP1, WP7
Related ICT System	B2B online system for stakeholder interaction

Attribute	Description
User Requirement Unique ID	USER_D_01b
Functional or Non-Functional	F
Classification of requirement	Design
Title	Consumer-Supply chain interactions b.
Description (3-4 lines)	Allow interaction between product designer and supply chain partners (Related to task 1.2). Examples of interactions are suggestions, fault reporting etc.
Prioritization	Must
Work Package	WP1, WP7
Related ICT System	B2B online system for stakeholder interaction

Attribute	Description
User Requirement Unique ID	USER_D_02
Functional or Non-Functional	F
Classification of requirement	Design
Title	Identify Products Impact
Description (3-4 lines)	Show to the product designers the eco impact of various materials or products. Potential interaction with the escrow, product information system.
Prioritization	Must
Work Package	WP1, WP2
Related ICT System	Impact Assessment Tool

2.3.2 Use

Attribute	Description
User Requirement Unique ID	USER_U_01
Functional or Non-Functional	F
Classification of requirement	Retailing
Title	Eco-shopping - Scan
Description (3-4 lines)	In the local store, consumer can view the eco-points via scanning the ID (e.g. barcode) of products displayed on the store shelf.
Prioritization	Must
Work Package	WP3, WP4, WP5
Related ICT System	ECO shopping Module

Attribute	Description
User Requirement Unique ID	USER_U_02
Functional or Non-Functional	F
Classification of requirement	Retailing
Title	Eco-shopping - ecoDebit
Description (3-4 lines)	Consumer buys the product at the check-out point, which adds the eco-debit of the products purchased in their eco-accounts. Interacts with the consumers ecoAccount containing the aggregation of ecoCredits etc. by allowing transfer of the relevant information to the consumers ecoAccount.
Prioritization	Must
Work Package	WP3, WP4, WP5
Related ICT System	Retailer tool for eco-accounting

Attribute	Description
User Requirement Unique ID	USER_U_03
Functional or Non-Functional	F
Classification of requirement	Retailing
Title	Eco-shopping - product debit
Description (3-4 lines)	The user shall have access to the ecoPoints information for the individual products being purchased.
Prioritization	Must
Work Package	WP3, WP4, WP5
Related ICT System	Consumer's ECO Account App

Attribute	Description
User Requirement Unique ID	USER_U_04
Functional or Non-Functional	F
Classification of requirement	Usage
Title	Eco-account review
Description (3-4 lines)	Consumer can view the eco-point information, such as the eco-debits via consumer purchasing, eco-credits via recycling and reuse and daily eco-credit balance, with their mobile phones.
Prioritization	Must
Work Package	WP3, WP4, WP5
Related ICT System	Consumer's ECO Account App

Attribute	Description
User Requirement Unique ID	USER_U_05
Functional or Non-Functional	F
Classification of requirement	Usage
Title	Detailed Product information
Description (3-4 lines)	Allow the user to Load complete data setup for product - or subset of data depending on preferences (allergens etc.)
Prioritization	Could
Work Package	WP3, WP4, WP5
Related ICT System	ECO shopping Module, Retailer tool for eco-accounting

Attribute	Description
User Requirement Unique ID	USER_U_06
Functional or Non-Functional	F
Classification of requirement	Usage
Title	Detailed Product information - producer

Description (3-4 lines)	Allow the user to load linked producer ID and data and more specifically information about the producer of the product
Prioritization	Could
Work Package	WP3, WP4, WP5
Related ICT System	ECO shopping Module, Retailer tool for eco-accounting

Attribute	Description
User Requirement Unique ID	USER_U_07
Functional or Non-Functional	F
Classification of requirement	Usage
Title	Detailed Producer Information - recycling
Description (3-4 lines)	Allow the user to load instruction data and recycling recommendations at product level
Prioritization	Could
Work Package	WP3, WP4, WP5
Related ICT System	ECO shopping Module, Retailer tool for eco-accounting,Brokerage

2.3.3 Recycle/Reuse

Attribute	Description
User Requirement Unique ID	USER_R_01
Functional or Non-Functional	F
Classification of requirement	Recycle/reuse
Title	Recycling / reuse -bins
Description (3-4 lines)	Consumer/Retailer can recycle their EoL products in dedicated recycle bins
Prioritization	Must
Work Package	WP2, WP4, WP5
Related ICT System	Recycling/reuse Module

Attribute	Description
User Requirement Unique ID	USER_R_02
Functional or Non-Functional	F
Classification of requirement	Recycle/reuse
Title	Recycling / reuse-Credits
Description (3-4 lines)	The consumer should be awarded the ECO Credits that correspond to the product that is recycled by an interaction with the users Eco Account.
Prioritization	Must
Work Package	WP2, WP4, WP5

Related ICT System	Consumer's ECO Account App

Attribute	**Description**
User Requirement Unique ID	USER_R_03
Functional or Non-Functional	F
Classification of requirement	Recycle/reuse
Title	Geo localization
Description (3-4 lines)	The user may have access to specific location master data: • Geo locations of recycle bins • Geo locations of supermarkets which offer rewards for ECO Credits
Prioritization	Should
Work Package	WP2
Related ICT System	ECO shopping Module, Retailer tool for eco-accounting

Attribute	**Description**
User Requirement Unique ID	USER_R_04
Functional or Non-Functional	F
Classification of requirement	Recycle/reuse
Title	Waste survey
Description (3-4 lines)	The user can incorporate information on the product to be recycled through a drop-down into the platform to get an initial estimation of the eco-credits. This should be different for meat or for electronic products: • For meat: select which time (poultry, pork.); whether it is fresh or treated meat; expiration date. • For EEE: type of equipment; life time; status (broken ,usable or repairable).
Prioritizations	Should
Work Package	WP2
Related ICT System	ECO shopping Module

Attribute	**Description**
User Requirement Unique ID	USER_R_05
Functional or Non-Functional	F
Classification of requirement	Recycle/reuse
Title	Incentives
Description (3-4 lines)	The user can see the possibilities to get incentives from the credits achieved. Information on how much credits are needed would be important. The user can see offer details of supermarkets etc. which provide incentives for ECO credits.
Prioritization	Should

Work Package	WP2
Related ICT System	ECO shopping Module

Attribute	**Description**
User Requirement Unique ID	USER_R_06
Functional or Non-Functional	F
Classification of requirement	Recycle/reuse
Title	Validation of products in the recycling bin
Description (3-4 lines)	The intelligent bin for WEEE incorporates an internal database in which each waste is assigned a code which in turn is associated to a user (this is a technical feature from the bins and external to our system). The ICT platform should cross-check the information of the user that logged into our system with that from the bin to ensure that the waste was effectively disposed of. That implies that the system should allow the user ID used in the intelligent bin to be linked to a CIRC4Life account.
Prioritization	Should
Work Package	WP2
Related ICT System	Recycling/reuse Module

Attribute	**Description**
User Requirement Unique ID	USER_R_07a
Functional or Non-Functional	F
Classification of requirement	Recycle/reuse
Title	Validation of eco-credits (1)
Description (3-4 lines)	Allow a user with role "Recycler" to link a product from the intelligent bin to a recycling process
Prioritization	Should
Work Package	WP2
Related ICT System	Eco Account APP, Recycle/reuse module

Attribute	**Description**
User Requirement Unique ID	USER_R_07b
Functional or Non-Functional	F
Classification of requirement	Recycle/reuse
Title	Validation of eco-credits (2)
Description (3-4 lines)	Add ECO Credits to a CIRC4Life account after • The user added the product to a recycling bin • The product was validated by a "recycler"
Prioritization	Should

Work Package	WP2
Related ICT System	Eco Account APP, Recycle/reuse module

2.3.4 Generic

Attribute	Description
User Requirement Unique ID	
Functional or Non-Functional	F
Classification of requirement	Generic
Title	User log in
Description (3-4 lines)	The consumer logs in to their smartphone (or other web enable device, PC etc.) and by this connects to their CIRC4Life account.
Prioritization	Must
Work Package	ALL
Related ICT System	Eco Account App, Brokerage system

Attribute	Description
User Requirement Unique ID	USER_G_02
Functional or Non-Functional	F
Classification of requirement	Generic
Title	User log in screen
Description (3-4 lines)	The user can see the total balance of ECO credit, ECO debit once logged in his personal account.
Prioritization	Must
Work Package	WP1
Related ICT System	Eco Account App, Brokerage System

Attribute	Description
User Requirement Unique ID	USER_G_03
Functional or Non-Functional	F
Classification of requirement	Generic
Title	User account history
Description (3-4 lines)	The system should keep the history of the transactions of each consumer.

Prioritization	Should
Work Package	WP1, WP4, WP5
Related ICT System	Eco Account App

Attribute	Description
User Requirement Unique ID	USER_G_04
Functional or Non-Functional	F
Classification of requirement	Generic
Title	User log in screen
Description (3-4 lines)	The user can use an ID screen for interaction with external systems while sending their IDs etc. The screen containing a photo, name and an OCR code for electronic registration.
Prioritization	Should
Work Package	WP1, WP4
Related ICT System	Eco Account App, Eco Shopping App

Attribute	Description
User Requirement Unique ID	USER_G_05
Functional or Non-Functional	NF
Classification of requirement	generic
Title	CE Brokerage systems and processes
Description (3-4 lines)	Users should get a service to make business with CE: Core logic and functions for handling data unified into core processes and systems for: CEBM 1, CEBM 2 and CEBM 3. Specific Logic and functions for handling data for CEBM 1, CEBM2, CEBM3
Prioritization	Must
Work Package	WP4
Related ICT System	Brokerage System

Attribute	Description
User Requirement Unique ID	USER_G_06
Functional or Non-Functional	F
Classification of requirement	Generic
Title	Broker Maturity Level Model
Description (3-4 lines)	User want to find the right partners in their supply chains with adequate capabilities: Definition of needed skills/maturity for CE

	collaboration, digitization and processes per level; companies contact the platform and will be matched to the best-fit suppliers.
Prioritization	Must
Work Package	WP4; T4.7
Related ICT System	Brokerage System

Attribute	Description
User Requirement Unique ID	USER_G_07
Functional or Non-Functional	NF
Classification of requirement	generic
Title	CE Partner Platform
Description (3-4 lines)	Users search for partners by matching own CE status with others: CE Brokerage – Trusted Partner Platform - security, privacy and administration
Prioritization	Must
Work Package	WP4; T4.7
Related ICT System	Brokerage System

Attribute	Description
User Requirement Unique ID	USER_G_08
Functional or Non-Functional	NF
Classification of requirement	generic
Title	Account Graphical Review
Description (3-4 lines)	The users should get a graphical review of their personal Eco-Points, Eco-Credits
Prioritization	Could
Work Package	WP1, WP4
	Eco Account App

Attribute	Description
User Requirement Unique ID	USER_G_09
Functional or Non-Functional	NF
Classification of requirement	generic
Title	Products Review
Description (3-4 lines)	Allow the end users to enter personal reviews about the products and consolidate them
Prioritization	Should
Work Package	WP1, WP4
Related ICT System	Eco Shopping Module, Eco Account App, B2B for Stakeholder Interaction

Attribute	Description
User Requirement Unique ID	USER_G_10
Functional or Non-Functional	F
Classification of requirement	Generic
Title	Eco Point calculation
Description (3-4 lines)	The ECO points should be computed based on a dedicated formula that will be provided in the work of the WP1, based on various criteria (LCA, product materials etc.)
Prioritization	Must
Work Package	WP1, WP4
Related ICT System	Core System

Attribute	Description
User Requirement Unique ID	USER_G_11
Functional or Non-Functional	F
Classification of requirement	Generic
Title	Product Retrieval information
Description (3-4 lines)	The users should be able to retrieve information on any type of products (Escrow database). The same system can be used by the product designers and procurement departments etc.
Prioritization	Must
Work Package	WP1, WP4
Related ICT System	Core System, Escrow Database

Attribute	Description
User Requirement Unique ID	USER_G_12
Functional or Non-Functional	F
Classification of requirement	Generic
Title	Product Scanning
Description (3-4 lines)	The users should be able to identify the products by scanning their barcode (Product management). The products should be able to be retrieved even after their lifetime.
Prioritization	Must
Work Package	WP1, WP4
Related ICT System	Eco Shopping Module, Escrow Database, Product barcode

Attribute	Description
User Requirement Unique ID	USER_G_13

Functional or Non-Functional	NF
Classification of requirement	Generic
Title	Product Tracking
Description (3-4 lines)	The users should be able to track the products at the usage, recycle/reuse process to get accurate dynamic eco information at any point in the product's life cycle
Prioritization	Must
Work Package	WP1, WP2, WP4, WP5,
Related ICT System	Traceability Module, online LCA Tool, Core System

Attribute	**Description**
User Requirement Unique ID	USER_G_14
Functional or Non-Functional	NF
Classification of requirement	Generic
Title	Security
Description (3-4 lines)	The system should provide security to the users and access to information based on various criteria/roles
Prioritization	Must
Work Package	WP1, WP2, WP4, WP5
Related ICT System	Core System

Attribute	**Description**
User Requirement Unique ID	USER_G_15
Functional or Non-Functional	NF
Classification of requirement	Generic
Title	Aggerated data retrieval
Description (3-4 lines)	The users should be able to retrieve aggregated information of the products in the fastest way possible
Prioritization	Must
Work Package	WP1, WP4, WP5
Related ICT System	Core System

3 User Requirements Traceability Matrix

The table below is matching all the user requirements with the related ICT component. In many cases more than one system is needed in order to fulfil the requirement. The exact way that the system behaves in order to match the user requirement is further elaborated in the Section 4 of the system requirements.

User Requirement ID	Requirement Title	Retailer Tool for ECO accounting	End Users Toolbox		Impact Assessment Tool	Stakeholders Interaction		Traceability module	Recycle Reuse Module	LCA Module	CIRC4Life Core Platform	Data Inputs	
			Eco Account App	Eco Shopping Module		Brokerage System	B2B for stakeholder Interaction					Escrow Database	Barcode Product management
Subcomponent		End Users Layer						Traceability	Recycle	LCA	Core Platform	Data Providers	
USER_D_01a	Consumer-Supply chain interactions (a)						X						
USER_D_01b	Consumer-Supply chain interactions (b)						X						
USER_D_02	Identify Products Impact				X					X			
USER_U_01	Eco-shopping -Scan			X									
USER_U_02	Eco-shopping - eco debit	X											
USER_U_03	Eco-shopping -product debit		X										

USER_U_04	Eco-account review		X										
USER_U_05	Detailed Product information	X		X									
USER_U_06	Detailed Product information - producer	X		X									
USER_U_07	Detailed Producer Information - recycling	X		X		X							
USER_R_01	Recycling / reuse -bins								X				
USER_R_02	Recycling / reuse-Credits		X										
USER_R_03	Geo localization	X		X									
USER_R_04	Waste survey			X									
USER_R_05	Incentives			X									
USER_R_06	Validation of products in the recycling bin								X				
USER_R_07a	Validation of eco-credits (1)		X						X				
USER_R_07b	Validation of eco-credits (2)		X						X				
USER_G_01	User log in		X			X							
USER_G_02	User log in screen		X			X							
USER_G_03	User account history		X										

USER_G_04	User log in screen	X		X									
USER_G_05	CE Brokerage systems and processes					X							
USER_G_06	Broker Maturity Level Model					X							
USER_G_07	CE Partner Platform					X							
USER_G_08	Account Graphical Review		X										
USER_G_09	Products Review		X	X		X	X						
USER_G_10	Eco Point calculation									X	X		
USER_G_11	Product Retrieval information					X					X	X	
USER_G_12	Product Scanning			X								X	X
USER_G_13	Product Tracking							X		X			
USER_G_14	Security										X		
USER_G_15	Aggerated data retrieval										X		

Table 3–1 *Summary Matrix of the user requirements with the components of the ICT platform.*

4 System Requirements Procedure

The high-level process used in order to match the user requirements is found in a schematic form in the following diagram.

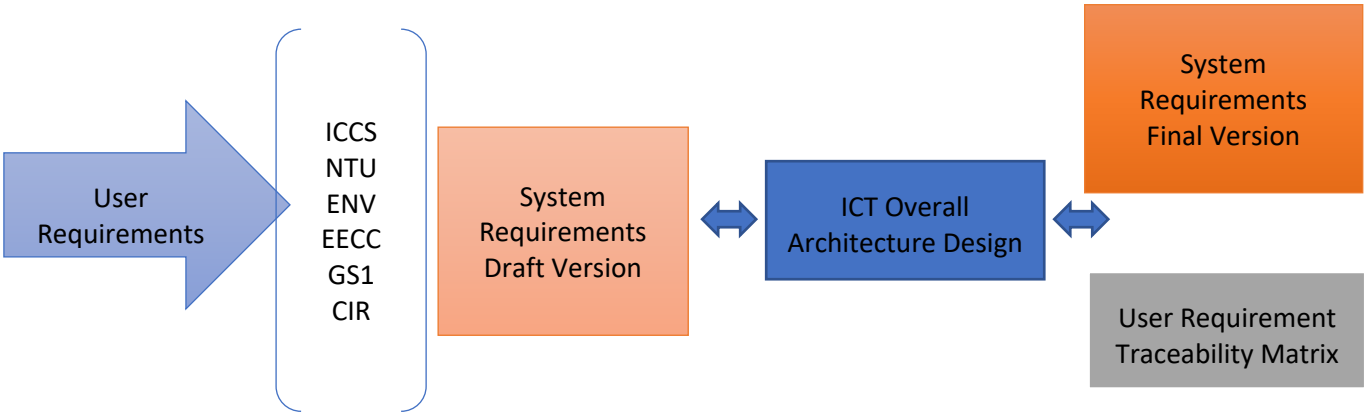

Figure 4-1 CIRC4Life system requirements Process

The starting point for the analysis of requirements was the Section 2 and the definition of the user requirements. The user requirements were then distributed to the technical partners who started to work in parallel and independently starting from the user-level requirements, to devise an initial set of system-level requirements. The input was structured according to a form developed by ICCS and reported below. The form defines the attributes to be defined for each requirement. The form is reported here with the instructions provided to the partners.

Attribute	Description
Unique ID	*It identifies each requirement through a unique identifier.*
Type	*It specifies the type of the requirement. Two types of requirements will be considered* ● ***Functional Requirements (FR),*** *They are the fundamental or essential subject matter of the product. They describe what the product has to do or what processing actions it is to take (Robertson & Robertson, 2007).* ● ***Non-Functional Requirements (NFR),*** *They are the properties that the functions must have. These requirements are as important as the functional requirements for the product's success (Robertson & Robertson, 2007)*
Priority	*The priority of a requirement is the decision on the importance of the requirement implementation. The priority depends highly on the specific domain of the application Priority is divided by (Bradner, 1997):* ● *MUST: It means that the definition is an absolute requirement of the specification.*

	● *SHOULD: It means that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.* ● *COULD: It means that an item is truly optional.*
Category	*The category is used in order to aggregate the requirements into coherent sets. The following set of categories shall be used:* • *Product Design* • *Product Usage* • *Recycle/Reuse* • *Interoperability* • *Performance* • *Usability* • *Reliability* • *Security* • *Legal* • *Openness*
Description	*The description is the intent of the requirement. It is a statement of what the requirement must fulfil.*
Rationale	*The rationale is the reason behind the requirement existence. It explains why the requirement is important and how it contributes to the system's purpose (provide mapping to the project objectives whenever possible).*
Fit Criterion	*A fit criterion is a measurement for a requirement. It is needed because some requirements are too vague or ambiguous to be properly useful. For example, "The system shall be easy to use" is well-intentioned, but not yet able to be implemented. However, if you add a fit criterion such as "75% of first-time users shall be able to buy the correct cinema tickets within 90 seconds, without using the help functionality" makes it clear to the designer what is needed to make the product successful. (Robertson & Robertson, 2007)*
Relevant User Requirement(s)	*As per the user requirement in the section above*
Dependencies	*Indicate if the requirement depends on another one. Relations between two or more requirements should be traced.*
Conflicts	*Conflicts between requirements imply that there exists contradiction upon system implementation, or one requirement makes the implementation of another requirement less feasible.*
Relevant WP	*The CIRC4Life work package teams that will address each specific requirement (better if the name of the partner and/or relevant officer can be specified).*
Comments	*Any additional comment or observation regarding the specific requirement. In particular it should include comments on possible technology limitations or to identify aspects which may be only partially relevant to the scope of the project (or totally out of scope, even).*

Related ICT system	*A mapping towards the system in which the system requirement will be implemented*
Responsible partner	*In case multiple partners are involved in the functionality/system, then all of them should be listed*

Table 4–1 Table summarizing the format of the system requirements collection

All the inputs by partners were then gathered by ICCS in order to consolidate the dependencies and provide a first version of the system architecture. Once the whole system architecture was created this was retrofitted to the system requirements in order to ensure that the whole architecture is in accordance with each system requirement.

Consequently, the final version of the system requirements was created as it can be seen in the section 4.1. Based on the consolidated results of the section 4.1, it was created the traceability matrix presented in the section 3.

4.1 List of System Requirements

In this section it is provided the list of all the system requirements.

4.1.1 Product Design system Requirements

Attribute	Description
Unique ID	*System_01*
Type	*FR*
Priority	*Must*
Category	*Product Design (related to B2B tool for stakeholder Interaction)*
Description	*Track the product sustainable information among suppliers and producers, utilizing the B2B stakeholder interaction tool, to achieve the information transmission related to the product development activities.*
Rationale	*Supply chains will become more traceable, B2B activities will be simpler and thus create new opportunities for innovation and co-creation of products.*
Fit Criterion	*The involvement of stakeholders along the supply chain can be handled by an online system incorporating mandatory data input fields, communication fields and an eBay-style 'review' function.*
Relevant User Requirement(s)	USER_D_01 (USER_D_01a, USER_D_01b)
Dependencies	*B2B tool for stakeholder interactions, to be developed in Task 7.4*
Conflicts	*N/A*

Relevant WP	*WP1, WP7*
Comments	*B2B tool is used to improve stakeholder interaction related to product development.*
Related ICT system	*B2B tool for stakeholder interactions*
Responsible partner	*ENV, ALIA*

Attribute	Description
Unique ID	*System_02*
Type	*FR*
Priority	*Must*
Category	*Product Design*
Description	*The system will be used in order to show to the Product designers the impact of various materials and products, helping the design of products as per the CEBM1. The system may also allow the designers to design completely new products and get the estimated Eco Impact.*
Rationale	*It is important in order to ensure the correct information to the Product designers as per the definition of the ECO points, ECO credits as well as potentially the recycling incentives.*
Fit Criterion	*The designers should be able to get the total impact of products in an easy to read format as well have a detailed view of the total impact .*
Relevant User Requirement(s)	USER_D_02
Dependencies	*There is a dependency with the CORE system for the calculation of the products impact as well as the product database. This is closely related to the task 1.2.*
Conflicts	
Relevant WP	*WP1, WP2*
Comments	
Related ICT system	*Impact Assessment Tool*

Responsible partner	*ICCS*

4.1.2 Retailing/Usage System Requirements

Attribute	Description
Unique ID	*System_03*
Type	*FR*
Priority	*Must*
Category	*Retailing/Usage*
Description	*Allow the consumer to view the eco-point information in the stores, via scanning the traceability tools (e.g. barcode, RFID and/or QR) of products displayed on the store shelf.*
Rationale	*The system will help the consumer select more sustainable products.*
Fit Criterion	*Consumer is able to view the sustainable information of products, such as eco-points and eco-manufacture processes, in the local store. Account login is not mandatory prior to payment.*
Relevant User Requirement(s)	USER_U_01
Dependencies	EPCIS traceability method to be developed in Task 5.1/T5.2
Conflicts	
Relevant WP	*WP3, WP4, WP5*
Comments	
Related ICT system	*ECO Shopping* tool
Responsible partner	*NTU*

Attribute	Description
Unique ID	*System_04*
Type	*FR*
Priority	*Must*
Category	*Retailing/Usage*

Description	*The system allows the consumer to buy the products at the check-out point and then get the receipt showing eco-debit information of the product purchased.*
Rationale	*The eco-debit is used to show negative impacts on the environment generated by consumer's purchasing.*
Fit Criterion	*Consumer is allowed to sign in and make payment, then receive the receipt with eco-debit data at the till.*
Relevant User Requirement(s)	USER_U_02
Dependencies	*Consumer's eco-account tool, to be developed in Task 3.3* *EPCIS traceability tool, to be developed in T5.1*
Conflicts	
Relevant WP	*WP3. WP4, WP5*
Comments	
Related ICT system	Retailer tool for eco-accounting
Responsible partner	*NTU*

Attribute	**Description**
Unique ID	*System_05*
Type	*FR*
Priority	*Must*
Category	*Retailing/Usage*
Description	*Enable the consumer to view the eco-debit data via their eco-accounts with their mobile phones.*
Rationale	*The consumer will be informed on the eco-debit data after their purchasing.*
Fit Criterion	*Eco-debit data are allowed to be displayed via the consumer's eco-account app.*
Relevant User Requirement(s)	USER_U_03
Dependencies	*Eco-shopping tool, to be developed in Task 3.2* *EPCIS traceability tool, to be developed in T5.1/ T5.2* *Retailer tool for eco-accounting, to be developed in T3.3*

Conflicts	
Relevant WP	*WP3. WP4, WP5*
Comments	
Related ICT system	*Consumer's ECO Account App*
Responsible partner	*NTU*

Attribute	**Description**
Unique ID	*System_06*
Type	*FR*
Priority	*Must*
Category	*Retailing/Usage*
Description	*Enable the consumer to get overall impact footprints, such as their eco-debits via consumer purchasing, eco-credits via recycling and reuse, and daily eco-balance, via their eco-account.*
Rationale	*The consumer should be informed on their environmental impacts.*
Fit Criterion	*The eco-debits, eco-credits and eco-credit balance are shown in table/graph form to reflect consumer's overall impact footprints per day.*
Relevant User Requirement(s)	USER_U_04
Dependencies	*Eco-point and resulted eco-credit, eco-debit and eco-balance.*
Conflicts	
Relevant WP	*WP3. WP4, WP5*
Comments	
Related ICT system	*Consumer's ECO Account App*
Responsible partner	*NTU*

Attribute	Description
Unique ID	*System_08*
Type	*FR*
Priority	*Could*
Category	*Retailing/Usage*
Description	*Allow the user to load complete data setup for product, or subset of data depending on preferences (e.g. allergens etc.)*
Rationale	*Detailed or subset of product information data will be shown to the retailer/consumer.*
Fit Criterion	*In the store, consumers can view the product information via smartphones. The retailer can obtain the detailed information the moment consumer checks out.*
Relevant User Requirement(s)	USER_U_05
Dependencies	*Product information provided by the producers*
Conflicts	
Relevant WP	*WP3. WP4, WP5*
Comments	
Related ICT system	*Consumer's ECO Account App* *Eco-shopping tool,* *Retailer tool for eco-accounting*
Responsible partner	*NTU*

Attribute	Description
Unique ID	*System_09*
Type	*FR*
Priority	*Could*
Category	*Retailing/Usage*
Description	*Allow the user to load linked producer ID and relevant information.*
Rationale	*The producer ID and relevant information linked to the product will be shown to retailer/consumer.*
Fit Criterion	*Consumer can view the producer data via smartphones in the store.*

Relevant User Requirement(s)	USER_U_06
Dependencies	*Producer information provided.*
Conflicts	
Relevant WP	*WP3. WP4, WP5*
Comments	
Related ICT system	*Consumer's ECO Account App*
Responsible partner	*NTU*

Attribute	**Description**
Unique ID	*System_010*
Type	*FR*
Priority	*Could*
Category	*Retailing/Usage*
Description	*Allow the user to load instruction data and recycling recommendations.*
Rationale	*The information related to the recycling/reuse, such as instruction, locations, etc. will be informed to consumers, in order to encourage their participation.*
Fit Criterion	*Consumers can obtain the information related to recycling/reuse activities with their mobile phones.*
Relevant User Requirement(s)	USER_U_07
Dependencies	*Recycling and reuse information provided by recycler.*
Conflicts	
Relevant WP	*WP3. WP4, WP5*
Comments	

Related ICT system	*Consumer's ECO Account App*
Responsible partner	*NTU*

4.1.3 Recycle/Reuse System Requirements

Attribute	Description
Unique ID	*System_11*
Type	*FR*
Priority	*Must*
Category	Recycle/reuse
Description	*Allow consumer/retailer to recycle their EoL products using dedicated intelligent bins.*
Rationale	*The products will be recycled when they come to the end of life.*
Fit Criterion	*The EoL products to be recycled/reused include: (i) consumer's electronic products (e.g. tablets and LED lights); (ii) farmer foods at the retailer.*
Relevant User Requirement(s)	USER_R_01
Dependencies	*Consumer eco-account App*
Conflicts	*N/A*
Relevant WP	*WP2. WP4, WP5*
Comments	
Related ICT system	*Recycling/Reuse Module*
Responsible partner	*NTU*

Attribute	Description
Unique ID	*System_12*
Type	*FR*
Priority	*Must*

Category	Recycle/reuse
Description	*To award the eco-credits to consumer when recycling/reusing their EoL products. ECO credits will be calculated based on the dedicated formula that will be provided in the WP2*
Rationale	*The consumers recycle their EoL products and then get the eco-credits, in order to incentivize them to continuously participate in recycling and reuse.*
Fit Criterion	*The eco-credits obtained from recycling/reusing will be added to the consumer's eco-account.*
Relevant User Requirement(s)	USER_R_02
Dependencies	*Recycling/Reuse Module* *Eco-credit calculation*
Conflicts	*N/A*
Relevant WP	*WP2. WP4, WP5*
Comments	
Related ICT system	*Consumer Eco Account App*
Responsible partner	*NTU*

Attribute	**Description**
Unique ID	*System_12*
Type	*FR*
Priority	*Could*
Category	Recycle/reuse
Description	*Allow the consumer to have access to the information of Geo-location of the intelligent bins which are placed in the supermarket.*
Rationale	*The consumer should be informed of the location where to recycle their products.*
Fit Criterion	*Geo-location of the intelligent bins is shown in the eco-account app.*
Relevant User Requirement(s)	USER_R_03
Dependencies	*Geo location information provided.*

Conflicts	*N/A*
Relevant WP	*WP2*
Comments	
Related ICT system	*ECO shopping Module , Retailer tool for eco-accounting*
Responsible partner	*NTU*

Attribute	**Description**
Unique ID	*System_13*
Type	*FR*
Priority	*Must*
Category	Recycle/reuse
Description	*Allow the consumer to get the initial estimation of eco-credits*
Rationale	*The user can incorporate information on the product to be recycled through a drop-down into the platform to get an initial estimation of the eco-credits. This should be different for meat or for electronic products:* *• For meat: select which time (poultry, pork...); whether it is fresh or treated meat; expiration date...* *• For EEE: type of equipment; life time; status (broken or usable).*
Fit Criterion	*The estimated eco-credits will be shown in consumer's eco-shopping tool.*
Relevant User Requirement(s)	USER_R_04
Dependencies	*Eco-credit calculation*
Conflicts	*N/A*
Relevant WP	*WP2*
Comments	
Related ICT system	ECO shopping Module

Responsible partner	*NTU*

Attribute	**Description**
Unique ID	*System_14*
Type	*FR*
Priority	*Must*
Category	Recycle/reuse
Description	*Allow the consumer to get the potential incentive schemes where the eco-credits can be applied.*
Rationale	*The user can see the possibilities to get incentives from the credits achieved. Information on how much credits are needed would be important. The user can see offer details of supermarkets etc. which provide incentives for Eco credits.*
Fit Criterion	*The incentive schemes are shown in consumer's eco-shopping tool.*
Relevant User Requirement(s)	USER_R_05
Dependencies	*Incentive schemes provided.*
Conflicts	
Relevant WP	*WP2*
Comments	
Related ICT system	ECO shopping Module
Responsible partner	*NTU*

Attribute	**Description**
Unique ID	*System_15*
Type	*FR*
Priority	*Must*
Category	Recycle/reuse
Description	*Allow the consumer ID to be linked to the eco-account, which can be used by the intelligent bin.*
Rationale	*The consumer ID is linked to the eco-account, in order to enable consumer to receive the eco-credits after recycling/reuse.*
Fit Criterion	*This function is assessed by the following:*

	(1) Allow to set up the consumer eco-account. Each account has a unique ID. *(2) Allow the consumer to be identified at the moment of disposing the products in the bin*
Relevant User Requirement(s)	USER_R_06
Dependencies	
Conflicts	
Relevant WP	*WP2*
Comments	*N/A*
Related ICT system	Recycling/reuse Module *Eco-account App*
Responsible partner	*NTU*

Attribute	Description
Unique ID	*System_16*
Type	*FR*
Priority	*Must*
Category	Recycle/reuse
Description	*Allow the EoL products within the intelligent bin to be collected by the recycler.*
Rationale	*The products recycled by the intelligent bin will be classified based on product ID and further checked by the recycler.*
Fit Criterion	*Allow a company with "Recycler" role to link a product from the intelligent bin to a recycling process.*
Relevant User Requirement(s)	USER_R_07a
Dependencies	*Recycling / reusing procedure and process provided by the recycler.*
Conflicts	

Relevant WP	*WP2. WP4, WP5*
Comments	
Related ICT system	EcoAccount App, Recycle/reuse module
Responsible partner	*IND, NTU*

Attribute	**Description**
Unique ID	*System_17*
Type	*FR*
Priority	*Must*
Category	Recycle/reuse
Description	*Allow the eco-credits to be validated and then added to consumer's eco-account, with concerns of product eco-point availability and quality check.*
Rationale	*The consumer is enabled to receive the eco-credit via their eco-accounts properly after the completion of recycling process*
Fit Criterion	*Add eco-credits to the consumer eco-account when the product recycled is validated by the recycler.*
Relevant User Requirement(s)	USER_R_07b
Dependencies	*Eco-credit calculation method*
Conflicts	
Relevant WP	*WP2*
Comments	
Related ICT system	Eco Account APP, Recycle/reuse module
Responsible partner	*NTU*

4.1.4 Generic System Requirements

Attribute	Description
Unique ID	*System_18*
Type	*FR*
Priority	*Must*
Category	Generic
Description	*Allow the consumer to log in via their smartphone, ID card, or other web enabled devices.*
Rationale	*The consumer has the eco-account with a unique ID, by which they can view product eco-information related to purchasing and recycling/reuse.*
Fit Criterion	*The consumer can log in their eco-account to enable various activities, particularly eco-shopping and recycling/reusing.*
Relevant User Requirement(s)	USER_G_01
Dependencies	*Traceability tool*
Conflicts	
Relevant WP	*WP2, WP3, WP4, WP5*
Comments	
Related ICT system	*Eco-shopping tool, Eco-account app, Retailer tool for consumer eco-accounting, recycling/ reusing module* Eco Account App, Brokerage
Responsible partner	*NTU*

Attribute	Description
Unique ID	*System_19*
Type	*FR*
Priority	*Must*
Category	Generic
Description	*Allow the consumer to view the product eco-information.*
Rationale	*Product eco-information will be accessible to the consumer after they conducted recycling/reuse and purchasing*
Fit Criterion	*The consumer is able to get the eco-information via their mobile phone, including eco-debits obtained via purchasing, eco-credits awarded by recycling/reusing, and eco-balance showing total daily impacts.*
Relevant User Requirement(s)	USER_G_02

Dependencies	*Eco-Shopping tool, Retail tool for consumer eco-accounting*
Conflicts	
Relevant WP	*WP3, WP4, WP5*
Comments	
Related ICT system	Eco Account App,Brokerage
Responsible partner	*NTU*

Attribute	**Description**
Unique ID	*System_20*
Type	*FR*
Priority	*Must*
Category	Generic
Description	*Enable the record of the transaction history of each consumer*
Rationale	*Consumer transaction history should be recorded.*
Fit Criterion	*Consumer can view the history of the transactions via their eco-account in terms of item, date, price, etc.*
Relevant User Requirement(s)	USER_G_03
Dependencies	*Retailer tool for consumer eco-accounting*
Conflicts	
Relevant WP	*WP3, WP4*
Comments	
Related ICT system	Eco Account App
Responsible partner	*NTU*

Attribute	Description
Unique ID	*System_21*
Type	*FR*
Priority	*Must*
Category	Generic
Description	*Log in information (UI)*
Rationale	*The login user interface should contain the input fields required for user ID, password; as well as QR code that can be recognized by intelligent bin and retailer/cashier tool.*
Fit Criterion	*The necessary information for consumer login will be shown in the mobile phone and/or web enabled devices.*
Relevant User Requirement(s)	USER_G_04
Dependencies	*Traceability tool*
Conflicts	
Relevant WP	*WP2, WP3, WP4, WP5*
Comments	
Related ICT system	Eco Account App, Eco Shopping App Retailer tool for consumer eco-accounting, recycling/reuse module
Responsible partner	*NTU*

Attribute	Description
Unique ID	*System_22*
Type	*FR*
Priority	*Must*
Category	Generic
Description	Users should get a service to make business with CE: Core logic and functions for handling data unified into core processes and systems for: CEBM 1, CEBM 2 and CEBM 3. Specific Logic and functions for handling data for CEBM 1, CEBM2, CEBM3
Rationale	*Use/ intake of resources and raw materials as core and ECO point functionalities specific to CEBMs 1 to 3*
Fit Criterion	*Users should get a service with in 12 months; make business with CE in the range of 10% of the resources used and 5% of trade value with ECO points*

Relevant User Requirement(s)	USER_G_05
Dependencies	*There is a dependency with the theoretical outcome of the WP1, WP2 and WP3 about the ECO point calculation*
Conflicts	
Relevant WP	*WP1; WP2; WP3*
Comments	*The planed work on the Brokerage System in T4.7 starts in May 2019.*
Related ICT system	*Brokerage System*
Responsible partner	*GS1G*

Attribute	**Description**
Unique ID	*System_23*
Type	*FR*
Priority	*Must*
Category	Generic
Description	Users want to find the right partners in their supply chains with adequate capabilities: Definition of needed skills/ maturity for CE collaboration, digitization and processes per level; companies contact the platform and will be matched to the best-fit suppliers.
Rationale	*CE business depends on the collaboration between partners in supply chains (SC) while both have their benefits; this implies comparable ambitions and conditions*
Fit Criterion	*99% consensus on the share of economies between partners in the SC*
Relevant User Requirement(s)	USER_G_06
Dependencies	*There is a dependency with the theoretical outcome of the WP1, WP2 and WP3 about the ECO point calculation*
Conflicts	
Relevant WP	*WP4*

Comments	*T4.7 starts in May 2019*
Related ICT system	*Brokerage System*
Responsible partner	*GS1G*

Attribute	**Description**
Unique ID	*System_24*
Type	*FR*
Priority	*Must*
Category	Generic
Description	Users search for partners by matching own CE status with others: CE Brokerage – Trusted Partner Platform - security, privacy and administration
Rationale	*Interested users want to find with a high level of services and a substantial conviction their potential partners for CE business.*
Fit Criterion	*100% access to platform for all partners; full satisfaction 99% with promised/ delivered properties*
Relevant User Requirement(s)	USER_G_07
Dependencies	*There is a dependency with the theoretical outcome of the WP1, WP2 and WP3 about the ECO point calculation*
Conflicts	
Relevant WP	*WP4; T4.7*
Comments	*T4.7 starts in May 2019*
Related ICT system	*Brokerage System*
Responsible partner	*GS1G*

Attribute	**Description**
Unique ID	*System_25*
Type	*NF*
Priority	*Must*
Category	Generic
Description	*Enable the consumer to view eco-credits, eco-debits and eco-balance in graphic form.*

Rationale	*The consumer should get a graphical review of their personal eco-credits, eco-debits and eco-balance.*
Fit Criterion	*The consumer uses the mobile phone to view the product eco-information.*
Relevant User Requirement(s)	USER_G_08
Dependencies	*Eco-points, eco-credits and eco-debits resulted.*
Conflicts	
Relevant WP	*WP3, WP4*
Comments	
Related ICT system	Eco Account App
Responsible partner	*NTU*

Attribute	**Description**
Unique ID	*System_26*
Type	*FR*
Priority	*Should*
Category	Generic
Description	*Allow the consumers to enter personal reviews of the product.*
Rationale	*The consumer should have the ability to provide feedback after they purchased the product.*
Fit Criterion	*The consumer can provide reviews for the purchased products, which is always valuable for the producers.*
Relevant User Requirement(s)	USER_G_09
Dependencies	*Consumer review functionality should be supported by product Website.*
Conflicts	
Relevant WP	*WP3, WP4, WP7*

Comments	
Related ICT system	EcoShopping Module, EcoAccount App*, B2B for Stakeholder Interaction*
Responsible partner	*NTU*

Attribute	**Description**
Unique ID	*System_27*
Type	*FR*
Priority	*Must*
Category	Generic
Description	The Eco points and the ECO credits will be calculated based on various criteria (LCA, impact etc.) as defined in the WP1 and WP2
Rationale	The ECO Points are crucial for the CIRC4Life project as it is the driver for the to be created CEBMs.
Fit Criterion	Needed in order to ensure the correct implementation of the CEBMs.
Relevant User Requirement(s)	USER_G_10
Dependencies	*There is a dependency with the theoretical outcome of the WP1 and WP2 about the ECO point and ECO Credit calculation.*
Conflicts	N/A
Relevant WP	WP1, WP2
Comments	All the information needed for the ECO Point calculation as well as the weights for the ECO credits should be provided to the core system
Related ICT system	*Core System*
Responsible partner	*ICCS*

Attribute	**Description**
Unique ID	*System_28*
Type	FR
Priority	Must
Category	Product usage

Description	The core system should be able to retrieve and provide the information needed for each scanned product. This could be either the ECO shopping module or any other front-end application
Rationale	It is important in order to help the user decide about the product to be purchased
Fit Criterion	100% needed in order to ensure the correct implementation of the CEBM.
Relevant User Requirement(s)	USER_G_11
Dependencies	There is a dependency with the systems that will provide the data, as well as the front-end applications that will display the data
Conflicts	N/A
Relevant WP	WP1, WP2
Comments	
Related ICT system	Core System, Escrow Database
Responsible partner	*ICCS, ENV*

Attribute	**Description**
Unique ID	*System_29*
Type	*FR*
Priority	*Must*
Category	Generic
Description	*Allow the products to be retrieved via scanning their RFID or barcode for the subsequent product classification and recycling.*
Rationale	*The products should be able to be retrieved even after their lifetime.*
Fit Criterion	*The users should be able to identify the products by scanning their RFID/barcode and getting the product eco-information from database*
Relevant User Requirement(s)	USER_G_12
Dependencies	*RFID/barcode information provided.*

Conflicts	
Relevant WP	*WP2, WP4, WP5*
Comments	
Related ICT system	*Eco Shopping Module, Escrow Database , Product barcode*
Responsible partner	*EECC, ENV, NTU, IND*

Attribute	**Description**
Unique ID	*System_30*
Type	*FR*
Priority	*Must*
Category	Generic
Description	The core system should be able to retrieve traceability data (bin disposal data, recycling data) including user-id and eco-relevant information from the traceability system.
Rationale	*This information is needed in order to provide the user with eco-credits.*
Fit Criterion	100% needed in order to ensure the correct implementation of the CEBM.
Relevant User Requirement(s)	USER_G_13
Dependencies	*Traceability module*
Conflicts	
Relevant WP	*WP2, WP3*
Comments	
Related ICT system	*Core system/ Traceability Module*
Responsible partner	*EECC*

Attribute	**Description**
Unique ID	*System_31*

Type	Non-Functional Requirement
Priority	Must
Category	Security
Description	The system in total should operate in a secure way. It should also ensure that the various roles of CIRC4Life accounts should have access to a specific level of information.
Rationale	The system should be compliant with all the security standards and the ethics
Fit Criterion	100% need to ensure the trust to the system for the stakeholders and all the legal aspects that may arise.
Relevant User Requirement(s)	USER_G_14
Dependencies	There is a dependency with the extremal systems of the Core Platform, which should also ensure an End TO End transparency to the security.
Conflicts	N/A
Relevant WP	WP1, WP2
Comments	
Related ICT system	Core System, Access Control Manager
Responsible partner	*ICCS*

Attribute	**Description**
Unique ID	*System_32*
Type	Non Functional Requirement
Priority	Must
Category	Performance, Usability
Description	The system should be able to aggregate the provided data, in order to be efficient and operate with the needed performance. An aggregated module should provide this capability.
Rationale	In order to ensure the performance of the system, in all instance this module is needed. Depending on the data storage technologies to be used, this could be either a separate system, or the function could be implemented with aggregation frameworks provided by the database.
Fit Criterion	Highly needed for the performance of the system.

Relevant User Requirement(s)	USER_G_15
Dependencies	Dependency with the webservices /APIs that will be used for the data exchange .
Conflicts	N/A
Relevant WP	ALL
Comments	
Related ICT system	Core System.
Responsible partner	*ICCS*

5 ICT platform components

At this early stage of the project, as it was mentioned in the section 2 the design of an ICT platform, is having a risk of changing user requirements. This problematic was already analysed in the past by Land and a ''future analysis'' technique was introduced [Land,1982]. The notion of a flexibility in the design of the system was further discussed among others by [[Oei, 1994)], and [Robertson, 1997] and it was considered as a success factor for any ICT system. In this context a tailorable approach for the development of the system was further introduced [Stamoulis, 2002].

Over the software community the SoA was proposed as a way to adopt easily to different providers but also accommodate any change to the users or the requirements [Bennett, 2000], [Budgen, 2004].

The figure 5.1 summarizes the role of the SoA between the business strategy and the IT systems as the common ground for a continuous evolvement on both sides [BEA Inc Systems ,2005].

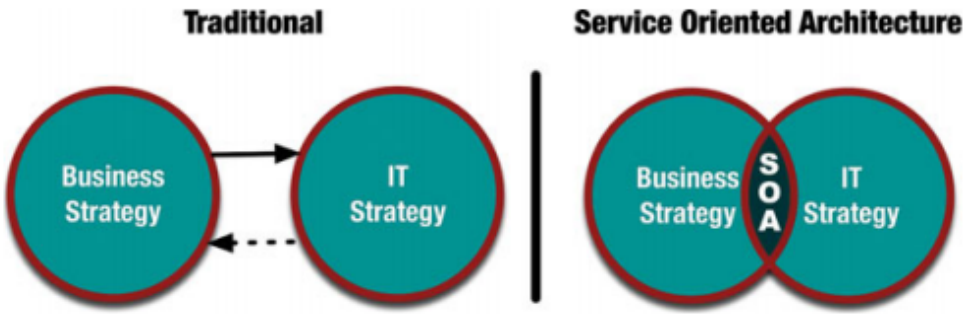

Figure 5-1 Traditional IT vs SOA. Source [BEA Inc Systems ,2005]

Furthermore, all the advantages of a service system compared to a component-based system were analysed by [Elfatatry, 2007]. Whereas the design of a SoA system, with multiple layers, in order to better serve the changing business models is analysed [Paik, 2017]

5.1 ICT overview

Considering the above, it was decided to create an Ecosystem of subsystems, with different layers, being served by a central platform of SoA architecture.

In this context a data layer is introduced which comprises of all the data providers to the system, including the Escrow Database of the Products and any other legacy data that could be potentially needed by the to be created business models.

Three independent modules with business logic serve all the 3 CEBMs:

1. Recycle/Reuse Module, including the recycle bins
2. Traceability Module
3. LCA Module

The Core platform of the system includes all the databases needed, in a harmonized data format, the webservice/API manager for the services provision and the Access Control manager to ensure the whole system security.
Finally, four different end user environments provide all the needed interfaces to the system users:

1. End Users Toolbox (Consumer Eco Account, Eco Shopping Module)
2. Retailer Tool for Eco Accounting
3. Impact Assessment Tool
4. Stakeholders Interaction Toolbox (Brokerage System, B2B system for Stakeholders Interaction)

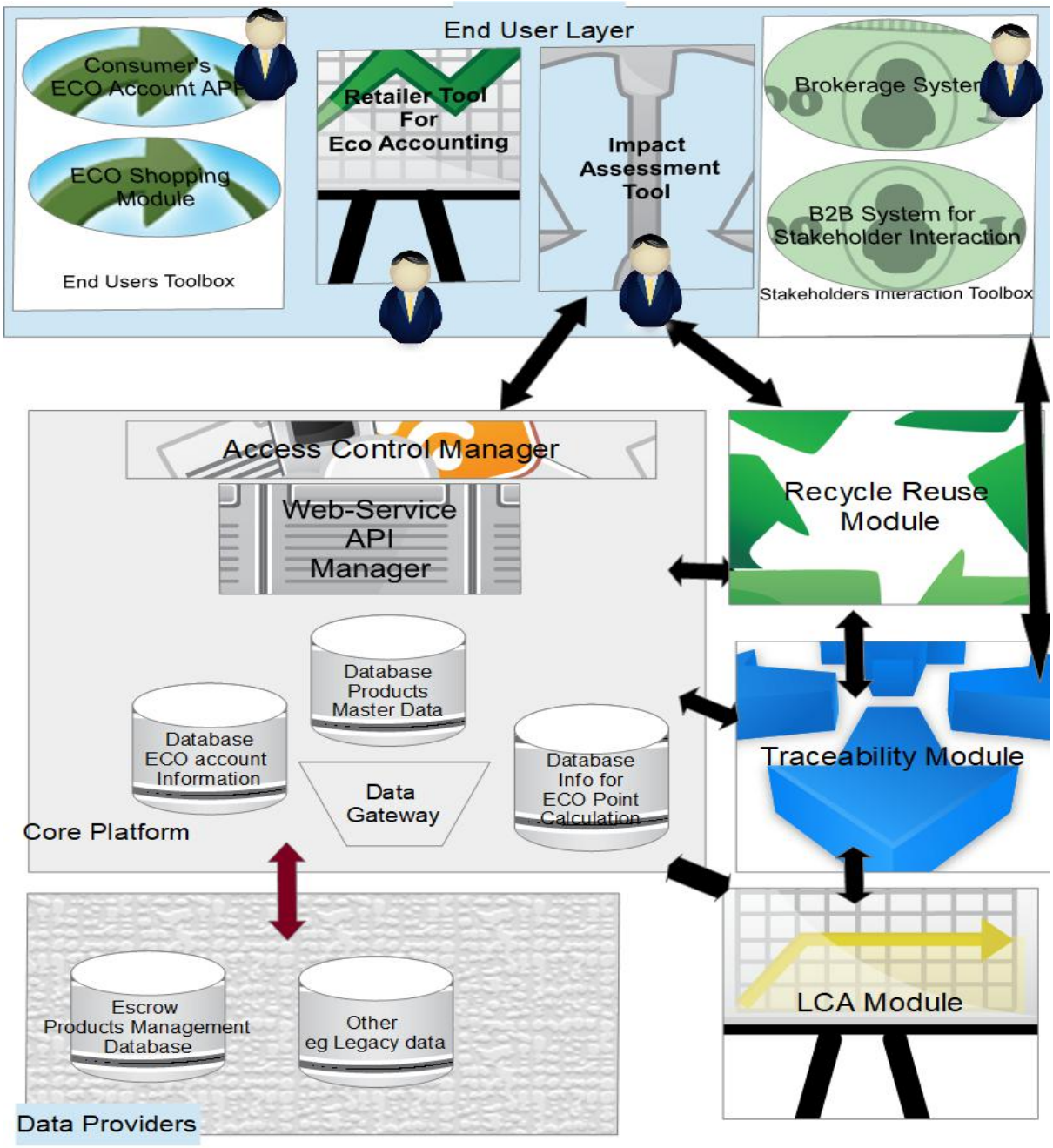

Figure 5-2 Overall ICT system architecture

As it can be seen in the graph above, in order to ease the development and further adaptation/maintenance of the system, few end user tools are merged. This gives the possibility of a modular development that could better serve the 3 CEBMs in the heterogenous context of the four different demonstration cases of the CIRC4Life project.

Trying to focus more on the subcomponents and the main interactions between the systems these are summarized in table 5-1. The relation to the CEBMs is following the format used in the user requirements section, having the categories of

- Design – Co-Creation of Products and Services
- Use- Sustainable Consumption
- recycle/reuse – Recycle and Reuse
- generic – Serving all the above CEBMs

System	Sub-**System**	**Main Interaction**	Relation to CEBMs
Retailer tool for eco-accounting	Retailer tool for eco-accounting	It interacts with the core platform to find the ECO points of products, retrieve the related eco accounts and charge the end users accordingly.	Serving the Sustainable consumption Business Model
End Users Toolbox	Consumer's eco-account	It interacts with the core platform where all the eco accounts are stored and shows them to the end users	Serving the Sustainable consumption and the Recycle/Reuse Business models
End Users Toolbox	ECO shopping Module	It interacts with the core platform to retrieve the product information and show them to the end users.	Serving the Sustainable consumption Business Model
Impact assessment Tool	Impact assessment Tool	It interacts with the core platform to retrieve product information and perform an assessment	Serving the Co-Creation of Products and Services
Stakeholder's Interaction	Brokerage System	Both systems allow the interaction between stakeholders in order to allow the application of the 3 CEBMs.	It serves all the 3 CEBMs
Stakeholder's Interaction	B2B system for stakeholder Interaction		
Traceability	Traceability Module	It allows the tracing of products and processes for all the CEBMs . it interacts with the various modules to identify events and passes them to the core platform of the system.	It serves all the 3 CEBMs
Recycling/reuse Module	Recycling/reuse Module	It interacts with the end users to identify them and with the traceability module to identify recycling events.	It serves the Recycle and Reuse CEBM
LCA	LCA Module	It allows the computation of ECO points. The system may interact with the core system to retrieve product data and similarly provides to the core platform the computed ECO-Points of the products	It serves all the 3 CEBMs
Core Platform	Access Control Manager	It interacts with all the end user layer applications as well as the systems that	It serves all the 3 CEBMs

		interact with the Core Platform ensuring the security of the whole system.	
Core Platform	Service/API Manager	It manages all the webservices and APIs created for whole systems	It serves all the 3 CEBMs
Core Platform	Databases, Products Master Data, Eco Account, Database info for Eco Point Calculation	It handles all the data inserted in the core platform by all the external systems	It serves all the 3 CEBMs
Core Platform	Data Gateway	It allows the interoperability and common data management of the whole architecture	It serves all the 3 CEBMs
Data Provider	Escrow Products Management Database	It allows the input of data to the core platform.	It serves all the 3 CEBMs

Table 5–1 Overview of ICT systems and partners

The above architecture is not fully following the mentions in the DoA of a P2P interconnected system. The priority was given to a more centralized architecture, as described above, that could be easier to adopt in possible change of business requirements and better serve the TO BE created business models.

5.2 ICT systems relation with other tasks/WPs

Many of the systems described in the section 5.1 are to be developed as part of other tasks of the project with various timelines. The following table gives an overview of the dependency with other tasks as well as the partners that are leading the corresponding tasks.

System	Sub-**System**	**Partner**	Related Task
ALL	Overall ICT Platform Architecture	ICCS	T4.1
Core Platform	Access Control Manager	ICCS	T4.3
Core Platform	Service/API Manager	ICCS	T4.5
Core Platform	Databases, Products Master Data, Eco Account, Database info for Eco Point Calculation	ICCS	T4.2
Data Provider	Escrow Products Management Database	ENV	T4.6, T1.3
Core Platform	Data Gateway	ENV	T4.4
Traceability	Traceability Module	EECC	T5.4
Data Provider	Legacy Systems for Data	ALL	n/a
LCA	LCA Module	NTU	T1.2
Stakeholder's Interaction	Brokerage System	GS1G	T4.7
Recycling/reuse Module	Recycling/reuse Module	NTU	T2.3

End Users Toolbox	Consumer's eco-account	NTU	T3.3
Retailer tool for eco-accounting	Retailer tool for eco-accounting	NTU	T3.2
End Users Toolbox	ECO shopping Module	NTU	T3.2
Stakeholder's Interaction	B2B system for stakeholder Interaction	ENV/ALIA	T7.4
Impact assessment Tool	Impact assessment Tool	ICCS	T1.2, 2.2

Table 5–2 Overview of ICT systems and partners

6 ICT platform components description

A success factor of the ICT platform would be the correct identification of the services that the newly created CEBMs need and the governance/security of these services. The governance of the services is following a mixed method among them presented in the literature [Niemann,2008] considering the main principles of capability, security and business alignment [Berbner,2006]. This is essential as the business models are not finalized and a flexibility about the business alignment is needed. The governance scheme is presented in the table 6.1.

Capability	Security	Business Alignment
The system is designed with a SoA architecture which could scale in order to serve the tools of the CEBMs.	A service control manager is introduced which controls the security and the access to information from all the end user applications	A Service identification technique with a hybrid method is used to ensure the compliance of the to be created CEBMs and the ICT tools.

Table *6–1 SOA governance*

6.1 Development Lifecycle Method and service Identification

6.1.1 Development Lifecyle

The lifecycle of our development is following the 5 steps proposed by [Papazoglou, 2007]

1. business process analysis (e.g. service identification),
2. service analysis and specification,
3. service provisioning,
4. deployment,
5. execution & monitoring.

The scope of this document is covering the first step of the lifecycle and gives an overview of the second step.

6.1.2 Service identification

The recent years there are various methods of Service identification without having concluded in a unique approach. In the literature review [Boerner,2009] compares various methods considering the advantages of each of them. Based on this work we consider the main strategy of our development as summarized in the table 6.2.

Basic Characteristics	
Industry	Mixed industry, at least for 4 demo cases (meat, tablet, farm, LEDs)

Understanding of services	Business processes as described in the DoA and a possibility of modular approach when needed
Service hierarchy	To be decided in which level the services will be split as there is a dependency with the 3 main modules of the system (Recycle, Traceability, LCA)
Granularity	Middle granularity between the processes/functions and the to be created services is used as the CEBMs are not yet finalized.
SOA paradigm	Architectural, as the Core platform is a mix of middleware and service provision
Direction of analysis	Hybrid analysis, top down for the understanding of the business models and bottom up for the limits of the to be used systems .
''Tools''	Decomposition of user requirements related to business processes.
Types of categorization	Separated in business models and generic requirements.

Table 6–2 Service Identification Method basic characteristics

6.1.3 Description of the systems, service analysis

The CIRC4Life ICT systems and main modules are described in the following paragraphs by the usage of the tables 6.3, 6.4. This format aims to apply the technique described in the 6.1.2.

System	Main Functions/services the systems needs/provides	System Description
Name of the system	*Description of the business processes that the system will serve and potential decomposition of the services*	*High level description of the service*

Table 6–3 Description of the ICT systems

System	
Physical Material needed?	*Needed to identify if there is any dependency with any existing or to be bought infrastructure*
Will the system interact with end users? Does the system itself have any type of display?	*Identification of the end users and any UI.*
Does the system have an existing gateway to interact? If not, is there any technology preference?	*Used to identify a Technological common ground for the various systems.*
Will the system have an internal storage? If yes, what type of data storage will be used?	*Data schema and Data flows*
Will the system transmit data in real time or batches?	*Data Flows*
Will the system store personal data? If yes, how the data will be protected	*Security and user protection*

Existing tools that we can use for this system? Any existing functionality?	Integration and limitations of existing tools/infrastructure.
What is the basic information/data that the system needs to receive/provide?	Identification of data flows and services.

Table 6–4 Main characteristics of the system

The tables above are filled in for all the basic systems modules of the system.

6.2 Retailer Tool for Eco Accounting

6.2.1 System Description

System	Main Functions/services the systems needs/provides	System Description
Retailer Tool for Eco Accounting	1. Allow to log in the consumer's account with ID card (similar to a point card for supermarket) and/or mobile phone, when purchasing the product at the check-out point in the store. 2. Consumer scan the product's barcode and/or RFID tag to retrieve the product ID. 3. Based on the product ID, eco-point is obtained in order to calculate eco-debit of product. 4. When consumer completes the payment, till device prints out a receipt showing eco-debits and purchasing information. 5. Add eco-debits and purchase information to the consumer eco-account.	This tool enables the consumer to buy the product at the store and get eco-debits via the eco-account.

6.2.2 System main Characteristics

Retailer Tool for Eco Accounting	
Physical Material needed?	Consumer ID card with QR code, RFID, and/or barcode.
Will the system interact with end users? Does the system itself have any type of display?	Yes, the tool will interact with the consumer via front-end devices, such as scanner/reader, PC, etc.
Does the system have an existing gateway to interact? If not, is there any technology preference?	No, the tool is to be developed for interacting with the ICT platform.
Will the system have an internal storage? If yes, what type of data storage will be used?	Yes, it has a local database system.
Will the system transmit data in real time or batches?	Real-time transfer upon request, subject to the operation of each payment.

Will the system store personal data? If yes, how the data will be protected	Yes, the system may store personal data, and the central database also have a anonymized copy.
Existing tools that we can use for this system? Any existing functionality?	No, it is to be developed.
What is the basic information/data that the system needs to receive/provide?	Consumer ID and product ID are required.

6.3 End Users Toolbox

6.3.1 System Description

System	Main Functions/services the systems needs/provides	System Description
End user Toolbox	The user shall be able to register to the C4L environment and store needed personal info and preferences – trustworthy storage.	User registration, login and personal data / properties management.
	The user shall be able to navigate in an easy way between the different modalities and functions in the system.	Screen / menu system to choose between different modules of the overall system
	The user shall be able to evaluate statistics and trends on their status regarding ecoPoints etc.	Dashboard and condensed statistical information on ecoPoints, ecoDebits, ecoCredits etc. Enable the consumer to view the eco-information related to consumer's purchasing and recycling activities (eco-debits, eco-credits earned, eco-balance, incentive schemes)
	The user shall be able to access product data by scanning IDs, get relevant information on ecoPoints, product properties, indicators and KPIs etc. And also access relevant data on the producer of the product (if available). Also access relevant information and resources on the products use and recycling options.	Modules to find, present and manage data on products, producers and recommended use and re-use of products
	The user shall be able to improve their participation in recycling and reuse processes and also more effectively manage the resulting incentives.	Modules to handle the recycling / reuse processes with adjacent incentive processes
	The users shall be able to send constructive feedback directly to the producers / developers of the product. They shall also be able to give feedback on the platform and its functions to the developers / maintainers of the system.	Modules to handle interaction between the user and producers / product developers and also the responsible actors for the system maintenance of the CIRC4Life platform.

6.3.2 System main Characteristics

End user Toolbox	
Physical Material needed?	n/a
Will the system interact with end users? Does the system itself have any type of display?	Yes
Does the system have an existing gateway to interact? If not, is there any technology preference?	The consumer tools system will interact with the C4L core using JSON (preferred protocol).
Will the system have an internal storage? If yes, what type of data storage will be used ?	Yes, allow the end-user to store data locally.
Will the system transmit data in real time or batches?	Real time
Will the system store personal data? If yes, how the data will be protected	The server structures will store personal data, ID system different from social numbers etc. Data stored in encrypted form in the database, communication links protected by SSL.
Existing tools that we can use for this system? Any existing functionality?	No
What is the basic information/data that the system needs to receive/provide?	The consumer tools system interacts intimately with the C4L Core structures – both receiving and supplying information.

6.4 Impact Assessment tool

6.4.1 System Description

System	**Main Functions/services the systems needs/provides**	**System Description**
Impact Assessment Tool	Function 1: Retrieve and display the impact of various materials/Products Function 2: Add/remove materials of products and assess the total new impact Function 3: Recycle/reuse information, incentive schemes, from where to retrieve this info Function 4: Allow the recyclers to retrieve products based on an ID and confirm if the products can be recycled/reused	A system to display the impact of various materials and contribute to the design of new products. The system could also provide information about recycle/reuse of materials.

6.4.2 System main Characteristics

Impact Assessment Tool	
Physical Material needed?	No
Will the system interact with end users? Does the system itself have any type of display?	Yes, Yes
Does the system have an existing gateway to interact? If not, is there any technology preference?	No. Preference to create a web-based App
Will the system have an internal storage? If yes, what type of data storage will be used?	Not sure. In all instance all the information will be retrieved from the ICT core platform
Will the system transmit data in real time or batches?	Webservices/APIs to be used
Will the system store personal data? If yes, how the data will be protected	No personal data
Existing tools that we can use for this system? Any existing functionality?	
What is the basic information/data that the system needs to receive/provide?	Products + Products Impact (ecoPoints or general impact of the products)

6.5 Stakeholders Interaction Toolbox

6.5.1 System Description

System	Main Functions/services the systems needs/provides	System Description
Stakeholders Interaction Toolbox	CE Brokerage systems and processes	Users should get a service to do business with CE: Core logic and functions for handling data unified into core processes and systems for: CEBM 1, CEBM 2 and CEBM 3. Specific Logic and functions for handling data for CEBM 1, CEBM 2, CEBM 3
	Broker Maturity Level Model	User want to find the right partners in their supply chains with adequate capabilities: Definition of needed skills/ maturity for CE collaboration, digitization and processes per level; companies contact the platform and will be matched to the best-fit suppliers.

	CE Partner Platform	Users search for partners by matching own CE status with others: CE Brokerage – Trusted Partner Platform - security, privacy and administration.

6.5.2 System main Characteristics

Stakeholders Interaction Toolbox	
Physical Material needed?	No
Will the system interact with end users? Does the system itself have any type of display?	Business users, yes; consumers, no To be decided
Does the system have an existing gateway to interact? If not, is there any technology preference?	Yes
Will the system have an internal storage? If yes, what type of data storage will be used?	Yes it depends on the content for data exchange
Will the system transmit data in real time or batches?	It depends on the requirements of the stakeholders, perhaps sufficient only in near-real time
Will the system store personal data? If yes, how the data will be protected	Yes, at least a name of a person
Existing tools that we can use for this system? Any existing functionality?	There might be comparable solutions in the logistics domain (?)
What is the basic information/data that the system needs to receive/provide?	Eco points, kind of resource, amount, location, owner, price, ...

6.6 Traceability Module

6.6.1 System Description

System	**Main Functions/services the systems needs/provides**	**System Description**
Traceability Module	The Traceability Module receives data about business events occurring along the supply circles, including all relevant primary (dynamic) information on ecological impacts. This data is stored and aggregated to provide the dynamic data input to the LCA (eco point) calculation.	The Traceability Module consists of Capture Interfaces, through which the partners can upload their data online or in batches into the system, query interfaces through which aggregated information can be retrieved, and an EPCIS backend (see the Standard: https://www.gs1.org/standards/epcis)

6.6.2 System main Characteristics

Traceability Module	
Physical Material needed?	No
Will the system interact with end users? Does the system itself have any type of display?	No (depending on the definition of “end user”)
Does the system have an existing gateway to interact? If not, is there any technology preference?	EECC develops CIRC4Life specific gateways (“accessing and capturing applications”)
Will the system have an internal storage? If yes, what type of data storage will be used?	Yes (DB)
Will the system transmit data in real time or batches?	Both (as appropriate for the individual capturing/accessing applications)
Will the system store personal data? If yes, how the data will be protected	no
Existing tools that we can use for this system? Any existing functionality?	https://www.gs1.org/standards/epcis Specific tools for CIRC4Life are developed in WP5.
What is the basic information/data that the system needs to receive/provide?	traceability data, I.e. what/when/where/why for all relevant business events -> dynamic, AKA primary, eco data

6.7 Recycle/Reuse Module

6.7.1 System Description

System	**Main Functions/services the systems needs/provides**	**System Description**
Recycle/Reuse Module	1. Allow the consumer to log in via QR code, with ID card and/or mobile phone. 2. Generate the barcode label including consumer ID and product ID, which is then placed on the product recycled. 3. Open the lid of intelligent bin, in order to get the product loaded. 4. Related user/product data are transmitted to the ICT platform. 5. Recycler is informed to collect the product and further processing.	This module is used to online recycle and reuse the EoL products such as tablets, lights and meat products, and then award the eco-credits to consumers.

	6. Based on the product ID, the eco-point is obtained and then the eco-credit is generated. 7. Eco-credit is awarded to the consumer, via the eco-account. (the above might vary subject to the specification of intelligent bin confirmed)	

6.7.2 System main Characteristics

Traceability Module	
Physical Material needed?	Yes , a recycle bin , consumer ID card and/or mobile phone with QR code.
Will the system interact with end users? Does the system itself have any type of display?	Yes, end users will recycle .. The system has no facility for display.
Does the system have an existing gateway to interact? If not, is there any technology preference?	Necessary program for the communication with the central platform/database.
Will the system have an internal storage? If yes, what type of data storage will be used ?	Limited storage capacity. Data to be cleaned at the end of day.
Will the system transmit data in real time or batches?	Transmit data on schedule in batch.
Will the system store personal data? If yes, how the data will be protected	Depend on the capacity of storage.
Existing tools that we can use for this system? Any existing functionality?	No, relevant program is needed.
What is the basic information/data that the system needs to receive/provide?	Consumer ID required. Barcode label (sticker) will be produced.

6.8 LCA Module

6.8.1 System Description

System	**Main Functions/services the systems needs/provides**	**System Description**
~~Recycle/Reuse Module~~ Online LCA tool	1. Online LCA is conducted to implement the eco-point method, with the concern of environmental/social impacts through product lifecycle, based on the existing LCA method and relevant software. 2. A novel Web based LCA tool will be developed to offer powerful LCA based services, such as life cycle inventory, dynamic data retrieve, product life cycle modelling, high speed calculations in a Web environment, etc.	The tool provides the functions to conduct LCA online to analyse the product's environmental/social impacts through their lifecycle, in order to produce eco-points.

	3. LCA will be utilized in the four areas: LED lights, tablets, meat, and farming foods.	

6.8.2 System main Characteristics

Traceability Module	
Physical Material needed?	No
Will the system interact with end users? Does the system itself have any type of display?	The tool may allow the consumer to provide input data online and retrieve the result.
Does the system have an existing gateway to interact? If not, is there any technology preference?	No, relevant tool and interface are to be developed.
Will the system have an internal storage? If yes, what type of data storage will be used?	EcoInvent database, preferably XML.
Will the system transmit data in real time or batches?	Possible real time connection subject to API required.
Will the system store personal data? If yes, how the data will be protected	No.
Existing tools that we can use for this system? Any existing functionality?	The existing LCA software will be used, which will be further developed enabling web access functionality
What is the basic information/data that the system needs to receive/provide?	EPCIS based dynamic input data to be retrieved from the LCA tool.

6.9 CIRC4Life Core Platform

6.9.1 System Description

System	**Main Functions/services the systems needs/provides**	**System Description**
CIRC4Life Core Node	• All the functions/services described by the 4 front end systems. • Data storage from all the external sources.	A core system backend that is handling all the data needed for the ecoPoint, ecoCredit, ecoDebit calculation , the user transaction history , as well as all a SoA that is handling all the services needed by the frontend systems

6.9.2 System main Characteristics

CIRC4Life Core Node	
Physical Material needed?	Servers. We will use the existing infrastructure of ICCS.
Will the system interact with end users? Does the system itself have any type of display?	No direct interaction with end users and no display for end users. It will be a backend system.
Does the system have an existing gateway to interact? If not, is there any technology preference?	It will be a completely new system created for the needs of CIRC4Life CEBMs.
Will the system have an internal storage? If yes, what type of data storage will be used?	The system will have databases in order to store the data. Considering the variation among the data to be used, a preference to non-relational databases is given for a part of the system. For simpler storage needs (e.g. ECO Account info) it is possible to use relational or non-relational Dbs. The final decision of the technology will be taken in the forthcoming tasks.
Will the system transmit data in real time or batches?	The system will receive data from external sources and technically will be able to receive data through a data gateway. The transmission could be either real time or batches.
Will the system store personal data? If yes, how the data will be protected	The system will store User IDs in an anonymized way, in order to fully protect the privacy of the users. The exact technique of anonymization to be used will be decided in the forthcoming tasks.
Existing tools that we can use for this system? Any existing functionality?	n/a
What is the basic information/data that the system needs to receive/provide?	As per the needs of the front-end systems.

6.10 Data Inputs (Escrow database, products , etc.)

6.10.1System Description

System	**Main Functions/services the systems needs/provides**	**System Description**

Data Inputs (Escrow database, products, etc.)	The product database and the escrow database are one and the same – acting as a central repository stable over time for product data and indicators etc. The escrow functionality will guarantee the availability of data over longer periods of time – needed for future proper recycling / re-furbishing efforts. The product / escrow system will receive full product detail data from the producer and must be able to deliver this information to other stakeholders in the overall environment according to their needs: • Data to the retailer: link information to complete product data, aggregated indicator values for ecoPoints, core indicators and links to use / maintenance / recycling information for consumer evaluations in the shop. • Interfaces for producers / developers of products to allow evaluation of the product/material for their own integrated product – ecoPoints, ecoCredits assignments, indicator values, detailed sub-materials listing with KPIs for recyclability / disassembly, use/maintenance/disassembly instructions, risk documentation etc. Later stages will involve qualified structures for searches / ontologies development.	Product / escrow database system with controlled access via services.

6.10.2System main Characteristics

Data Inputs (Escrow database, products , LCA etc.)	
Physical Material needed?	Server structures allowing controlled access via web service architectures.
Will the system interact with end users? Does the system itself have any type of display?	The system will interact via end-user interfaces for consumers and producing companies' actors. Recommended platform for end-user interfaces is web browser interfaces handled by separate application / web servers.
Does the system have an existing gateway to interact? If not, is there any technology preference?	Recommended gateway technology – web services (RESTful, JSON).
Will the system have an internal storage? If yes, what type of data storage will be used?	Database system.

Will the system transmit data in real time or batches?	Real-time.
Will the system store personal data? If yes, how the data will be protected	No personal data.
Existing tools that we can use for this system? Any existing functionality?	No existing system or tools.
What is the basic information/data that the system needs to receive/provide?	Product data

7 Conclusions

This deliverable includes the set of user and system requirements, which are meant to drive the design, development and deployment of the CIRC4Life ICT platform.

A traceability Matrix of all the user requirements mapped to the ICT components of the ICT platform will ensure the correct design and development of the ICT components. Furthermore, the whole architecture of the system was designed, setting the ground for the next technical deliverables.

In parallel this task was very important for all the partners in order to set the common ground for the basic concepts that will be used along the project (e.g. LCA, Traceability, Eco-points etc), as well as improve the communication among the WP, and not only, participants.

References

Maguire M., Bevan N. (2002) User Requirements Analysis. In: Hammond J., Gross T., Wesson J. (eds) Usability. IFIP WCC TC13 2002. IFIP — The International Federation for Information Processing, vol 99. Springer, Boston, MA

Frank Land, 1982, Adapting to changing user requirements
Available at: https://doi.org/10.1016/0378-7206(82)90039-8

Robertson, J., & Robertson, S. (2007). Volere Requirements Specification Template.
http://www11.informatik.uni-erlangen.de/Lehre/SS2015/PR-SWE/Material/volere-template.pdf

S. Bradner (1997), Key words for use in RFCs to Indicate Requirement Levels, IETF RFC 2119,
https://www.ietf.org/rfc/rfc2119.txt

Oei, J.L.H., Proper, H.A., and Falkenberg, E.D. (1994). Evolving Information Systems: Meeting the Ever – Changing. Information Systems Journal Vol. 4, pp. 213-233.

Robertson, P. (1997). Integrating Legacy Systems with Modern Corporate Applications. Communications of the ACM Vol.40, 5, pp.39-46.

Dimitrios Stamoulis, Panagiotis Kanellis, Drakoulis Martakos, 2002, Tailorable Information Systems: Resolving the Deadlock of Changing User Requirements

Bennett, K., Layzell, P., Budgen, D., Brereton, P., Macaulay, L. and Munro, M. Service-based software: The future for flexible software. In Proceedings of the 7th Asia-Pacific Software Engineering Conference, (Singapore, 2000). IEEE.

Budgen, D., Brereton, P. and Turner, M. Codifying a service architectural style. In Proceedings of the 28th Annual International Computer Software and Applications Conference, (Hong Kong, 2004). IEEE, 16–22.

Ahmed Elfatatry , 2007, Dealing with change: components versus services , Communications of the ACM CACM Homepage archive Volume 50 Issue 8,Pages 35-39

Paik H., Lemos A.L., Barukh M.C., Benatallah B., Natarajan A. (2017) Introduction to Service Oriented Architecture. In: Web Service Implementation and Composition Techniques. Springer, Cham

BEA Inc. Systems. Domain Model for SOA: Realising the Business Benefit of Service-Oriented Architecture. BEA Inc Systems (2005)

M. Niemann, J. Eckert, N. Repp and R. Steinmetz, "Towards a Generic Governance Model for Service-oriented Architectures," in Fourteenth Americas Conference on Information Systems, 2008.

R. Berbner, W. Johannsen, J. Eckert, M. Goeken and N. Repp, "SOA Governance - Management of Opportunities and Risk," efinance lab quarterly., no. 04, 2006, 4-5.

R. Boerner and M. Goeken, "Service identification in SOA Governance literature review and implications for a new method," *2009 3rd IEEE International Conference on Digital Ecosystems and Technologies*, Istanbul, 2009, pp. 588-593.

M.P. Papazoglou and W.J. van den Heuvel, ‘‘Business Process Development Life Cycle Methodology,’’ Commun. ACM, vol. 50, no. 10, pp. 79-85, Oct. 2007.