TREASURE

D4.11: Validation, verification, best practices and lessons learned (1st version)

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Technical References

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EXECUTIVE SUMMARY

The present deliverable is the first document released within T4.6 "Functional and non-functional evaluation" describing the reference framework and the execution of testing activities performed on the Circularity Web Platform and the Circular AI-based advisory tool. The goal of this document is to provide an accurate depiction of how the test of the TREASURE system has been planned and executed, presenting an aggregated analysis of the assessment results.

The evaluation process methodology has been defined based on the standard ISO/IEC 25040:2011 "Systems and software engineering — Systems and software Quality Requirements and Evaluation" (SQuaRE). The SQuaRE set of standards has been used because it covers two main processes: software quality requirements specification and software quality evaluation, supported by a software quality measurement process. TREASURE Evaluation Process comprises 5 phases:

1. Evaluation requirements definition: dedicated to the preparation of the preconditions for the test and the evaluation requirement consisting in validation purpose, test target, test perspectives and testers
2. Evaluation Specification: concerns definition of the metrics, split in functional and non-functional measures, the rating levels for evaluation and, finally, the criteria used for test assessment
3. Evaluation Design: provides the instruments, mainly test sheets, used by testers to accomplish the execution of the validation process. The test sheet consists in 4 main sections:
   o Test Case References
   o Test Script
   o Functional Evaluation
   o Non-Functional Evaluation
4. Execution Phase: assigned to test performance by the appointed tester with the support of the development team, using the tools provided in the design stage.
5. Evaluation Reporting: focuses on summarizing the results coming from the previous stage, providing key takeaways for specific module assessment and comparison.

The execution phase is described in detail in chapter 3 with full depiction of the tests carried out in all modules of both the Circularity Web Platform and the Circular AI-based advisory tool, that is the Disassemblability, Recycling and Eco-design Module with its equivalent advisory application. For each module, the tests have been performed taking into consideration 2 major elements: the purpose of the specific application component to check the system availability for the key sections relevant for the user; and the type of users that operates on the modules according to the authorization protocol. More specifically, the following categories of users are possible based on the granted authoring rights: the Basic user with visualization mode only, the Editor user and the Moderator user.

Overall, a total amount of 166 tests have been executed for both functional and non-functional assessment. For the former, the whole script is provided with the bar chart summarizing the results while for the latter the global score only is presented in form of radar graph due to its length. Both sections of the test sheet contain evaluation and recommendations for the assessment of software product quality, providing a process description for stating the application compliance to specific requirements.

The full test reports are provided as annex attached at the present document.

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1 Introduction

The aim of this document is to provide an accurate description of the test plan and execution of the first version of TREASURE platform, considering all modules of both the Circularity Web Application and the Circular AI-based Advisory Tool. The design and implementation of TREASURE platform is fully described in D4.7 for former and D4.9 for the latter.

The test is conducted on two major streams: functional and non-functional evaluation of the system. The validation process encompasses from one side a software quality evaluation methodology and, for the other, the performance indicators mechanism resulting in TSS (Test Sheet Score) score.

Thus, the document is divided in two major sections:

- Overview and methodology of the validation process, presenting the reference framework used, the process phases followed for the preparation, execution and evaluation of the TREASURE platform
- Test execution and reports, presenting the details of the test performance and result for each platform module and type of user

Finally, the conclusions and future steps for the refinement of testing activities close the chapter.

As annex to the document, the full test sheets are provided.

1.1 Project Overview

TREASURE – "*leading the TRansition of the European Automotive SUpply chain towards a circulaR futurE*" wants to support the transition of the automotive sector towards Circular Economy (CE), by providing a concrete demonstration of how the industry can benefit from the adoption of Circular Economy practices and principles, both from a business and a technological perspective. One of the main encountered issues highlighted by the automotive actors, refers to the huge information gap existent between Beginning-of-Life (BoL) and End-of-Life (EoL) actors along the whole automotive value chain up to the final consumers.

TREASURE aims at filling this gap through the development of an AI-based assessment tool able to connect and facilitate the interaction among the key involved stakeholders dedicated to car electronics: car parts suppliers, car makers, dismantlers, and shredders. On the other hand, TREASURE goal consists in assisting both BoL and EoL actors in performing their operations, (best recycling options for optimal recovery), taking the most suitable decision according to up-to-date information, as well as in assessing the impact and the effect of their decision on the final customers.

To this aim, a web-based platform will be developed as a new information sharing tool among all stakeholders, both in forward and backward directions, ensuring secure access and confidentiality. The platform will indeed be developed in order to enhance the connection among the actors, making information available through specific modules that will be built and tailored according to their needs.

The platform will be tested with a set of dedicated demonstration actions within the project boundaries. However, it will be designed assuring that its potential can go beyond the project and its sustainability will be properly defined and agreed with the TREASURE consortium, guaranteeing the possibility for its scale-up and adoption by a wider group of stakeholders.

1.2   Scope of the deliverable

The Evaluation process carried out in T4.6 had as major goal testing all technical developments performed in T4.4. and T4.5, thus concerning both the Circularity Web Platform and the Circular AI-based Advisory Tool. The validation activities have been executed taking into consideration the purpose of the specific application component in order to check the system availability for the key part of the platform according to the most relevant tasks the user will perform. Moreover, the evaluation process was performed considering the several types of users according to the granted authoring rights: the Basic user with visualization only mode, the Editor user and the Moderator user.

1.3   Contribution to other WPs

Given the fact that the present document is the first step of the functional and non-functional evaluation of the T4.6, it's evident that the activities carried out in this task are strongly connected with T4.4 "Design of the eco-design, dismantling and recycling modules" and T4.5 "Circular AI-based Advisory Tool". The tests have been performed on the first version of the platform modules implemented in these tasks and reported in D4.7 and D4.9. Since the TREASURE project is based on an iterative approach, the outcomes of this document will have in turn a major impact on the activities plan of T4.4 and T4.5. In fact, the recommendations provided in the test sheets will serve as a starting point for next technical improvements.

Moreover, the evaluation process performed for the first version of the platform will also affect the work performed in T4.5 that will also play a role in the technical execution of WP5 activities related to platform application, testing and validation in selected uses cases. Finally, the TREASURE Platform will then be assessed in the demonstration phase performed within WP6, evaluating the new procedure performances in terms of circularity and economic feasibility.

2 TREASURE Evaluation Methodology

Evaluation is the systematic determination of the extent to which an entity meets its specified criteria. The evaluation of software product quality is vital to both the acquisition and development of software. The relative importance of the various characteristics of software quality depends on the intended usage or objectives of the system of which the software is a part; software products need to be evaluated to decide whether relevant quality characteristics meet the requirements of the system.

2.1 Methodological Approach

TREASURE Evaluation process is based on the reference methodology defined by the standard ISO/IEC 25040:2011 "Systems and software engineering — Systems and software Quality Requirements and Evaluation" (SQuaRE). The SQuaRE set of standards cover two main processes: software quality requirements specification and software quality evaluation, supported by a software quality measurement process. The purpose is to support specification and evaluation of quality requirements by establishing specific criteria for their measurement and evaluation. The SQuaRE standards include a quality model for aligning user definitions of quality with attributes of the development process, providing recommended set of software product quality reference guidelines that can be used by developers and evaluators.

This standard has been chosen due to its relevance for project activities since the ISO/IEC 25040:2011 concerns the same scope of application of TREASURE, being focused on software quality evaluation. Moreover, this system can be used for different purposes and approaches during or after the development process, including quality assessment of pre-developed software, commercial-off-the-shelf software or custom software. This flexibility is in line with the technical implementation of TREASURE platform that requires an agile approach based on an iterative procedure focused on demonstrator requirements and emerging needs for technological improvements.

The Evaluation Process, foreseen in ISO/IEC 25040:2011 standards, has been adapted to the validation of TREASURE system, using the same reference framework for defining the testing methodology, starting from the characterization of functional and non-functional properties to its related execution procedure step by step.

2.2 Evaluation process

TREASURE testing process has been conducted following a set of five phases derived from the reference evaluation process which are described in detail in next sub-chapters and represented in the figure below.
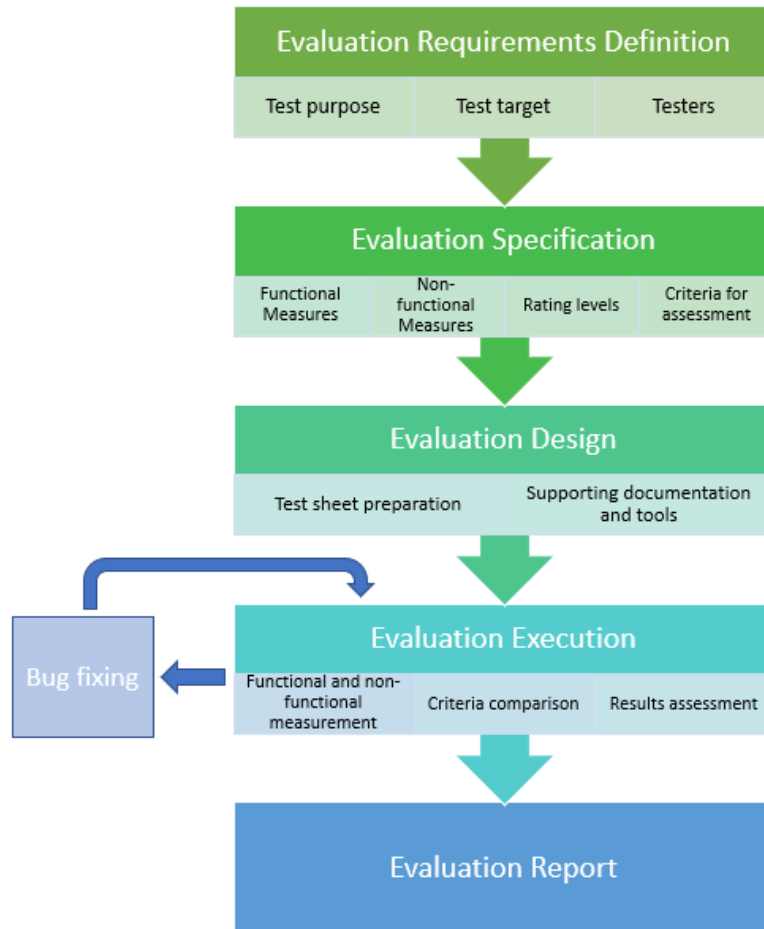
Figure 1 TREASURE Evaluation Process

TREASURE Evaluation Process has been designed to apply not only to the functional evaluation but also to non-functional characteristics, adapting the SQuaRE standards to project purpose and scope. A summary of the whole process is here outlined while the detailed description of the work performed in each phase is provided in the following chapters.

1. Evaluation requirements definition: it is the first phase of the assessing process dedicated to preliminary activities that are essential for the execution of the following tasks. This step is split is two stages: firstly, the preparation of the preconditions for the test, including availability of the system and responsibilities; secondly, the evaluation requirement consisting in the identification of validation purpose, test target, test perspectives and testers. More details can be found in chapter 2.2.1**Errore. L'origine riferimento non è stata trovata.**

2. Evaluation Specification: the second phase concerns activities related to the definition of the metrics, split in functional and non-functional measures, the rating levels for evaluation and, finally, the criteria used for test assessment. A detailed description is provided in chapter 2.2.2.

3. Evaluation Design: the third phase provides the instruments, mainly test sheets, used by testers to accomplish the execution of the validation process. The test sheet consists in 4 main sections:

   a. Test Case References
   b. Test Script

      c.   Functional Evaluation

      d.   Non-Functional Evaluation

More details can be found in chapter **Errore. L'origine riferimento non è stata trovata.**.

4. Execution Phase: the fourth phase is assigned to test performance by the appointed tester with the support of the development team, using the tools provided in the design stage. This step is paramount for the technical improvements of TREASURE platform since, thanks testing activities, lacks and problems are discovered. These bugs will be fixed in order to repeat the evaluation process in an iterative approach. More details on the step process, including the test plan, are reported in chapter 2.2.4, while the activities report is presented in chapter 3 with a comprehensive description of how the tests have been conducted and related outcomes.

5. Evaluation Reporting: the final phase takes focuses on summarizing the results coming from the previous stage, providing key takeaways for specific module assessment and comparison. This topic is addressed in chapter 2.2.5 and extensively reported in chapter 3.

2.2.1 Evaluation Requirements Phase

The first step in the evaluation process is to establish the requirements of the evaluation. To perform this operation, it's primarily necessary to set preconditions for the test. In particular, in the evaluation preparation phase the consistence of TREASURE platform and its availability have been checked to ensure that all sections of the modules are operatives. This preliminary step is pivotal also for the validation execution since it's an essential condition for a smooth testing performance.

The Evaluation Requirements phase is composed of three stages, the test purpose definition, the test target identification and the tester appointment. Their description is provided in the following sections.

2.2.1.1 Test purpose

The goal of this task is to document the purpose for evaluating the quality of the software, deciding on the acceptance of the intermediate (for this deliverable) and final (for D4.12) result. In the project scope, the goal of the test performed is to evaluate and assess overall TREASURE platform, executing the validation on all modules of both the Circularity Web Application and the Circular AI-based Advisory Tool. The design and implementation of TREASURE platform is fully described in D4.7 for former and D4.9 for the latter.

The integrated TREASURE system test has been addressed by different perspectives in order to cover the different aspects of this complex and evolutionary system. To achieve this goal, the test object may differ according to which platform modules is taken into consideration with the aim at focusing the attention to key elements that affect the user experience. In fact, since each module has a specific purpose, some sections of the platform are more relevant from a user perspective. For this reason, the test has been planned to focus on determined operations to be performed or tables/buttons to visualize to ensure a comprehensive evaluation. From a technical point of view this approach allows the system to be tested by different perspectives reaching the goal to test all the major functionalities of the system contained in the 4 major block of the system: Disassemblability module, Recyclability module, Eco-Design module and the Circular AI-based Advisory Tool, including their integrations. From

a non-technical point of view this approach allows the acceptability of the software to be checked with the users; from one hand, testing the aspects related with the data services availability and their retrieval/consumption, and on the other hand the test of the evolutionary behaviour of the system that is crucial for its usage after the end of the project.

2.2.1.2 Test targets

The Evaluation process carried out in T4.6 had as major goal testing all technical developments performed in T4.4. and T4.5, thus concerning both the Circularity Web Platform and the Circular AI-based Advisory Tool. The validation activities have been executed taking into consideration the purpose of the specific application component in order to check the system availability for the key part of the platform according to the most relevant tasks the user will perform. More specifically, regarding the Circularity Web Platform, the evaluation procedure concerns the following sections:

- Disassemblability Module
- Recyclability Module
- Eco-design Module

If we consider the Circular AI-based Advisory Tool, the testing activities regard the following applications:

- Disassemblability AI-based Advisory Module
- Recyclability AI-based Advisory Module
- Eco-design AI-based Advisory Module

For all this platform section the testing activities focuses on the following key operations: access the TREASURE Circularity Web Platform Login as the type of user/s foreseen by each module; select the desired car part/component for which basic information has to be visualized; assess that every resource expected is present and displayed in the correct format; export the detailed information in Excel format.

It's important to note that the evaluation process has been carried out taking into consideration not only the different sections of the platform but also the several types of users. In fact, the following categories of users are possible based on the granted authoring rights:

- The basic user with visualization only mode: the user can only see the platform content with no authorization to edit
- The editor mode: enables the user not only to visualize the information but also to add new content on specific platform sections by clicking on the "Edit" button
- The moderator mode: the user can approve or reject the data provided by the editor, leaving feedback in case of non-approval

The first type of user is present for all platform modules while the second user is foreseen for the Disassemblability module and the Circular AI-based Advisory Tool. The third category of user is valid for the Disassemblability module only.

2.2.1.3 Testers

Testers have been selected in the TREASURE project following the proximity to the characteristics of the different kind of users presented in the chapter above due to their professional background and technological expertise. To ensure a comprehensive evaluation that includes not only technical matters but also overall user experience, two types of testers have been identified:

- Industrial user: he focuses on the technical developments by analysing the system response to specific actions
- Business user: he focuses on the smoothness, graphic design, clarity, understandability of the platform

The testers have performed both functional and non-functional tests, reporting the results on the evaluation factsheet.

2.2.2 Evaluation Specification

In this activity the evaluation modules and the decision criteria for quality measures are specified by selecting metrics that cover all software validation requirements. Measurement procedures concern the platform quality characteristic (or sub characteristic) they claim to be measuring with sufficient accuracy to allow criteria to be set and comparisons to be made.

2.2.2.1 Indicators and Rating for functional evaluation

To measure the success of the test a set of indicators have been prepared to be matched in advance with the real measurement had during the test. For the functional test the tester should indicate the availability of the running functionality by "Yes/No/Partial".

Another important test for the functionalities is the error check, that is if the system manages and prompts correctly to the users the errors occurred. For example, at the time an empty list is provided, back or a wrong command is launched. For each error the user should check the behavior of the system and report the right behavior by "Yes/No/Partial".

To total amount of Success/Partial/Fail is given a specific score that, converted in percentage, allows to assess the overall test result.

Expected results are visible in the table below.

Mapping of measures				
	Poor	Fair	Good	Excellent
TSS Success	[0 .. 0.25]	]0.25 .. 0.50]	]0.50 .. 0.75]	]0.75 .. 1]
TSS Partial	[0 .. 0.25]	]0.25 .. 0.50]	]0.50 .. 0.75]	]0.75 .. 1]
TSS Fail	]0.75 .. 1]	]0.50 .. 0.75]	]0.25 .. 0.50]	[0 .. 0.25]

Figure 2 Mapping of functional evaluation

2.2.2.2 Indicators and Rating for non-functional evaluation

The non-functional properties are derived from a reference framework based on SQuaRE standards that provide the background for the evaluation according to seven dimensions. These aspects take into consideration are:

- Dim.A - Effectiveness -- usefulness to the network/company: it refers to the benefit or value deriving from the platform use to reach company objectives, i.e. outcomes/ value-based perspective, goal orientation, degree of task achievement, following business logic, benefits understandability, suitability to own environment/network
- Dim.B - Efficiency - performance of the service: it concerns the generated improvements in executing a specific operation, i.e. time & resource to achieve a task, number of good and bad characteristics recalled by users, available commands not called upon
- Dim.C - Understandability/simplicity: it measures how understandable and clear the service is for the user, i.e. clarity, simplicity, visualization of complex things in the background
- Dim.D - Satisfaction & Attractiveness: it applies to user appreciation of the platform, i.e. comfort, running speed, emotional response/ attitudes (mental/ cognitive workload included) short response time, rewarding the user, social tools, first impression, feel of control
- Dim.E -Learnability, memorability: it regards how easy it is to learn to use the system and return back after a break in usage, i.e. training support, gradual starting, path from starter to power player
- Dim.F - Use preparation & maintenance: it measures how easy the service is to take into use and maintain, i.e. customizability, portability, adaptability, implementation, low barriers
- Dim.G - Suitability to network/collaborative environment: it concerns how well the service fits to network environment, i.e. universality (diversity of users), requirement/capability level

Several questions are provided to the user for each dimension. The users can answer to them with a number comprises from 0 (min) to 4 (max). Results are grouped by dimension, then aggregated for all users and then provided with a result number (average). A radio graph will summarize the values of the different dimensions in just one picture.

Expected results are visible in the table below.

Mapping of measures				
	Poor	Fair	Good	Excellent
Effectiveness	[0 .. 1]	]1 .. 2]	]2 .. 3]	]3 .. 4]
Efficiency	[0 .. 1]	]1 .. 2]	]2 .. 3]	]3 .. 4]
Understandability	[0 .. 1]	]1 .. 2]	]2 .. 3]	]3 .. 4]
Satisfaction & Attractiveness	[0 .. 1]	]1 .. 2]	]2 .. 3]	]3 .. 4]
Learnability	[0 .. 1]	]1 .. 2]	]2 .. 3]	]3 .. 4]
Use preparation & maintenance	[0 .. 1]	]1 .. 2]	]2 .. 3]	]3 .. 4]
Suitability	[0 .. 1]	]1 .. 2]	]2 .. 3]	]3 .. 4]

Table 1 Mapping of non-functional evaluation

2.2.3 Evaluation Design

The first phase is the creation of test sheet that was used by testers to have a reference about what has to be tested and to report the experience had during the test. The same template has been used by all testers for each platform module to ensure result uniformity.

The test sheet is composed by four main parts which are fully described in the following sub-chapters:

- Test Case References
- Test Script
- Functional Evaluation
- Non-Functional Evaluation

2.2.3.1 Test Case References

Test Case References section provides all the information about the test and the support for testers. It presents an identifier to the scenario in order to facilitate the merge between different copies of the same test.

🔷 TREASURE Circularity Web Platform - Test Sheet			
Test Case References			
Test Case ID	CWP_DIS_UT_01	**Components involved**	TREASURE Circularity Web Platform, TREASURE Data Lake
Actors involved	Veronica Antonello (TXT) (business user)	**Contact Point**	Michele Sesana (TXT) michele.sesana@txtgroup.com
Short Description	Visualize basic information about a car part/component in the Disassemblability Dashboard		

Figure 3 Test Sheet Template: Test Case References section

This upper section is composed by the following elements:

- *Test Case ID*: identify the id of the path built upon the demo case
- *Actor/s Involved:* define the name of testers and the role they played in the test
- *Component/s Involved:* depict the major components involved in the test
- *Contact point/s:* testers are not alone in the execution phase; two experts are available to offer support: one for the front-end part and another person for the back-end part. In this section is defined the name of the contact points. In this way the support could be done by chat, by call or by remote desktop session.

2.2.3.2 Test Script

The test script section is devoted to the description of the steps that the user should done in the test. This serves as a guideline for the tester in order to ensure a homogenous process for all evaluation procedures regardless the platform module peculiarity.

🔷 TREASURE Circularity Web Platform - Test Sheet
Test Script
Access the TREASURE Circularity Web Platform Login as a Basic Dismantler type of user Select the desired car part/component for which basic information has to be visualized Assess that every resource expected is present and displayed in the correct format

Figure 4 Test Sheet Template: Test Script section

2.2.3.3 Functional Evaluation

The functional evaluation of the TREASURE platform is provided by the session *Functional Evaluation*, composed by a list of functionalities that will be tested during the execution of the test script and the expected result.

The functionalities list and the expected results are provided by the technical partner/s that describes the test script. The user should provide only the evaluation of the functionality inserting in the "*passed Y/N/PARTIAL*" box the result.

In addition to the functionalities, the user can also report remarks to provide additional information concerning the test results. This is particularly useful in case of Partial outcomes since it enables the user to give reason for its evaluation and indicate margin of improvements. For this motivation, the column "*Next step*" is included in the sheet serving as a note for technical enhancement to implement.

TREASURE Circularity Web Platform - Test Sheet						
TSS$_{success}$	8		TSS$_{partial}$	2	TSS$_{fail}$	0
Functionalities	**Expected Results**			**Passed**	**Remarks**	**Next step**
Access to the Circularity Web Platform	Circularity Web Platform shows login page			YES	-	-
Login to the Platform	User successfully logged in			PARTIAL	Login took to long	Speed up login procedure
User redirected to home page	Home page correctly opened			YES	-	-
Search for specific car component	List of relevant component shows up			PARTIAL	If list is too long, it overflows the page	Prevent page overflow
Select component to visualize	Disassemblability dashboard is shown for the selected component			YES	-	-
Assess component scores section	All relevant information for the desired section are displayed			YES	-	-
Assess "Materials composition" & "Material Costs"	All relevant information for the desired section are displayed			YES	-	-
Assess "Disassembly time" & "Material value"	All relevant information for the desired section are displayed			YES	-	-
Assess "Disassemblability metrics" section	All relevant information for the desired section are displayed			YES	-	-
Insert desired value into hourly cost input in	The Disassemblability metrics adjust their values accordingly			YES	-	-

Figure 5 Test Sheet Template: Functional evaluation section

Results are summarized automatically at the end of the test sheet in a bar chart with clear indication of the score obtained in each evaluation category (Yes/No/Partial). It must be noted that the TSS acronym refers to Test Sheet Score.

	TSS Results
TSS Success	8
TSS Partial	2
TSS Fail	0

Figure 6 Test Sheet Template: Summary of Functional Evaluation
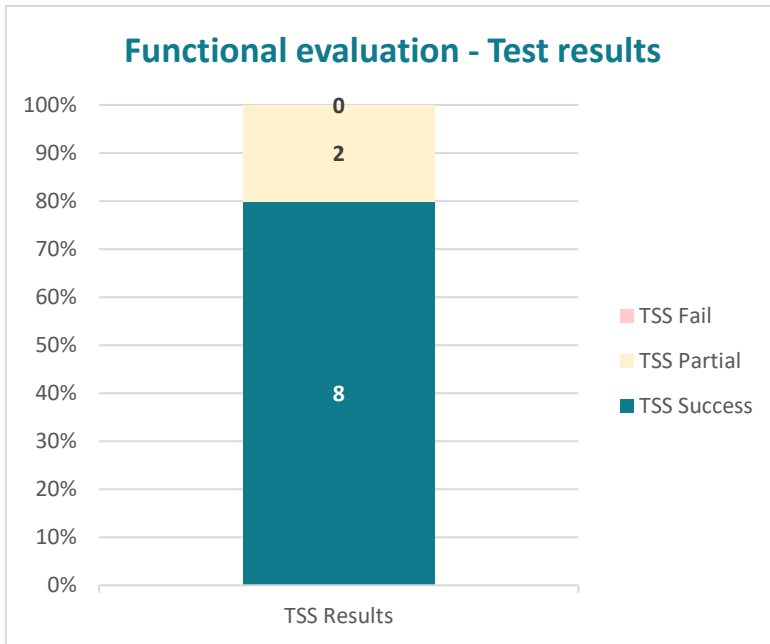
Figure 7 Test Sheet Template: Functional Evaluation Bar Chart

2.2.3.4   Non-functional Evaluation

The non-functional evaluation is the fourth section of the test sheet. The questions to be answered are divided in the seven dimensions described in chapter 2.2.2.2 and the user should only inserts its answer in the proper column. The answer starts from 0 disagree to 4 totally agree. Results are calculated automatically.

TREASURE Circularity Web Platform - Test Sheet

Non-Functional Evaluation		

Dim.A (Effectiveness -- usefulness to the network/company)	Total	3,0
Ref #	**Question**	**Answer (0-4)**
A1	It is easy to **understand** the objective and benefit of the service to my organization/network.	3
A2	The **outcome of the service** is important / useful for the company/network. The service creates **value** for my company &network, for example by	3
A3	It is easy to **achieve** the planned business objectives / perform the tasks with the service.	3
A4	**What could be improved to make more value of the tool/service?**	

Dim.B (Efficiency - performance of the service)	Total	3,2
Ref #	**Question**	**Answer (0-4)**
B1	The time and resources required to achieve the objectives with the service are reasonable/moderate.	3
B2	The service runs fast enough.	3
B3	The service does not require too many steps to achieve the result.	4
B4	All the functions are beneficial for my company/ network.	3
B5	The service structure allows flexible & fast performance of the tasks.	3
B6	**What could be improved to make more value of the tool/service?**	

Dim.C (Understandability/simplicity)	Total	3,1
Ref #	**Question**	**Answer (0-4)**
C1	The service structure and logic is easy and self-clear to understand and recognizable.	3
C2	The concepts are understandable for my organization and in line with TREASURE terminology	4
C3	The service offers sufficient guidance	3
C4	The responses to user actions are understandable. The look and feel is self explanatory and follows the TREASURE style.	3
C5	The support to business processes / tasks is clear. The user can understand his/her role and the purpose of the actions required.	3
C6	The service is simple enough for practical use. The tasks do not look complex to perform. It is clear what is required for input.	3
C7	The output of the service is clear and understandable.	3
C8	**What could be improved to make more value of the tool/service?**	

Dim.D (Satisfaction & Attractiveness)	Total	2,6
Ref #	**Question**	**Answer (0-4)**
D1	The service is attractive to the user. I feel satisfied and comfortable when using the service.	3
D2	I can keep the control of the service, for example by pausing& continuing, canceling, saving the status and starting again.	2
D3	The mental workload when using the service is low.	3
D4	The service rewards the user also personally	2
D5	I could recommend the service for other people/organizations.	3
D6	**What could be improved to make more value of the tool/service?**	

Dim.E (Learnability, memorability)	Total	2,5
Ref #	**Question**	**Answer (0-4)**
E1	It is easy to start using the service and to perform the main tasks.	3
E2	It is easy to learn new features/ functionalities.	3
E3	When coming back to an unfinished task, it is easy to remember / identify the actions needed.	3
E4	The service offers sufficient training support.	1
E5	**What could be improved to make more value of the tool/service?**	

Dim.F (Use preparation & maintenance)	Total	2,9
Ref #	**Question**	**Answer (0-4)**
F1	The take-up of the service does not require high preparation.	3
F2	Technical installation does not require specific setups or additional downloads.	3
F3	The data needed by the service exist in my company/network in the proper format and can be easily made available for the service.	2
F4	The service can be easily customized/ configured to my environment/ network.	3
F5	The service can be easily shared in the network.	3
F6	The service does not require specific knowledge from the users.	2
F7	The service is easy to take up also for SMEs.	4
F8	The service does not require extensive change of business processes.	3
F9	The service does not require high maintenance.	3
F10	**What could be improved to make more value of the tool/service?**	

Dim.G (Suitability to network/collaborative environment)	Total	2,8
Ref #	**Question**	**Answer (0-4)**
G1	The service supports collaboration and interoperability for my network.	3
G2	The service is suitable for heterogeneous users and different networks.	2
G3	The service takes into account safety and security.	3
G4	The service usage does not require high negotiation or complex agreements in the network.	3

Figure 8 Test Sheet Template: Non-Functional evaluation section

Results are summarized automatically at the end of the test sheet in a radio graph. Each dimension is represented on the different axis.

Non-fuctional Dimension	Results
Dim.A (Effectiveness -- usefulness to the network/company)	2,7
Dim.B (Efficiency - performance of the service)	2,4
Dim.C (Understandability/simplicity)	3,1
Dim.D (Satisfaction & Attractiveness)	3,0
Dim.E (Learnability, memorability)	2,8
Dim.F (Use preparation & maintenance)	3,0

Dim.G (Suitability to network/collaborative environment)	3,5
TOTAL	2,9

Figure 9 Test Sheet Template: Summary of Non-Functional Evaluation
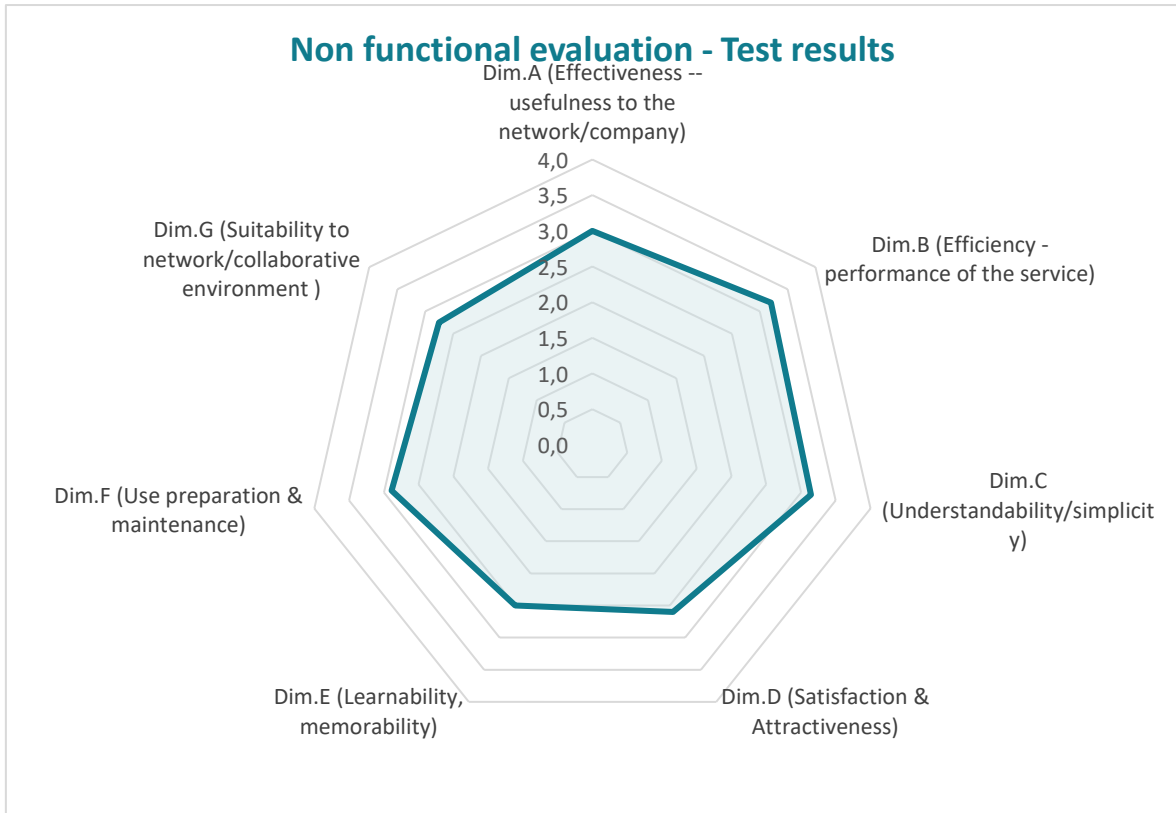
Figure 10 Test Sheet Template: Non-Functional Evaluation Radar Chart

2.2.4 Evaluation Execution

The execution of the test is conducted by selected users autonomously relying on the web availability of the TREASURE system. In case of troubles, users can receive online support from the contact point included in the test sheet. In case of bugs, the contact point takes in charge of their fix and a new execution can be done afterwards.

The output of the test execution is the filled in test sheet providing feedbacks on functional and non-functional aspects tested.

The test of the TREASURE platform has been done following a plan:

- Preparation of test sheet including online contact point and test factsheet by the 10th of October
- On the 17th of October testers receive the material and can start their activities supported online by the contact point;
- Starting from the 20th of October, test activities are performed with the submission of reports expected by December 9
- Test results are summarized and described in this deliverable submitted on the 30th of November

Details of the execution including test sheets/scripts are reported in chapter 3 together with evaluation reporting details.

2.2.5 Evaluation Reporting

The final phase of the test is the summary of the evaluation report within this deliverable. In the full description of the tests presented in chapter 3, conclusions regarding the validation activities and results are included. The output of this phase consists in two different items:

- automatic evaluation results coming from measures and graph;
- plain text report summarising the test and the experience had by testers coming also from plain text suggestions inserted in the test sheets.

3 TREASURE Evaluation Execution

In this section details of the execution of the test and the summary of results are reported. A specific chapter is provided for each module and user type according to the categories presented in chapter 2.2.1.2. Each chapter is composed by an introduction of the scenario, information about test sheet/s used by testers and the report about the scenario evaluation.

Overall, a total amount of 166 tests have been executed. A detailed description of functional and non-functional evaluations of the system have been performed approaching the project platform from 13 different perspectives corresponding to all modules of both the Circularity Web Platform and the Circular AI-based advisory tool, that is the Disassemblability, Recycling and Eco-design Module with its equivalent advisory application, as follows:

I. Circularity Web Platform
- Disassemblability Module:
  - o Basic user: the functional and non-functional evaluation was carried out considering not only the main page of the platform but also the Disassembly time detail page (referenced as Level 2).
  - o Editor user
  - o Moderator user
- Recyclability module:
  - o Basic user: the functional and non-functional evaluation was carried out considering not only the main page of the platform but also the detail page (referenced as Level 2) that provides additional information on the assessment of specific data about individual recycling rates for a car part/component.
- Eco-design module:
  - o Basic user: the functional and non-functional evaluation was carried out considering not only the main page of the platform but also the detail page (referenced as Level 2) that provides additional information on the metrics used to assessment car part/component recycling and dismantling procedure
II. Circular AI-based Advisory Tool:
- Disassemblability AI-based Advisory Module
  - o Basic user
- Recyclability AI-based Advisory Module
  - o Basic user
- Eco-design AI-based Advisory Module
  - o Basic user: the functional and non-functional evaluation was carried out considering not only the *Old design* page of the platform but also the *New design* and *Old vs New design comparison* page

For the functional test the whole script is provided with the bar chart summarizing the results while for the non-functional evaluation the overall score only is presented in form of radar graph due to its length. The full test reports are provided as annex attached at the present document.

3.1 Disassemblability Module

The Evaluation process performed in the Disassemblability module of the Circularity Web Platform mainly focused on user log in, search and visualization of the selected car component and use of the assessment instruments to evaluate disassembly procedure.

The tests have been carried out for each type of user foreseen in this platform section, as follows:

- The basic user with visualization mode only
- The editor mode
- The moderator mode

The validation process for each user is fully described in the following chapters for both the functional and non-functional evaluation.

3.1.1 Basic Dismantler User

3.1.1.1 Functional evaluation

The functional evaluation to the Circularity Web Platform was carried out considering not only the main page of the platform but also the Disassembly time detail page (referenced as Level 2). More detail about this module structure is presented in D4.7.

The testing tasks concerned the log in phase, which must be improved in term of timing, and the assessment of disassembly routes according to the selected car part.

For the homepage, the tests performed and related results with recommendations are presented in the figure below.

🔷 TREASURE Circularity Web Platform - Test Sheet					
Test Case References					
Test Case ID	CWP_DIS_UT_01	**Components involved**	TREASURE Circularity Web Platform, TREASURE Data Lake		
Actors involved	Veronica Antonello (TXT) (business user)	**Contact Point**	Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)		
Short Description	Visualize basic information about a car part/component in the Disassemblability Dashboard				
Test Script					
Access the TREASURE Circularity Web Platform Login as a Basic Dismantler type of user Select the desired car part/component for which basic information has to be visualized Assess that every resource expected is present and displayed in the correct format					
TSS$_{success}$	8	**TSS$_{partial}$**	2	**TSS$_{fail}$**	0
Functionalities	**Expected Results**		**Passed**	**Remarks**	**Next step**
Access to the Circularity Web Platform	Circularity Web Platform shows login page		YES	-	-
Login to the Platform	User successfully logged in		PARTIAL	Login took to long	Speed up login procedure
User redirected to home page	Home page correctly opened		YES	-	-
Search for specific car component	List of relevant component shows up		PARTIAL	If list is too long, it overflows the page	Prevent page overflow
Select component to visualize	Disassemblability dashboard is shown for the selected component		YES	-	-
Assess component scores section	All relevant information for the desired section are displayed		YES	-	-
Assess "Materials composition" & "Material Costs" section	All relevant information for the desired section are displayed		YES	-	-
Assess "Disassembly time" & "Material value"	All relevant information for the desired section are displayed		YES	-	-
Assess "Disassemblability metrics" section	All relevant information for the desired section are displayed		YES	-	-
Insert desired value into hourly cost input in "Disassemblability metrics" section	The Disassemblability metrics adjust their values accordingly		YES	-	-

Figure 11 Functional evaluation of Disassemblability module for Basic User – Homepage

The evaluation shows no TSS fail, granting a satisfactory score overall, as visible in the figure below.
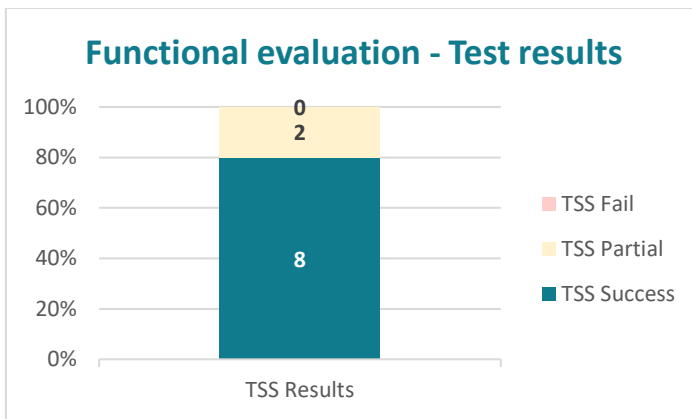
Figure 12 Results of Functional evaluation of Disassemblablity module for Basic User – Homepage

	TSS Results
TSS Success	8
TSS Partial	2
TSS Fail	0

The Evaluation process has been also executed for the detailed page that provides more information related to disassembly time and difficulty level. Since this platform section represents an important part of the Disassemblablity module, the tester focused not only on the log in phase but mainly on the correct visualization and understandability of the table. As for the previous test, the critical points concerned the access time and page overflow while in this case, some errors with the difficulty level table occurred, as visible in the figure below.

TREASURE Circularity Web Platform - Test Sheet

Test Case References

Test Case ID	CWP_DIS_UT_02 (CWP_DIS_UT_03)	Components involved	TREASURE Circularity Web Platform, TREASURE Data Lake
Actors involved	Veronica Antonello (TXT) (business user)	Contact Point	Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)
Short Description	Assess and export specific information about a car part/component's disassembly time from the Disassemblablity Dashboard		

Test Script

Access the TREASURE Circularity Web Platform
Login as a Basic Dismantler type of user
Select the desired car part/component for which the specific data has to be exported
Open the Disassembly time (level 2) details page
Access that all the detailed information about the car part/component's disassembly time (level 2) are present and correct
Export the detailed information in Excel format

NOTE : The following procedures have a similar interaction model and are grouped under this test case for brevity:
- Open the Disassembly time (level 1) (should be CWP_DIS_UT_03)

TSS$_{success}$	10		TSS$_{partial}$	3		TSS$_{fail}$		0
Functionalities		**Expected Results**		**Passed**		**Remarks**		**Next step**
Access to the Circularity Web Platform		Circularity Web Platform shows login page		YES		-		-
Login to the Platform		User successfully logged in		PARTIAL		Login took to long		Speed up login procedure
User redirected to home page		Home page correctly opened		YES		-		-
Search for specific car component		List of relevant component shows up		PARTIAL		If list is too long, it overflows the page		Prevent page overflow
Select component to visualize		Disassemblablity dashboard is shown for the selected component		YES		-		-
Locate the "Disassembly time" section		All relevant information for the desired section are displayed		YES		-		-
Press the "Info" button next to the level 2		Disassembly time (level 2) is correctly shown		YES		-		-
Press the "Details" button to the left of the chart		Disassembly time (level 2) page is correctly shown		YES		-		-
Assess the parts table		Parts table correctly displays all the relevant information		YES		-		-
Press the "Info" button next to the "Difficulty level"		Filter is applied correctly on table items		YES		-		-
Assess the difficulty level table		The difficulty level table contains the proper information		PARTIAL		The rules don't consider all possible combinations		Adjust the rules to account for all cases
Press the "Close" ("X") button		The difficulty level popup closes		YES		-		-
Press the "Export" button		Data are exported successfully in ".xlsx" format		YES		-		-

Figure 13 Functional evaluation of Disassemblablity module for Basic User - Level 2

Like the previous test, the overall functional evaluation proved to be successful with no negative results, as shown in the figure below.
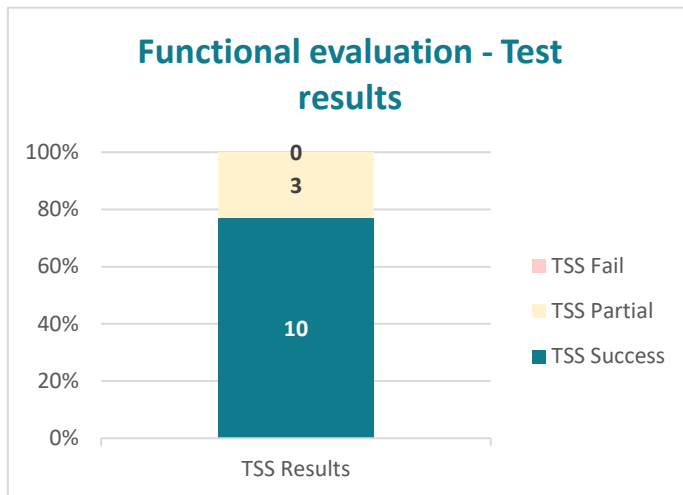
	TSS Results
TSS Success	10
TSS Partial	3
TSS Fail	0

Figure 14 Results of Functional evaluation of Disassemblability module for Basic User - Level 2

If we consider both tests performed on the Disassemblability module with basic user, the outcomes are satisfactory since no TSS Fail have been registered and most results are TSS Success.

3.1.1.2 Non-functional evaluation

For the Basic User homepage of the Disassemblability module, the non-functional evaluation shows an overall good result with a score of 2.9 with a high appreciation of efficiency and understandability. On the other side, the elements to improve concern the learnability due to the high number of KPIs represented in the tables that require the user to have prior knowledge of the metrics. This aspect affects the satisfaction dimension that should be enhanced to meet user need for a smoother experience and reduce the log in time.

The score achieved for each dimension is reported in the table below.

Non-functional Dimension	Results
Dim.A (Effectiveness -- usefulness to the network/company)	3,0
Dim.B (Efficiency - performance of the service)	3,2
Dim.C (Understandability/simplicity)	3,1
Dim.D (Satisfaction & Attractiveness)	2,6
Dim.E (Learnability, memorability)	2,5
Dim.F (Use preparation & maintenance)	2,9
Dim.G (Suitability to network/collaborative environment)	2,8
TOTAL	
	2,9

Table 2 Results of Non-Functional evaluation of Disassemblability module for Basic User – Homepage

The results are graphically visualized through the radar chart in the figure below that allows developers to understand at a glance the areas of improvements.
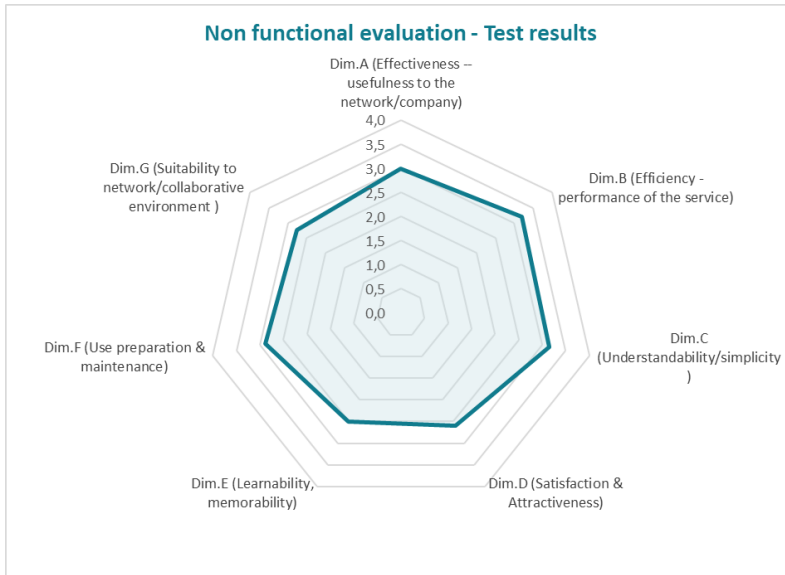
Figure 15 Results of Non-Functional evaluation of Disassemblability module for Basic User – Homepage

If we consider the non-functional evaluation of the detail page of the Basic User, a fair score is achieved with the higher ranking in suitability to network environment, due to its smooth integration with the Basic and Moderator User, and use preparation and maintenance, since it's easily customizable given its graphic design simplicity. Major improvements should be made in the understandability dimension to enhance user experience and ready to use application in connection with its learnability.

The score achieved for each dimension is reported in the table below.

Non-functional Dimension	Results
Dim.A (Effectiveness -- usefulness to the network/company)	2,0
Dim.B (Efficiency - performance of the service)	2,2
Dim.C (Understandability/simplicity)	1,9
Dim.D (Satisfaction & Attractiveness)	2,4
Dim.E (Learnability, memorability)	2,0
Dim.F (Use preparation & maintenance)	2,6
Dim.G (Suitability to network/collaborative environment)	2,8
TOTAL	
	2,3

Table 3 Results of Non-Functional evaluation of Disassemblability module for Basic User – Level 2

The results are graphically visualized through the radar chart in the figure below that allows developers to understand at a glance the areas of improvements.
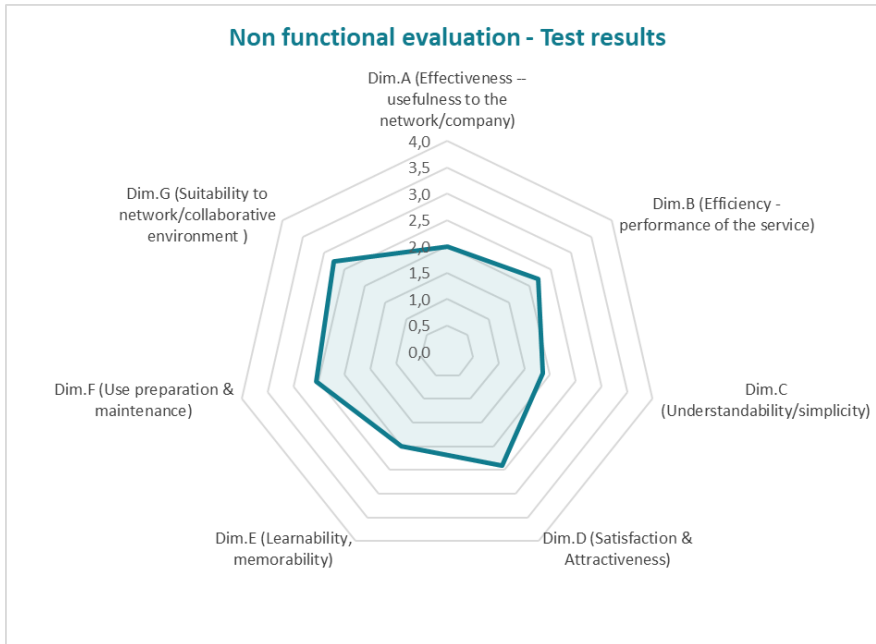
Figure 16 Results of Non-Functional evaluation of Disassemblability module for Basic User – Level 2

3.1.2 Editor Dismantler User

3.1.2.1 Functional evaluation

The editor mode enables the user not only to visualize the information but also to add new content on specific platform sections by clicking on the "Edit" button. Since this module is in some parts similar to the Basic User, the test focused on the peculiarity of this platform section, that is the creation of a new car part followed by sending the request for approval to the platform moderator. In particular, the operations concerned: press the "New" button on the home page, fill-in the required information to create a new car component, confirm the car part creation and submit it for consent.

Like the Basic User, the functional evaluation for the Editor User was carried out considering not only the main page of the platform but also the Disassembly time detail page (referenced as Level 2). More detail about this module structure is presented in D4.7.

For the homepage, the tests performed and related results with recommendations are presented in the figure below.

TREASURE Circularity Web Platform - Test Sheet

Test Case References

Test Case ID	CWP_DIS_UT_04	**Components involved**	TREASURE Circularity Web Platform, TREASURE Data Lake
Actors involved	Veronica Antonello (TXT) (business user)	**Contact Point**	Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)
Short Description	Create a new car part/component from the Disassemblability Dashboard and send it for approval		

Test Script

Access the TREASURE Circularity Web Platform
Login as an Editor Dismantler type of user
Press the "New" button on the home page
Fill-in the required information to create a new car part
Confirm the car part creation & send it for approval

$TSS_{success}$	11		$TSS_{partial}$	3		TSS_{fail}		0
Functionalities		**Expected Results**			**Passed**	**Remarks**		**Next step**
Access to the Circularity Web Platform		Circularity Web Platform shows login page			YES	-		-
Login to the Platform		User successfully logged in			PARTIAL	Login took to long		Speed up login procedure
User redirected to home page		Home page correctly opened			YES	-		-
Press "New" button		New component page loaded successfully			YES	-		-
Fill-in the component name and description		Fields filled in, component name is present in "Level 1" table			YES	-		-
Upload component image		Image uploaded			PARTIAL	Image preview not showing		Show image preview after upload
Click "Set" button in "Disassemblability levels"		Difficulty level edit popup opened			YES	-		-
Fill-in the difficulty level questionnaire		Questionnaire filled successfully			YES	-		-
Click "Save" button		Questionnaire is saved, edit popup closed and Difficulty level is			YES	-		-
Fill "Level 1" table		Table filled successfully			YES	-		-
Fill "Level 2" table		Table filled successfully, still some data left to be inserted			PARTIAL	Number of default row is too low		Increase the number of default rows
Press "Add rows" button		5 empty rows are appended to the "Level 2" table			YES	-		-
Fill disassemblability questionnaire		Questionnaire filled successfully			YES	-		-
Click "Create" button		Component successfully created and sent for approval			YES	-		-

Figure 17 Functional evaluation of Disassemblability module for Editor User – Homepage

The critical points regard the log in time, the image preview visualization and the number of rows in the Level 2 table displayed.

The evaluation shows no TSS fail, granting a satisfactory score overall with most outcomes assessed as TSS Success, as visible in the figure below.

	TSS Results
TSS Success	11
TSS Partial	3
TSS Fail	0
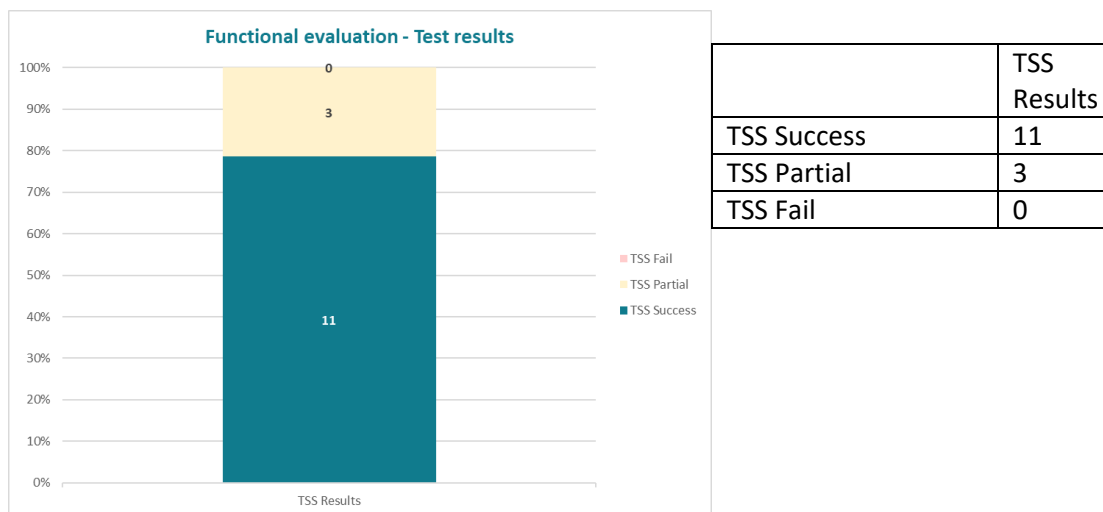
Figure 18 Results of Functional evaluation of Disassemblability module for Editor User – Homepage

The Evaluation process has been also executed for the detailed page that provides more information on the status of requests submitted for moderator approval. Since this platform section represents an important part of the Disassemblability module, the tester focused not only on the log in phase but mainly on the assessment of the presence of a pending request in the Requests section of the dashboard. As for the previous test, the only critical point concerned the access time.

TREASURE Circularity Web Platform - Test Sheet

Test Case References			
Test Case ID	CWP_DIS_UT_05	**Components involved**	TREASURE Circularity Web Platform, TREASURE Data Lake
Actors involved	Veronica Antonello (TXT) (business user)	**Contact Point**	Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)
Short Description	Assess the presence of a pending request in the Requests section of the Disassemblability Dashboard		

Test Script				
Access the TREASURE Circularity Web Platform Login as an Editor Dismantler type of user Switch to the "My requests" section Assess the presence of the request created in test case CWP_DIS_UT_4				

TSS$_{success}$	4		TSS$_{partial}$	1		TSS$_{fail}$		0	
Functionalities			**Expected Results**			**Passed**	**Remarks**		**Next step**
Access to the Circularity Web Platform			Circularity Web Platform shows login page			YES	-		-
Login to the Platform			User successfully logged in			PARTIAL	Login took to long		Speed up login procedure
User redirected to home page			Home page correctly opened			YES	-		-
Select "My requests" section			Section loaded successfully			YES	-		-
Assess the pending request			Request is present and in "Pending" status			YES	-		-

Figure 19 Functional evaluation of Disassemblability module for Editor User - Level 2

Like the previous test, the overall functional evaluation proved to be successful with no negative results, as shown in the figure below.

	TSS Results
TSS Success	4
TSS Partial	1
TSS Fail	0
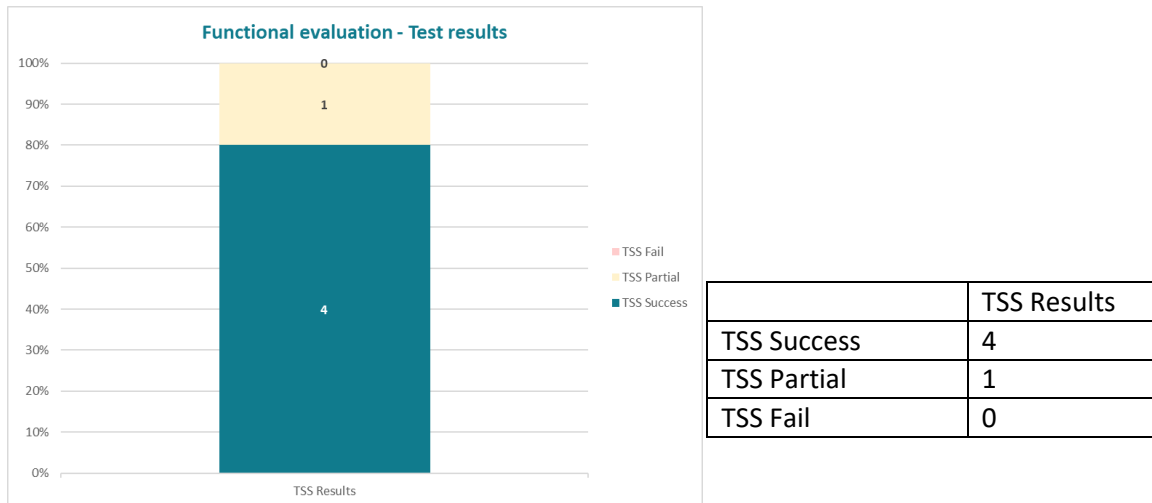
Figure 20 Results of Functional evaluation of Disassemblability module for Editor User - Level 2

3.1.2.2 Non-functional evaluation

If we analyse the non-functional evaluation of the Editor User homepage, a fair global result is displayed with several areas of improvements. These mainly concern the following dimension: attractiveness, due to its basic visualization with minimum graphic elements that thus requires a major intervention in the GUI domain; effectiveness, given its limited use since few operations can be performed; and efficiency, because of the fault observed in the functional evaluation.

The score achieved for each dimension is reported in the table below.

Non-functional Dimension	**Results**
Dim.A (Effectiveness -- usefulness to the network/company)	2,0
Dim.B (Efficiency - performance of the service)	2,0
Dim.C (Understandability/simplicity)	2,4

Dim.D (Satisfaction & Attractiveness)	1,8
Dim.E (Learnability, memorability)	2,3
Dim.F (Use preparation & maintenance)	2,6
Dim.G (Suitability to network/collaborative environment)	2,5
TOTAL	
	2,2

Table 4 Results of Non-Functional evaluation of Disassemblability module for Editor User – Homepage

In general, the service has been positively rated by the tester similarly to the Editor and Basic User evaluation. As visible in the table below, all dimensions receive an evaluation around 2.2 in a scale from 0 to 4 (see chapter **Errore. L'origine riferimento non è stata trovata.** for more details) that is the threshold between Fair (< 2) and Good (>2).

The results are graphically visualized through the radar chart in the figure below that allows developers to understand at a glance the areas of improvements.
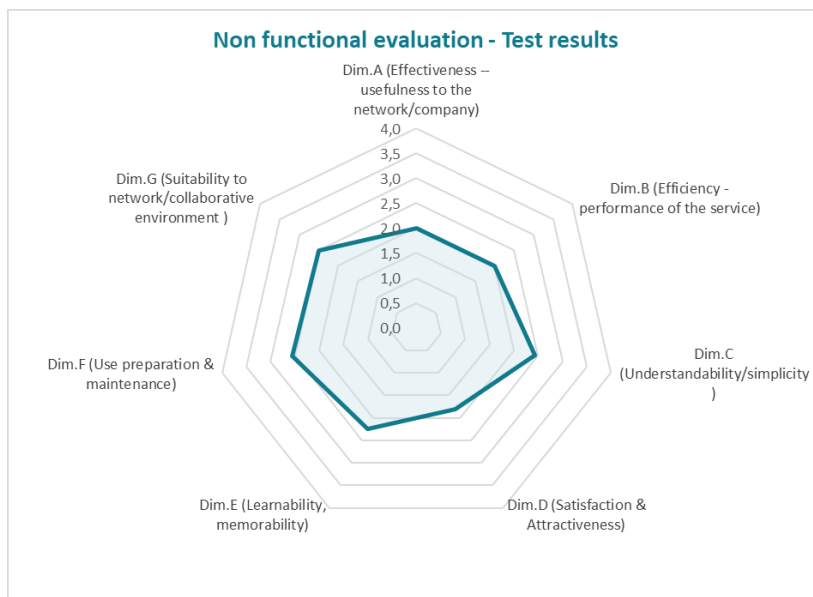
Figure 21 Results of Non-Functional evaluation of Disassemblability module for Editor User – Homepage

For the page dedicated to new car part creation of the Editor User, the non-functional evaluation shows an overall good result with a score of 3.1 with almost uniform results in the seven dimensions. Since the information displayed are fewer than the Basic User module, learnability achieved a higher ranking together with the customizability and adaptability. A minor effort on improving the platform overall must be performed concerning all other aspects.

The score achieved for each dimension is reported in the table below.

Non-functional Dimension	**Results**
Dim.A (Effectiveness -- usefulness to the network/company)	3,0
Dim.B (Efficiency - performance of the service)	3,0
Dim.C (Understandability/simplicity)	3,0
Dim.D (Satisfaction & Attractiveness)	3,0
Dim.E (Learnability, memorability)	3,3
Dim.F (Use preparation & maintenance)	3,4
Dim.G (Suitability to network/collaborative environment)	3,0

	TOTAL
	3,1

Table 5 Results of Non-Functional evaluation of Disassemblability module for Editor User – Level 2

The results are graphically visualized through the radar chart in the figure below that allows developers to understand at a glance the areas of improvements.

Figure 22 Results of Non-Functional evaluation of Disassemblability module for Editor User – Level 2

3.1.3   Moderator Dismantler User

3.1.3.1   Functional evaluation

The Moderator Dismantler User in the Disassemblability module can approve or reject the data provided by the Editor, leaving feedback in case of non-approval. This platform section contains fewer data with respect to the previous modules; thus, the tester dedicated its attention to the visualization of pending requests, assessment of the information provided by the Editor and approval or rejection of the new content (in the first case, writing in the feedback field has also been tested). Since this platform section doesn't include a detailed page, the Evaluation process has been carried out for the homepage only.

The tests performed and related results with recommendations are presented in the figure below.

	TREASURE Circularity Web Platform - Test Sheet		
Test Case References			
Test Case ID	CWP_DIS_UT_06 (CWP_DIS_UT_07)	**Components involved**	TREASURE Circularity Web Platform, TREASURE Data Lake
Actors involved	Veronica Antonello (TXT) (business user)	**Contact Point**	Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)
Short Description	Approve a pending request from the Disassemblability Dashboard		
Test Script			

Access the TREASURE Circularity Web Platform
Login as a Moderator Dismantler type of user
Switch to the "Approve requests" section
Inspect a pending request
Assess that all the required information about a car/component are present
Approve the pending request and provide a text description

NOTE : The following procedures have a similar interaction model and are grouped under this test case for brevity:
- Reject the pending request (should be CWP_DIS_UT_07)

TSS$_{success}$	8		TSS$_{partial}$	2		TSS$_{fail}$		0
Functionalities		**Expected Results**			**Passed**	**Remarks**		**Next step**
Access to the Circularity Web Platform		Circularity Web Platform shows login page			YES	-		
Login to the Platform		User successfully logged in			PARTIAL	Login took to long		Speed up login procedure
User redirected to home page		Home page correctly opened			YES	-		-
Switch to "Approve requests" section		Section loaded successfully			YES	-		
Locate the request to be approved		Desired request is present			YES	-		
Press the "Inspect" button		Component dashboard opened in inspect mode successfully			YES	-		-
Assess component dashboard		All information are present, correct and in the appropriate format			YES	-		-
Press the "Approve" button		Approve popup showed up correctly			YES	-		-
Insert an approve comment		Comment inserted correctly			PARTIAL	Approve comment should be optional		Allow user to omit approve comment
Press the "Approve" button		Request approved successfully, user redirected to "Approve			YES	-		-

Figure 23 Functional evaluation of Disassemblability module for Moderator User

The critical points regarded the log in time and an error incurred in the approval comment section that results as mandatory while it should be optional according to GUI design.

The evaluation shows no TSS fail, granting a satisfactory score overall with most outcomes assessed as TSS Success, as visible in the figure below.

	TSS Results
TSS Success	8
TSS Partial	2
TSS Fail	0

Figure 24 Summary of Functional evaluation of Disassemblability module for Moderator User

3.1.3.2   Non-functional evaluation

In general, the service has been positively rated by the tester similarly to the Editor and Basic User evaluation. The score is aligned to the result achieved for the previous modules with a global mark of 2.5 thanks to higher value in suitability to collaborative environment, since it's strongly correlated to the Editor page, and use preparation and maintenance, given its limited number of graphic elements. Space for improvements can be find in the learnability dimension

by providing more specifications to facilitate the user tasks, in addition to effectiveness, due to the error incurred with the feedback comment field.

The score achieved for each dimension is reported in the table below.

Non-functional Dimension	Results
Dim.A (Effectiveness -- usefulness to the network/company)	2,3
Dim.B (Efficiency - performance of the service)	2,6
Dim.C (Understandability/simplicity)	2,4
Dim.D (Satisfaction & Attractiveness)	2,6
Dim.E (Learnability, memorability)	2,0
Dim.F (Use preparation & maintenance)	2,8
Dim.G (Suitability to network/collaborative environment)	3,0
TOTAL	
	2,5

Table 6 Results of Non-Functional evaluation of Disassemblability module for Moderator User

As visible in the radar chart below, all dimensions receive an evaluation around 2.5 in a scale from 0 to 4 (see chapter 2.2.2.2 for more details) that is the threshold between Fair (< 2) and Good (>2).

The results are graphically visualized through the radar chart in the figure below that allows developers to understand at a glance the areas of improvements.
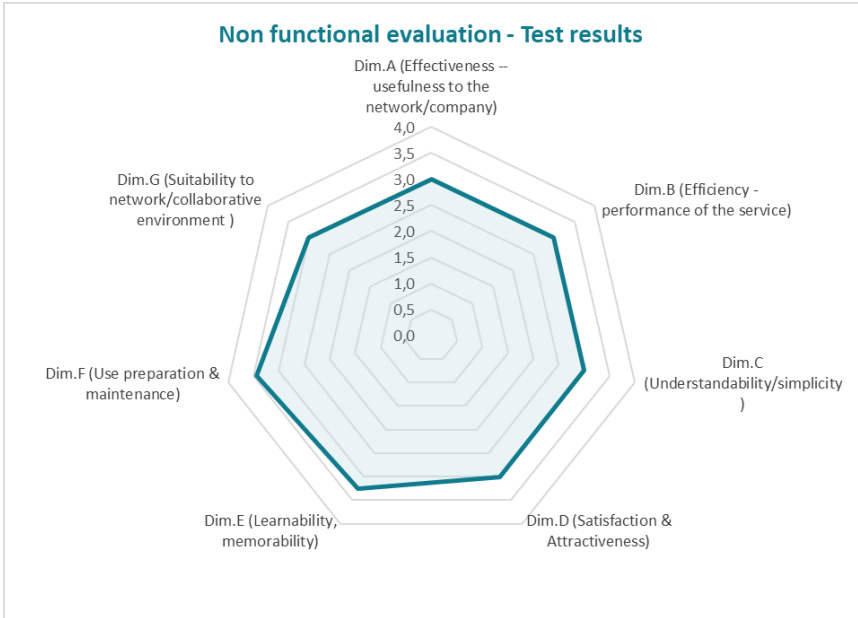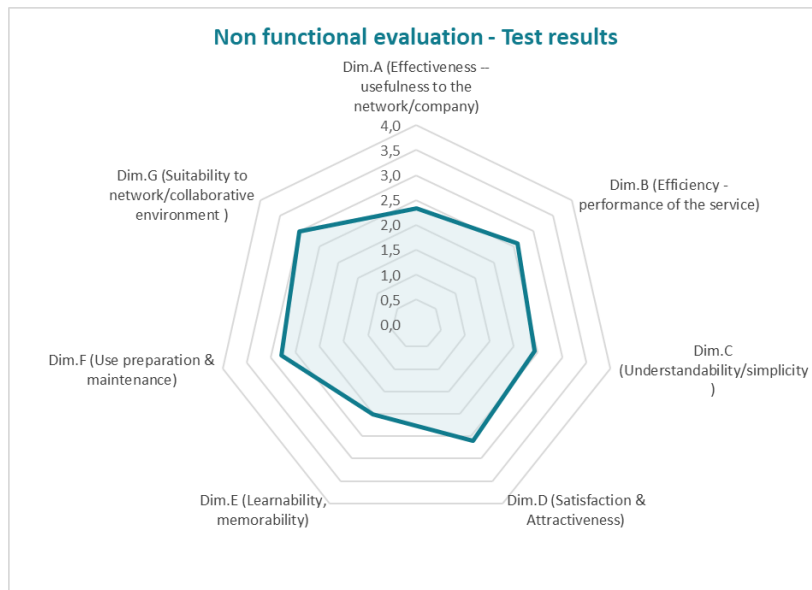

Figure 25 Radar chart of Non-Functional evaluation of Disassemblability module for Moderator User

3.2   Recyclability Module

The Recyclability module provides information concerning the most suitable recycling routes based on the LCA performed by the Sustainability Tool through the representation of recovery rate for each car part material. Since there is currently no need for editing the data displayed by the platform, Basic user only is foreseen.

3.2.1 Functional evaluation

Like the Disassemblability module, the Recyclability module is composed of the homepage and a detail page (referenced as Level 2) that provides additional information on the assessment of specific data about individual recycling rates for a car part/component. Thus, the functional evaluation was carried out considering not only the main page of the platform but also the detail page.

The focus of the testing activities concerned the log in phase, which must be improved in term of timing, the visualization of car part list, that should be fixed to prevent page overflow, and the assessment of the different sections dedicated to recycling routes.

For the homepage, the tests performed and related results with recommendations are presented in the figure below.

TREASURE Circularity Web Platform - Test Sheet			
Test Case References			
Test Case ID	CWP_REC_UT_01	**Components involved**	TREASURE Circularity Web Platform, TREASURE Data Lake
Actors involved	Francesca Lazzari (TXT) (business user)	**Contact Point**	Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)
Short Description	Visualize basic information about a car part/component in the Recyclability Dashboard		

Test Script

Access the TREASURE Circularity Web Platform
Login as a Basic Recycler type of user
Select the desired car part/component for which basic information has to be visualized
Assess that every resource expected is present and displayed in the correct format

$TSS_{success}$	9		$TSS_{partial}$	2		TSS_{fail}		1
Functionalities		**Expected Results**		**Passed**	**Remarks**		**Next step**	
Access to the Circularity Web Platform		Circularity Web Platform shows login page		YES	-		-	
Login to the Platform		User successfully logged in		PARTIAL	Login took to long		Speed up login procedure	
User redirected to home page		Home page correctly opened		YES	-		-	
Search for specific car component		List of relevant component shows up		PARTIAL	If list is too long, it overflows the page		Prevent page overflow	
Select component to visualize		Recyclability dashboard is shown for the selected component		YES	-		-	
Assess component scores section		All relevant information for the desired section are displayed		YES	-		-	
Select a recycling objective via the radio button		All related information in the dashboard updates accordingly		YES	-		-	
Assess "General composition build-up" section		All relevant information for the desired section are displayed		YES	-		-	
Assess "Recycling system flowsheet architecture"		All relevant information for the desired section are displayed		YES	-		-	
Assess "Total recycling rate" & "Individual recycling		All relevant information for the desired section are displayed		YES	-		-	
Assess "Recommendations for additional		All relevant information for the desired section are displayed		YES	-		-	
Assess "Eco-design feedback" section		All relevant information for the desired section are displayed		NO	Feedback should be displayed as text		Replace circularity wheel with text	

Figure 26 Functional evaluation of Recyclability module for Basic User – Homepage

The critical points noted in the previous test sheet part affected the evaluation score since one TSS fail is present in correlation with the *Eco-design feedback* section that requires to replace the circularity wheel with text.

The overall ranking is provided in the figure below.
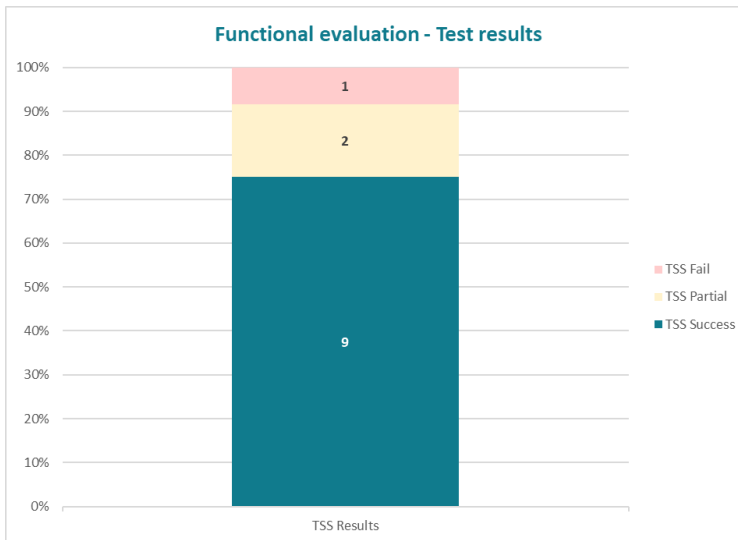
	TSS Results
TSS Success	9
TSS Partial	2
TSS Fail	1

Figure 27 Summary of Functional evaluation of Recyclability module for Basic User – Homepage

The Evaluation process has been also executed for the detailed page. Since this platform section represents an important part of the Recyclability module, the tester focused its attention not only on the log in phase but mainly on the selection of the desired car part/component for which the individual recycling rates have to be visualized and the assessment that every resource expected is present and displayed in the correct format. As for the previous test, the critical points concerned the access time and page overflow.

For the detail page, the tests performed and related results with recommendations are presented in the figure below.

Figure 28 Functional evaluation of Recyclability module for Basic User – Level 2

In this case, no TSS fails occurred while some improvements are required to raise the positive number of TSS Success.
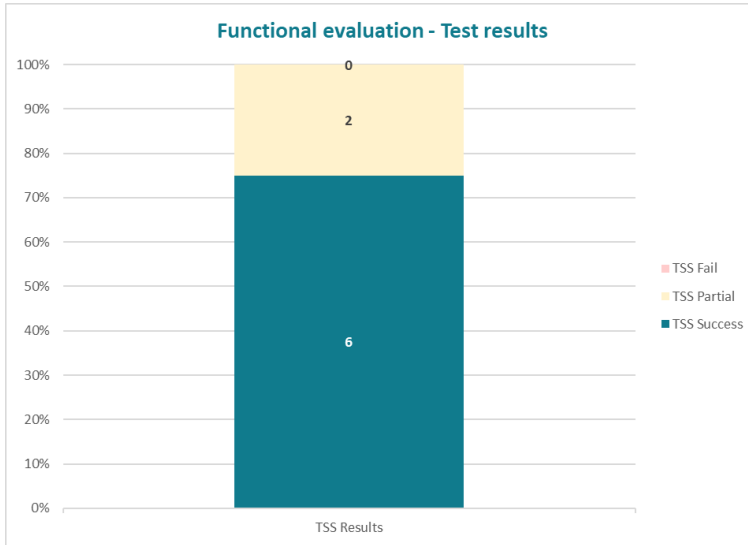
	TSS Results
TSS Success	6
TSS Partial	2
TSS Fail	0

Figure 29 Summary of Functional evaluation of Recyclability module for Basic User – Level 2

3.2.2 Non-functional evaluation

The non-functional evaluation of the homepage of the Recyclability module shows a satisfactory score of 2.9 derived from the higher marks of the following dimensions: suitability to network, due to its connection with the other platform modules that leverage on the LCA especially for the eco-design recommendations; understandability, given the presence of flower chart that facilitate the user experience and also contributes to the satisfaction score; and finally the use preparation and maintenance due to its adaptability.

The score achieved for each dimension is reported in the table below.

Non-functional Dimension	Results
Dim.A (Effectiveness -- usefulness to the network/company)	2,7
Dim.B (Efficiency - performance of the service)	2,4
Dim.C (Understandability/simplicity)	3,1
Dim.D (Satisfaction & Attractiveness)	3,0
Dim.E (Learnability, memorability)	2,8
Dim.F (Use preparation & maintenance)	3,0
Dim.G (Suitability to network/collaborative environment)	3,5
	TOTAL
	2,9

Table 7 Summary of Non-Functional evaluation of Recyclability module for Basic User – Homepage

As visible in the radar chart below, all dimensions receive an evaluation around 2.9 in a scale from 0 to 4 (see chapter 2.2.2.2 for more details) that is the threshold between Fair (< 2) and Good (>2).

The results are graphically visualized through the radar chart in the figure below that allows developers to understand at a glance the areas of improvements.
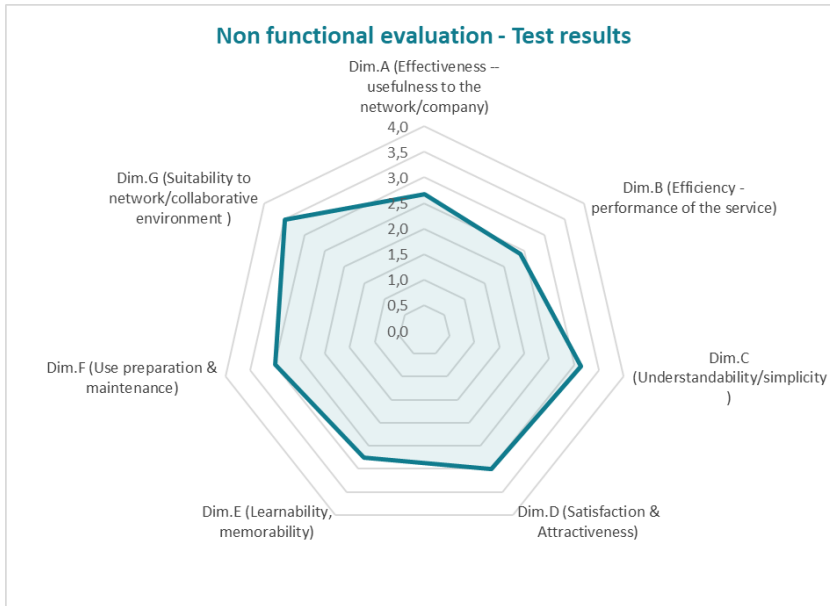
Figure 30 Radar chart of Non-Functional evaluation of Recyclability module for Basic User – Homepage

If we consider the non-functional evaluation of the detail page of the Basic User, a good score is achieved with the higher ranking in the following dimensions: learnability, since lesser information is provided with respect to the dashboard facilitating the user comprehension; and suitability to network, due to the same reasons explained for the home page evaluation. Improvements should be made in the efficiency dimension to enhance user experience, the satisfaction dimension to enhance the graphic design and the use preparation and maintenance.

The score achieved for each dimension is reported in the table below.

Non-functional Dimension	Results
Dim.A (Effectiveness -- usefulness to the network/company)	2,7
Dim.B (Efficiency - performance of the service)	2,6
Dim.C (Understandability/simplicity)	2,7
Dim.D (Satisfaction & Attractiveness)	2,6
Dim.E (Learnability, memorability)	3,0
Dim.F (Use preparation & maintenance)	2,6
Dim.G (Suitability to network/collaborative environment)	2,8
TOTAL	
	2,7

Table 8 Summary of Non-Functional evaluation of Recyclability module for Basic User – Level 2

Similar to the previous test, all dimensions receive an evaluation around 2.7 in a scale from 0 to 4 (see chapter 2.2.2.2 for more details) that is the threshold between Fair (< 2) and Good (>2).

The results are graphically visualized through the radar chart in the figure below that allows developers to understand at a glance the areas of improvements.
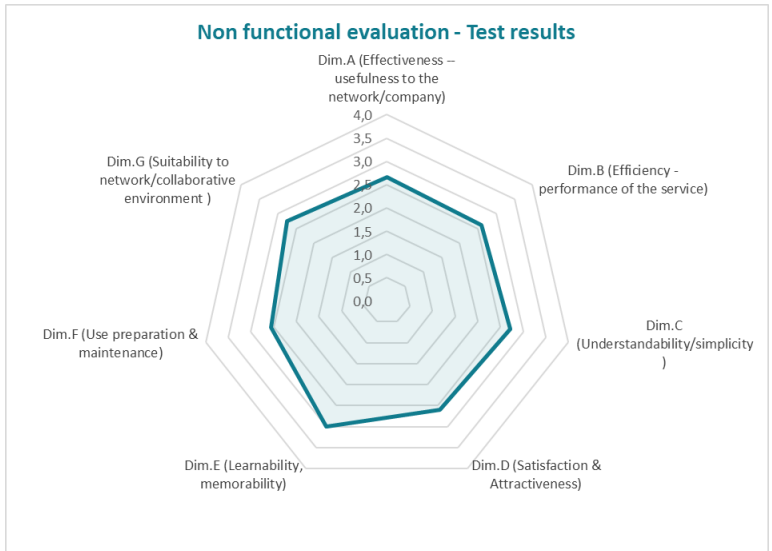
Figure 31 Radar chart of Non-Functional evaluation of Recyclability module for Basic User – Level 2

3.3 Eco-Design Module

The Eco-Design module is focused on providing recommendations to car manufacturers with the aim at improving vehicle design to improve car parts recyclability. Since there is currently no need for editing the data displayed by the platform, Basic user only is foreseen.

3.3.1 Functional evaluation

Like the previous module, the Recyclability module is composed of the homepage and a detail page (referenced as Level 2) that provides additional information on the metrics used to assessment car part/component recycling and dismantling procedure. Thus, the functional evaluation was carried out considering not only the main page of the platform but also the detail page.

The focus of the testing activities concerned the log in phase, which must be improved in term of timing, the visualization of relevant components list, that should be fixed to prevent page overflow, and the evaluation of the different sections dedicated to metrics assessment.

For the homepage, the tests performed and related results with recommendations are presented in the figure below.

TREASURE Circularity Web Platform - Test Sheet

Test Case References			
Test Case ID	CWP_ECO_UT_01	**Components involved**	TREASURE Circularity Web Platform, TREASURE Data Lake
Actors involved	Michele Sesana (TXT) michele.sesana@txtgroup.com	**Contact Point**	Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)
Short Description	Visualize basic information about a car part/component in the Eco-Design Dashboard		

Test Script
Access the TREASURE Circularity Web Platform Login as a Basic Eco-Designer type of user Select the desired car part/component for which basic information has to be visualized Assess that every resource expected is present and displayed in the correct format

TSS$_{success}$	7		TSS$_{partial}$	4		TSS$_{fail}$		0

Functionalities	Expected Results	Passed	Remarks	Next step
Access to the Circularity Web Platform	Circularity Web Platform shows login page	YES	-	-
Login to the Platform	User successfully logged in	PARTIAL	Login took to long	Speed up login procedure
User redirected to home page	Home page correctly opened	YES	-	-
Search for specific car component	List of relevant component shows up	PARTIAL	If list is too long, it overflows the page	Prevent page overflow
Select component to visualize	Eco-Design dashboard is shown for the selected component	YES	-	-
Assess component scores section	All relevant information for the desired section are displayed	YES	-	-
Assess "Top 5 metals" section	All relevant information for the desired section are displayed	YES	-	-
Assess "Plastic characterization" section	All relevant information for the desired section are displayed	YES	-	-
Assess "Disassemblability metrics" section	All relevant information for the desired section are displayed	YES	-	-
Assess "Recyclability metrics" section	All relevant information for the desired section are displayed	PARTIAL	Metrics are too few and general	Improve metrics quality and quantity
Assess "Eco-Design recommendations" section	All relevant information for the desired section are displayed	PARTIAL	Metrics are too general	Improve metrics quality

Figure 32 Functional evaluation of Eco-design module for Basic User – Homepage

The critical points noted in the previous test sheet part affected the evaluation score since, even though no TSS fail are present, the number of TSS partial shows the need to improve the metrics section.

The overall ranking is provided in the figure below.
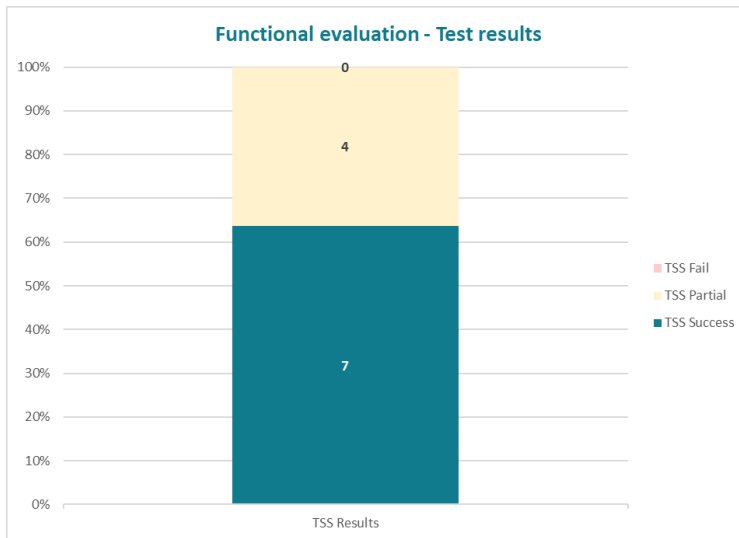
	TSS Results
TSS Success	7
TSS Partial	4
TSS Fail	0

Figure 33 Summary of Functional evaluation of Eco-design module for Basic User – Homepage

The Evaluation process has been also executed for the detailed page. Since this platform section represents an important part of the Eco-design module, the tester focused its attention not only on the log in phase but also on the correct visualization of the Top 5 materials (by weight) and the export of the selected information in Excel format. As for the previous test, the critical points concerned the access time and page overflow, in addition to the data export that should follow specific filters.

TREASURE Circularity Web Platform - Test Sheet

Test Case References

Test Case ID	CWP_ECO_UT_02 (CWP_ECO_UT_03) (CWP_ECO_UT_04)	Components involved	TREASURE Circularity Web Platform, TREASURE Data Lake
Actors involved	Michele Sesana (TXT) michele.sesana@txtgroup.com	Contact Point	Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)
Short Description	Assess and export specific information about a car part/component from the Eco-Design Dashboard		

Test Script

Access the TREASURE Circularity Web Platform
Login as a Basic Eco-Designer type of user
Select the desired car part/component for which the specific data has to be exported
Open the Details page relative to the Top 5 materials (by weight)
Access that all the detailed information about the selected aspect for the desired car part/component are present and correct
Export the detailed information in Excel format

NOTE : The following procedures have a similar interaction model and are grouped under this test case for brevity:
- Retrieve the detailed information for top 5 materials (by thermodynamic rarity) (should be CWP_ECO_UT_03)
- Retrieves the detailed information for plastic characterization (should be CWP_ECO_UT_04)

TSS$_{success}$	9		TSS$_{partial}$	2		TSS$_{fail}$	1	
Functionalities		**Expected Results**			**Passed**	**Remarks**	**Next step**	
Access to the Circularity Web Platform		Circularity Web Platform shows login page			YES	-	-	
Login to the Platform		User successfully logged in			PARTIAL	Login took to long	Speed up login procedure	
User redirected to home page		Home page correctly opened			YES	-	-	
Search for specific car component		List of relevant component shows up			PARTIAL	If list is too long, it overflows the page	Prevent page overflow	
Select component to visualize		Eco-Design dashboard is shown for the selected component			YES	-	-	
Locate the "Top 5 materials" section		All relevant information for the desired section are displayed			YES	-	-	
Locate the "By weight" sub-section		All relevant information for the desired sub- section are displayed			YES	-	-	
Press the "Details" button to the left of the chart		Details page for "Top 5 metals" "By Weight" is correctly shown			YES	-	-	
Assess that metals table is sorted by weight		Metals table is correctly sorted			YES	-	-	
Select the desired amount of materials to show		Filter is applied correctly on table items			YES	-	-	
Select the desired type of materials to show from		Filter is applied correctly on table items			YES	-	-	
Press the "Export" button		Data are exported successfully in ".xlsx" format			NO	Exported data ignores the selected filter	Export data following specified filters	

Figure 34 Functional evaluation of Eco-design module for Basic User – Level 2

The critical points noted in the previous test sheet part affected the evaluation score the ranking shows a TSS fail.

The overall ranking is provided in the figure below.
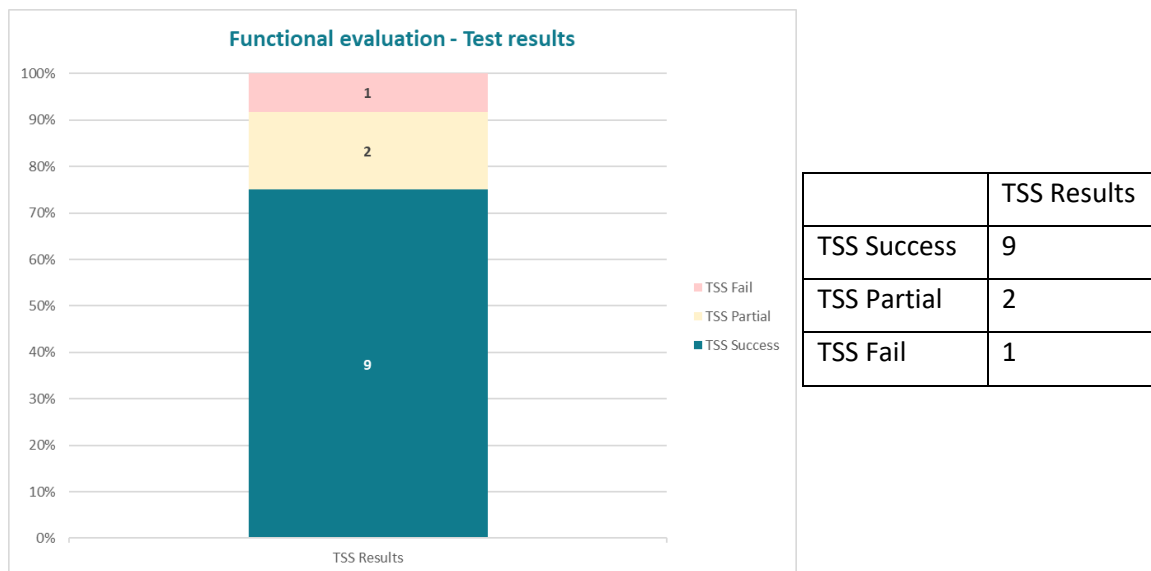
Figure 35 Summary of Functional evaluation of Eco-design module for Basic User – Level 2

3.3.2 Non-functional evaluation

The non-functional evaluation of the homepage of the Eco-design module shows a good score of 2.7 derived from average marks in all dimensions except for the effectiveness that should be improved concerning the area of *Recyclability metrics* and *Eco-design recommendations,* as reported in the functional test.

The score achieved for each dimension is reported in the table below.

Non-functional Dimension	Results
Dim.A (Effectiveness -- usefulness to the network/company)	2,3
Dim.B (Efficiency - performance of the service)	3,0
Dim.C (Understandability/simplicity)	2,6
Dim.D (Satisfaction & Attractiveness)	2,6
Dim.E (Learnability, memorability)	2,8
Dim.F (Use preparation & maintenance)	2,8
Dim.G (Suitability to network/collaborative environment)	2,8
TOTAL	2,7

Table 9 Summary of Non-Functional evaluation of Eco-design module for Basic User – Homepage

As visible in the radar chart below, all dimensions receive an evaluation around 2.7 in a scale from 0 to 4 (see chapter 2.2.2.2 for more details) that is the threshold between Fair (< 2) and Good (>2).

The results are graphically visualized through the radar chart in the figure below that allows developers to understand at a glance the areas of improvements.
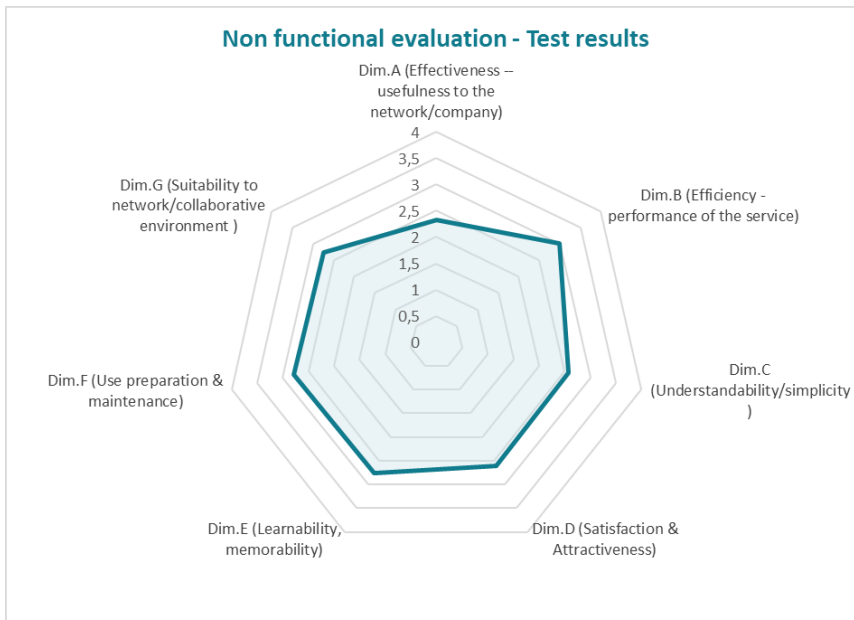
Figure 36 Radar chart of Non-Functional evaluation of Eco-design module for Basic User – Homepage

If we consider the non-functional evaluation of the detail page of the Basic User, a good score is achieved similarly to the previous test. The same analogy also refers to the uniformity of results that are mostly aligned, except for the higher score of the suitability to network, due to the smooth integration with the homepage, and the lower mark of the learnability, given the need to acquire specific knowledge related to the correct understand the *Top 5 material* table functioning.

The score achieved for each dimension is reported in the table below.

Non-functional Dimension	Results
Dim.A (Effectiveness -- usefulness to the network/company)	2,7
Dim.B (Efficiency - performance of the service)	2,6
Dim.C (Understandability/simplicity)	2,3

Dim.D (Satisfaction & Attractiveness)	2,6
Dim.E (Learnability, memorability)	2,0
Dim.F (Use preparation & maintenance)	2,8
Dim.G (Suitability to network/collaborative environment)	3,0
TOTAL	
	2,6

Table 10 Summary of Non-Functional evaluation of Eco-design module for Basic User – Level 2

As visible in the radar chart below, all dimensions receive an evaluation around 2.6 in a scale from 0 to 4 (see chapter 2.2.2.2 for more details) that is the threshold between Fair (< 2) and Good (>2).

The results are graphically visualized through the radar chart in the figure below that allows developers to understand at a glance the areas of improvements.
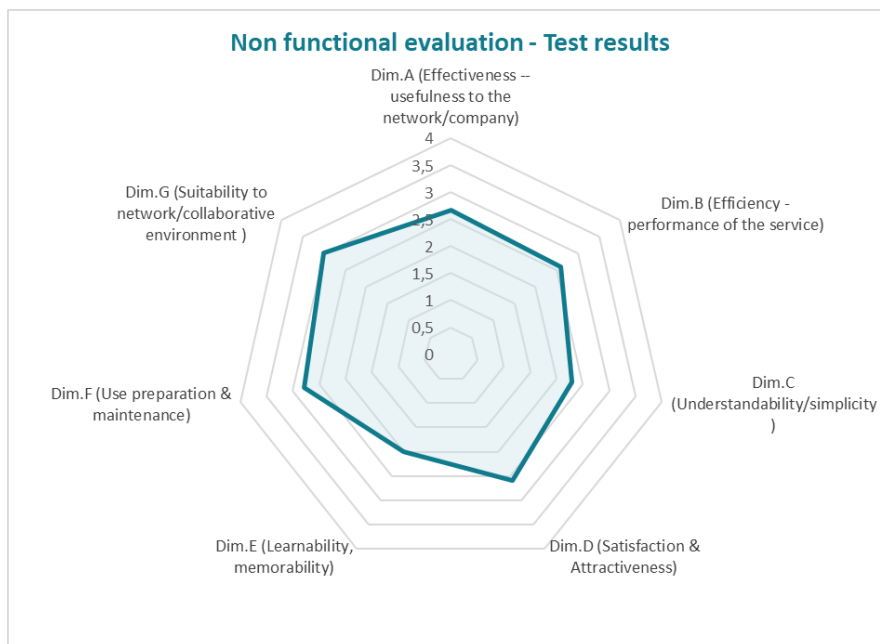
Figure 37 Radar chart of Non-Functional evaluation of Eco-design module for Basic User – Level 2

3.4 Circular AI-Based Advisory Tool

The Circular AI-based advisory tool comprises three modules, similarly to the Circularity Web Platform:

- Disassemblability AI-based Advisory Module: provides a ranking of critical components to be extracted from a selected car part presenting the most convenient disassembly path to follow.
- Recyclability AI-based Advisory Module: provides a ranking of most convenient recyclability routes starting from the analysis performed by the Recycling Simulation Tool and further complemented by a socio-economic impact assessment.
- Eco-design AI-based Advisory Module: defines the compliance level of the existing and improved design with specific guidelines using a radar graphic that highlights key impact factors according to user preferences.

The functional and nonfunctional Evaluation process has been performed on all three modules by different testers.

3.4.1 Disassemblability AI-based Advisory Module

3.4.1.1 Functional evaluation

Since in the Disassemblability AI-based Advisory Module there is no need to integrate new information in the platform concerning car parts, the Basic user only is foreseen.

The focus of the testing activities concerned the log in phase, which must be improved in term of timing, the visualization of car part list, that should be fixed to prevent page overflow.

The tests performed and related results with recommendations are presented in the figure below.

TREASURE Circularity Web Platform - Test Sheet

Test Case References

Test Case ID	CWP_AAT_UT_03	Components involved	TREASURE Circularity Web Platform, TREASURE Data Lake
Actors involved	Jacopo Costa (TXT) (industrial user)	Contact Point	Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)
Short Description	Assess Disassemblability suggestions for a specific car part/component through the Disassemblability dashboard of the AI-Based Advisory Tool		

Test Script

Access the TREASURE Circularity Web Platform
Login as any Dismantler type of user
Select the desired car part/component for which the advisory dashboard has to be visualized
Select the "AI Advisory" section
Assess that every resource expected is present and displayed in the correct format
Leave a disassemblability feedback

TSS_{success}	15		TSS_{partial}	2		TSS_{fail}	0	

Functionalities	Expected Results	Passed	Remarks	Next step
Access to the Circularity Web Platform	Circularity Web Platform shows login page	YES	-	-
Login to the Platform	User successfully logged in	PARTIAL	Login took to long	Speed up login procedure
User redirected to home page	Home page correctly opened	YES	-	-
Search for specific car component	List of relevant component shows up	PARTIAL	If list is too long, it overflows the page	Prevent page overflow
Select component	Disassemblability dashboard is shown for the selected component	YES	-	-
Select the "AI Advisory" button	The Advisory section is correctly loaded	YES	-	-
Assess the "Disassembly route" section	All relevant information for the desired section are displayed	YES	-	-
Input "Total disassembly cost"	Value inserted correctly	YES	-	-
Assess the "Estimated revenue" section	All relevant information are displayed. Table is filled but not colored.	YES	-	-
Input "Estimated disassembly cost"	Value inserted correctly	YES	-	-
Input "Desired profit margin"	Value inserted correctly	YES	-	-
Input "Thermodynamic rarity value limit"	Value inserted correctly	YES	-	-
Input "Limit value for revenue"	Value inserted correctly. Table rows colored according to rules. Chart	YES	-	-
Assess the "Feedback collection" section	All relevant feedback are present and properly displayed	YES	-	-
Press "Add feedback" button	Feedback popup correctly shows up	YES	-	-
Fill disassembly feedback input	Input filled successfully	YES	-	-
Press "Add" button	Feedback is added successfully. Popup closed. User sees feedback	YES	-	-

Figure 38 Functional evaluation of Disassemblability AI-based Advisory Tool module for Basic User

The only remarks concerned the log in time that takes too long and requires fixing by speeding up the access procedure and the page overflow that should be improved to ensure the correct visualization. For this reason, no TSS Fail are reported while a higher number of TSS Success is achieved.

The overall ranking is provided in the figure below.
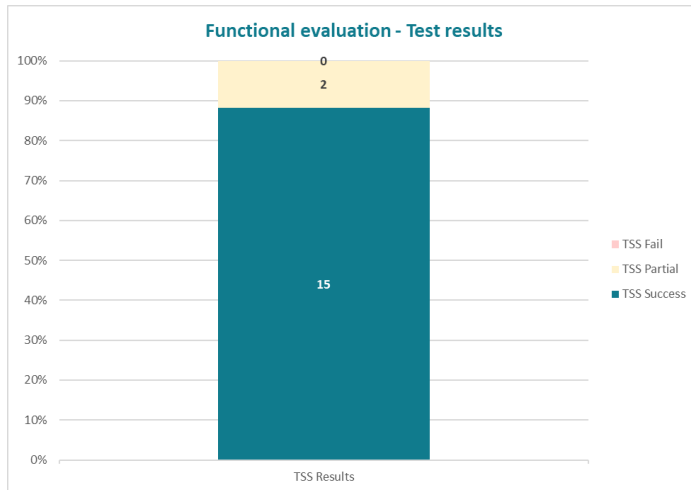
	TSS Results
TSS Success	15
TSS Partial	2
TSS Fail	0

Figure 39 Summary of Functional evaluation of Disassemblability AI-based Advisory Tool module for Basic User

3.4.1.2 Non-functional evaluation

The non-functional evaluation of the homepage of the Eco-design module shows one of the highest scores of all tests performed reaching 2.9 ranking. This derives from average positive marks in all dimensions lead by the use preparation and maintenance, since no major effort is needed to keep the service in use, and efficiency, due to the satisfactory performance of the platform in calculating the recovery rate, thermodynamic rarity indicator and profit margin for car material.

The score achieved for each dimension is reported in the table below.

Non-functional Dimension	Results
Dim.A (Effectiveness -- usefulness to the network/company)	2,7
Dim.B (Efficiency - performance of the service)	3,0
Dim.C (Understandability/simplicity)	2,7
Dim.D (Satisfaction & Attractiveness)	2,8
Dim.E (Learnability, memorability)	2,8
Dim.F (Use preparation & maintenance)	3,3
Dim.G (Suitability to network/collaborative environment)	2,8
TOTAL	2,9

Table 11 Non-Functional evaluation of Disassemblability AI-based Advisory Tool module for Basic User

As visible in the radar chart below, all dimensions receive an evaluation around 2.9 in a scale from 0 to 4 (see chapter 2.2.2.2 for more details) that is the threshold between Fair (< 2) and Good (>2).

The results are graphically visualized through the radar chart in the figure below that allows developers to understand at a glance the areas of improvements.
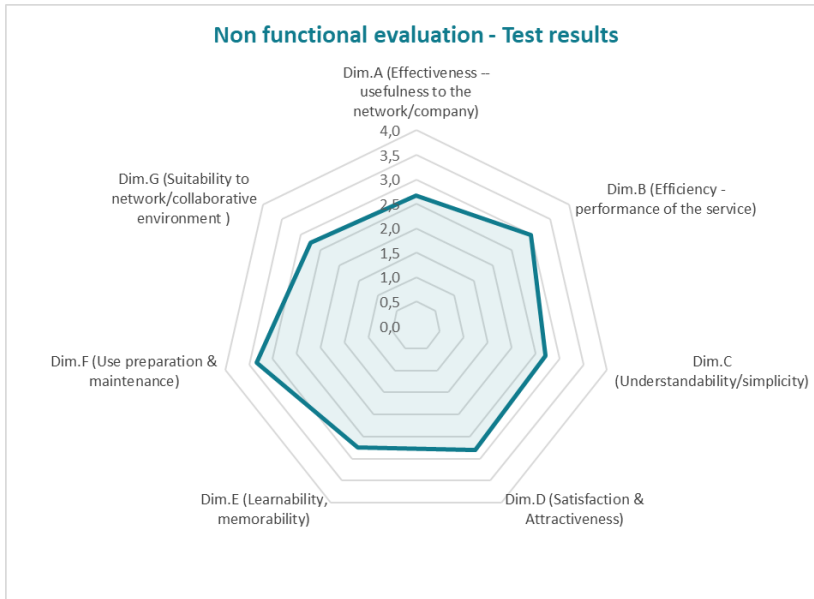
Figure 40 Radar chart of Non-Functional evaluation of Disassemblability AI-based Advisory Tool module for Basic User

3.4.2 Recyclability AI-based Advisory Module

3.4.2.1 Functional evaluation

Like the Disassemblability AI-based Advisory Module, also in the Recyclability AI-based Advisory Module there is no need to integrate new information in the platform concerning car parts; thus, the Basic user only is foreseen.

Similarly to the previous module, the focus of the testing activities concerned the log in phase, which must be improved in term of timing, the visualization of car part list, that should be fixed to prevent page overflow, in addition to the charts presented in the *Graphical integration approach* section that needs to undergo some changes related to enhancement of graph resolution, currently stated as low.

The tests performed and related results with recommendations are presented in the figure below.

TREASURE Circularity Web Platform - Test Sheet					
Test Case References					
Test Case ID	CWP_AAT_UT_04	**Components involved**		TREASURE Circularity Web Platform, TREASURE Data Lake	
Actors involved	Jacopo Costa (TXT) (industrial user)	**Contact Point**		Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)	
Short Description	Assess Recyclability suggestions for a specific car part/component through the Recyclability dashboard of the AI-Based Advisory Tool				
Test Script					
Access the TREASURE Circularity Web Platform Login as any Recycler type of user Select the desired car part/component for which the advisory dashboard has to be visualized Select the "AI Advisory" section Assess that every resource expected is present and displayed in the correct format Leave a recyclability feedback					
TSS$_{success}$ 12		TSS$_{partial}$ 3		TSS$_{fail}$ 0	
Functionalities	**Expected Results**		**Passed**	**Remarks**	**Next step**
Access to the Circularity Web Platform	Circularity Web Platform shows login page		YES	-	-
Login to the Platform	User successfully logged in		PARTIAL	Login took to long	Speed up login procedure
User redirected to home page	Home page correctly opened		YES	-	-
Search for specific car component	List of relevant component shows up		PARTIAL	If list is too long, it overflows the page	Prevent page overflow
Select component	Recyclability dashboard is shown for the selected component		YES	-	-
Select the "AI Advisory" button	The Advisory section is correctly loaded		YES	-	-
Assess the "Disassembly & recycling routes	All relevant information for the desired section are displayed		YES	-	-
Press the "Info" button of a selected route	Route info popup correctly shows up		YES	-	-
Assess route info table	All relevant information for the desired section are displayed		YES	-	-
Press the "Close" ("X") button	Route info popup closes		YES	-	-
Assess the "Graphical integration approach"	All relevant information for the desired section are displayed		PARTIAL	Graphs have low resolution	Improve graphs resolution
Assess the "Feedback collection" section	All relevant feedback are present and properly displayed		YES	-	-
Press "Add feedback" button	Feedback popup correctly shows up		YES	-	-
Fill recyclability feedback input	Input filled successfully		YES	-	-
Press "Add" button	Feedback is added successfully. Popup closed. User sees feedback		YES	-	-

Figure 41 Functional evaluation of Recyclability AI-based Advisory Tool module for Basic User

Given the remarks reported in the previous paragraph, the functional evaluation resulted in a satisfactory score with no TSS Fail are reported while a higher number of TSS Success is achieved.

The overall ranking is provided in the figure below.

	TSS Results
TSS Success	12
TSS Partial	3
TSS Fail	0

Figure 42 Summary of Functional evaluation of Recyclability AI-based Advisory Tool module for Basic User

3.4.2.2 Non-functional evaluation

The non-functional evaluation of the homepage of the Eco-design module shows one of the highest scores of all tests performed reaching 3.0 ranking. This is due to average positive marks near 3-point score in all dimensions with higher grade in efficiency, because it summarize in one table all key information regarding the LCA and social and economic impact assessment, followed by effectiveness, due to the quality of the outcomes provided, learnability, since no prior training is needed to use the platform, and suitability to network, considering its easy integration within the Advisory Tool.

The score achieved for each dimension is reported in the table below.

Non-functional Dimension	Results
Dim.A (Effectiveness -- usefulness to the network/company)	3,0
Dim.B (Efficiency - performance of the service)	3,2
Dim.C (Understandability/simplicity)	3,0
Dim.D (Satisfaction & Attractiveness)	2,6
Dim.E (Learnability, memorability)	3,0
Dim.F (Use preparation & maintenance)	3,1
Dim.G (Suitability to network/collaborative environment)	3,0
TOTAL	
	3,0

Table 12 Non-Functional evaluation of Recyclability AI-based Advisory Tool module for Basic User

As visible in the radar chart below, all dimensions receive an evaluation of 3 in a scale from 0 to 4 (see chapter 2.2.2.2 for more details) that is the threshold between Fair (< 2) and Good (>2), almost reaching the Excellent level.

The results are graphically visualized through the radar chart in the figure below that allows developers to understand at a glance the areas of improvements.
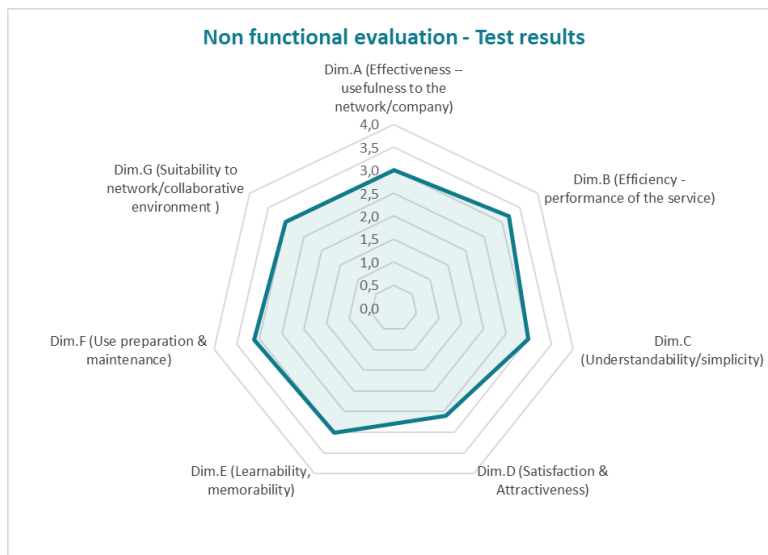
Figure 43 Radar chart of Non-Functional evaluation of Recyclability AI-based Advisory Tool module for Basic User

3.4.3   Eco-design AI-based Advisory Module

3.4.3.1   Functional evaluation

The Eco-design AI-based Advisory Module is composed of two main sections:

- the old design, assigned to the displays the 2D image of the selected car part with the key issues related to the disassembly and recycling process based on the feedbacks gathered from dismantlers and recyclers homepage
- the new design, focused on the evaluation of the improved design compliance to guideline groups
- the comparison of the old and new design, dedicated to assessing the layout improvements impact on the selected guidelines

Thus, the Evaluation process has been performed in two steps: firstly, testing the old design section and secondly validating the new design and comparison page altogether.

The testing activities included the select the desired car part/component for which the advisory dashboard has to be visualized, the opening of the "AI Advisory" section, the check that every resource expected is present and displayed in the correct format and the completion of the required sections to have the whole overview on the advisory process.

For the *Old design* page, the tests performed and related results with recommendations are presented in the figure below.

TREASURE Circularity Web Platform - Test Sheet

Test Case References

Test Case ID	CWP_AAT_UT_01	Components involved	TREASURE Circularity Web Platform, TREASURE Data Lake
Actors involved	Jacopo Costa (TXT) (industrial user)	Contact Point	Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)
Short Description	Assess Eco-Design suggestions for a specific car part/component through the Eco-Design dashboard of the AI-Based Advisory Tool		

Test Script

Access the TREASURE Circularity Web Platform
Login as any Eco-Designer type of user
Select the desired car part/component for which the advisory dashboard has to be visualized
Select the "AI Advisory" section
Assess that every resource expected is present and displayed in the correct format
Complete the required sections to have the whole overview on the advisory process

TSS$_{success}$	20		TSS$_{partial}$	2		TSS$_{fail}$		0
Functionalities		**Expected Results**			**Passed**	**Remarks**		**Next step**
Access to the Circularity Web Platform		Circularity Web Platform shows login page			YES	-		
Login to the Platform		User successfully logged in			PARTIAL	Login took to long		Speed up login procedure
User redirected to home page		Home page correctly opened			YES	-		
Search for specific car component		List of relevant component shows up			PARTIAL	If list is too long, it overflows the page		Prevent page overflow
Select component without new design to visualize		Eco-Design dashboard is shown for the selected component			YES	-		-
Select the "AI Advisory" button		The Advisory section is correctly loaded. No "New design " section.			YES	-		-
Assess the "Old design" section		All relevant information for the desired section are displayed			YES	-		-
Selects the "Eye" button in the list of feedbacks		The relevant red indicator is shown on the component image at the			YES	-		-
Press the "Edit" button in the "Design for		The edit popup correctly shows up			YES	-		-
Select the first guideline group to edit		The guidelines table shows the associated guidelines. The first two			YES	-		-
Input the "Margin of improvement" field		Input filled correctly			YES	-		-
Input the "Relevance"		Input filled correctly. "Circularity improvement" field is computed			YES	-		-
Repeat previous three steps for all guideline		Guideline tables filled correctly			YES	-		-
Press "Save" button		Guideline tables saved correctly. User redirected to home page.			YES	-		-
Repeat previous six steps for the "Design for		Guidelines saved correctly. Guidelines shows in the home page as			YES	-		-
Select a radio button in the "Guidelines group"		"Design for disassembly" radar chart updaters accordingly			YES	-		-
Select a radio button in the "Guidelines group"		"Design for recycling" radar chart updates accordingly			YES	-		-
Assess the "Advisory" sub-section		First two columns of "Design for disassembly" and "Design for			YES	-		-
Select the desired guideline group form the		"Design for disassembly" table updates accordingly			YES	-		-
Add advisory in the last column of the "Design for		Advisory comment added successfully			YES	-		-
Select the desired guideline group form the		"Design for recycling" table updates accordingly			YES	-		-
Add advisory in the last column of the "Design for		Advisory comment added successfully			YES	-		-

Figure 44 Functional evaluation of Eco-design AI-based Advisory module – Old design

The only remarks concerned the log in phase, which must be improved in term of timing, the visualization of car part list, that should be fixed to prevent page overflow. For this reason, no TSS Fail are reported while a higher number of TSS Success is achieved.

The overall ranking is provided in the figure below.

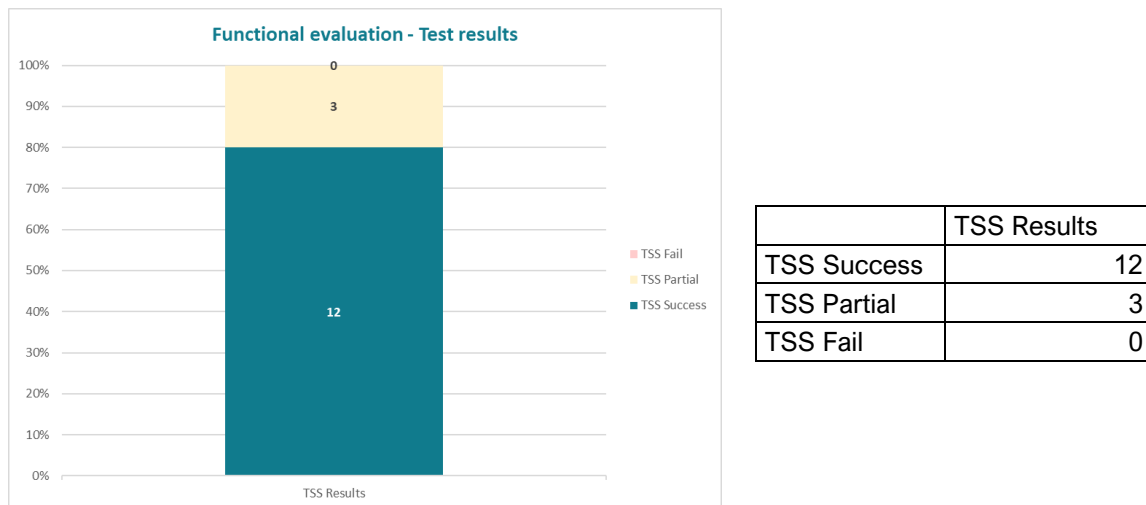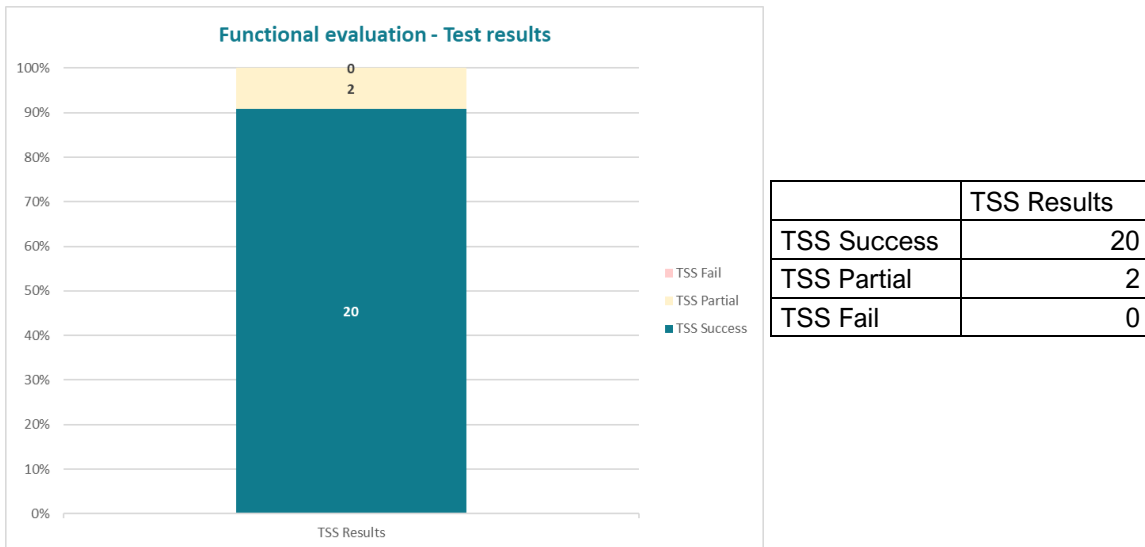*Figure 45 Summary of Functional evaluation of Eco-design AI-based Advisory module – Old design*

The Evaluation process has been also executed for the *New Design* and *Comparison Old vs New Design* page. Since this platform section represents an important part of the Eco-design module, the tester focused its attention not only on the log in phase but also on the correct selection of specific guidelines and the export of determined information in Excel format. As for the previous test, some critical points concerned the access time and page overflow. Moreover, for this platform section some errors were noted for the guidelines export both for the *Design for disassembly* and *Design for recycling* table, since the filter application must be improved to ensure that only selected data are extracted.

For the *New Design* and *Comparison Old vs New Design* page, the tests performed and related results with recommendations are presented in the figure below.

🔷 **TREASURE Circularity Web Platform - Test Sheet**					
Test Case References					
Test Case ID	CWP_AAT_UT_02	**Components involved**		TREASURE Circularity Web Platform, TREASURE Data Lake	
Actors involved	Jacopo Costa (TXT) (industrial user)	**Contact Point**		Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)	
Short Description	**Assess Eco-Design suggestions for the new design of a specific car part/component through the Eco-Design dashboard of the AI-Based Advisory Tool**				
Test Script					
Access the TREASURE Circularity Web Platform Login as any Eco-Designer type of user Select the desired car part/component for which the advisory dashboard has to be visualized Select the "AI Advisory" section Navigate to the "New Design" section Assess that every resource expected is present and displayed in the correct format Navigate to the "New vs old design" section Assess that every resource expected is present and displayed in the correct format					

TSS_{success}	13		TSS_{partial}	2			TSS_{fail}		2

Functionalities	Expected Results	Passed	Remarks	Next step
Access to the Circularity Web Platform	Circularity Web Platform shows login page	YES	-	-
Login to the Platform	User successfully logged in	PARTIAL	Login took to long	Speed up login procedure
User redirected to home page	Home page correctly opened	YES	-	-
Search for specific car component	List of relevant component shows up	PARTIAL	If list is too long, it overflows the page	Prevent page overflow
Select component with new design to visualize	Eco-Design dashboard is shown for the selected component	YES	-	-
Select the "AI Advisory" button	The Advisory section is correctly loaded. "New design" section is	YES	-	-
Assess the "New design" section	All relevant information for the desired section are displayed	YES	-	-
Select the desired guideline group from the	The relevant comments are present in the table	YES	-	-
Select the appropriate evaluation from the	Evaluation correctly set	YES	-	-
Add relevant comment in the "Comment" text input	Comment added successfully	YES	-	-
Press "Export" button for the "Design for	Table exported successfully according to the selected guidelines	NO	All guidelines exported, regardless of the	Take into account filter while exporting
Select the desired guideline group from the	The relevant comments are present in the table	YES	-	-
Select the appropriate evaluation from the	Evaluation correctly set	YES	-	-
Add relevant comment in the "Comment" text input	Comment added successfully	YES	-	-
Press "Export" button for the "Design for recycling"	Table exported successfully according to the selected guidelines	NO	All guidelines exported, regardless of the	Take into account filter while exporting
Assess the "New vs old design" section	All relevant information for the desired section are displayed	YES	-	-
Select the desired guideline group from the drop	Plot adjusted accordingly	YES	-	-

Figure 46 Functional evaluation of Eco-design AI-based Advisory module – New design and comparison section

Due to the problems incurred in data export, two TSS Fail were registered indicating the areas of improvements to be made.

The overall ranking is provided in the figure below.

	TSS Results
TSS Success	13
TSS Partial	2
TSS Fail	2
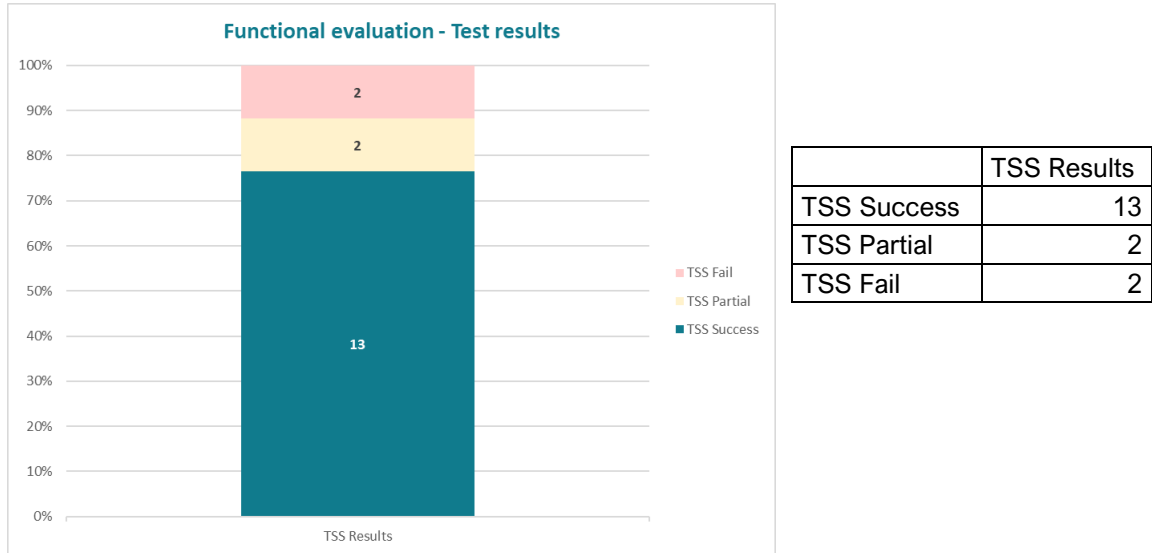
Figure 47 Summary of Functional evaluation of Eco-design AI-based Advisory module – New design and comparison section

3.4.3.2 Non-functional evaluation

The non-functional evaluation of the *Old Design* page of the Eco-design AI-based Advisory Tool module shows a 2.5 score with relevant margins of improvements related to the following dimensions: effectiveness, given the poor achievement of planned objectives because of the high amount of data to be provided by the user filling in the table that allows the system to generate the radar chart; efficiency, correlated to the previous point since many tasks are previously required; understandability, because the service doesn't provide the right amount of guidance; and learnability, due to its partial initial barrier in discovering how to use the platform.

The score achieved for each dimension is reported in the table below.

Non-functional Dimension	Results
Dim.A (Effectiveness -- usefulness to the network/company)	2,0
Dim.B (Efficiency - performance of the service)	2,0
Dim.C (Understandability/simplicity)	2,3
Dim.D (Satisfaction & Attractiveness)	2,6
Dim.E (Learnability, memorability)	2,3
Dim.F (Use preparation & maintenance)	3,0
Dim.G (Suitability to network/collaborative environment)	3,3
TOTAL	
	2,5

Table 13 Non-Functional evaluation of Eco-design AI-based Advisory module – Old design

As visible in the radar chart below, all dimensions receive an evaluation around 2.5 in a scale from 0 to 4 (see chapter 2.2.2.2 for more details) that is the threshold between Fair (< 2) and Good (>2).

The results are graphically visualized through the radar chart in the figure below that allows developers to understand at a glance the areas of improvements.

Figure 48 Radar chart of Non-Functional evaluation of Eco-design AI-based Advisory module – Old design

If we consider the non-functional evaluation of the *New Design* and *Comparison Old vs New Design* page, a higher score is achieved with respect to the previous module. The tester appreciated the use preparation and maintenance, since the technical installation does not require specific setups or additional downloads, and the suitability to network, due to its interoperability. On the other side, need to improve is registered in the following dimensions: satisfaction, by enhancing its GUI to raise service attractiveness; effectiveness, due to its autonomy with respect to other modules since the results displayed in this section are only relevant by the user without integration with other platform applications; and understandability, by providing more guidelines for the comparison bar chart enabling the user to quickly discern the impact of both the old and new design on the guidelines compliance.

The score achieved for each dimension is reported in the table below.

Non-functional Dimension	Results
Dim.A (Effectiveness -- usefulness to the network/company)	2,7
Dim.B (Efficiency - performance of the service)	2,8
Dim.C (Understandability/simplicity)	2,7
Dim.D (Satisfaction & Attractiveness)	2,6
Dim.E (Learnability, memorability)	2,8
Dim.F (Use preparation & maintenance)	3,2
Dim.G (Suitability to network/collaborative environment)	3,0
TOTAL	
	2,8

Table 14 Non-Functional evaluation of Eco-design AI-based Advisory module – New design and comparison section

As visible in the radar chart below, all dimensions receive an evaluation around 2.8 in a scale from 0 to 4 (see chapter 2.2.2.2 for more details) that is the threshold between Fair (< 2) and Good (>2).

The results are graphically visualized through the radar chart in the figure below that allows developers to understand at a glance the areas of improvements.
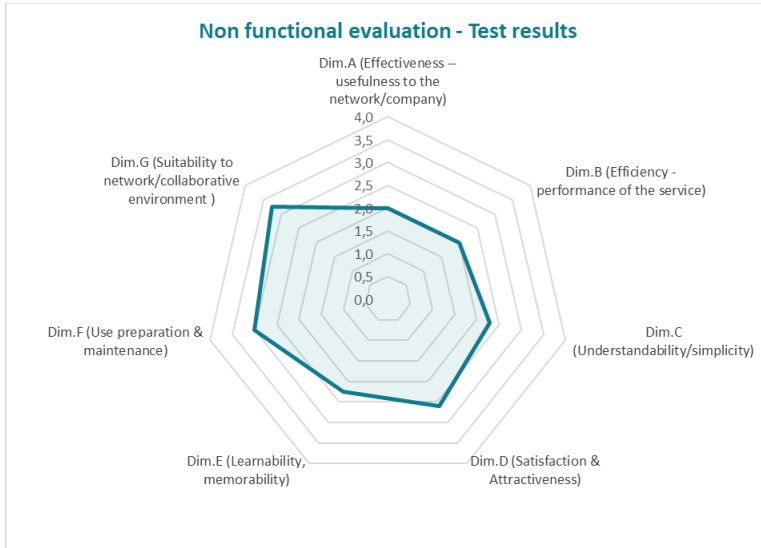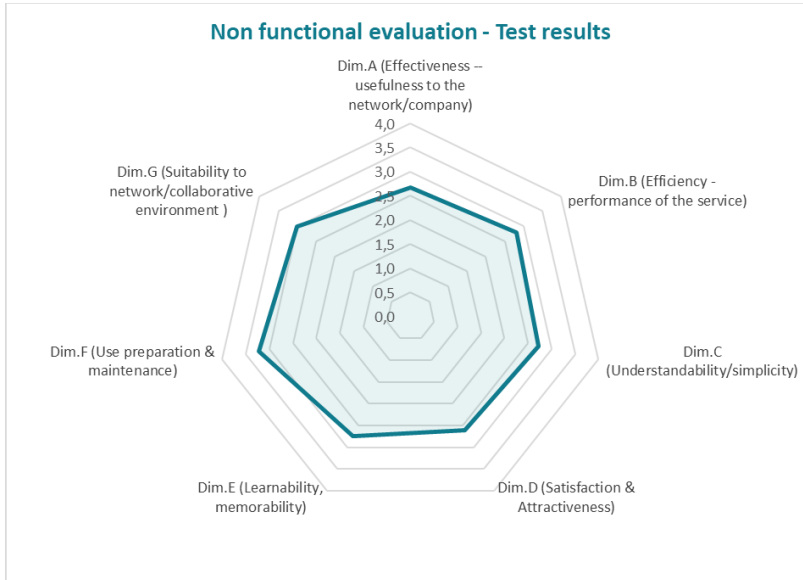

Figure 49 Radar chart of Non-Functional evaluation of Eco-design AI-based Advisory module – New design and comparison section

4 Conclusions and Next Steps

The Evaluation process carried out in T4.6 had as major goal testing all technical developments performed in T4.4. and T4.5, thus concerning both the Circularity Web Platform and the Circular AI-based Advisory Tool. The validation activities have been executed taking into consideration 2 major elements: the purpose of the specific application component to check the system availability for the key sections relevant for the user; and the type of users that operates on the modules according to the authorization protocol.

In this deliverable the test of TREASURE platform has been reported. The two major sections of the document describe: i) the process followed to prepare, accomplish and measure the test of the system and ii) the test execution (test sheet – test report and evaluation analysis) where a specific sub-section has been devoted for each test of the TREASURE application.

Overall, a total amount of 166 tests have been executed. A detailed description of functional and non-functional evaluations of the system have been performed approaching the project platform from 12 different perspectives:

III. Circularity Web Platform
- Disassemblability Module:
  o Basic user: the functional and non-functional evaluation was carried out considering not only the main page of the platform but also the Disassembly time detail page (referenced as Level 2).
  o Editor user
  o Moderator user
- Recyclability module:
  o Basic user: the functional and non-functional evaluation was carried out considering not only the main page of the platform but also the detail page (referenced as Level 2) that provides additional information on the assessment of specific data about individual recycling rates for a car part/component.
- Eco-design module:
  o Basic user: the functional and non-functional evaluation was carried out considering not only the main page of the platform but also the detail page (referenced as Level 2) that provides additional information on the metrics used to assessment car part/component recycling and dismantling procedure
IV. Circular AI-based Advisory Tool:
- Disassemblability AI-based Advisory Module
  o Basic user
- Recyclability AI-based Advisory Module
  o Basic user
- Eco-design AI-based Advisory Module
  o Basic user: the functional and non-functional evaluation was carried out considering not only the *Old design* page of the platform but also the *New design* and *Old vs New design comparison* page

In these perspectives the focus of the attention is on the usage of the system by the different kind of end-users; this approach was selected due to the fact that this is the first of the TREASURE platform in the scope of the project.

The common remarks for all modules concerned two major elements; the log in time that currently takes too long and consequently requires fixing by speeding up the access procedure; the page overflow in some tables when a long list of rows is displayed, that should be improved to ensure the correct visualization. Some specific recommendations were provided when an error occurred, mainly in chart representation (requiring for example a higher resolution) or data export (with the need to consider the filter while extracting the table).

The received results of the test are satisfactory and in line with expectations for both functional and non-functional tests. In general, the TREASURE platform has been rated as good in the different perspectives.

Space for improvements have been extracted from the testers' reports and summarized in this report. This will be the starting point for the improvement of the system after the end of the project.

The activities will be carried out collaborating with the other task of WP4, since the evaluation process will be performed in a second iteration once the final version of the platform is released. Thus, the ultimate validation of both the Circularity Web Application and the Circularity AI-based Advisory Tool will be provided in D4.12 due on M36 as a result of the refinement of testing activities including the technical developments carried out in all platform modules.

Abbreviations

SQuaRE	Systems and software Quality Requirements and Evaluation
CE	Circular Economy
GUI	Graphic user interface
TSS	Test Sheet Score

Annexes

The full test reports are provided as annex attached at the present document.

TREASURE Circularity Web Platform - Test Sheet

Test Case References

Test Case ID	CWP_AAT_UT_03	Components involved	TREASURE Circularity Web Platform, TREASURE Data Lake
Actors involved	Jacopo Costa (TXT) (industrial user)	Contact Point	Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)
Short Description	**Assess Disassemblability suggestions for a specific car part/component through the Disassemblability dashboard of the AI-Based Advisory Tool**		

Test Script

Access the TREASURE Circularity Web Platform
Login as any Dismantler type of user
Select the desired car part/component for which the advisory dashboard has to be visualized
Select the "AI Advisory" section
Assess that every resource expected is present and displayed in the correct format
Leave a disassemblability feedback

TSS$_{success}$	15		TSS$_{partial}$	2		TSS$_{fail}$		0
Functionalities		**Expected Results**			**Passed**	**Remarks**		**Next step**
Access to the Circularity Web Platform		Circularity Web Platform shows login page			YES	-		-
Login to the Platform		User successfully logged in			PARTIAL	Login took to long		Speed up login procedure
User redirected to home page		Home page correctly opened			YES	-		-
Search for specific car component		List of relevant component shows up			PARTIAL	If list is too long, it overflows the page		Prevent page overflow
Select component		Disassemblability dashboard is shown for the selected component			YES	-		-
Select the "AI Advisory" button		The Advisory section is correctly loaded			YES	-		-
Assess the "Disassembly route" section		All relevant information for the desired section are displayed			YES	-		-
Input "Total disassembly cost"		Value inserted correctly			YES	-		-
Assess the "Estimated revenue" section		All relevant information are displayed. Table is filled but not colored.			YES	-		-
Input "Estimated disassembly cost"		Value inserted correctly			YES	-		-
Input "Desired profit margin"		Value inserted correctly			YES	-		-
Input "Thermodynamic rarity value limit"		Value inserted correctly			YES	-		-
Input "Limit value for revenue"		Value inserted correctly. Table rows colored according to rules. Chart			YES	-		-
Assess the "Feedback collection" section		All relevant feedback are present and properly displayed			YES	-		-
Press "Add feedback" button		Feedback popup correctly shows up			YES	-		-
Fill disassembly feedback input		Input filled successfully			YES	-		-
Press "Add" button		Feedback is added successfully. Popup closed. User sees feedback in			YES	-		-

Non-Functional Evaluation

Dim.A (Effectiveness -- usefulness to the network/company)		**Total**	2,7
Ref #	**Question**	**Answer (0-4)**	
A1	It is easy to **understand** the objective and benefit of the service to my organization/network.	3	
A2	The **outcome of the service** is important / useful for the company/network. The service creates **value** for my	2	
A3	It is easy to **achieve** the planned business objectives / perform the tasks with the service.	3	
A4	**What could be improved to make more value of the tool/service?**		

Dim.B (Efficiency - performance of the service)		**Total**	3,0
Ref #	**Question**	**Answer (0-4)**	
B1	The time and resources required to achieve the objectives with the service are reasonable/moderate.	3	
B2	The service runs fast enough.	3	
B3	The service does not require too many steps to achieve the result.	3	
B4	All the functions are beneficial for my company/ network.	3	
B5	The service structure allows flexible & fast performance of the tasks.	3	
B6	**What could be improved to make more value of the tool/service?**		

Dim.C (Understandability/simplicity)		**Total**	2,7
Ref #	**Question**	**Answer (0-4)**	
C1	The service structure and logic is easy and self-clear to understand and recognizable.	3	
C2	The concepts are understandable for my organization and in line with TREASURE terminology	3	
C3	The service offers sufficient guidance	2	
C4	The responses to user actions are understandable. The look and feel is self explanatory and follows the	2	
C5	The support to business processes / tasks is clear. The user can understand his/her role and the purpose of the	3	
C6	The service is simple enough for practical use. The tasks do not look complex to perform. It is clear what is	3	
C7	The output of the service is clear and understandable.	3	
C8	**What could be improved to make more value of the tool/service?**		
	Improve explanation for popup next to "Estimated revenue" chart		

Dim.D (Satisfaction & Attractiveness)		**Total**	2,8
Ref #	**Question**	**Answer (0-4)**	
D1	The service is attractive to the user. I feel satisfied and comfortable when using the service.	3	
D2	I can keep the control of the service, for example by pausing& continuing, canceling, saving the status and	3	
D3	The mental workload when using the service is low.	2	
D4	The service rewards the user also personally	3	
D5	I could recommend the service for other people/organizations.	3	
D6	**What could be improved to make more value of the tool/service?**		

Dim.E (Learnability, memorability)		**Total**	2,8
Ref #	**Question**	**Answer (0-4)**	
E1	It is easy to start using the service and to perform the main tasks.	3	
E2	It is easy to learn new features/ functionalities.	3	
E3	When coming back to an unfinished task, it is easy to remember / identify the actions needed.	3	
E4	The service offers sufficient training support.	2	
E5	**What could be improved to make more value of the tool/service?**		

Dim.F (Use preparation & maintenance)		**Total**	3,3
Ref #	**Question**	**Answer (0-4)**	
F1	The take-up of the service does not require high preparation.	2	
F2	Technical installation does not require specific setups or additional downloads.	4	
F3	The data needed by the service exist in my company/network in the proper format and can be easily made	4	
F4	The service can be easily customized/ configured to my environment/ network.	3	
F5	The service can be easily shared in the network.	4	
F6	The service does not require specific knowledge from the users.	2	

Ref #	Question	Answer (0-4)
F7	The service is easy to take up also for SMEs.	3
F8	The service does not require extensive change of business processes.	4
F9	The service does not require high maintenance.	4
F10	**What could be improved to make more value of the tool/service?**	

Dim.G (Suitability to network/collaborative environment)		Total	2,8

Ref #	Question	Answer (0-4)
G1	The service supports collaboration and interoperability for my network.	3
G2	The service is suitable for heterogeneous users and different networks.	2
G3	The service takes into account safety and security.	3
G4	The service usage does not require high negotiation or complex agreements in the network.	3
G5	**What could be improved to make more value of the tool/service?**	

Non-fuctional Dimension	Results		
Dim.A (Effectiveness -- usefulness to the network/company)	2,7		TSS Results
Dim.B (Efficiency - performance of the service)	3,0	TSS Success	15
Dim.C (Understandability/simplicity)	2,7	TSS Partial	2
Dim.D (Satisfaction & Attractiveness)	2,8	TSS Fail	0
Dim.E (Learnability, memorability)	2,8		
Dim.F (Use preparation & maintenance)	3,3		
Dim.G (Suitability to network/collaborative environment)	2,8		
TOTAL	2,9		

Non functional evaluation - Test results

Functional evaluation - Test results

TREASURE Circularity Web Platform - Test Sheet

Test Case References

Test Case ID	CWP_DIS_UT_06 (CWP_DIS_UT_07)	Components involved	TREASURE Circularity Web Platform, TREASURE Data Lake
Actors involved	Veronica Antonello (TXT) (business user)	Contact Point	Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)
Short Description	Approve a pending request from the Disassemblability Dashboard		

Test Script

Access the TREASURE Circularity Web Platform
Login as a Moderator Dismantler type of user
Switch to the "Approve requests" section
Inspect a pending request
Assess that all the required information about a car/component are present
Approve the pending request and provide a text description

NOTE : The following procedures have a similar interaction model and are grouped under this test case for brevity:
- Reject the pending request (should be CWP_DIS_UT_07)

TSS_{success}	8		TSS_{partial}	2		TSS_{fail}	0

Functionalities	Expected Results	Passed	Remarks	Next step
Access to the Circularity Web Platform	Circularity Web Platform shows login page	YES	-	-
Login to the Platform	User successfully logged in	PARTIAL	Login took to long	Speed up login procedure
User redirected to home page	Home page correctly opened	YES	-	-
Switch to "Approve requests" section	Section loaded successfully	YES	-	-
Locate the request to be approved	Desired request is present	YES	-	-
Press the "Inspect" button	Component dashboard opened in inspect mode successfully	YES	-	-
Assess component dashboard	All information are present, correct and in the appropriate format	YES	-	-
Press the "Approve" button	Approve popup showed up correctly	YES	-	-
Insert an approve comment	Comment inserted correctly	PARTIAL	Approve comment should be optional	Allow user to omit approve comment
Press the "Approve" button	Request approved successfully, user redirected to "Approve requests"	YES	-	-

Non-Functional Evaluation

Dim.A (Effectiveness -- usefulness to the network/company)		Total	2,3
Ref #	Question		Answer (0-4)
A1	It is easy to **understand** the objective and benefit of the service to my organization/network.		3
A2	The **outcome of the service** is important / useful for the company/network. The service creates **value** for my		2
A3	It is easy to **achieve** the planned business objectives / perform the tasks with the service.		2
A4	**What could be improved to make more value of the tool/service?**		

Dim.B (Efficiency - performance of the service)		Total	2,6
Ref #	Question		Answer (0-4)
B1	The time and resources required to achieve the objectives with the service are reasonable/moderate.		3
B2	The service runs fast enough.		3
B3	The service does not require too many steps to achieve the result.		3
B4	All the functions are beneficial for my company/ network.		2
B5	The service structure allows flexible & fast performance of the tasks.		2
B6	**What could be improved to make more value of the tool/service?**		

Dim.C (Understandability/simplicity)		Total	2,4
Ref #	Question		Answer (0-4)
C1	The service structure and logic is easy and self-clear to understand and recognizable.		2
C2	The concepts are understandable for my organization and in line with TREASURE terminology		3
C3	The service offers sufficient guidance		2
C4	The responses to user actions are understandable. The look and feel is self explanatory and follows the		2
C5	The support to business processes / tasks is clear. The user can understand his/her role and the purpose of		3
C6	The service is simple enough for practical use. The tasks do not look complex to perform. It is clear what is		2
C7	The output of the service is clear and understandable.		3
C8	**What could be improved to make more value of the tool/service?**		
	Allow the user to skip the comment when approving a request. The comment should be mandatory only when rejecting requests		

Dim.D (Satisfaction & Attractiveness)		Total	2,6
Ref #	Question		Answer (0-4)
D1	The service is attractive to the user. I feel satisfied and comfortable when using the service.		3
D2	I can keep the control of the service, for example by pausing& continuing, canceling, saving the status and		2
D3	The mental workload when using the service is low.		3
D4	The service rewards the user also personally		2
D5	I could recommend the service for other people/organizations.		3
D6	**What could be improved to make more value of the tool/service?**		

Dim.E (Learnability, memorability)		Total	2,0
Ref #	Question		Answer (0-4)
E1	It is easy to start using the service and to perform the main tasks.		2
E2	It is easy to learn new features/ functionalities.		2
E3	When coming back to an unfinished task, it is easy to remember / identify the actions needed.		2
E4	The service offers sufficient training support.		2
E5	**What could be improved to make more value of the tool/service?**		

Dim.F (Use preparation & maintenance)		Total	2,8
Ref #	Question		Answer (0-4)
F1	The take-up of the service does not require high preparation.		2
F2	Technical installation does not require specific setups or additional downloads.		4
F3	The data needed by the service exist in my company/network in the proper format and can be easily made		1
F4	The service can be easily customized/ configured to my environment/ network.		3
F5	The service can be easily shared in the network.		3

F6	The service does not require specific knowledge from the users.	1
F7	The service is easy to take up also for SMEs.	4
F8	The service does not require extensive change of business processes.	4
F9	The service does not require high maintenance.	3
F10	**What could be improved to make more value of the tool/service?**	

Dim.G (Suitability to network/collaborative environment)		Total	3,0
Ref #	Question	Answer (0-4)	
G1	The service supports collaboration and interoperability for my network.	3	
G2	The service is suitable for heterogeneous users and different networks.	3	
G3	The service takes into account safety and security.	3	
G4	The service usage does not require high negotiation or complex agreements in the network.	3	
G5	**What could be improved to make more value of the tool/service?**		

Non-fuctional Dimension	Results			
Dim.A (Effectiveness -- usefulness to the network/company)	2,3			TSS Results
Dim.B (Efficiency - performance of the service)	2,6		TSS Success	8
Dim.C (Understandability/simplicity)	2,4		TSS Partial	2
Dim.D (Satisfaction & Attractiveness)	2,6		TSS Fail	0
Dim.E (Learnability, memorability)	2,0			
Dim.F (Use preparation & maintenance)	2,8			
Dim.G (Suitability to network/collaborative environment)	3,0			
TOTAL	2,5			

Non functional evaluation - Test results

Functional evaluation - Test results

TREASURE Circularity Web Platform - Test Sheet

Test Case References

Test Case ID	CWP_DIS_UT_05	Components involved	TREASURE Circularity Web Platform, TREASURE Data Lake
Actors involved	Veronica Antonello (TXT) (business user)	Contact Point	Back-end: Giuseppe Maraviglia (giuseppe.maraviglia@txtgroup.com) Front-end: Mattia Calabresi (mattia.calabresi@txtgroup.com)
Short Description	Assess the presence of a pending request in the Requests section of the Disassemblability Dashboard		

Test Script

Access the TREASURE Circularity Web Platform
Login as an Editor Dismantler type of user
Switch to the "My requests" section
Assess the presence of the request created in test case CWP_DIS_UT_4

TSS_{success}	4		TSS_{partial}	1		TSS_{fail}		0

Functionalities	Expected Results	Passed	Remarks	Next step
Access to the Circularity Web Platform	Circularity Web Platform shows login page	YES	-	-
Login to the Platform	User successfully logged in	PARTIAL	Login took to long	Speed up login procedure
User redirected to home page	Home page correctly opened	YES	-	-
Select "My requests" section	Section loaded successfully	YES	-	-
Assess the pending request	Request is present and in "Pending" status	YES	-	-

Non-Functional Evaluation

Dim.A (Effectiveness -- usefulness to the network/company)		Total	3,0
Ref #	**Question**	**Answer (0-4)**	
A1	It is easy to **understand** the objective and benefit of the service to my organization/network.	3	
A2	The **outcome of the service** is important / useful for the company/network. The service creates **value** for my	3	
A3	It is easy to **achieve** the planned business objectives / perform the tasks with the service.	3	
A4	What could be improved to make more value of the tool/service?		

Dim.B (Efficiency - performance of the service)		Total	3,0
Ref #	**Question**	**Answer (0-4)**	
B1	The time and resources required to achieve the objectives with the service are reasonable/moderate.	3	
B2	The service runs fast enough.	3	
B3	The service does not require too many steps to achieve the result.	3	
B4	All the functions are beneficial for my company/ network.	3	
B5	The service structure allows flexible & fast performance of the tasks.	3	
B6	What could be improved to make more value of the tool/service?		

Dim.C (Understandability/simplicity)		Total	3,0
Ref #	**Question**	**Answer (0-4)**	
C1	The service structure and logic is easy and self-clear to understand and recognizable.	3	
C2	The concepts are understandable for my organization and in line with TREASURE terminology	3	
C3	The service offers sufficient guidance	3	
C4	The responses to user actions are understandable. The look and feel is self explanatory and follows the	3	
C5	The support to business processes / tasks is clear. The user can understand his/her role and the purpose of the	3	
C6	The service is simple enough for practical use. The tasks do not look complex to perform. It is clear what is	3	
C7	The output of the service is clear and understandable.	3	
C8	What could be improved to make more value of the tool/service?		

Dim.D (Satisfaction & Attractiveness)		Total	3,0
Ref #	**Question**	**Answer (0-4)**	
D1	The service is attractive to the user. I feel satisfied and comfortable when using the service.	3	
D2	I can keep the control of the service, for example by pausing& continuing, canceling, saving the status and	3	
D3	The mental workload when using the service is low.	3	
D4	The service rewards the user also personally	3	
D5	I could recommend the service for other people/organizations.	3	
D6	What could be improved to make more value of the tool/service?		

Dim.E (Learnability, memorability)		Total	3,3
Ref #	**Question**	**Answer (0-4)**	
E1	It is easy to start using the service and to perform the main tasks.	3	
E2	It is easy to learn new features/ functionalities.	3	
E3	When coming back to an unfinished task, it is easy to remember / identify the actions needed.	4	
E4	The service offers sufficient training support.	3	
E5	What could be improved to make more value of the tool/service?		

Dim.F (Use preparation & maintenance)		Total	3,4
Ref #	**Question**	**Answer (0-4)**	
F1	The take-up of the service does not require high preparation.	3	
F2	Technical installation does not require specific setups or additional downloads.	4	
F3	The data needed by the service exist in my company/network in the proper format and can be easily made	3	
F4	The service can be easily customized/ configured to my environment/ network.	3	
F5	The service can be easily shared in the network.	3	
F6	The service does not require specific knowledge from the users.	4	
F7	The service is easy to take up also for SMEs.	4	
F8	The service does not require extensive change of business processes.	4	
F9	The service does not require high maintenance.	3	
F10	What could be improved to make more value of the tool/service?		

Dim.G (Suitability to network/collaborative environment)		Total	3,0
Ref #	**Question**	**Answer (0-4)**	
G1	The service supports collaboration and interoperability for my network.	3	
G2	The service is suitable for heterogeneous users and different networks.	3	
G3	The service takes into account safety and security.	3	

G4	The service usage does not require high negotiation or complex agreements in the network.	3
G5	**What could be improved to make more value of the tool/service?**	

Non-fuctional Dimension   **Results**

Dimension	Results			TSS Results
Dim.A (Effectiveness -- usefulness to the network/company)	3,0			
Dim.B (Efficiency - performance of the service)	3,0	TSS Success	4
Dim.C (Understandability/simplicity)	3,0	TSS Partial	1
Dim.D (Satisfaction & Attractiveness)	3,0	TSS Fail	0
Dim.E (Learnability, memorability)	3,3		
Dim.F (Use preparation & maintenance)	3,4		
Dim.G (Suitability to network/collaborative environment)	3,0		
TOTAL	3,1		

Non functional evaluation - Test results

Functional evaluation - Test results