Deliverable D4.3

User interaction and user experience concept – v1

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Abstract:	Initial version of the report on the developed mock-ups for the user interaction und user experience concept.
Keyword List:	Paper-based mock-ups, Clickable mock-ups, User journeys
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Terms and abbreviations

AI	Artificial Intelligence
AI-SEC	AI Security Evidence Collector
AMOE	Assessment and Management of Organisational Evidence
BYOCS	Bring Your Own Certification Scheme
BSI	Bundesamt für Sicherheit in der Informationstechnik
CaaS	Certification-as-a-service
CISO	Chief Information Security Officers
CSP	Cloud Service Provider
DoA	Description of Action
EC	European Commission
ENS	Esquema Nacional de Seguridad
EUCS	European Cybersecurity Certification Scheme for Cloud Service
GA	Grant Agreement to the project
ICO	Internal Control Owner
KPI	Key Performance Indicator
MARI	Mapping Assistant for Regulations with Intelligence
NLP	Natural Language Processing
OSCAL	Open Security Controls Assessment Language
RCM	Repository of Controls and Metrics
TWS	Trustworthiness System
UI	User Interface
UX	User Experience

Executive Summary

The EMERALD UI/UX (user interface/user experience) offers the user interface (UI) and user experience (UX) to address (CaaS) and its continuous and lean re-certification aspects with a focus on the pilot partners and component owner's needs. The goal certification-as-a-service is to develop an integrated and fully-fledged UI/UX for EMERALD.

This deliverable D4.3 is related to *WP4 - User interaction and user experience development* and presents first results regarding *T4.3 - Designing a user interaction and user experience concept.* The document describes the applied methodology for deriving the user interaction concept and the user interface by considering the needs from the pilot partners as well as the component owners. The deliverable presents two sets of paper-based mock-ups followed by a first version of the clickable mock-ups of the EMERALD UI/UX.

In more detail, this deliverable presents the following results:

- **Paper-based mock-ups**: two sets of paper-based mock-ups are presented:
  - First, we present a set of **paper-based mock-ups** that was derived **from the interviews and focus groups** conducted in T4.2 (see Deliverable 4.1 [1] for details).
  - Second, we present of a set of **paper-based mock-ups** derived from the personas (see Deliverable 4.1 [1]) and the interactions with the EMERALD UI derived from **user journeys**.
- **Clickable mock-ups**: We present the initial version of the **clickable mock-ups** for **the integrated EMERALD UI** considering the needs of the pilot partners as well as of the component owners.

In the upcoming months, we will continue with the development of the clickable mock-ups of the EMERALD UI building upon iterative co-design activities with the pilot partners, as well as with the component owners. Therefore, a subsequent version of this document (D4.4 - User interaction and user experience concept– v2) will be released in M24, where the final results of T4.3, i.e. the final clickable mock-up of the EMERALD UI/UX, will be presented.

1 Introduction

The EMERALD UI/UX offers the user interface (UI) and user experience (UX) to address certification-as-a-service (CaaS) and its continuous and lean re-certification aspects with a focus on the user's needs. The user experience (UX) is the overall experience a user has when interacting with a product, focusing on understanding their needs, behaviours, and pain points. It aims to design intuitive, efficient, and satisfying experiences through factors like usability, accessibility, information architecture, and interaction design. UI, on the other hand, deals with the visual and interactive aspects of a product, such as layout, typography, buttons, and colour schemes. Its goal is to create an appealing and easy-to-navigate interface, helping users quickly find what they need and complete tasks efficiently.

This deliverable describes the methodology and the individual steps taken to derive a first set of paper-based and clickable mock-ups for the integrated EMERALD UI/UX. Different methods were applied and different activities and workshops were conducted bringing together the insights gained from the EMERALD pilot partners and the EMERALD component owners. The goal of the EMERALD UI is to provide the EMERALD target users a seamless user experience for continuous auditing in the cloud cybersecurity domain, offering easy-to-use and explainable workflows to support the auditors' work and the audits conducted.

Section 1 sets this deliverable in the context of the overall EMERALD project, presents the goal of the deliverable, as well as the target audience and the document structure. This deliverable summarizes the initial results of task *T4.3 - Designing a user interaction and user experience concept*, which will continue until M24 of the project. The final result of T4.3 will be presented in D4.4 [2] in M24.

1.1 About this deliverable

This deliverable is related to the project's key results (KR6), defined in the DoA [2] as:

"KR6: EMERALD UI/UX - User experience for complexity reduction: *A user interaction concept and conducted studies to show what information each user needs in an audit process. The concept shall lead to a user interface (UI), which is tailored to the users' needs during all stages of an audit and guides them through the process of identifying problems top down – from high level requirements down to specific implementation in documents (e.g., policies) or technical specifications."*

This deliverable summarizes the first results tailored to reach key result KR6 of the project. It presents the methodological approach taken to develop an integrated user interface for EMERALD and presents first concrete outcomes regarding *T4.3 - Designing a user interaction and user experience concept*. These outcomes consist of paper-based and clickable mock-ups on how the EMERALD UI/UX should look like, covering the perspectives of the pilot partners as well as the component owners of EMERALD. All presented results are preliminary and will be continuously further developed, updated, and validated until M24 of the project.

Different methods have been used and applied for developing the EMERALD UI, consisting of three major iterative approaches and following a co-design, participatory, and contextual design approach:

- **Interviews with the pilot partners**: A series of interviews and focus groups with the pilot partners was conducted to derive insights about the working processes and tasks in the respective companies. From the insights gained, a first set of paper-based mock-ups was developed.

- **Development of Personas, Scenarios and User Journeys**: Different workshops with project partners were conducted for developing personas, scenarios, and user journeys. Especially the user journeys were used for developing concrete interactions of a respective persona with the EMERALD UI to fulfil specific tasks. The insights from the user journeys helped to improve the paper-based mock-ups.
- **Individual workshops with the component owners:** Different workshops were conducted with the individual EMERALD component owners to investigate which information the different components offer and how to integrate them into the EMERALD user interface. The paper-based mock-ups were used as baseline, and after having discussed them the first clickable prototype of the EMERALD UI was developed.

The target audience of this deliverable is twofold:

- First, all EMERALD partners: The pilot partners, as their employees including compliance managers, internal control owners and auditors, are the target groups of the EMERALD project. The technical partners, because their components and the corresponding outputs will be connected to and presented in the EMERALD UI.
- Second, this document is also targeted to the broader EMERALD target users (e.g., potential end-users, strategic partners, communities, or policymakers) who are interested in socio-technical design, co-creation, and co-design. For them, it will provide some guidance and concrete examples on how to elicit knowledge from people with different backgrounds (e.g., interviews, focus groups), and derive mock-ups that are iteratively refined with the target users. It shows how to carry out a user interface development process that corresponds to the needs and wishes of the target users.

The goal of this deliverable is to present the applied methodology conducted so far, as well as the initial versions of paper-based mock-ups. Furthermore, it provides a first version of a clickable prototype for the EMERALD UI.

1.2 Document structure

The document is structured as follows: After the introduction section (Section 1), Section 2 presents the overall methodology used for fulfilling the objectives of Tasks 4.3, and includes separate sub-sections for each step of the methodology taken to describe the different phases of the development of the EMERALD UI/UX. The subsequent sections – Section 3, Section 4, and Section 5 - present the detailed results.

Section 3 presents the first paper-based mock-ups that were derived from the interviews and focus groups conducted with the pilot partners. Section 4 presents a short summary of the first set of personas and scenarios, followed by a detailed description of the developed user journeys, including the interaction of the personas with an EMERALD UI. Thereupon a set of paper-based mock-ups were developed. Section 5 presents a summary of the workshops conducted with the individual EMERALD component partners and the resulting first clickable prototypes.

Finally, Section 6 concludes the report and presents the next steps.

In addition, *APPENDIX A: Mock-ups derived from the interviews* and *APPENDIX B: Mock-ups derived from the user journeys* contain further developed the paper-based mock-ups.

2 Methodology

The overall methodology of WP4 follows a co-design, participatory and contextual design approach (see [3], [4], [5], and [6]) using different methods such as interviews, workshops, and mock-up development. A co-design strategy like this seeks to close the communication gap between target users, technology developers, and designers. This method, which came forth as a result of designers and end users working together, moved the emphasis from just making things to taking care of users' requirements [6]. Similar ideas are emphasized by terms like "co-design", "participatory design" and "contextual design", which emphasize the active participation of all stakeholders to satisfy organizational and individual goals [7], in accordance with software developers. Giving end users a voice during the software development they are going to use can be seen as an emancipatory act [6]. Co-creation involves shared creativity [5], while co-design applies this creativity throughout the entire design process [5]. Throughout the whole development process, active user participation is encouraged, creating a hybrid space that combines users' and developers' knowledge and feedback. This shift from "user as subject" to "user as partner" has changed stakeholder roles [5], with users potentially becoming meta-designers and researchers acting as facilitators. Co-design is characterized by iterative learning processes involving all relevant stakeholders, in our case the pilot partners (as end-users) and the component owners (as software developers).

The application of co-design as the overarching technique for WP4 activities was viewed as a feasible way to close the gap between the EMERALD pilot partners and technology partners in order to create an advanced EMERALD UI/UX that satisfies their respective needs. The overall goal is to have a fully developed user interaction and user experience concept that can be validated regarding its usefulness and acceptance together with the target groups.

Figure 1 presents the methodology applied for developing the EMERALD UI so far. The first mock-ups were developed with the insights gained from the pilot partners – the EMERALD target users. These mock-ups were then iteratively defined with the component partners – the EMERALD technology partners. In more detail:

- **Pilot partners**: In spring 2024, we conducted a series of interviews with the pilot partners (see D4.1 [1]). From these interviews, a first set of paper-based mock-ups were developed (see Section 3). These paper-based mock-ups were then used in the first Persona, Scenario, and User Journey Workshop to develop concrete User Journeys for three personas. After the workshop, the paper-based mock-ups were reworked, and new mock-ups were developed so that the EMERALD can fulfil the activities developed in the workshop (see Section 4).
- **Component owners**: Subsequently, a series of workshops was conducted with the individual component partners of EMERALD. Two workshops were conducted with each component partner. In the first workshop, the EMERALD component was presented followed by a discussion on how to integrate the component into the EMERALD UI. Based on these discussions, the existing paper-based mock-ups were elaborated in-depth and implemented in Figma[1] (see Section 5).

[1] Figma: https://www.figma.com

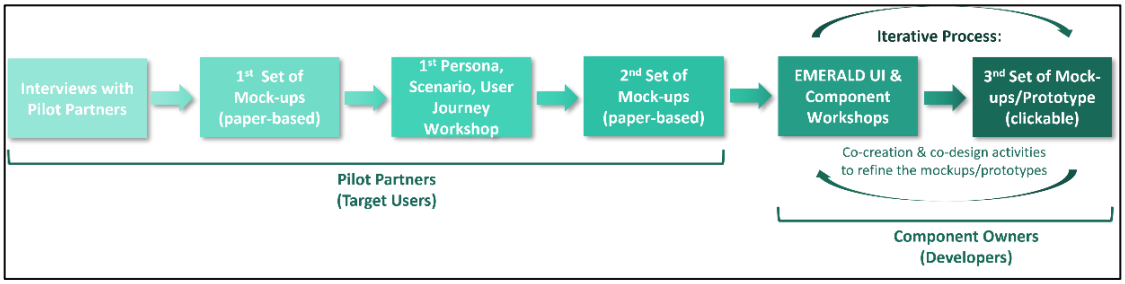

Figure 1. Overall Methodology used for developing the EMERALD UI

Mock-ups & Prototypes: Mock-ups were used in industrial design long before they were used in software design processes [8]. In the middle of 1990s, a number of well-known companies adopted paper prototyping in their product development process [9]. Prototypes were already taken into consideration by Floyd [10] as a way to help software developers and customers communicate and provide feedback, and by Ehn [11], who regarded prototypes as a way to help designers as well as a way to involve non-experts in the design process. According to Bødker and Grønbaek [7], the goal of cooperative prototyping is to start a design process where users and designers actively and creatively work together to create a prototype, with the goal of giving users the chance experiment with it and to try it out.

In software development, mock-ups and clickable prototypes are essential tools that facilitate the visualization and testing of a product before full-scale development [9]. Mock-ups are static representations of a user interface, providing a detailed visual design without interactive elements. They help stakeholders and developers understand the look and feel of the final product. Clickable prototypes, on the other hand, are interactive models that simulate the user experience by allowing users to click through the interface as they would in the final product [12]. These prototypes are crucial for usability testing, enabling early detection and resolution of potential issues. Utilizing these tools not only improves communication among team members but also accelerates the development process by providing clear guidance and reducing the need for extensive revisions.

2.1 Interview with Pilot Partners

The overall goal of the interviews is to elicit requirements for the EMERALD UI/UX from our target groups, i.e., (internal) auditors, chief information security officers (CISO), compliance managers, etc. With the interviews, in-depth insights about the target users working tasks and activities in relation to continuous cloud auditing processes were elicited. Thus, we aimed to get: i) a good understanding of the work of our target users in general, ii) activities and tasks relevant to the certification process of cloud computing systems, iii) insights on how EMERALD could support these working activities, iv) insights about the target users' expectations regarding the EMERALD UI, v) insights about existing pain points, and vi) insights about the users' background knowledge, especially regarding artificial intelligence (AI) (as some parts of EMERALD will use AI technologies).

After having analysed the interview results, the first set of work processes were derived, and an initial set of requirements was developed – more details can be found in D4.1 [1]. Moreover, a first set of paper-based mock-ups were created that served as initial starting point for the future EMERALD UI/UX.

A detailed description about the interviews, the derived work processes and the corresponding UI/UX requirements can be found in D4.1 [1].

2.2 Personas, Scenarios, and User Journeys Workshops

Based on the insights gained from the interviews and the focus groups, e.g., what the audit preparation processes and audits in general look like, which persons and roles are involved in these processes and what information is needed, a first *Personas, Scenarios, and User Journey* workshop was organised. Table 1 gives an overview of the conducted and planned workshops. The goal of these workshops was to develop detailed personas, scenarios, and user journeys on how the target groups will use the EMERALD UI/UX and which functionalities should be available. Details about the developed Personas and Scenarios can be found in D4.1 [1].

Table 1. List of the Personas, Scenarios and User Journeys Workshops

Participants	Part I	Part II	Place
Pilots (round 1)	05.06.2024	12.06.2024	Online (MS Teams)
Pilots (round 2)	07.10.2024		Online (MS Teams)

In part II of round 1 of the *Personas, Scenarios, and User Journey* workshops, three User Journeys were developed for the three personas and scenarios developed so far.

After having created personas and scenarios, user journeys can be easily developed [13]. User journeys illustrate how a user interacts with a system step-by-step, incorporating their emotions to identify the needs of the intended application or tool. User journeys help designers and businesses understand the user's needs, motivations, and potential pain points throughout their interaction. This visual representation can highlight gaps in the user experience, leading to targeted improvements in functionality and satisfaction. By employing techniques like journey mapping organizations can better empathize with users and refine their offerings to enhance usability and engagement ([14], [15]). Consequently, well-crafted user journeys are instrumental in fostering user-centric development and driving successful outcomes.

2.2.1 Procedure

To invite participants to the workshop, we contacted the pilot partners and all members of WP4 and WP5 by email. The Personas & Scenarios Workshop was conducted online using MS Teams. To facilitate collaboration, we used Miro[2], an online collaborative whiteboard.

The workshop was conducted on two different days, i.e., in two parts (see Table 1). In the first part of the workshop, four different personas were developed. In the second part of the workshop, for three out of four personas, concrete scenarios were developed. More information about the personas and the scenarios can be found in D4.1 [1].

The second part of the workshop was attended by 9-11 participants. After the development of the three scenarios for the personas Emerson, Dylan, and Charlie, three corresponding User Journeys were developed. To do so, we asked the participants to divide each scenario in individual steps. For each of these individual steps, the participants were asked to describe the interactivity of the persona with the EMERALD UI. For this task, they should consider the prepared paper-based mock-ups – either as inspiration for the interaction with the EMERALD UI or to add concrete suggestions or ideas of how the EMERALD mock-ups should be further developed or which functionalities to add. To guide the development of the User Journeys, we developed a template – see Figure 2 – consisting of three parts:

[2] https://miro.com/

- Scenario steps: the upper part of the template allows to split the scenario into different steps (see Figure 2, point 1).
- Interaction with the EMERALD UI: For each step of the scenario, a description of the interaction with the EMERALD UI should be added (see Figure 2, point 2).
- Mock-ups: Below we have added some mock-ups that might fit to the corresponding scenario (see Figure 2, point 3).

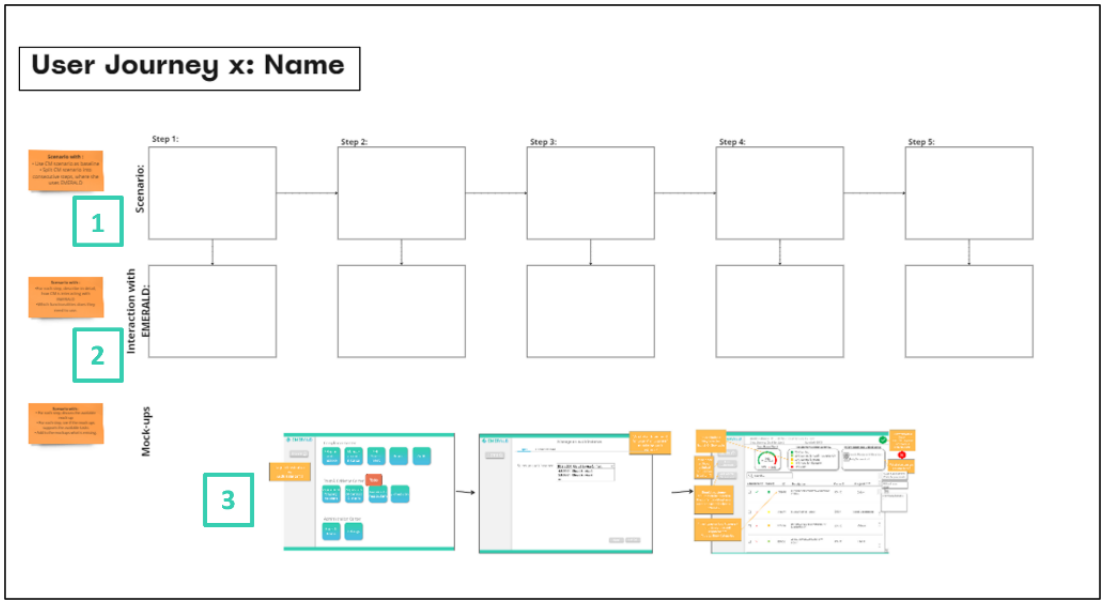

Figure 2. Template for developing the user journeys

The resulting User Journeys for the three personas are presented in detail in Section 4.

2.3 EMERALD UI & Component Workshops

After having done a set of interviews and focus groups with the pilot partners, and after having done a first workshop on Personas & Scenarios, and especially User Journeys, we set up a workshop series with all EMERALD component owners (see Table 2). The goal of this workshop series is to find out how to integrate all EMERALD components into the EMERALD UI.

Table 2. Overview of the workshops: EMERALD UI & Components

Component	Part I	Part II	Part III
AMOE	31.07.2024	22.08.2024	
Clouditor-Orchestrator	31.07.2024	11.10.2024	
MARI	23.07.2024	09.10.2024	17.10.2024
RCM	24.07.2024	10.09.2024	
TWS	01.08.2024	26.08.2024	
eknows / Codyze	09.10.2024	Not planned yet	
AI-SEC / Clouditor-Discovery	Not planned yet	Not planned yet	

2.3.1 Procedure

To set up the workshop series, we sent out an invite to all EMERALD project partners. We asked them to fill in a Doodle to schedule two dates for each component. The first workshop date for each component meeting (Workshop – Part I) was set for the last two weeks of July and beginning of August 2024. The second workshop series (Workshop – Part II) took place

end of August and mid of September 2024. In all workshops, we used Miro[3] as an online collaborative whiteboard.

Workshop (Part I): Each workshop followed the same structure. At the beginning of each workshop, we presented the goal of the workshop namely to find out how to integrate the EMERALD component into the EMERALD UI. For each of the components we have created a Miro board with three different frames as presented in Figure 3. In the first Miro frame, we shortly summarized the purpose of the respective component. In a first discussion round we discussed with the component owner the respective component to see if we have understood its purpose correctly or if something was missing. Subsequently we discussed with the component owner how to integrate the component into the UI from two perspectives – the first one was about how to set-up the component (if necessary) and the second one was about the integration of the component into the UI when working with it.

- "Set-up" of the component: In the second frame of the Miro Board, we made available predefined mock-ups of the EMERALD landing page, possibilities to set up EMERALD as well as neutral mock-ups. Then we discussed with the component owner step-by-step what was needed for setting up the component (if necessary) asking questions such as: Which information is needed to set up the component? Which information should be presented in the UI? Which functionality should be offered by the UI?
- "Working" with the component: In the third frame, we added on the one hand mock-ups we have prepared regarding how we thought the component could be integrated into the UI. On the other hand, we again added empty mock-ups to leave room for innovation and creativity. Again, we asked similar questions regarding the visualisation and functionality.

[3] Miro: https://miro.com/

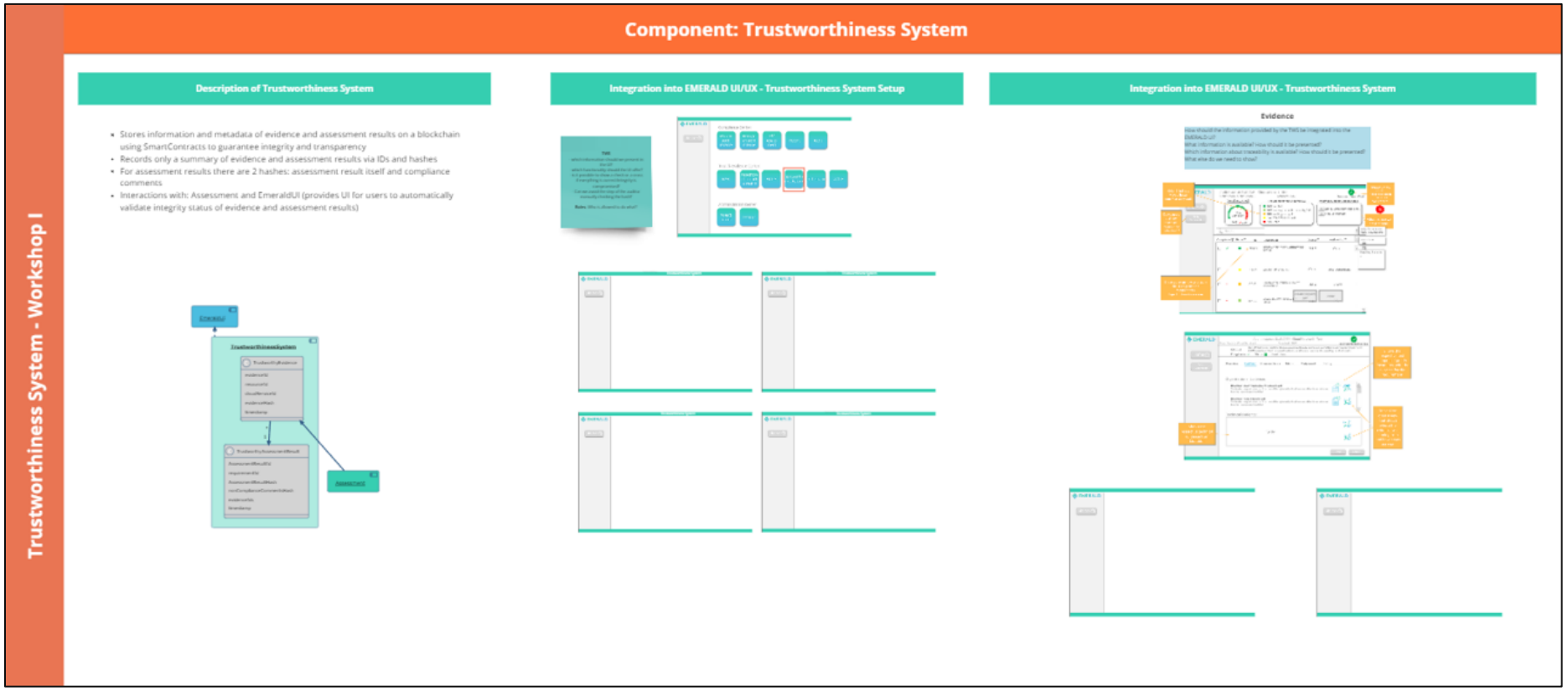

Figure 3. Example of a prepared Miro board for TWS with the three different frames

Workshop (Part II): The goal of each follow-up workshop was to present the created clickable prototypes developed in Figma[4] to discuss if they work in a way that is in line with what the component owners would like to have and if the prototype fulfils all required functionalities. Similar to the first workshop, we first presented the results from two perspectives – the set-up phase (where applicable) and the working phase. As those phases are strongly dependent on the different components, the workshops were tailored to the component owner's needs and the component's integration into the UI. For example, to set up a cloud service, registered evidence extractors need to be added to the cloud service to retrieve the assessment results from *Clouditor-Orchestrator*. For *AMOE* no set-up is necessary, and it must be possible to upload the respective policy documents for the different controls or schemes.

2.4 EMERALD Terminology

During the development of the paper-based and clickable mock-ups, the consortium discussed and unified the naming convention for the whole EMERALD project. "Certification target" is a (cloud) service that will be certified according to a specific certification scheme; it represents what a system or service does and how it does it (including the architecture). "Audit scope" (previously called audit instance) is a detailed description of what will be audited; it consists of a combination of the certification target and a respective certification scheme. More information about the EMERALD terminology can be found in D1.3 [16].

As the development of the EMERALD terminology took place after the development of the first paper-based mock-ups, the paper-based mock-ups presented below (Section 3 and 4) contain the previous terminology – namely "audit instance" (instead of audit scope). The clickable mock-ups (Section 5) contain already the correct EMERALD terminology.

[4] Figma: https://www.figma.com

3 Mock-ups derived from Interviews with Pilot Partners

In the context of WP4, we have conducted different types of interviews. On the one hand, we conducted an interactive interview session with all pilot partners at the general assembly in Bilbao (March 2024). The goal of this session was to get insights about the pilot partners, their pain points and needs during the set-up and conduction of audit processes, and to get first ideas or insights where the EMERALD UI could support them. On the other hand, we conducted interviews with all pilot partners individually. The goal of these interviews was to elicit in-depth insights about the work of auditors (A), compliance managers (CM), and (chief information) security officers (CISO) in relation to continuous cloud auditing processes. From these, we were able to derive concrete work processes and 17 initial requirements (as presented in D4.1 [1]) for the development of the EMERALD UI/UX.

More information about the interactive interview session and the interviews conducted with the pilot partners was presented in D4.1 [1].

Based on the insights gained from the different types of interviews, as well as the derived UI/UX requirements, we derived a first set of paper-based mock-ups. These mock-ups were drawn with PowerPoint to get a first impression of how the EMERALD UI/UX could look like and which functionalities should be available.

Altogether, we were able to create around 20 mock-ups consisting of the following parts:

- **EMERALD Look & Feel:** Before starting with the development of the mock-ups, we developed an initial EMERALD Design, as depicted in Figure 4, which was then used throughout all the mock-ups.
- **EMERALD Landing Page:** We developed a first version of how the EMERALD Landing Page could look like, as depicted in Figure 5.
- **Set-up an audit scope**: We drew a first mock-up about how an EMERALD audit scope (previously called target of evidence) could be set up, as shown in Figure 6.
- **Overview of an audit scope**: After having created an audit scope, we prepared some mock-ups of what the audit scope overview page might look like as, presented in Figure 7.
- **Managing individual controls**: We developed a mock-up showing the respective information per control, including an overview of the control, evidence, non-compliance, metric, assignment, and history, as presented in Figure 8.

Be aware, that in this first set of mock-ups only the needs of the pilot partners were considered. Up to this point, we had not talked in detail with the component owners, consequently these mock-ups did not yet represent the needs of each component, nor their functionalities and features. This means that the mock-ups presented below were not completed and needed further refinements and continuous design iterations.

Figure 4 presents the first idea of the EMERALD design, considering the overall EMERALD project design and the colour palette designed of the project.

Figure 4. Paper-based Mock-ups - EMERALD Design

Figure 5 presents the landing page which should provide direct access to the most relevant functionalities and features of EMERALD, including the respective EMERALD components. In the first draft, we added all EMERALD components explicitly here, however, as the EMERALD

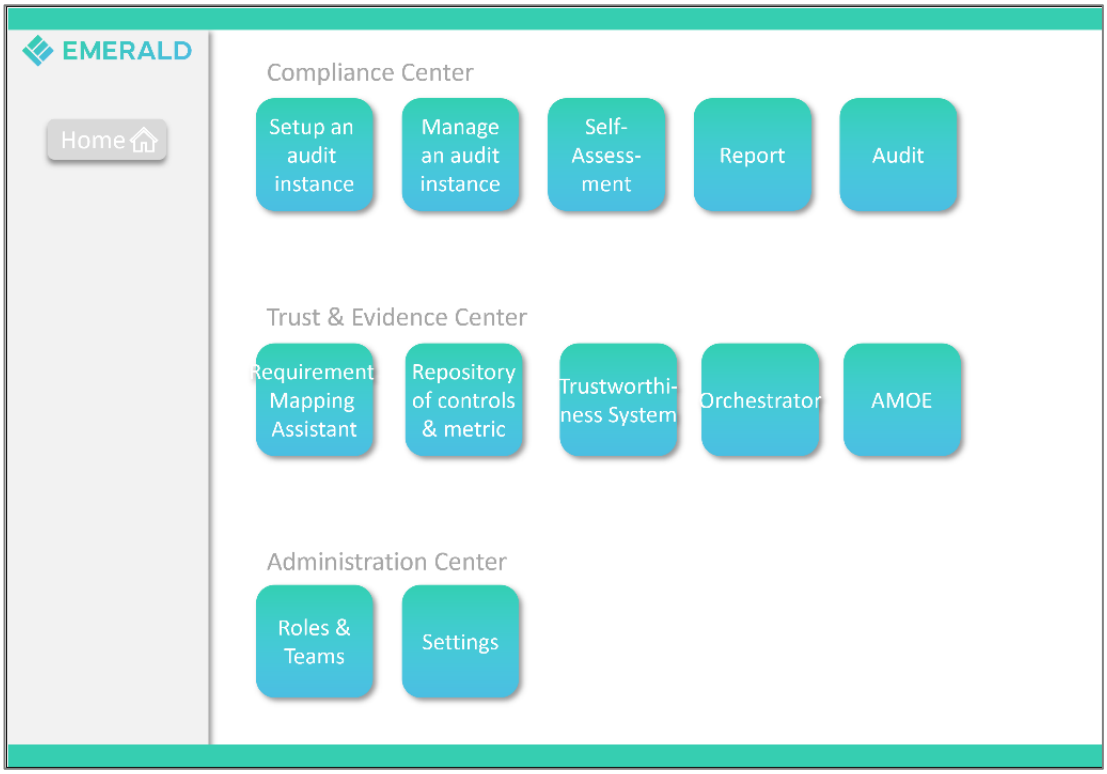

Figure 5. Paper-based Mock-ups - EMERALD Landing Page

UI should be an integrated UI including all EMERALD components, this would be changed.

Figure 6 shows the initial version of how-to setup an audit scope (still called “audit instance” in the mock-up). In addition to naming the audit scope, it allows the user to select a predefined cloud service and the respective certification scheme (still called “standard” in the mock-up). Furthermore, it is possible to upload policy documents. What is missing is the relation to the technical evidence, which would be addressed at a later stage.

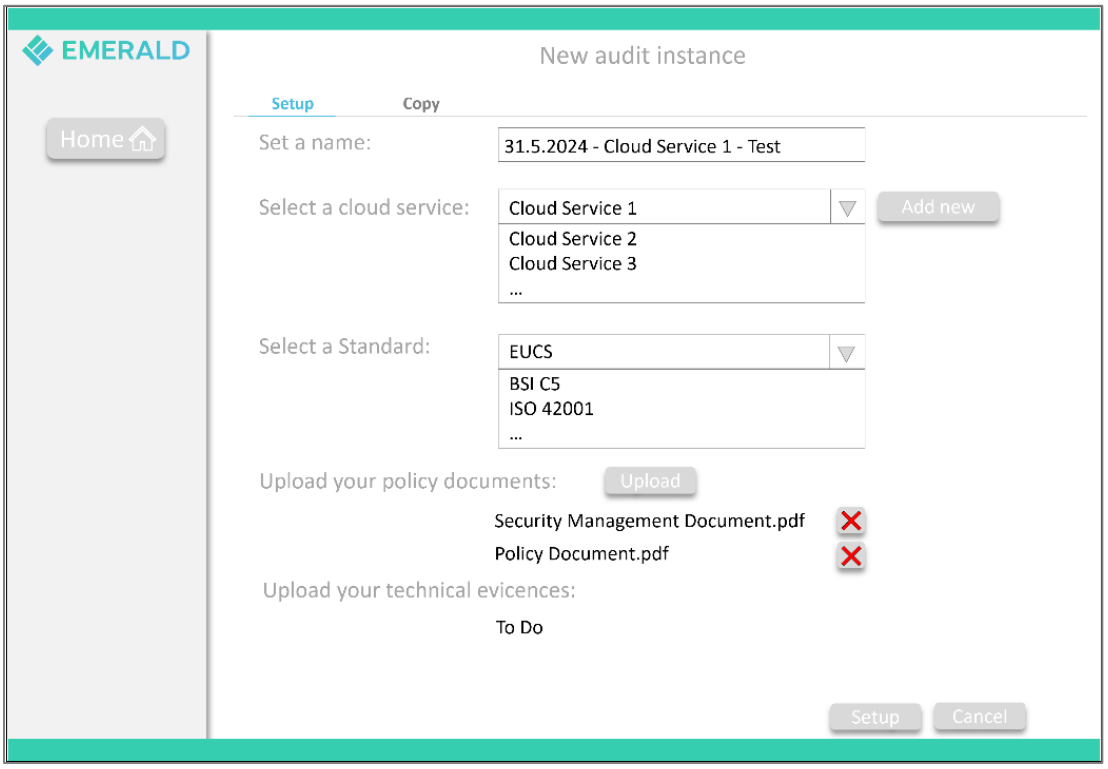

Figure 6. Paper-based Mock-ups - Setup of a new audit scope

Figure 7 shows what the overview page for an audit scope might look like. On top it presents information regarding the audit scope, the selected certification target (still called “cloud service” in the mock-up), the certification scheme (called “standard” in the mock-up) and the assurance level. Below it provides some boxes with overview information about the compliance and non-compliance states across all controls, general status information about the individual controls as well as a box regarding the upload of the policy documents. Below it presents a search bar allowing to search for specific controls and then presents a list of the categories and controls of the respective certification schemes, functionalities for filtering the list and accessing the individual controls.

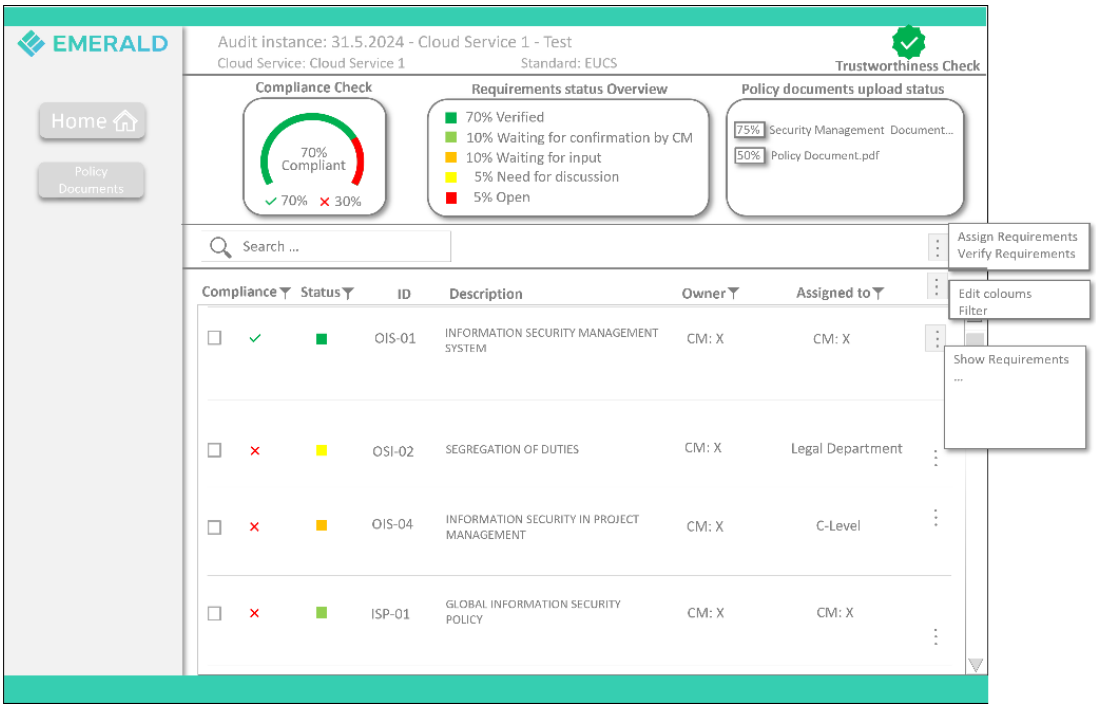

Figure 7. Paper-based Mock-ups - Audit scope overview

Figure 8 presents a detailed view of a control. Information about the audit scope and the control are on top of the mock-up. Below a user can switch via several “tabs” to the different information including: i) overview of the control - presenting some general information, ii) evidence – showing the pieces of evidences extracted for the control, iii) non-compliance – if this control would be non-compliant, the reasons would be presented here, iv) metric information – presents which metrics were assigned to the control, v) assignment information – showing information on who is responsible for the control, vi) and a history – showing how the implementation of the control has evolved over time.

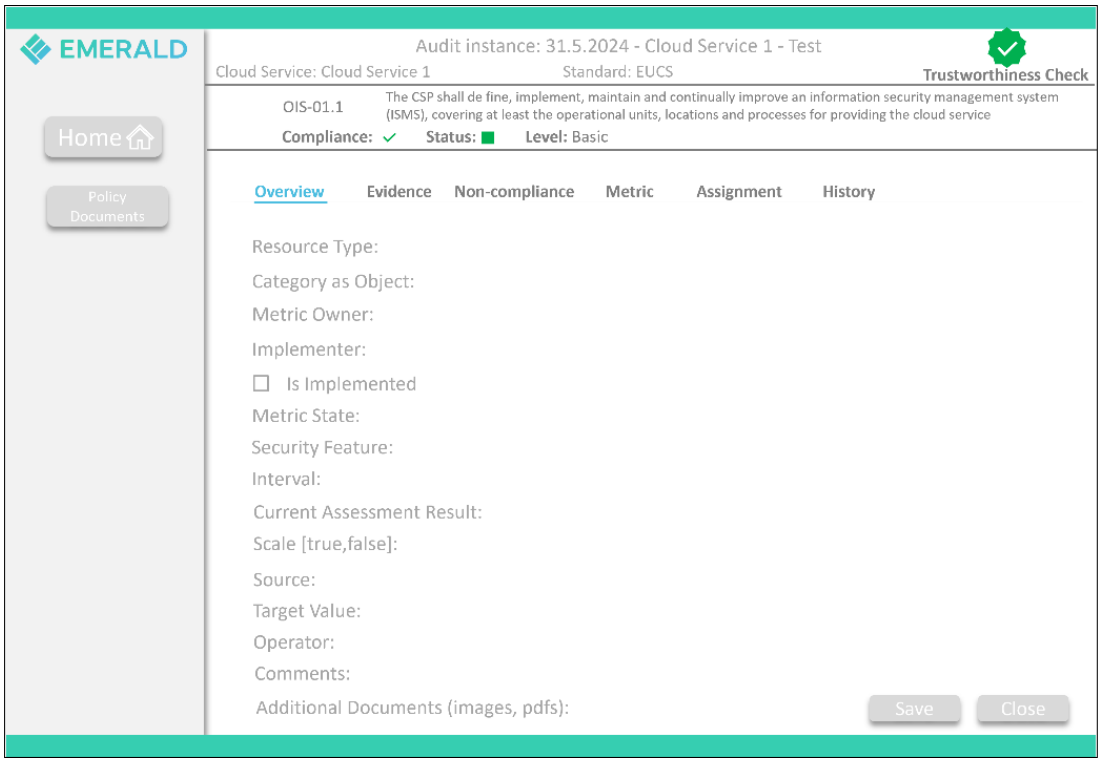

Figure 8. Paper-based Mock-ups - Show information about a control

Further mock-ups can be found in the *APPENDIX A: Mock-ups derived from the interviews*.

4 Mock-ups developed with the User Journeys

The first *Personas, Scenarios, and User Journey* workshop was conducted in June 2024. This workshop was divided into two parts. In the first part (05.06.2024) four personas were developed, in the second part (12.06.2024), three concrete scenarios and corresponding user journeys were developed.

4.1 Summary of Personas and Scenarios

In this section, a short summary of the developed personas and scenarios are presented. The detailed results of the developed personas and scenarios are reported in D4.1 [1].

In the first part of the workshop, four different personas were developed, which are summarized below:

- **Emerson – Compliance Manager in Financial Services Institution**: Emerson focuses on risk management of third-party cloud services, assesses controls based on risk and regulation, manages contractual agreements, and monitors compliance. The overall goal of Emerson is to ensure i) that all service providers are compliant with given standards, and ii) safety by mitigating risks associated with audit requirements. Challenges refer to the communication across departments. EMERALD could help in the day-to-day tasks by providing a centralized point for evidence, metrics, and controls, by automating tedious processes and management of numerous audits and reducing the workload.
- **Riley – Cloud Service Compliance Manager**: Riley is a junior compliance analyst whose responsibilities are organizing audits and managing the scheduling of different compliance schemes. Riley's goals are to support the company in being trustworthy, perfecting audit processes, being up to date with security standards, and performing tasks more efficiently. Riley's pain points refer to i) reliance on others to finish tasks timely, ii) lack of efficient audit tools, and iii) lack of understanding of complex certification frameworks. EMERALD should help Riley with the day-to-day tasks by speeding up the work.
- **Dylan – Internal Control Owner**: Dylan is an experience product owner and is responsible for leading the head of production team and overseeing and planning product development and backend services. Regarding audits, Dylan's tasks consist of defining metrics, collecting evidence for controls, assigning and delegating control implementation to the team aiming at having no non-compliance for all services. EMERALD could help Dylan by allowing to i) simply delegate tasks, ii) provide an overview of assigned controls and iii) display assessment results.
- **Charlie – Internal Auditor**: Charlie is a senior auditor, and Charlie's responsibilities include managing the audit process, planning, reporting, and maintaining contact with customers. Charlie offers templates to the customers/colleagues with the goal to i) provide easy access to information/evidence, ii) reduce risks, iii) fulfil audit KPIs, and iv) help customers. Challenges refer to getting in contact with the responsible person and retrieving the relevant information. The EMERALD UI could help by providing an overview of the required information and support the creation of respective reports.

In the second part of the workshop, three different scenarios were developed for Emerson, Dylan, and Charlie, which are summarized as follows:

- **Scenario 1: Emerson – Bring Your Own Certification Scheme**: In this scenario, Emerson is tasked with creating a custom certification scheme by selecting and combining controls from existing schemes (e.g. EUCS, BSI C5), a process referred to as

"Bring Your Own Certification Scheme" (BYOCS). After being informed that Department X has chosen a new cloud service provider, XYZ, Emerson creates an audit scope in EMERALD to manage the certification process using the newly defined scheme for this provider. Emerson then uploads relevant documents and uses EMERALD's user interface to filter, review, and assess the status of all certification controls, identifying which ones need attention and which are already compliant.

- **Scenario 2: Dylan – Internal Control Owner Requirement Implementation** Dylan uses the EMERALD UI to assess an open control and assigns it to a colleague Y. Y selects a set of metrics that matches the controls, implements the control, and informs Dylan via the EMERALD UI that the metric was implemented. Dylan checks whether the metric has been implemented correctly.
- **Scenario 3: Charlie – Preparation of an Audit by an Internal Auditor**: Charlie would like to review all controls of an audit scope that are marked as non-compliant according to their compliance status. Charlie has a closer look to the reasons of non-compliance for the respective controls so that the compliance manager can be informed. Afterwards Charlie creates an internal report for the compliance manager with EMERALD.

4.2 User Journeys and Mock-ups

Based on the personas and scenarios, user journeys were developed. To do so, each scenario was divided into different steps. Thereby, each step was divided into two sections. The first section consists of the description of the task the persona would like to do according to the scenario. And the second section describes the desired interaction with the EMERALD UI, including the relevant functionalities that the EMERALD UI should offer to be able to conduct the task.

In the following sections, we first describe in detail the user journey, and then the resulting paper-based mock-ups.

4.2.1 User Journey 1: Emerson – Bring your own certification scheme.

The scenario for Emerson was divided into the following six step, as depicted in Figure 9. For each step, first Emerson's task is described and then the interaction with the EMERALD UI.

Step 1:

- **Emerson's Task**: One day, Emerson was informed by their superior that the X Department had decided to acquire a new cloud service provider for one of their services – namely XYZ.
- **Interaction with the EMERALD UI**: no interaction required.

Step 2:

- **Emerson's Task**: Emerson builds up a new certification scheme based on the combination of regulations that the institution needs to be compliant with ("Bring Your Own Certification Scheme -BYOCS-" option). Emerson selects the set of controls from the available certification schemes. Emerson would also like to define their own controls.
- **Interaction with the EMERALD UI**: Emerson enters the EMERALD tool, selects the certification schemes tab, chooses the "new certification scheme" option, and enters a name for it. Emerson then selects a list of controls from different certification schemes. Additionally, Emerson also wants to define their own controls. Then they save the scheme.

Step 3:

- **Emerson's Task**: Emerson creates an audit scope that will be used for managing cloud solutions and the respective BYOCS standard.
- **Interaction with the EMERALD UI**: Emerson goes to EMERALD tab for creating a new audit scope (target of evaluation) and selects the previous tailored certification scheme of Step 1.

Step 4:

Emerson's Task: Emerson opens the EMERALD solution, selects the audit scope and the XYZ cloud solution to be audited, and uploads all relevant documents (and links, ...) to be able to get the respective evidence for some of the controls.

- **Interaction with the EMERALD UI**: Emerson selects the audit scope and the provider XYZ and starts uploading evidence.

Step 5:

- **Emerson's Task**: Emerson's task is now to go through all controls to check if all of them can be met with some evidence (technical or organisational).
- **Interaction with the EMERALD UI**: Emerson goes to EMERALD UI and visualizes the evidence linked with the control and the overall compliance in a first automatic iteration.

Step 6:

- **Emerson's Task**: Emerson goes to the EMERALD UI to check the status of the controls regarding evidence and status. Emerson uses different functionalities available in the EMERALD UI like to filter controls and uses different visualisations of the overall status of all controls, etc., to find out which controls need some treatment, and which are already ok.
- **Interaction with the EMERALD UI**: Emerson goes to EMERALD UI and visualizes, filters, and manages the controls. Emerson can also extract metrics. Furthermore, from this view, Emerson must be able to follow the whole process to understand the decisions made.

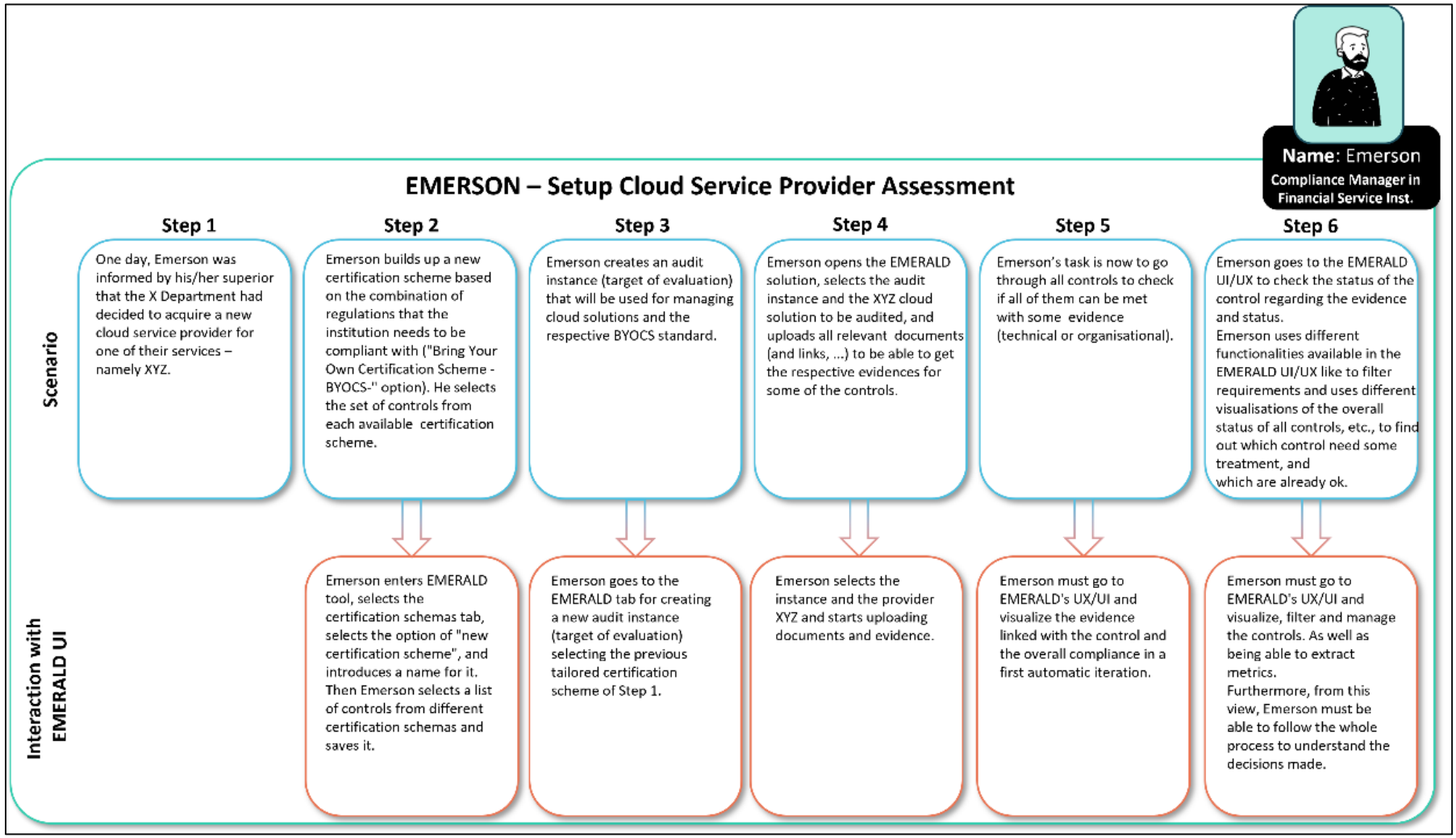

Figure 9. User Journey 1: Emerson – Bring your own certification scheme

4.2.1.1 Mock-ups: Emerson – Bring your own certification scheme

Based on the user journey, we have created a set of mock-ups that maps parts of the user journey to the mock-ups. In the case of user journey 1, we present the mock-ups for creating a new certification scheme (Step 2), where Emerson can select different controls from different schemes. Additionally, the mock-ups present how to select for a new audit scope the newly developed scheme (Step 3).

Figure 10 shows that an BYOCS ("Bring your own certification scheme") was added to the landing page of the EMERALD UI.

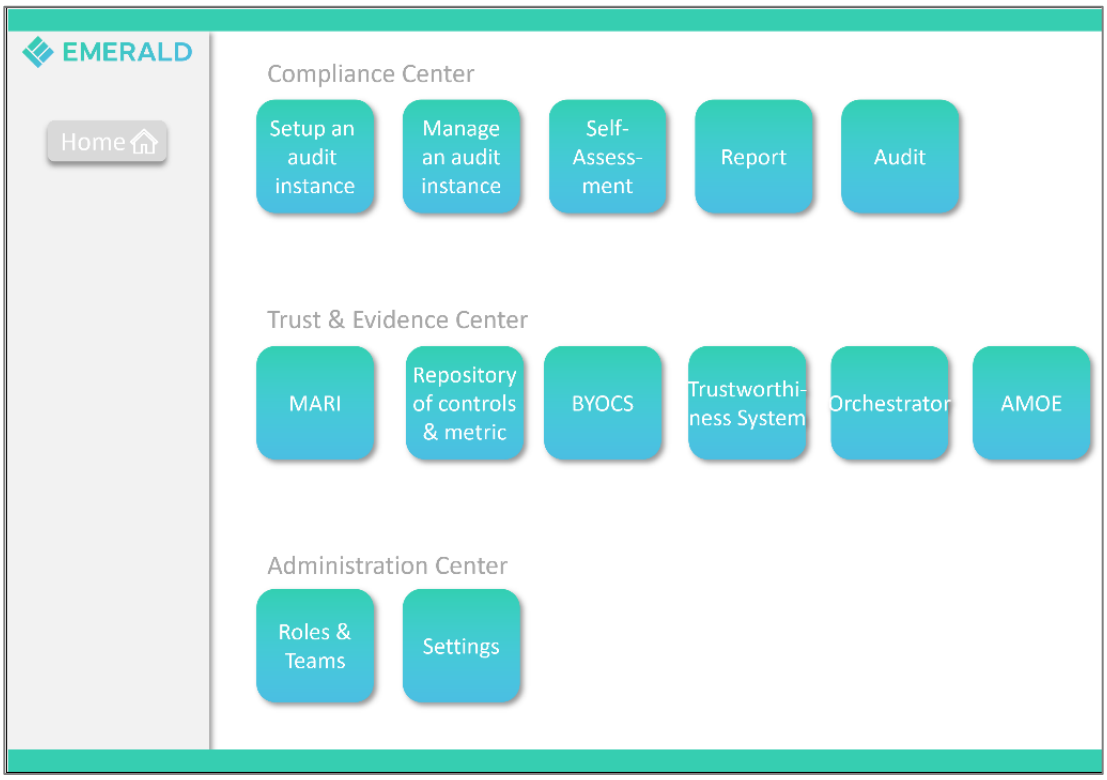

Figure 10. Paper-based Mock-ups - User Journey 1 - Step 2: Add BYOCS to the EMERALD UI Landing Page

Figure 11 asks Emerson to add a name for the new scheme and to choose those certifications schemes from which they would like to use the controls from to create a new scheme.

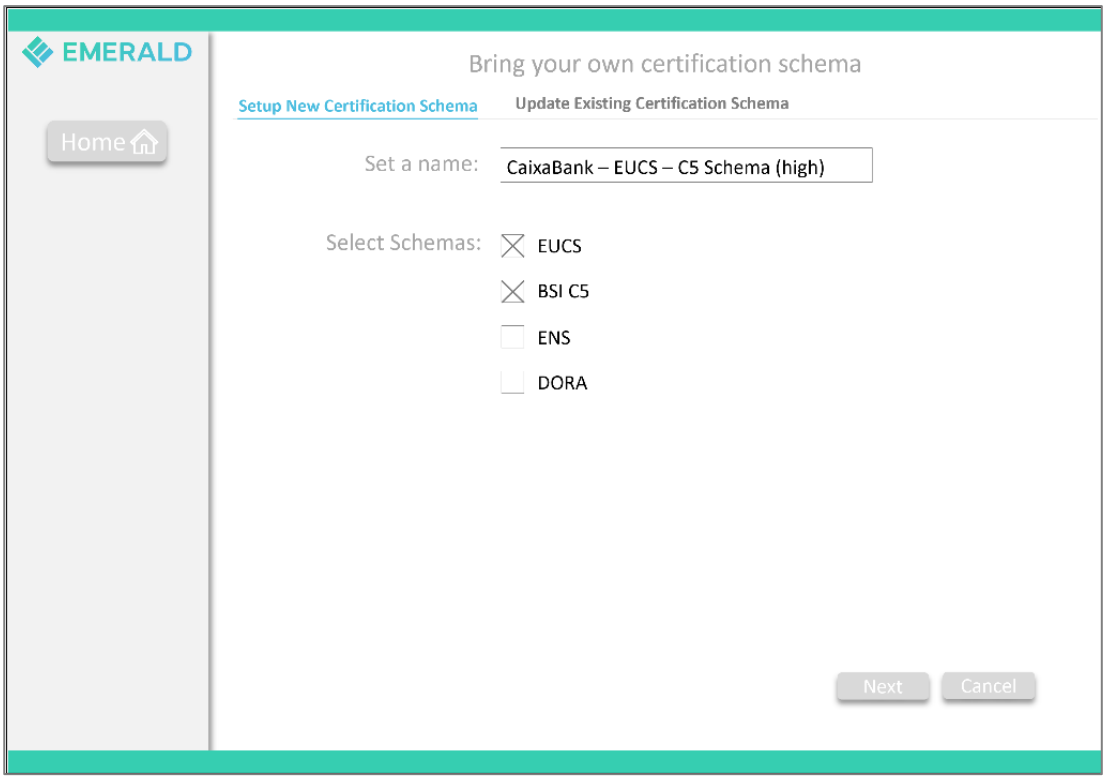

Figure 11. Paper-based Mock-ups - User Journey 1 - Step 2: Set a scheme name and select the schemes

Figure 12 shows the user interface that allows to select different controls including their respective metrics assigned from existing certification schemes like EUCS or BSI C5 to the new certification scheme.

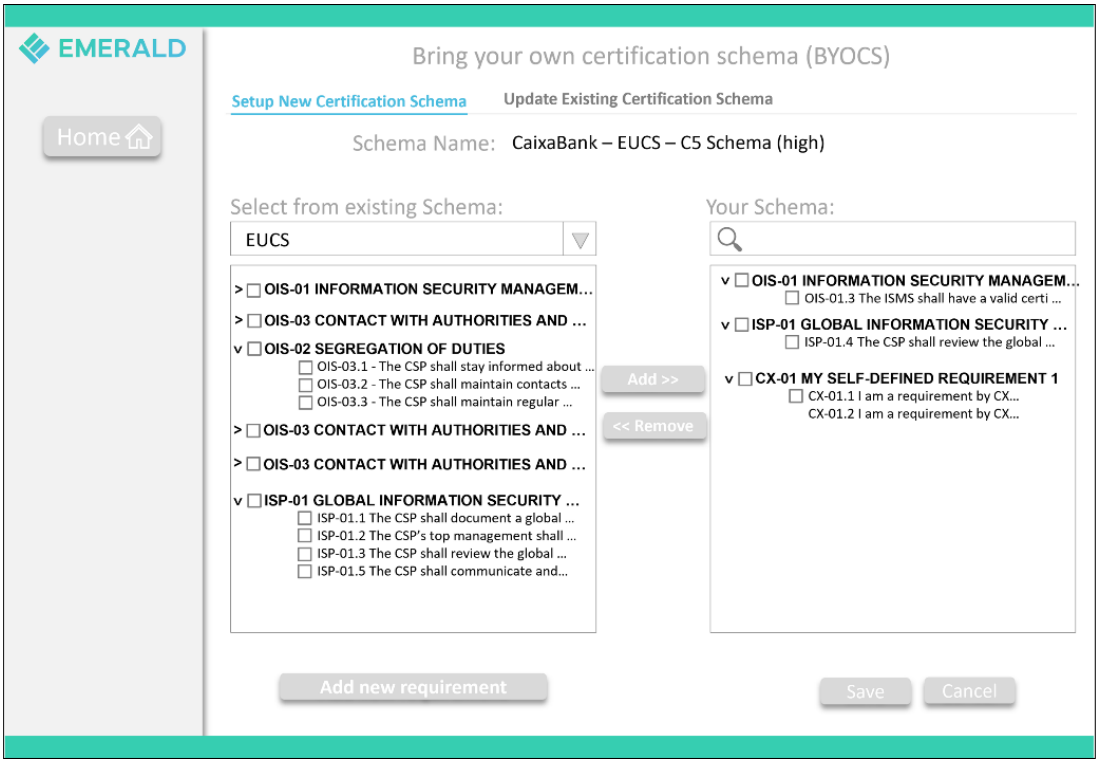

Figure 12. Paper-based Mock-ups - User Journey 1 – Step 2: Add controls from existing scheme to new scheme

Figure 13 presents the possibility to add a new self-defined control.

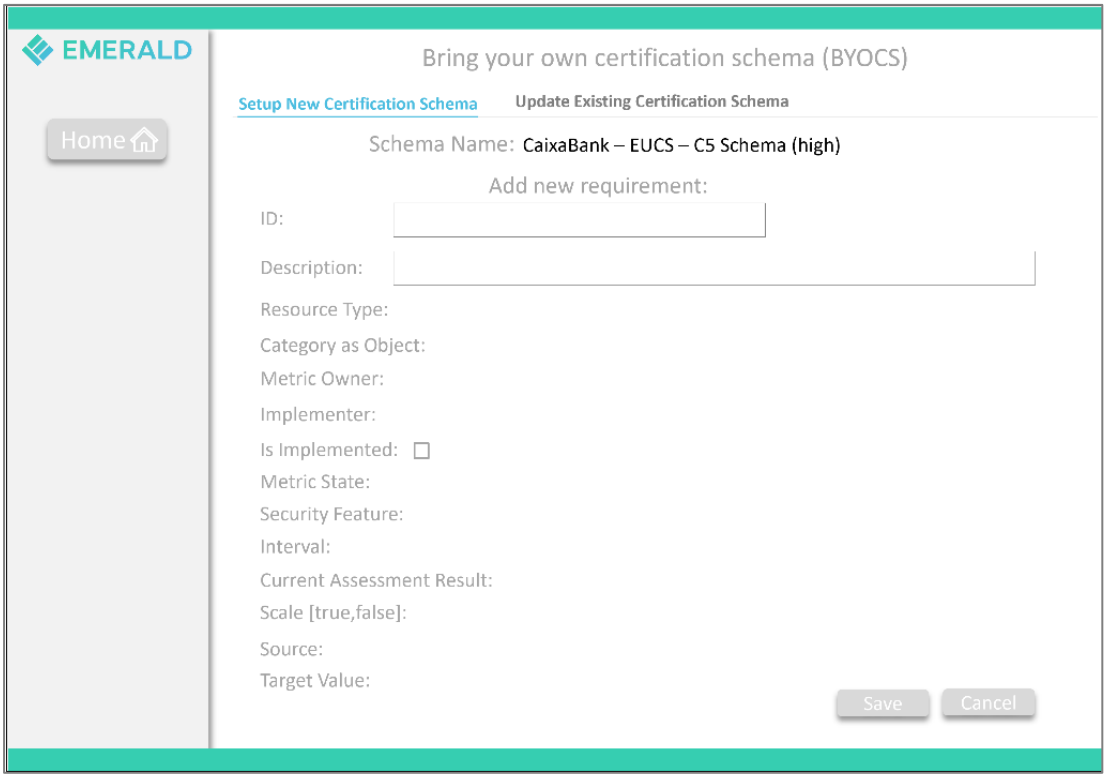

Figure 13. Paper-based Mock-ups - User Journey 1 – Step 2: Define own control

Figure 14 presents how to select the newly created scheme for setting up a new audit scope.

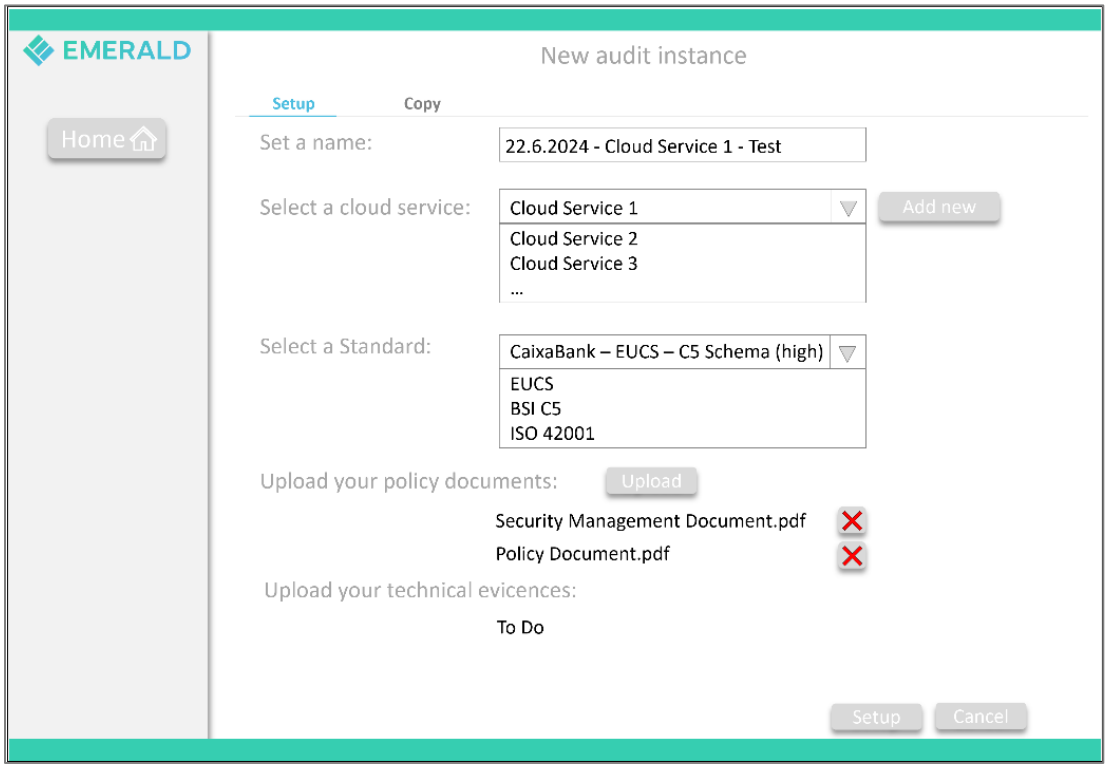

Figure 14. Paper-based Mock-ups - User Journey 1 – Step 3: Select new scheme for a new audit scope

In addition to the mock-ups presented above, three further mock-ups were developed that show how to edit the self-defined scheme. These mock-ups are added in *APPENDIX B: Mock-ups derived from the user journeys*, in Section 9.1.

4.2.2 User Journey 2: Dylan – Internal Control Owner Control Implementation

The scenario for Dylan was also divided into six steps, as depicted in Figure 15. For each step, first Dylan's task is described and then the interaction with the EMERALD UI.

Step 1:

- **Dylan's Task**: Dylan opens the EMERALD UI to check if there are any new controls that need to be worked on.
- **Dylan's Interaction with the EMERALD UI**: Dylan opens the EMERALD UI in their web-browser and signs in with their credentials. They are then redirected to the EMERALD Dashboard where all assigned controls can be easily seen.

Step 2:

- **Dylan's Task**: If Dylan finds a new control, but they cannot provide the evidence by themselves, they assign it to colleague Y.
- **Dylan's Interaction with the EMERALD UI**: In the detail view of a control, Dylan assigns a colleague of theirs as its implementer. EMERALD notifies their colleague about a new control.

Step 3:

- **Y's Task:** Y views the personal control Todo list.
- **Y's Interaction with the EMERALD UI:** Y navigates to their personal control overview and opens the detailed view of a control.

Step 4:

- **Y's Task**: Y checks if there are already recommended metrics that can be used. Y assigns the metrics to the control.
- **Y's Interaction with the EMERALD UI:** Y opens the *MARI* component and selects a set of metrics for the control.

Step 5:

- **Y's Task**: Y checks all metrics for their implementation status. If they are not yet implemented, they are assigned.
- **Y's Interaction with the EMERALD UI**: Y can see the implementation status of the necessary metrics in the overview of the control. If they are not yet implemented, they can also be assigned to another colleagues – colleague Z - in the view.

Step 6:

- **Z's Task**: Z implements the metric and makes sure the evidence is included in the EMERALD solution.
- **Z's and Dylan's Interaction with the EMERALD UI**: Z sees the list of metrics to be implemented. Z implements the metric and confirms the implementation once it is

done. Dylan gets notified about the new status of the control. The dashboard is updated. Dylan sees the new status of their controls.

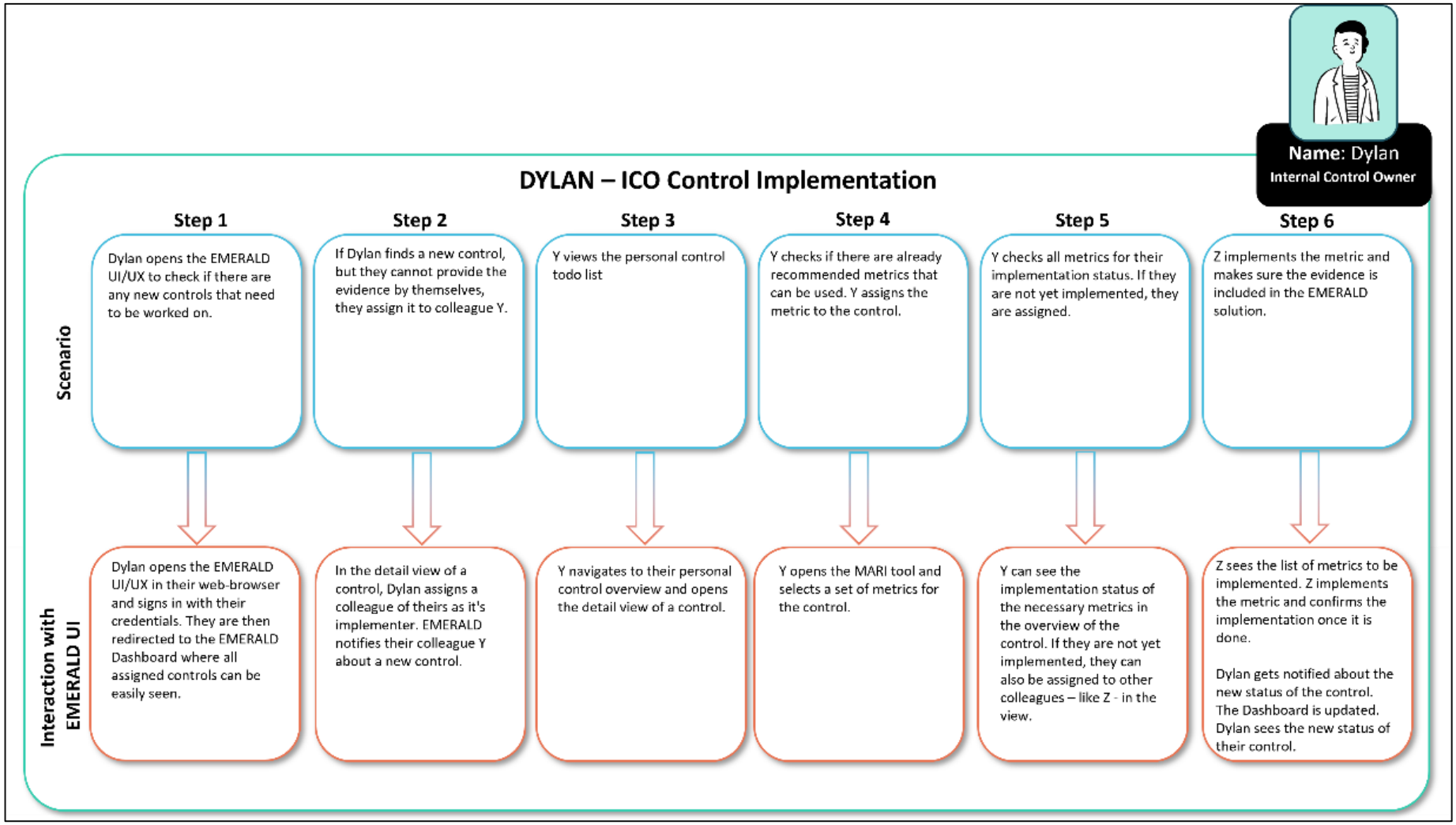

Figure 15. User Journey 2: Dylan – ICO Control Implementation

4.2.2.1 Mock-ups: Dylan – Internal Control Owner Control Implementation

Based on the user journey from Dylan, we have created a set of mock-ups that maps parts of the user journey to the mock-ups. In the case of user journey 2, we focus on the mock-ups for filtering for non-compliant controls (Step 1) and for assigning an open control to a colleague (Step 2).

Figure 16 shows how to select an existing audit scope.

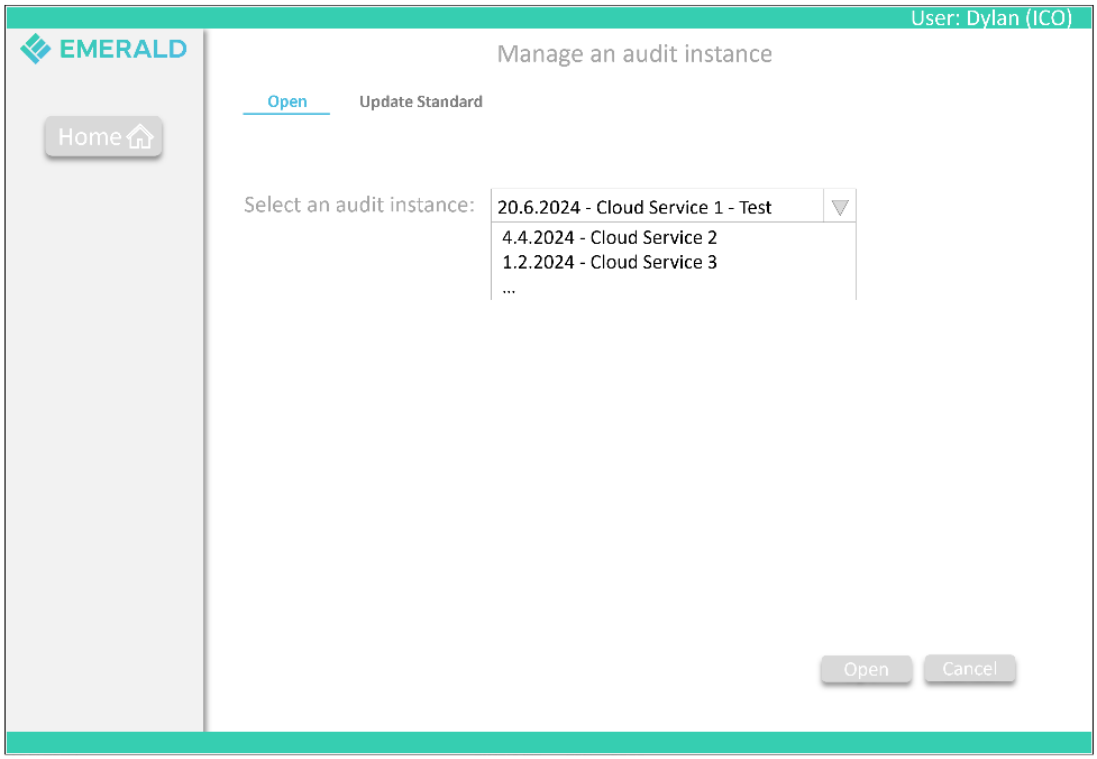

Figure 16. Paper-based Mock-ups - User Journey 2 - Step 1: Open an existing audit scope

Figure 17 presents the overview page of an existing audit scope and the list of the respective controls.

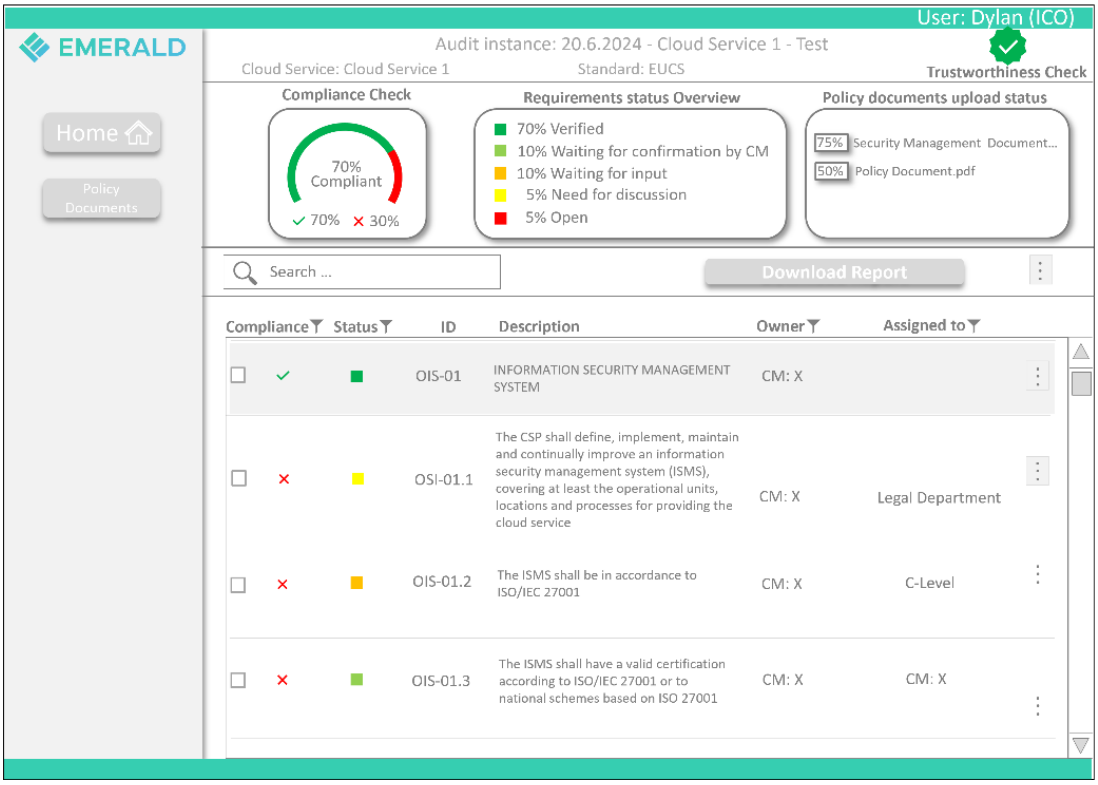

Figure 17. Paper-based Mock-ups - User Journey 2 – Step 1: Audit scope overview with the list of controls

Figure 18 presents the overview of an audit scope and the possibility to filter for open controls – these are controls that have not been dealt with so far.

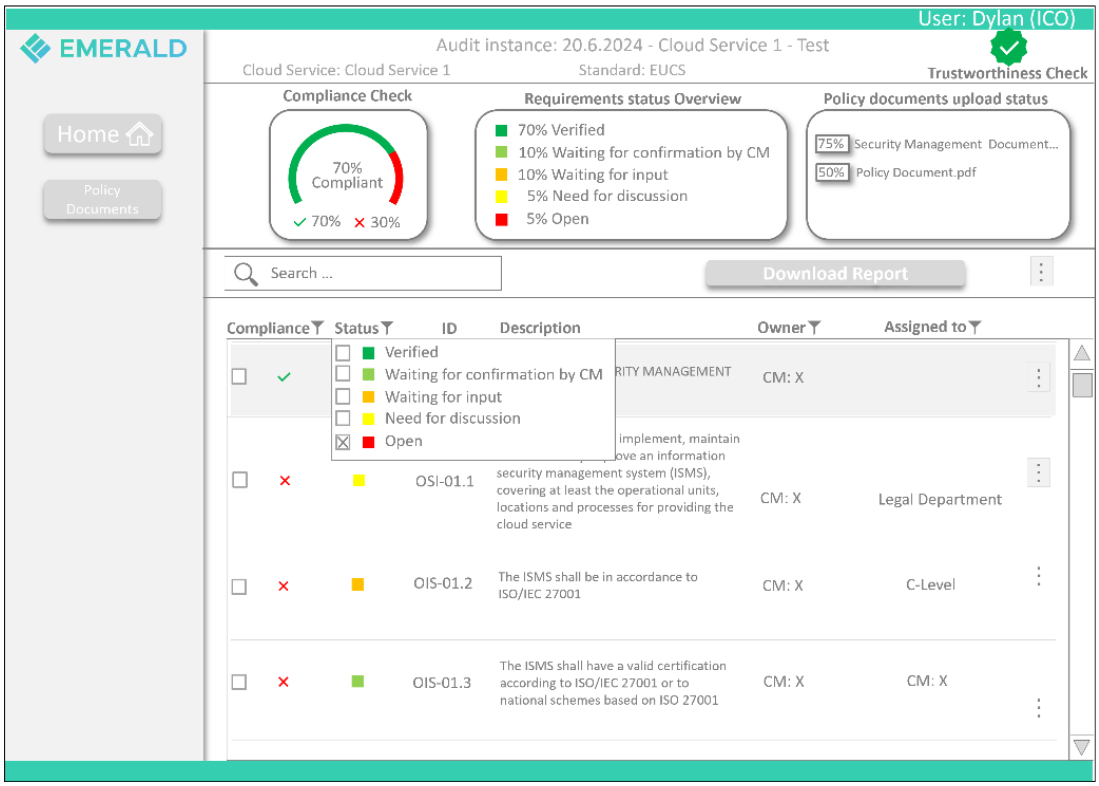

Figure 18. Paper-based Mock-ups - User Journey 2 – Step1: Filtering of controls

Figure 19 presents the list of open controls.

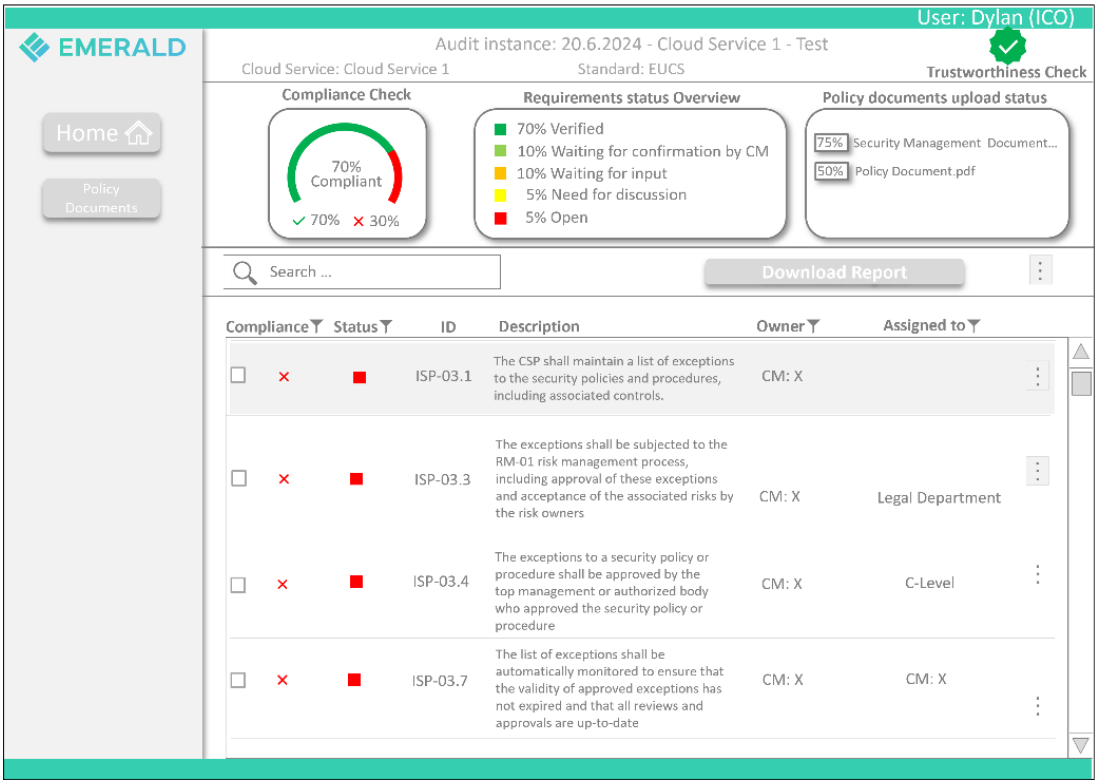

Figure 19. Paper-based Mock-ups - User Journey 2 – Step 1: List of open controls

Figure 20 presents the UI for assigning a control to either an individual person or to a whole department.

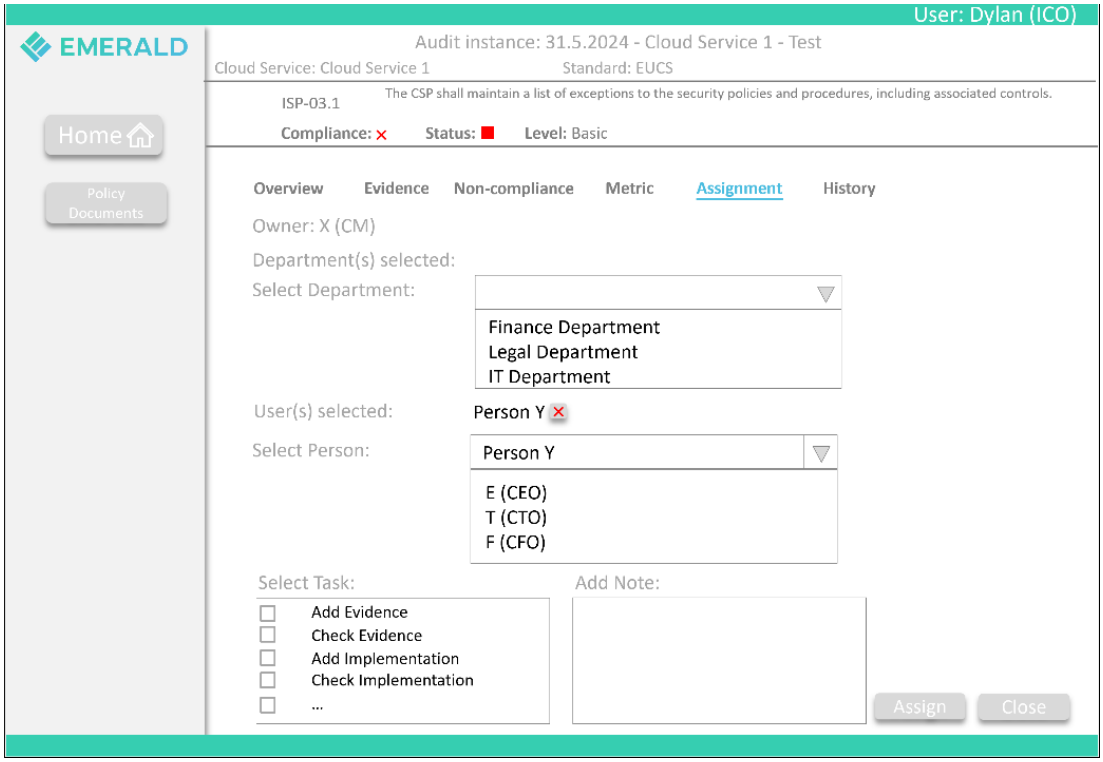

Figure 20: Paper-based Mock-ups - User Journey 2 – Step 2: Assigning a control to employees or departments

Figure 21 presents an example of how the individual workspace looks like. Additionally, it shows the person's assigned number of tasks.

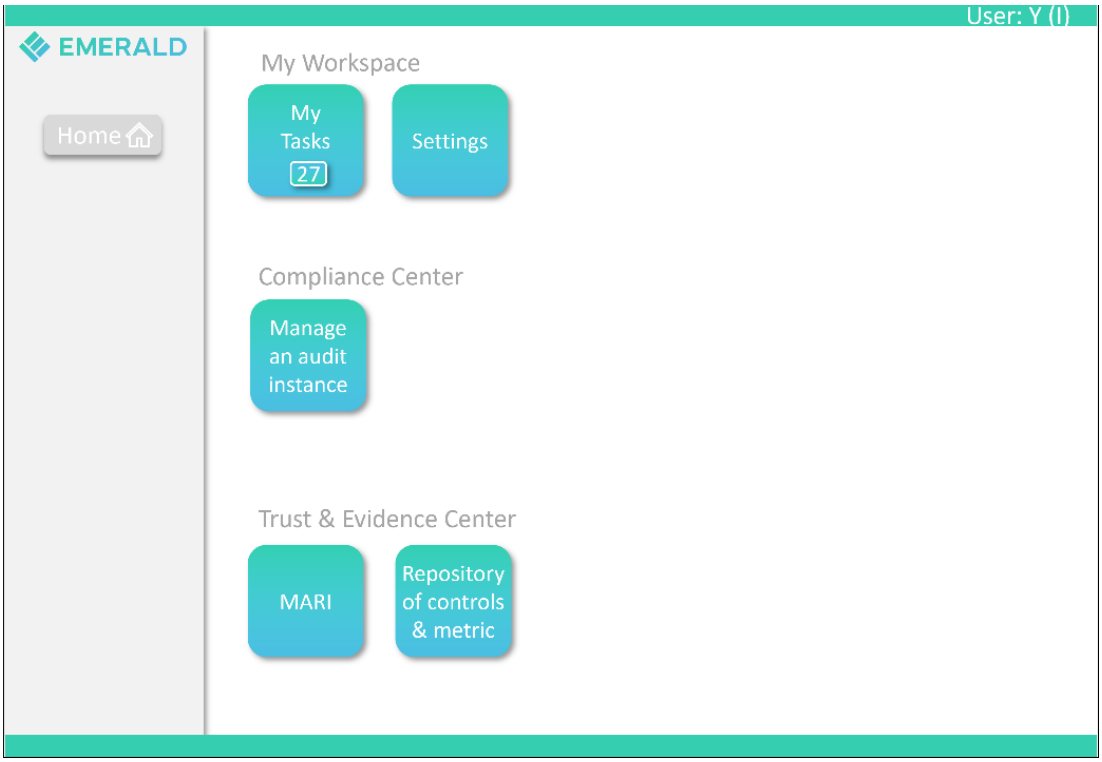

Figure 21. Paper-based Mock-ups - User Journey 2 – Step 3: Personal workspace and number of open tasks

4.2.3 User Journey 3: Charlie – Preparation of an audit by an internal auditor

The scenario for Charlie was divided into five steps as depicted in Figure 22. For each step, first Charlie's task is described and then the interaction with the EMERALD UI.

Step 1:

- **Charlie's Task**: Charlie is an internal auditor at a Cloud Ferro and is responsible for the management of the audit processes against EUCS, including the preparation of the audit. Charlie needs to review all the controls and check if all have their respective evidence assigned to them.
- **Charlie's Interaction with the EMERALD UI:** no interaction is required.

Step 2:

- **Charlie's Task**: Charlie enters the EMERALD UI/UX, looks for the controls related to EUCS high.
- **Charlie's Interaction with the EMERALD UI**: 1) Charlie logs into the EMERALD UI/UX. 2) Charlie selects the components to be audited. 3) Charlie selects the EUCS scheme. 4) Charlie looks for the associated controls.

Step 3:

- **Charlie's Task**: Charlie checks the non-conformities of the associated evidence.

- **Charlie's Interaction with the EMERALD UI**: 5) Charlie clicks on the red flag /icon for the controls that are not compliant.

Step 4:

- **Charlie's Task**: When Charlie discovers a non-compliance, Charlie wants to see which of the metric/assessment result is causing that non-compliance so that they can inform the compliance manager.
- **Charlie's Interaction with the EMERALD UI**: Charlie opens the detailed view on the non-conformities cause: not reaching the threshold, metric not measured (connection lost, etc...), non-trustworthy evidence, etc.

Step 5:

- **Charlie's Task**: Once Charlie has reviewed all the non-compliances they complete an internal report for the compliance manager.
- **Charlie's Interaction with the EMERALD UI**: Charlie exports the summary of the non-conformities (including the detailed information).

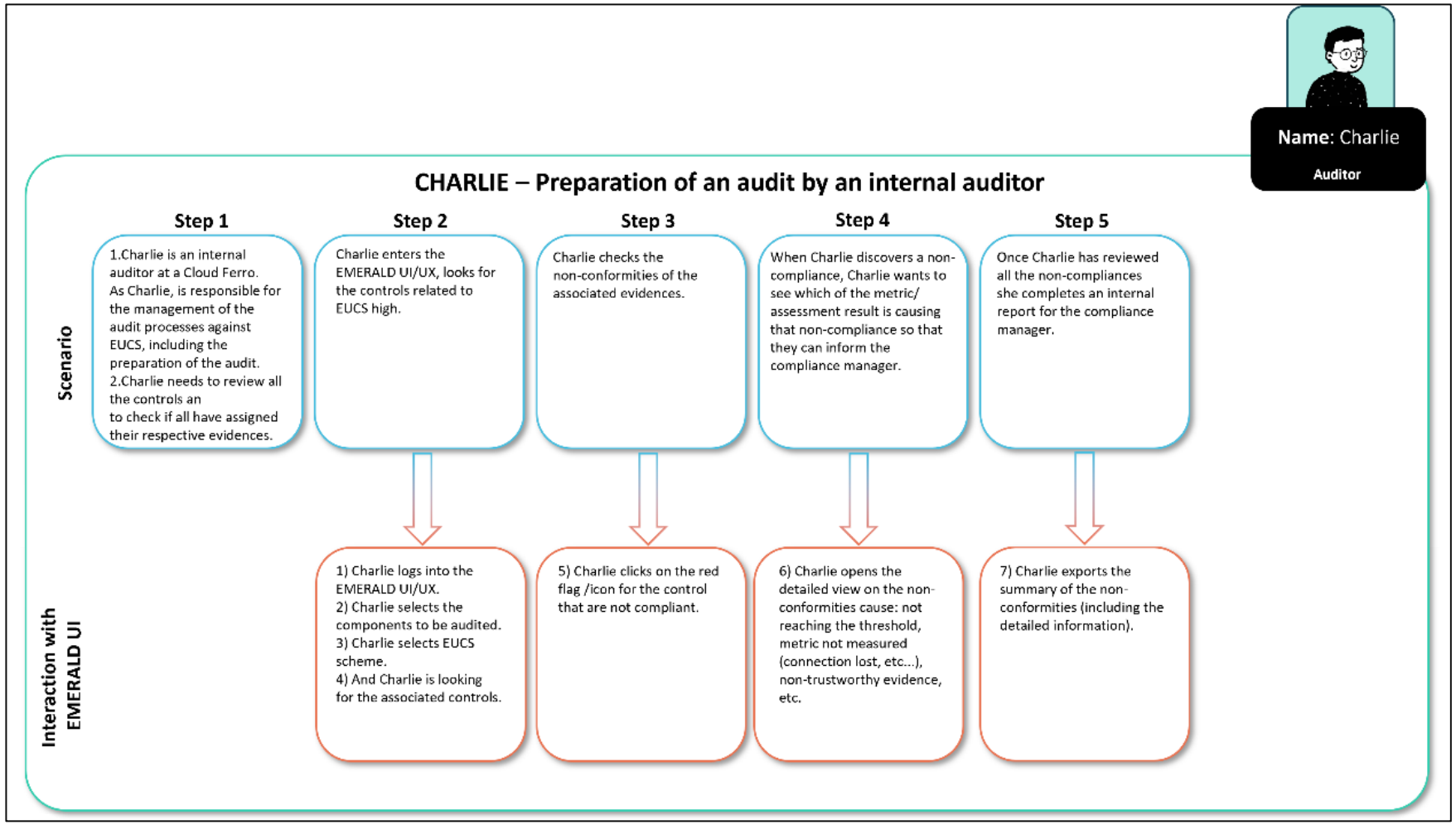

Figure 22. User Journey 3: Charlie – Preparation of an audit by an internal auditor

4.2.3.1 Mock-ups: Charlie – Preparation of an audit by an internal auditor

Based on the user journey from Charlie, we have created a set of mock-ups that maps parts of the user journey to the mock-ups. In the case of user journey 3, we have mapped the whole user journey steps 2-5, setting up a new audit scope (Step 2), filtering for non-compliant controls (Step 3), checking the reason for non-compliance (Step 4), and downloading a report (Step 5).

Figure 23 presents the mock-up for setting up a new audit scope in EMERALD.

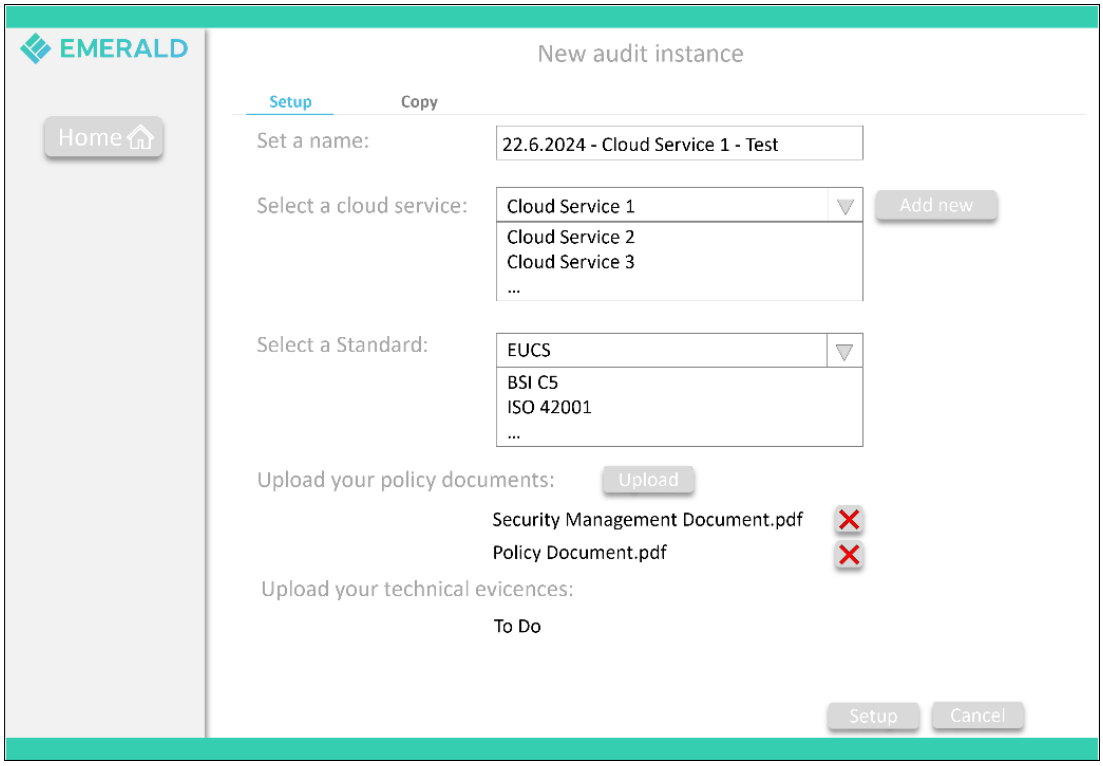

Figure 23. Paper-based Mock-ups - User Journey 3 – Step 2: Setting up a new audit scope

Figure 24 presents the overview of the audit scope including the control list.

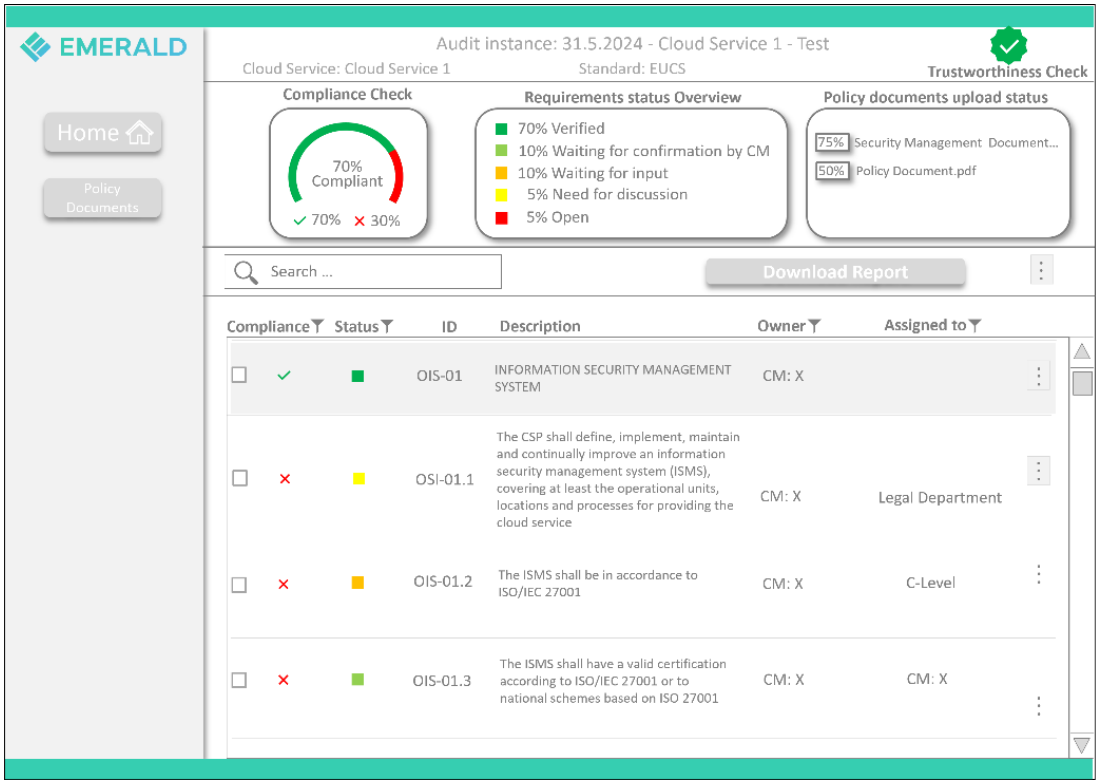

Figure 24. Paper-based Mock-ups - User Journey 3 – Step 2: Audit scope overview

Figure 25 shows how to filter for non-compliant controls in the control list.

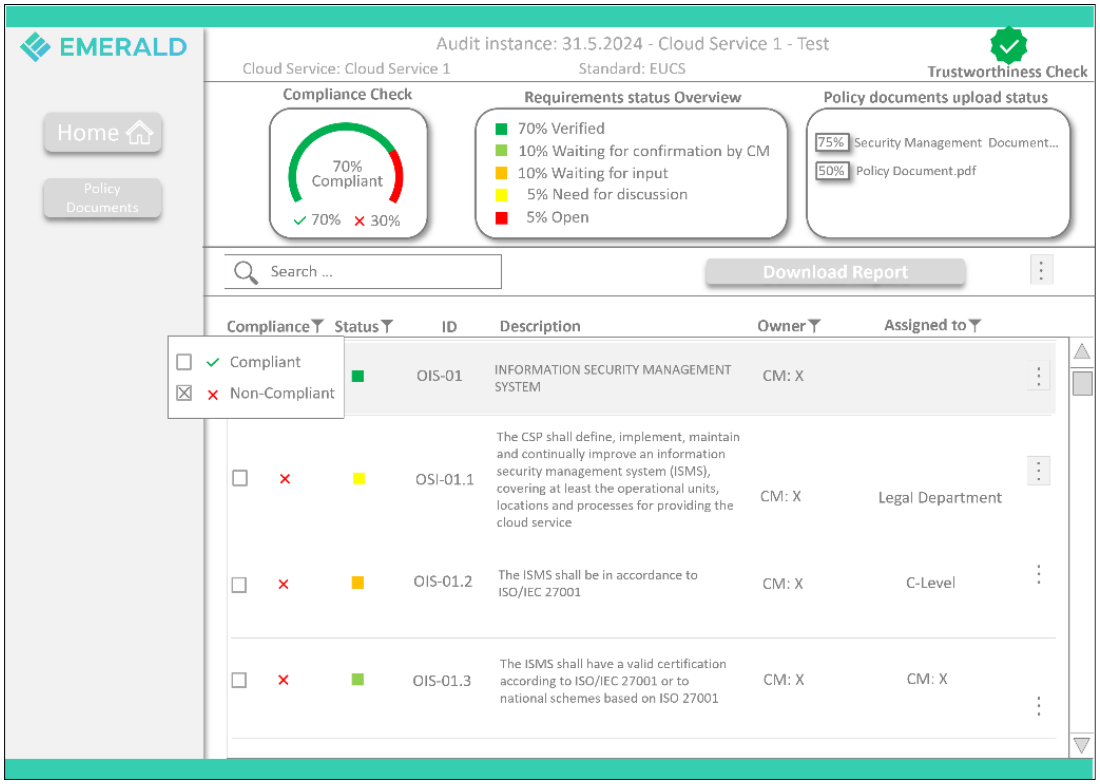

Figure 25. Paper-based Mock-ups - User Journey 3 – Step 3: Filtering for non-compliant controls

Figure 26 presents how to quickly check for the reasons of a control marked as non-compliant.

Figure 26. Paper-based Mock-ups - User Journey 3 – Step 4: Check the reason of non-compliance

Figure 27 presents more detailed information about why a control is non-compliant.

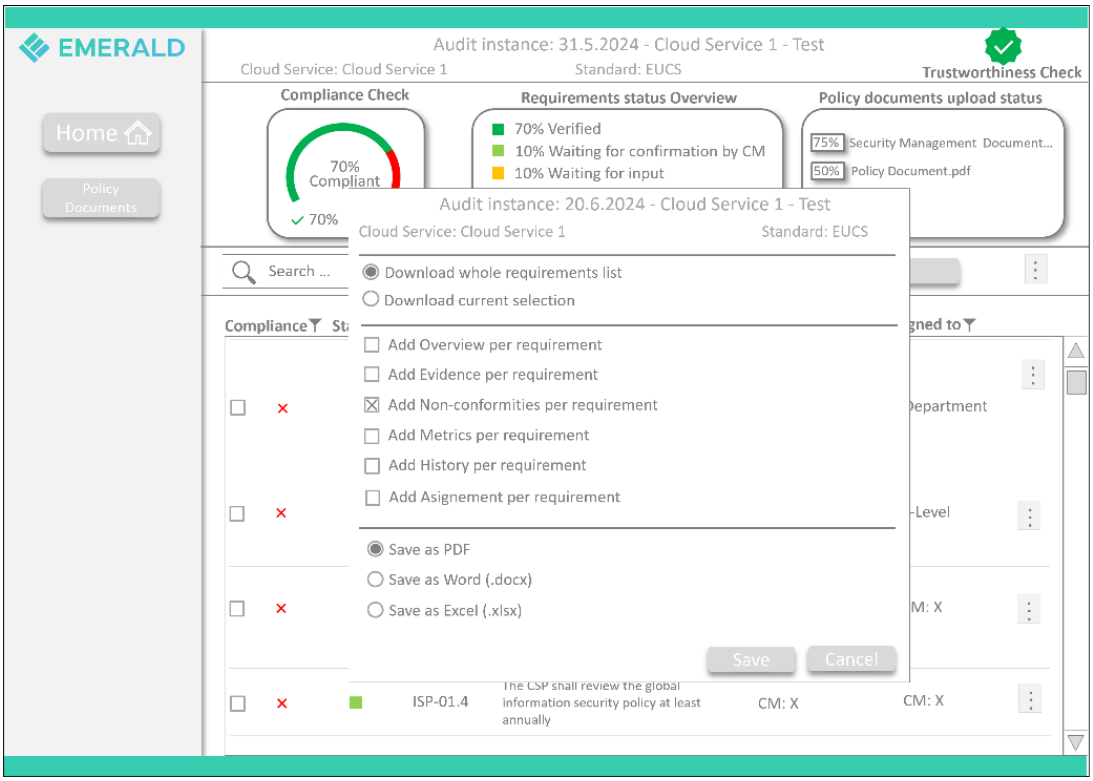

Figure 27. Paper-based Mock-ups - User Journey 3 – Step 4: Detailed information about non-compliance

Figure 28 presents the mock-up of how to download the report about non-compliant controls for a compliance manager.

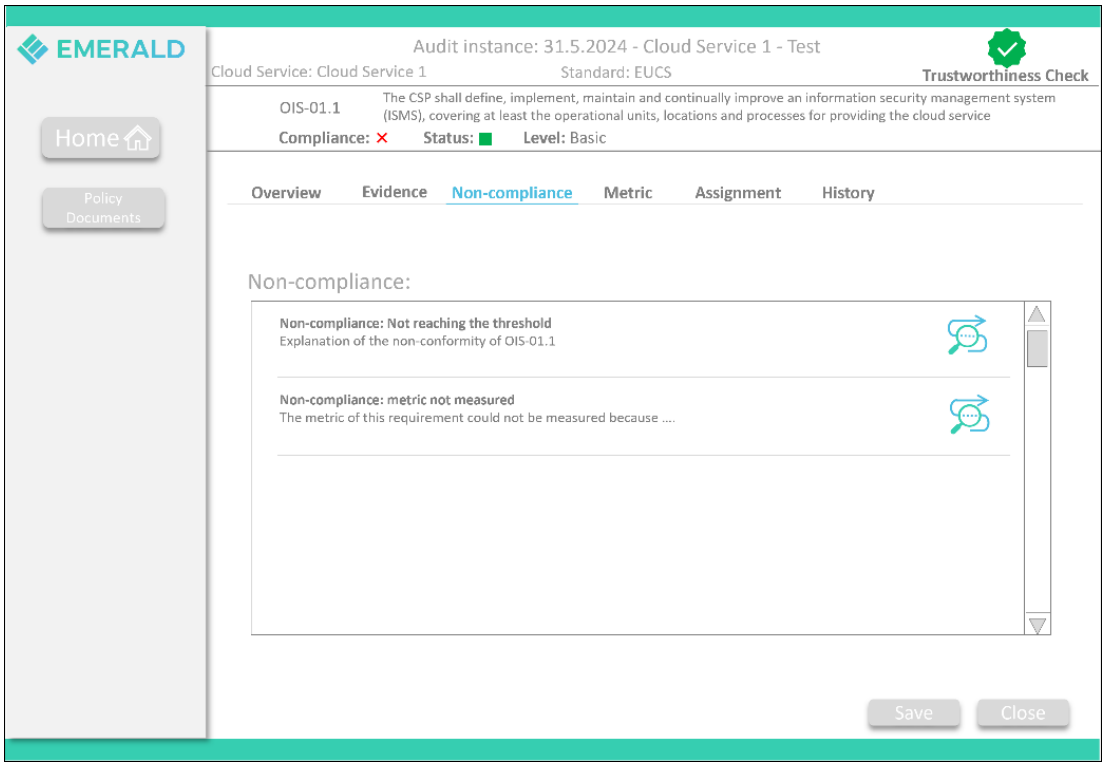

Figure 28. Paper-based Mock-ups - User Journey 3 – Step 5: Download the report

5 Clickable Prototypes

To develop the integrated EMERALD UI, we aim to bring together the needs from the pilot partners and the technical partners. With the pilot partners, we have conducted interviews and focus groups, and have developed personas, scenarios, and user journeys in different workshops. From the insights gained, we have derived a first set of paper-based mock-ups (see Section 3). Subsequently we conducted individual workshops with the different component owners to i) get their feedback about the paper-based mock-ups; ii) find out which functionalities and features needed to be added; and iii) identify what else was missing. Based on these discussions, we were able to start the development on the clickable mock-ups.

It is important to notice that the development of the clickable mock-ups is still work-in-progress during the time of writing this deliverable. This means that the development is neither complete nor that everything is already in place. In the upcoming months, there will be regular feedback loops with the pilot partners and component owners to improve the EMERALD UI, until it fulfils the needs of all partners. Thus, all screenshots of the clickable prototype presented in the next sections are still under development and are subject to change. Additionally, not all elicited features and functionalities have been implemented yet; this will be mentioned where applicable. The final version of the clickable prototype will be available in M24 (October 2025) of the project.

5.1 General EMERALD UI

The overall EMERALD UI should provide a user interface (UI) "*… which is tailored to the users' needs during all stages of an audit and guides them through the process of identifying problems top down – from high level requirements down to specific implementation in documents (e.g., policies) or technical specifications."* as described in the DoA [2]. Therefore, in WP4 several activities with pilot partners as well as component owners were conducted to elicit the needs of the different partners (as described in Sections 2, 3, and 4).

From these activities, we were able to derive three major visualisation streams so that the EMERALD UI can support all relevant stages during an audit: Stream 1: Setting up and managing the Certification Target; Stream 2: Setting up and managing the Audit Scope; Stream 3: Setting up and managing the certification schemes. Additional visualisations include the authentication, role, and access management, as well as the management of "My ToDo List". An overview of the EMERALD UI, the different visualisation streams, and the related EMERALD components is presented in Figure 29.

In the following we put the focus on the three main visualisation streams that will be described in more detail.

- **Stream 1: Setting up and managing Certification Targets**: This stream focusses on the selection of certification targets (e.g. cloud services...), allows to select and setup the different evidence extractors including *eknows*, *Codyze*, *AI-SEC*, *Clouditor-Discovery*, and *AMOE*, and allows to set the settings for the *TWS*. This stream will be presented in the subsequent Section 5.1.1 as well as in Section 5.2 and Section 5.3.
- **Stream 2: Setting up and managing Audit Scopes**: This stream focuses on setting up the audit scopes, thus selecting the certification target and the corresponding certification scheme to be prepared for an audit. Furthermore, it shows the assessment results of the evidence extractors and allows to manage all controls regarding their compliance or non-compliance (*AMOE*, *Clouditor-Orchestrator*); additionally different controls can be assigned to different people and departments.

This stream will be presented in the subsequent Section 5.1.2 as well as in Section 5.2 and Section 5.3.

- **Stream 3: Setting up and managing the certification schemes**: This stream focuses on the upload of the certification schemes, the possibility to browse through them as well as the mapping of controls and metrics, and the mapping of controls across different schemes. This stream is presented in Section 5.4 and Section 5.5 dealing with the integration and the interplay of the *MARI* and *RCM* components in the EMERALD UI.

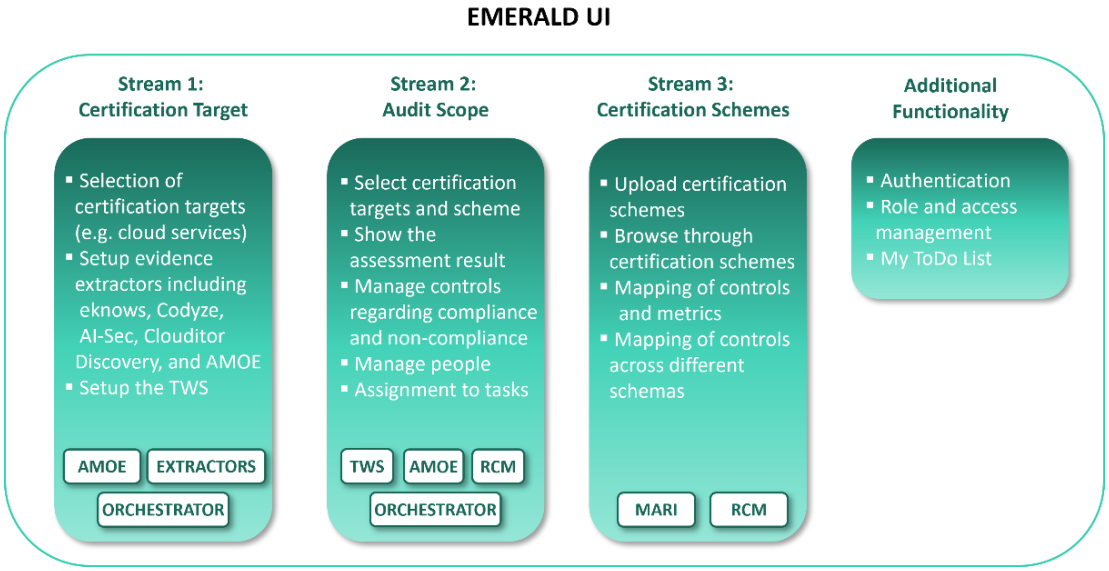

Figure 29. Overview of the EMERALD UI Visualisation Streams

Currently, the main entry point of the EMERALD framework looks as presented in Figure 30. It provides the entry points to the management of the certification targets and audit scopes, as well as access to the certification schemes. Not depicted now are the access to the authentication, role, and access management, and the My ToDo list.

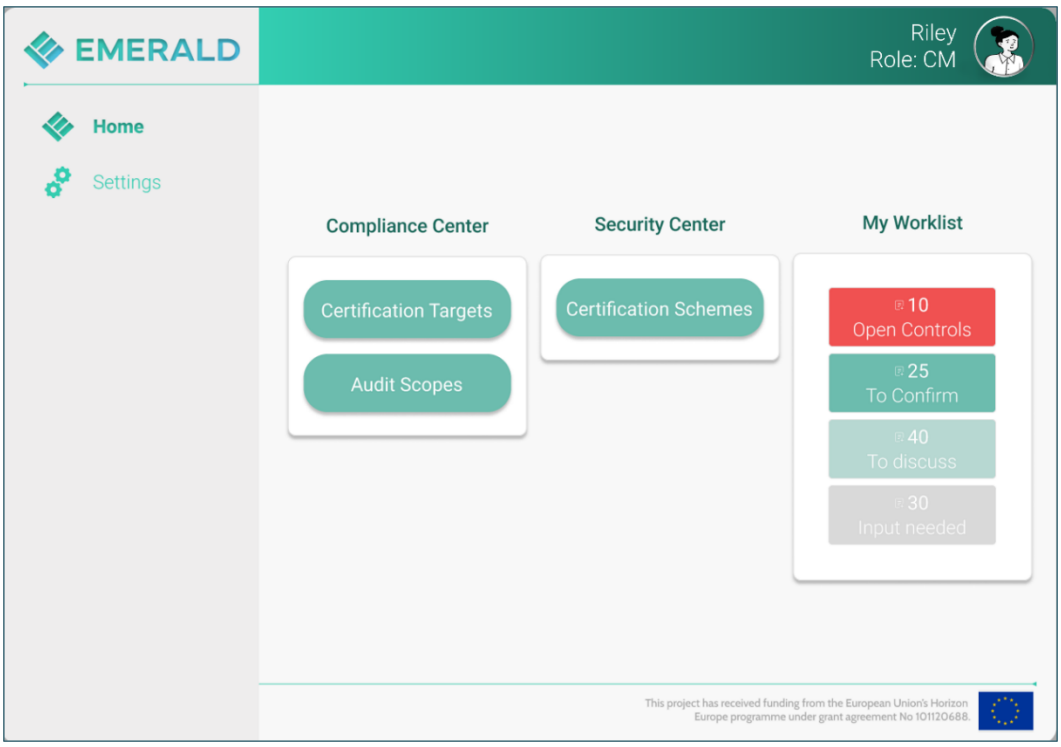

Figure 30. EMERALD Landing Page

5.1.1 Setting up and managing Certification Targets

When entering the “Setup Certification Target” view, the EMERALD UI guides the user step-by-step through the setup process. This is visualized with a kind of metro map representation always visible on top of the view, so that the users always knows where they are.

For setting up the certification target, the user must fill in information such as the cloud service title, a description, and the cloud service tags. After the user has saved the certification target, it receives a unique identifier called Cloud Service Token from the Orchestrator. The user can still edit all information; however, the id is fixed. This is presented in Figure 31.

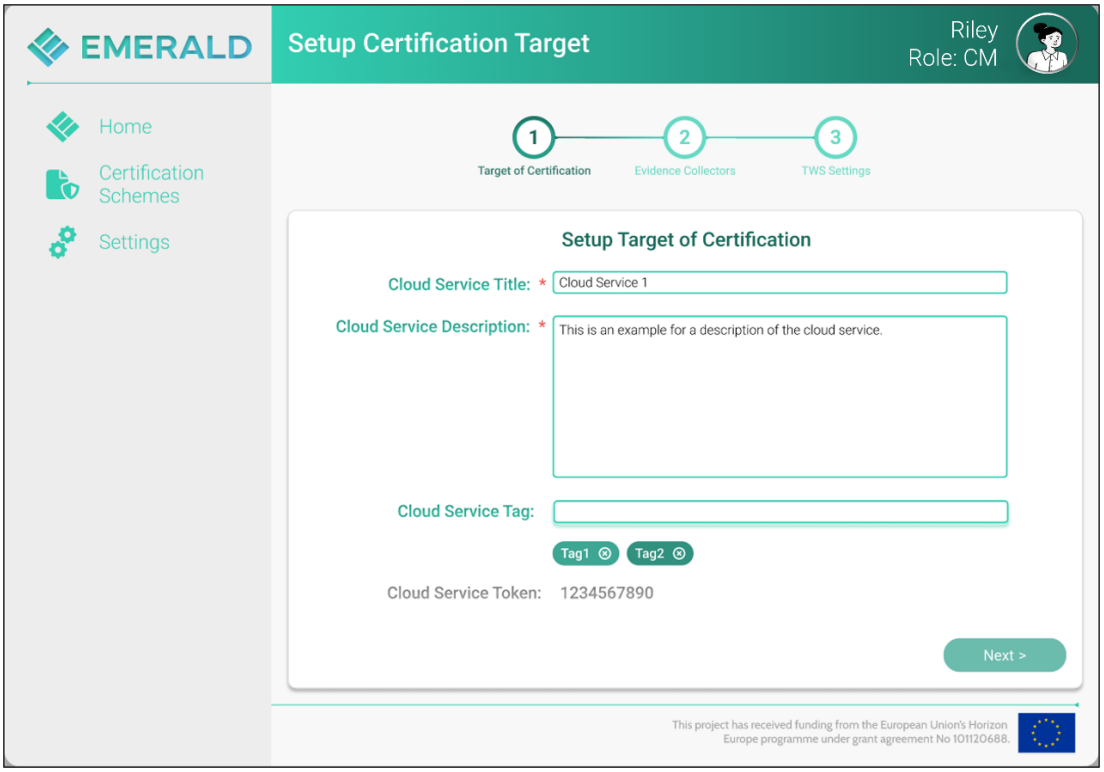

Figure 31. Certification Target - Setup Certification Target

The next step in the setup of the certification target is to attach the evidence collectors as depicted in Figure 33.

To install a new evidence collector that should be displayed in the list, a user can click on the “Add new” Button as shown in Figure 33, point 4. Accordingly, a new view is opened that presents a detailed description of how to set up the respective evidence collector as presented in Figure 32. It must be clearly stated that the installation of the evidence extractors cannot be done via the EMERALD UI.

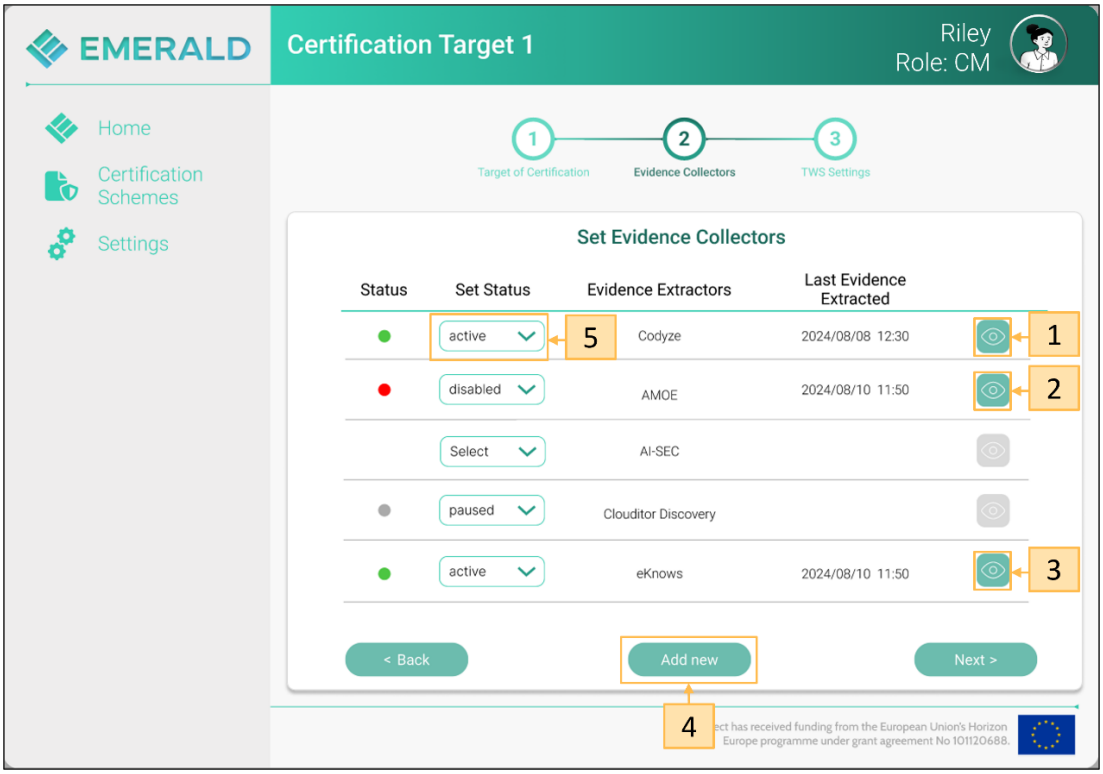

Figure 33. Certification Target - Evidence collectors for the respective target of evaluation

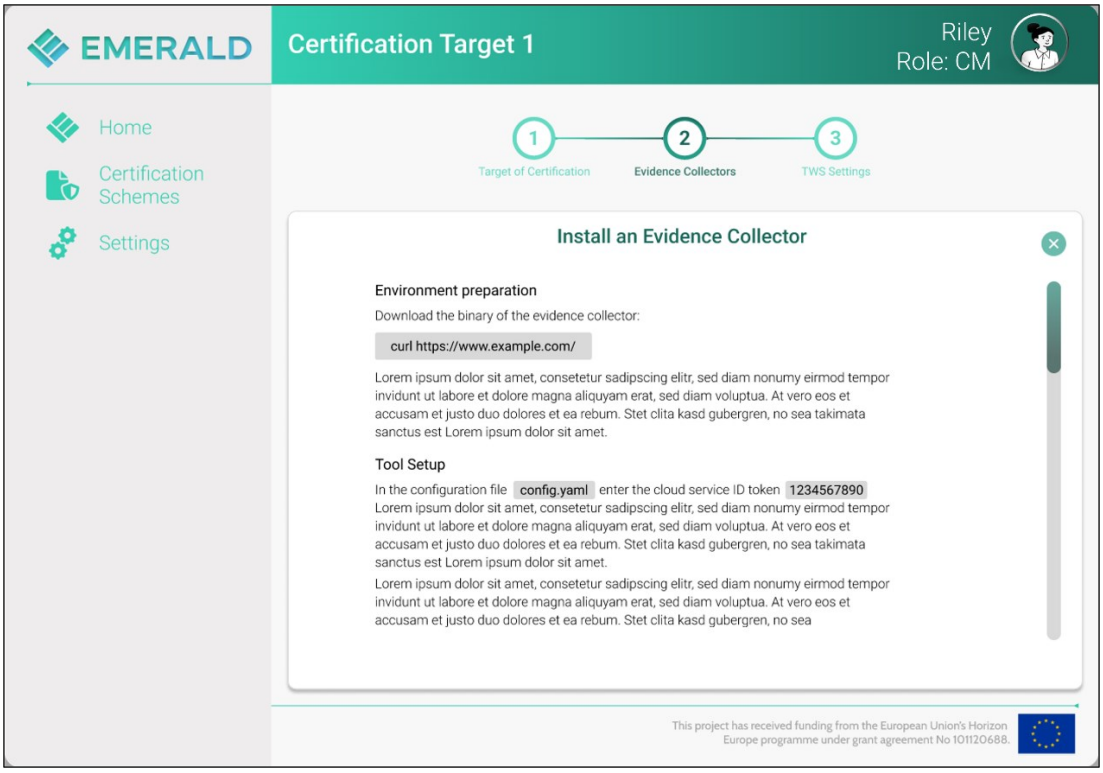

Figure 32. Certification Target - Description of how to install an evidence collector

For each evidence extractor the status can be set, namely if the extractor should be active, disabled or generally paused as presented in Figure 33, point 5.

Additionally, when clicking on the respective view icon on the right side of the evidence extractors as shown in Figure 33, point 1, 2, and 3, further information is shown about the evidence extractor.

For example, when clicking on the view icon for *Assessment and Management of Organisational Evidence* (*AMOE*) (see Figure 33, point 2), the view presented in Figure 34 is opened. In the list below, an overview is provided about the metrics that are already extracted from the respective policy documents. In addition, new policy documents can be uploaded.

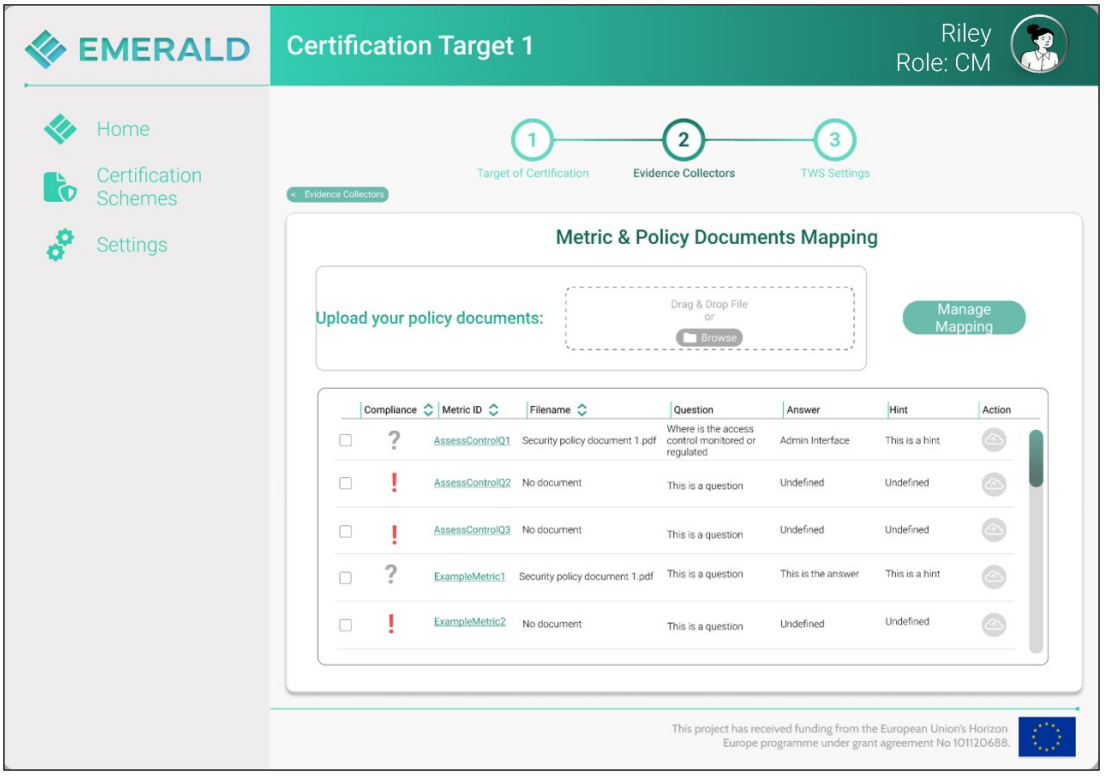

Figure 34. Certification Target - AMOE – Overview of metrics and corresponding policy files

A new policy document can be added via drag & drop. If a policy document was added, the file is not immediately uploaded but a new view is presented – see Figure 35. Here, the user can select those metrics that should be extracted from the policy document that is to be uploaded.

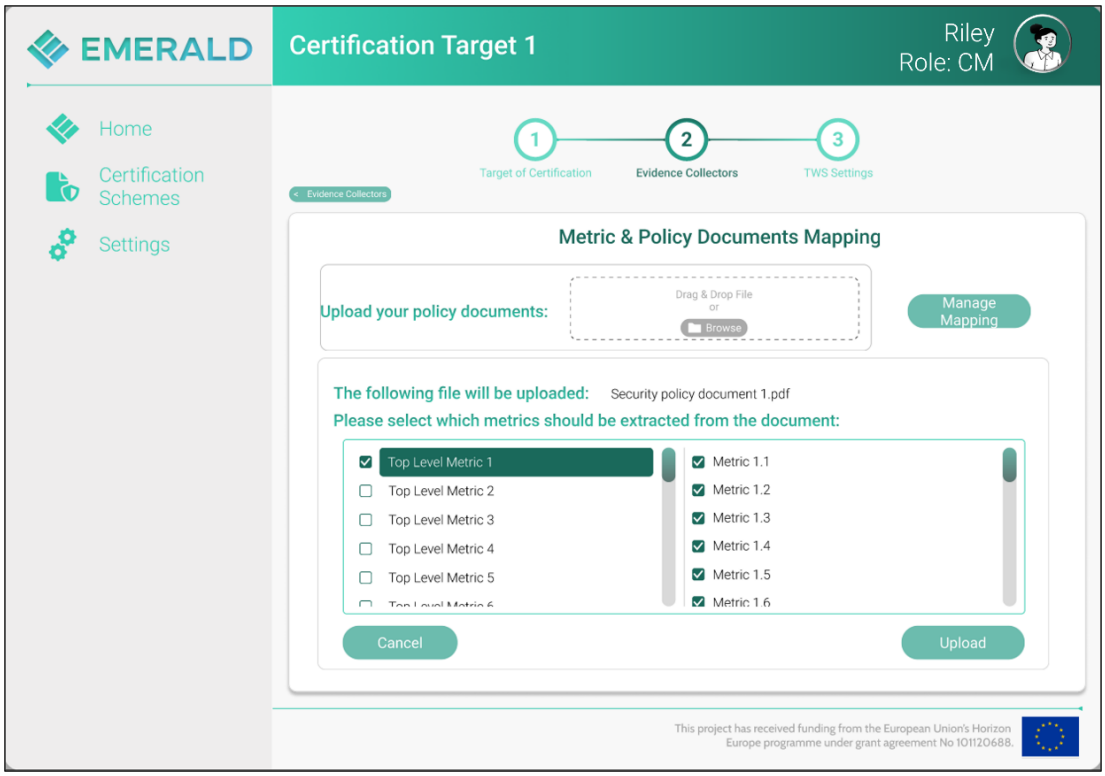

Figure 35. Certification Target - AMOE – Upload a policy document and select the respective metrics that should be extracted from it

It is important to notice that during the setup of the certification target it might not be clear which policy documents will be used. Therefore, it is not mandatory to upload these documents during the setup phase. Policy documents can added be later here or also in the audit scope view, where the controls and metrics are managed (see Figure 44).

When clicking on the view icon for the source code and API evidence (*eknows*) (see Figure 33, point 1), the view presented in Figure 36 is opened.

For the other evidence collectors such as *Codyze*, *AI-SEC* and *Clouditor-Discovery*, the discussions are ongoing on how they will be attached to the EMERALD UI and which functionalities will be presented there.

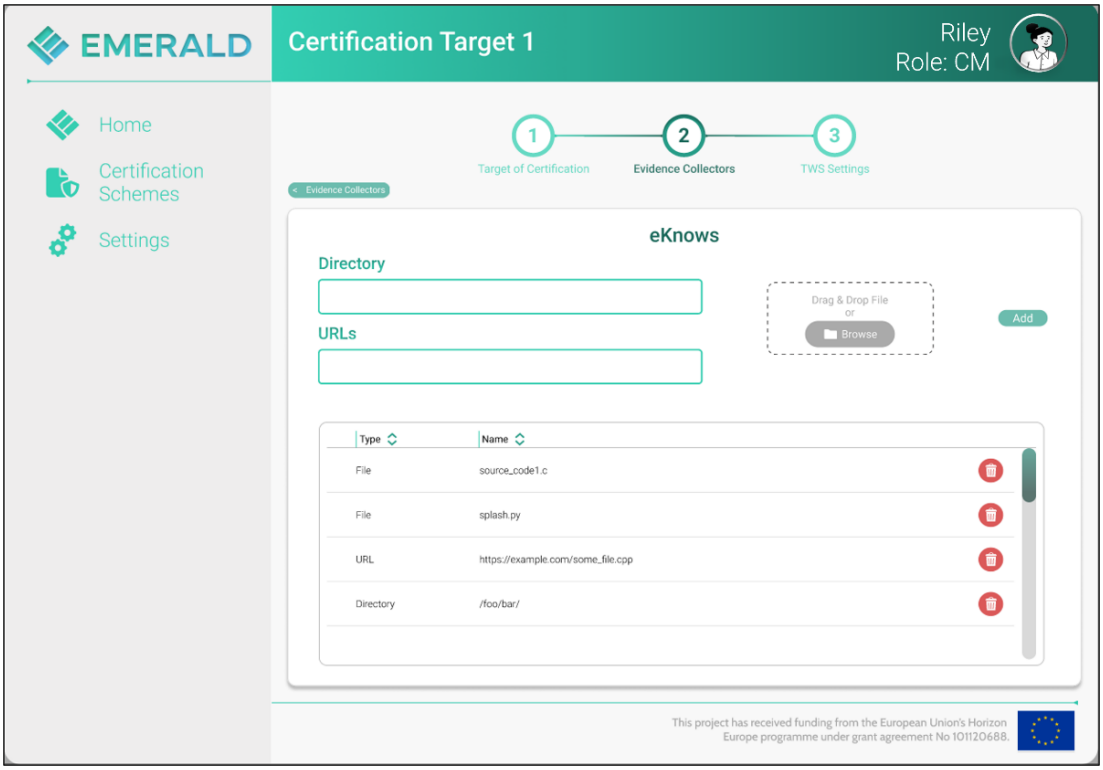

Figure 36. Certification Target - eknows - Define where to find the resources for eknows

The last step in the setup of the certification target is to add the settings regarding the *Trustworthiness System* (*TWS*), thus, to define when the *TWS* should be updated when and how often – automatically and/or on demand, as depicted in Figure 37. Options that should be available are:

- Always, when entering a respective audit scope
- On demand by the user
- Automatically every 1, 5, 10, or 15 minute(s).

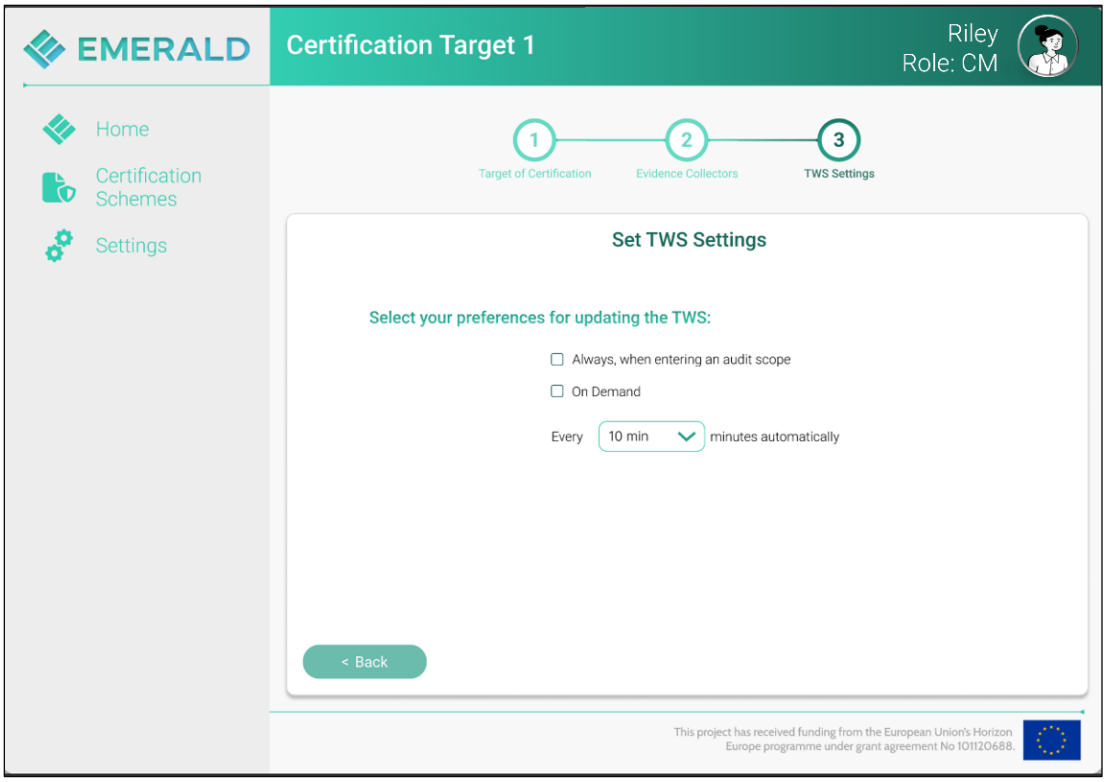

Figure 37. Certification Target - Screenshot of the TWS Setup Page

For managing an existing certification target, a user can select the certification target from the list, as depicted in Figure 38.

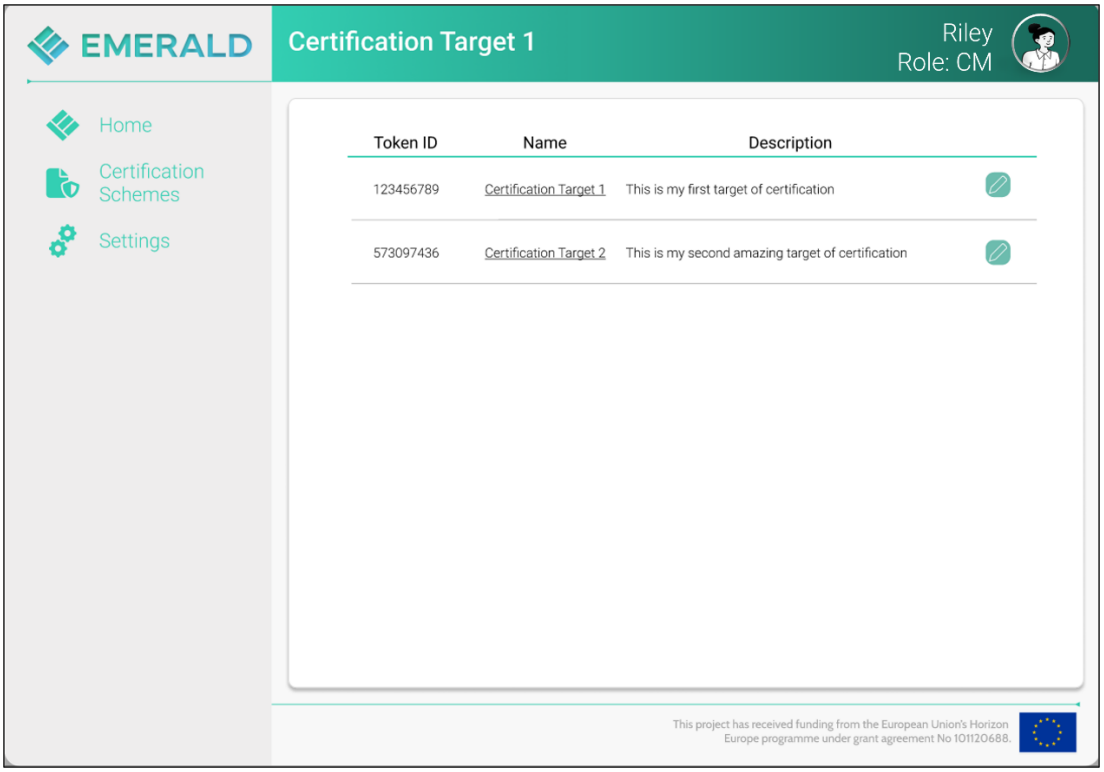

Figure 38. Certification Target - Select an existing certification target from the list to open it

5.1.2 Setting up and managing Audit Scopes

When entering the "Setup Audit Scope" view via the EMERALD Landing Page (see Figure 30), a form is opened that needs to be filled in by the user as shown in Figure 39. The form consists of the audit scope name, the certification target that needs to be selected from a list, the respective certification scheme, also selected from the list of available schemes in the EMERALD framework, and the desired assurance level for EUCS (basic, medium, and high). For other schemas like BSI C5, ENS, etc. this field is not available.

After having clicked on the "Save" Button, the new audit scope is created.

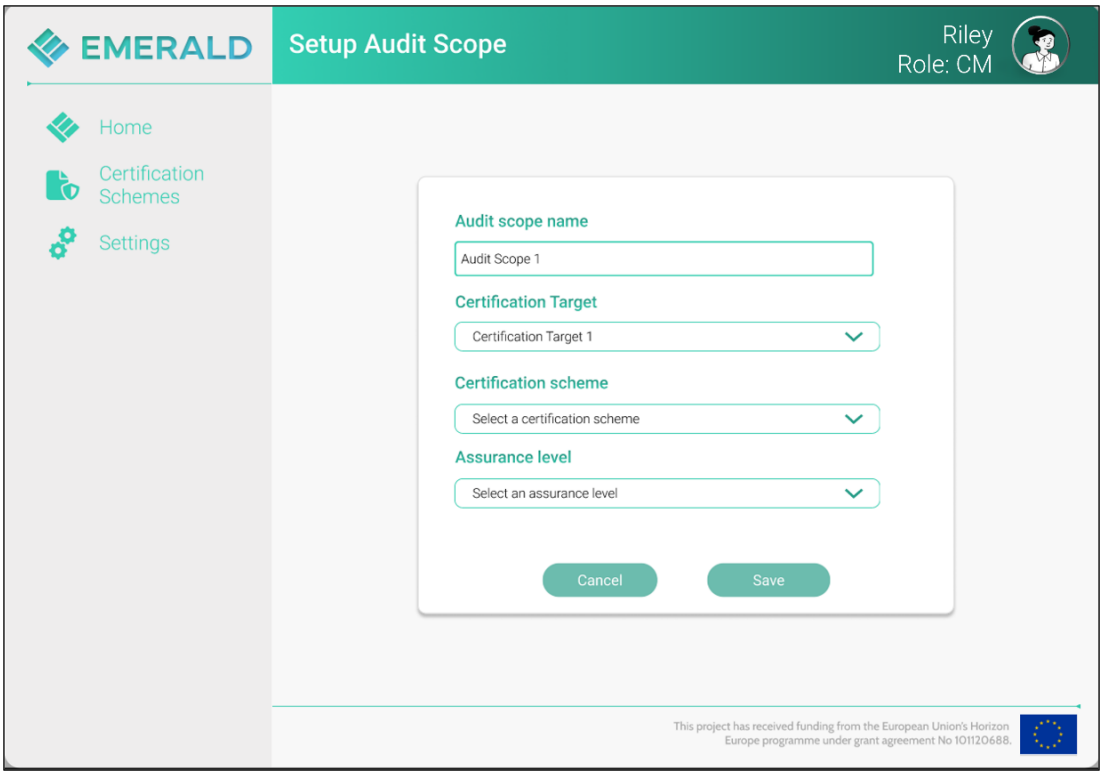

Figure 39. Audit Scope – Setup a new audit scope

To reopen and manage an already existing audit scope, one needs to click on the "Manage Audit Scope" on the EMERALD landing page (see Figure 30). Before being able to manage the audit scope, a user must select the audit scope they would like to work with, as presented in Figure 40.

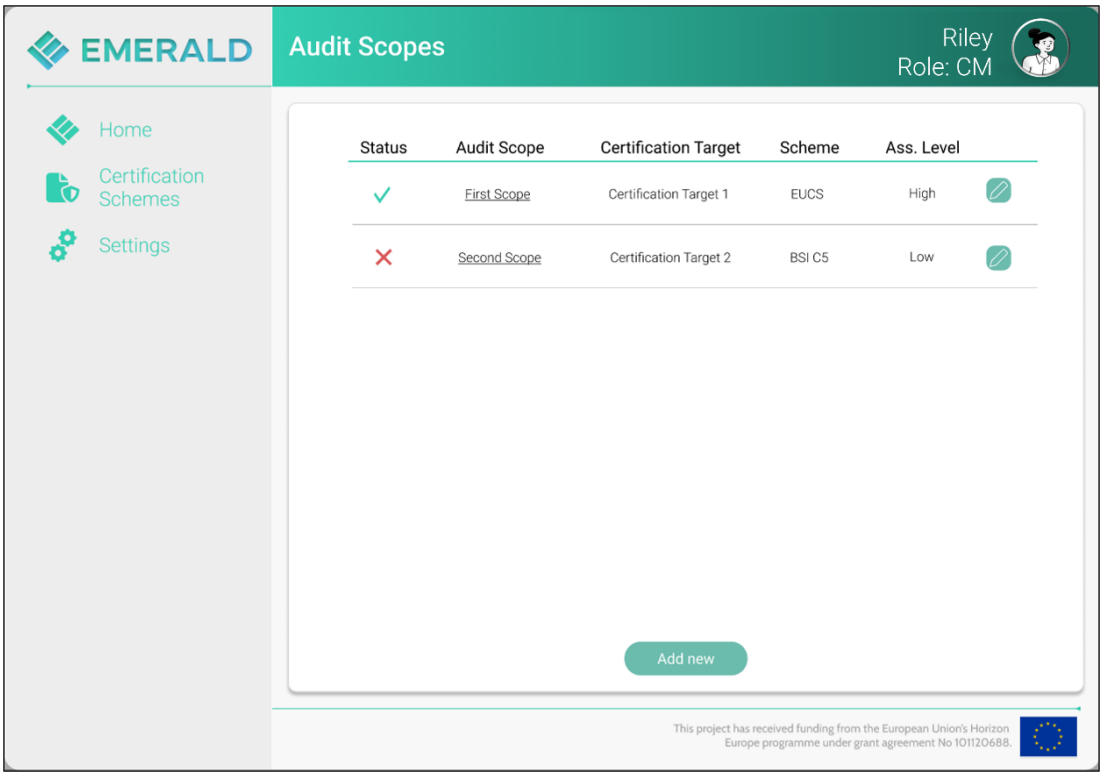

Figure 40. Audit Scope - Select an existing audit scope

When entering an audit scope, the following overview is provided, as shown in Figure 41. On top of the view, the name of the audit scope is shown. Figure 41, point 1 provides information about the certification target, the scheme, and the assurance level. Figure 41, point 2 shows the result of the integrity check provided by the *TWS* (see Section 5.6 for details). Figure 41, point 3 presents the compliance status of all controls in the audit scope in percentage. Figure 41, point 4 presents a status overview of all the controls of the audit scope – the currently presented status are still under discussion. Figure 41, point 5 provides an overview of tasks of the current user. Figure 41, point 6 allows to search in the control list, while point 7 shows the list with categories and controls of the current scheme including the compliance state, the status of implementation, the category or control id, the owner of the control and the person assigned to the control.

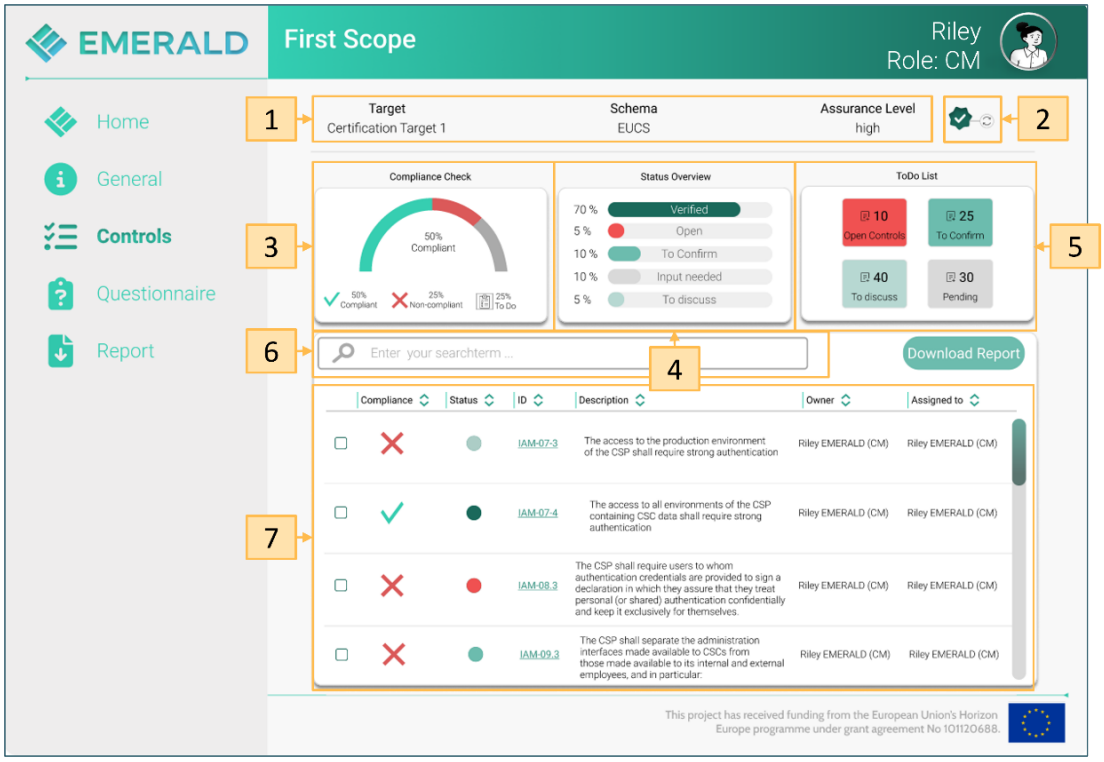

Figure 41. Audit Scope – Entry page of an audit scope

When clicking on one control, detailed information about the control is provided as shown in Figure 42. Figure 42, point 1 provides information about the certification target, the scheme, and the assurance level. Figure 42, point 2 shows the result of the integrity check provided by the *TWS* (see Section 5.6 for details). Figure 42, point 3 provides information about the control including its id, description, compliance state and status of implementation. Figure 42, point 4 is the menu for navigating through the different information regarding the control. In Figure 42, 4 the Overview menu is activated showing in point 5 further information about the control (this will be enhanced with further information).

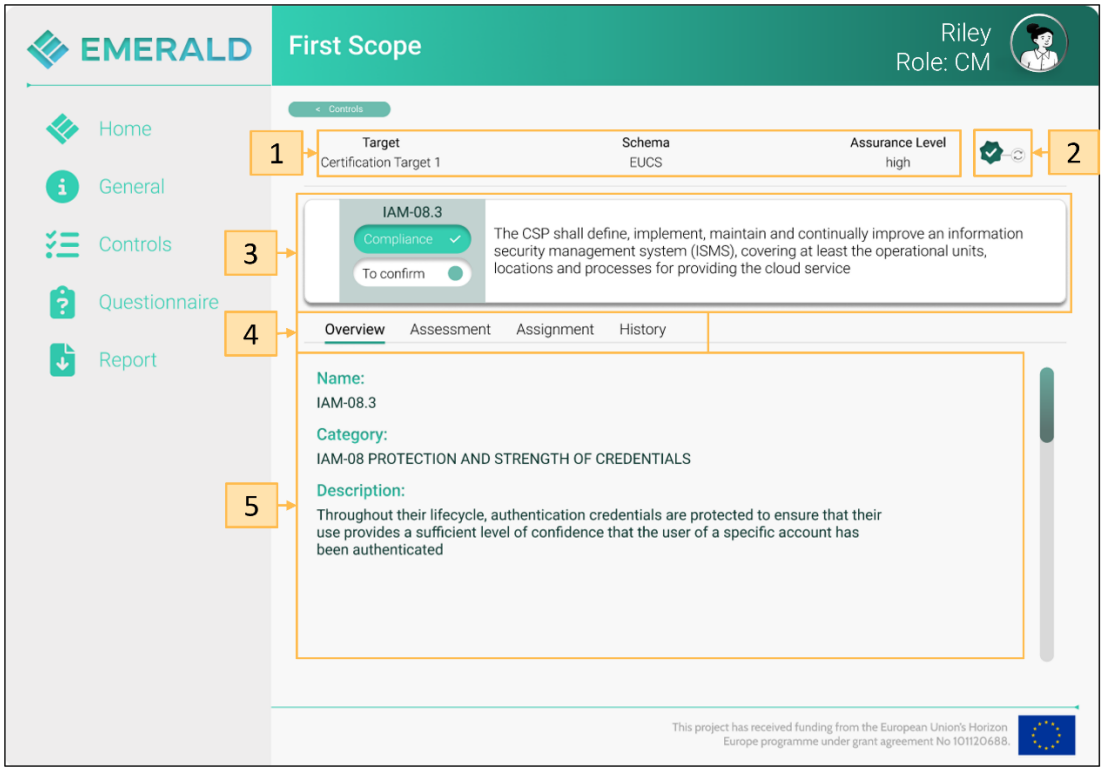

Figure 42. Audit Scope – Overview page of a control

When clicking in Figure 42, point 4 on "Assessment", the corresponding view is opened as shown in Figure 43. In this view the list of technical and organisational metrics assigned to the respective control is shown including the sources where the assessment results are coming from.

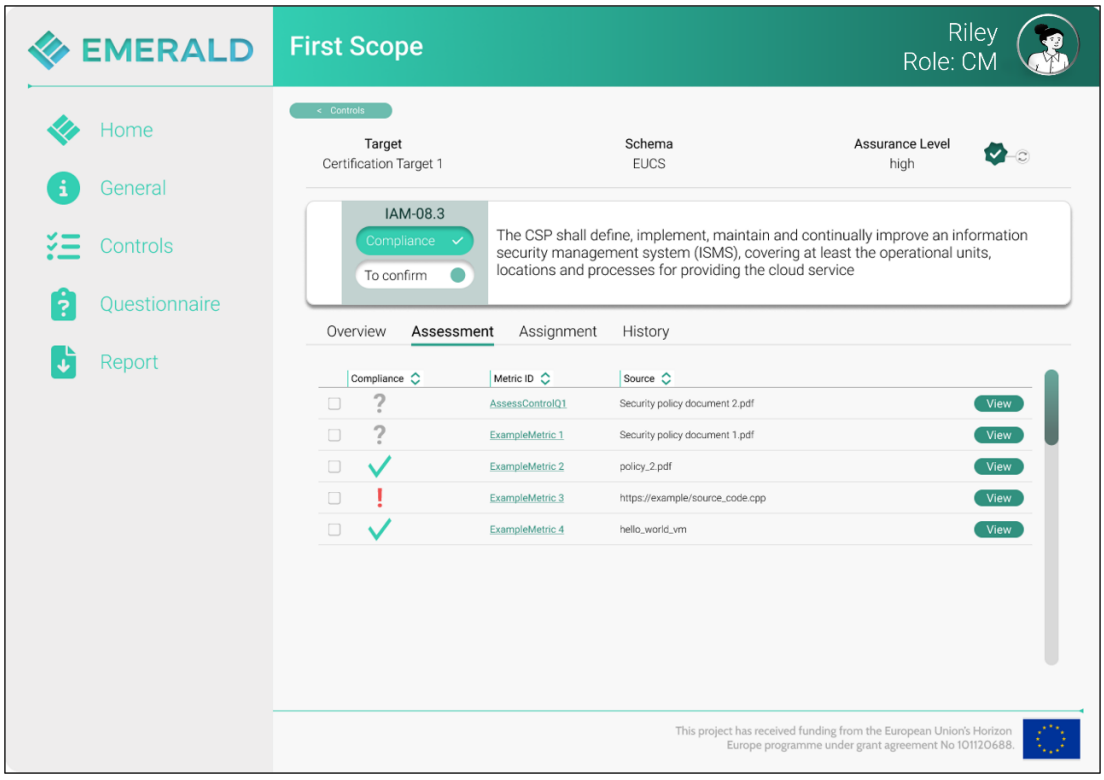

Figure 43. Audit Scope – Assessment overview of the metrics assigned to a control

In the following, we present the views for organisational metrics, where the creation of the assessment results and evidence extraction is done by *AMOE*. The views for the technical metrics and their assessment results are work in progress and will not be presented in this deliverable.

When clicking on one of the organisational metrics in the list, a view is shown where a user can deal with the metric, its respective evidence, and its compliance status as depicted in Figure 44. In Figure 44, point 1 more information about the metrics is presented. In Figure 44, point 2 a user has the possibility to upload a policy document. When a document is dragged to this filed a new view is shown, as depicted in Figure 45. Here the user has again the possibility to add further metrics for which evidence should be derived from the policy document by *AMOE*. After having uploaded the document, and after the respective evidence has been extracted by *AMOE*, in Figure 44, point 3 the information about the evidence in the document is shown. A user has also the possibility to open the PDF an see the respective paragraphs where the evidence was extracted from. Subsequently, depending on the evidence, the user can decide whether the metric is compliant or non-compliant. Based on the decision taken, the compliance status of the metric is updated and reflected in Figure 43.

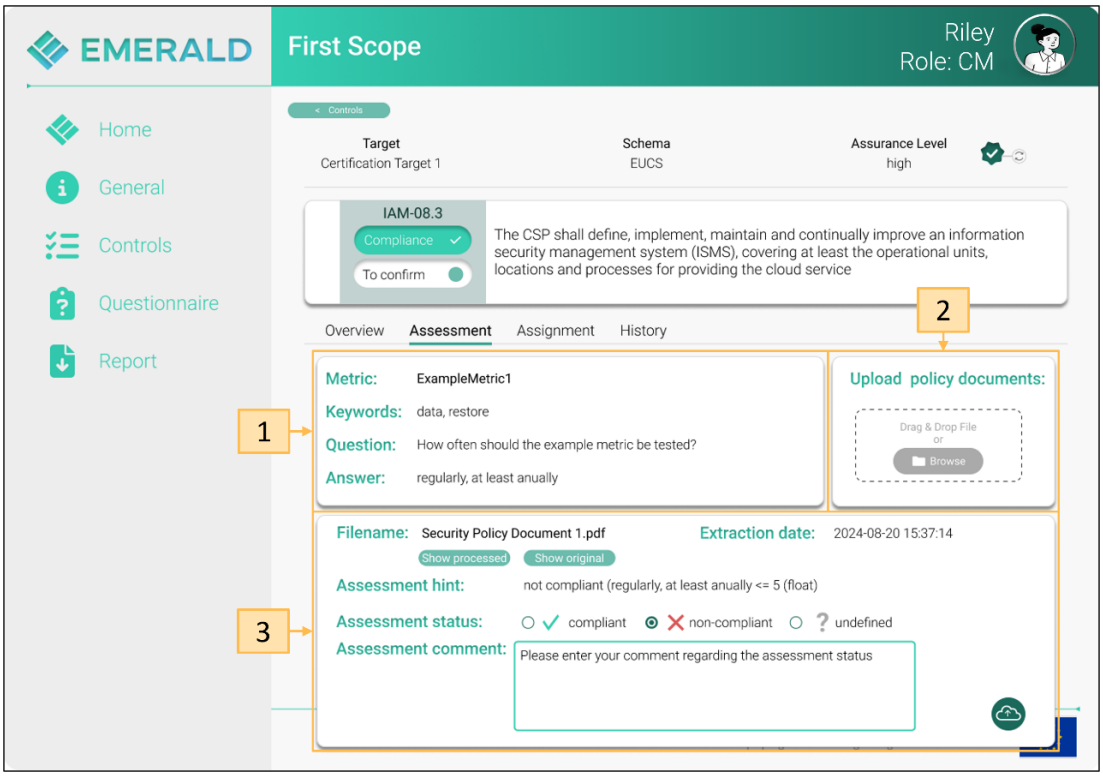

Figure 44. Audit Scope – Overview of an organisational metric

Figure 45 presents the selection of the metrics that should be extracted from the policy document. This view will be updated so that the metrics are shown in a hierarchical way similarly to Figure 35. Additionally, it must be mentioned that policy documents that are uploaded in this view, will also be shown in the corresponding view when setting up or managing a certification target (see Figure 34).

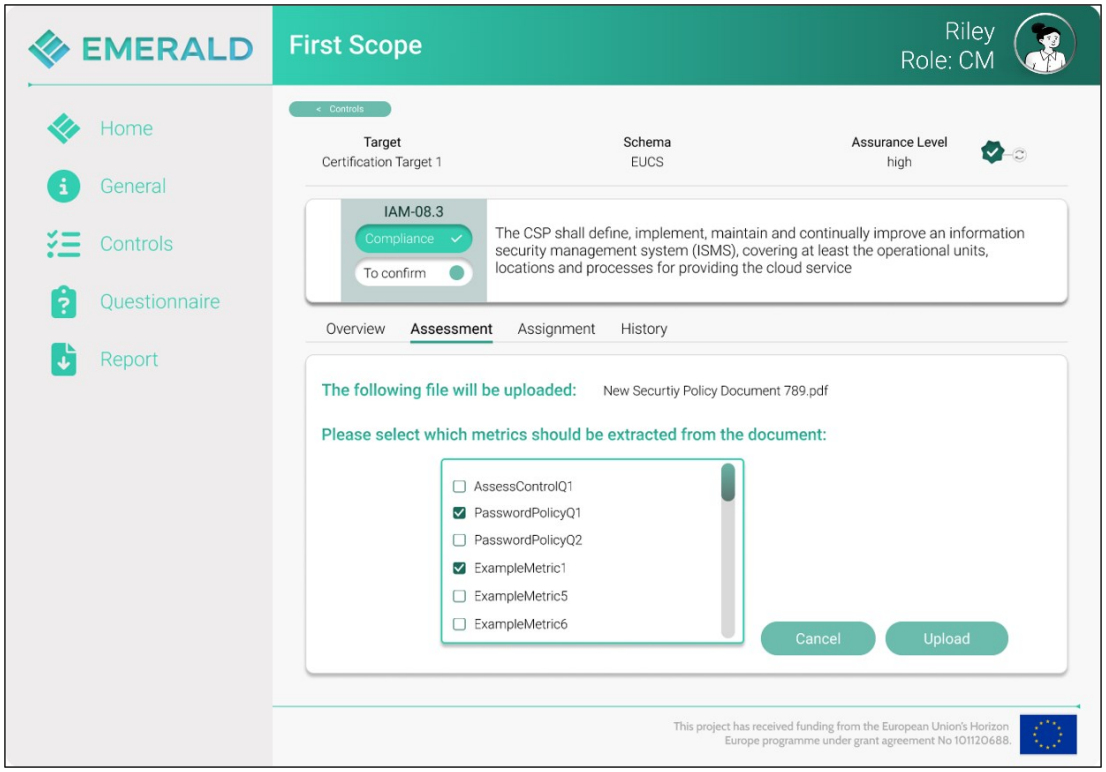

Figure 45. Audit Scope – Upload a policy document and select metrics

When clicking in Figure 42, point 4 on "Assignment", the corresponding view is opened as shown in Figure 46. Here the control owner can assign an individual colleague or a whole department to care for the control.

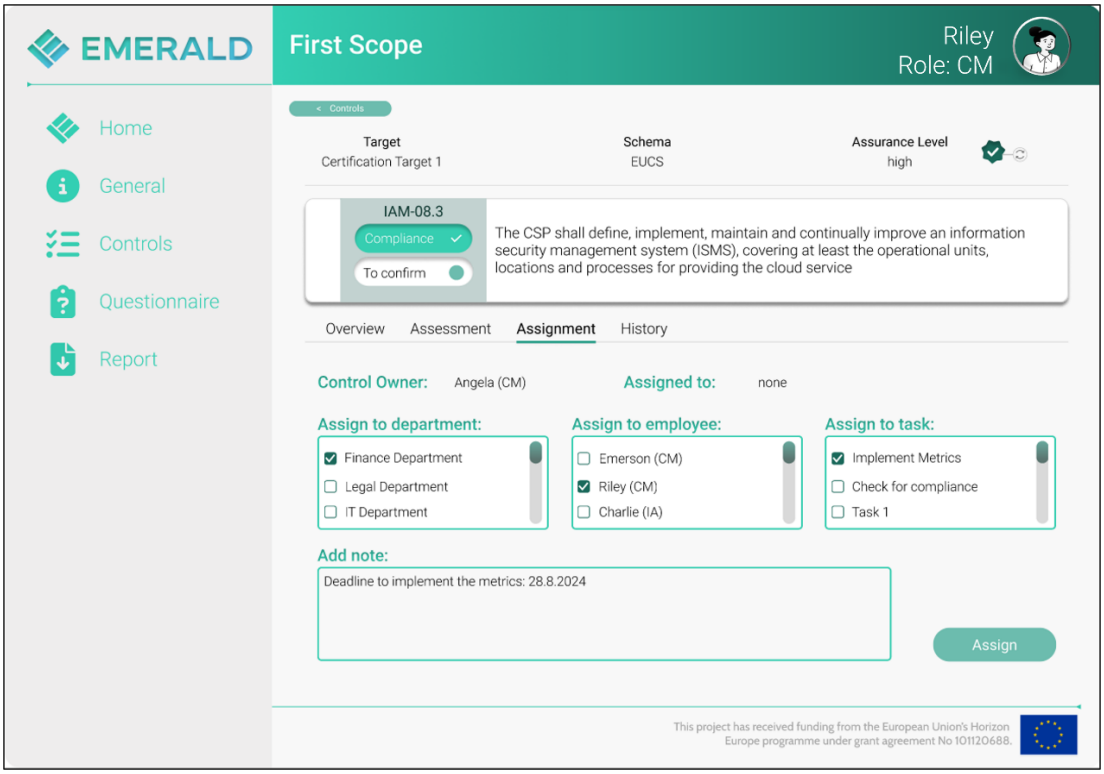

Figure 46. Audit Scope – Assignment of individuals or departments to a control

When clicking in Figure 42, point 4 on “History”, the corresponding view is opened, as shown in Figure 47. Here all activities that have been done regarding the respective control are shown for transparency and reproducibility reasons.

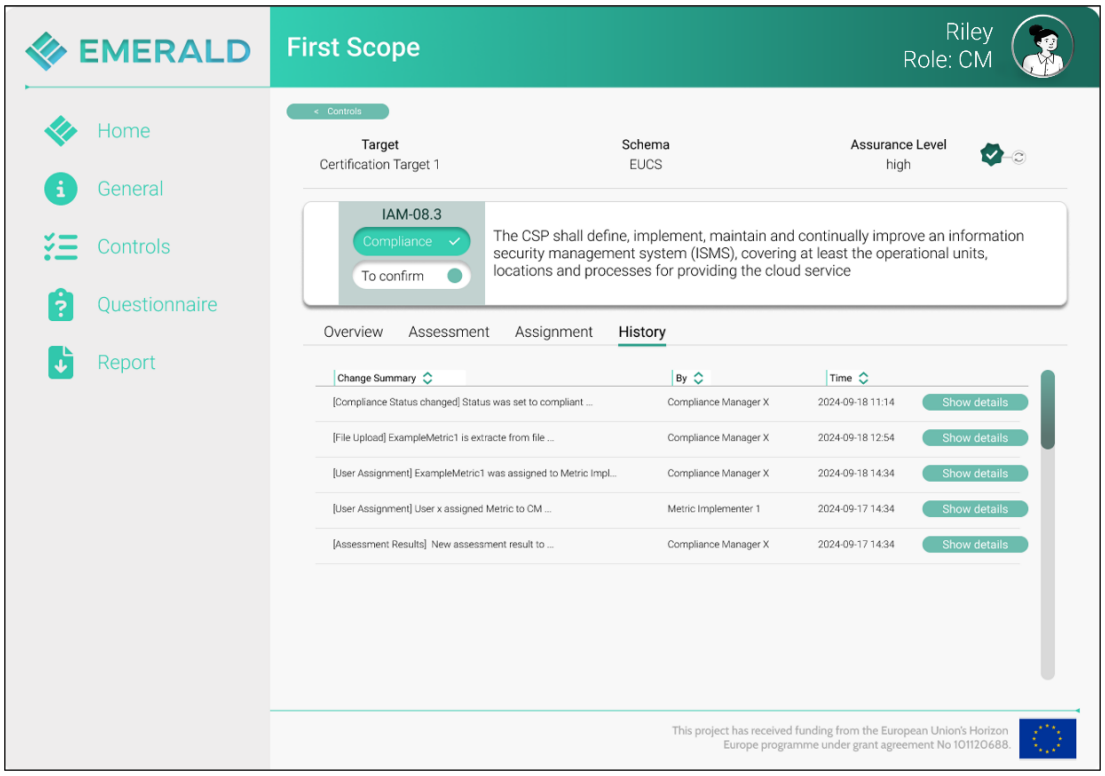

Figure 47. Audit Scope – Show history of changes for the respective control

When clicking on the “show details” button, more details about what was done is presented as depicted in Figure 48.

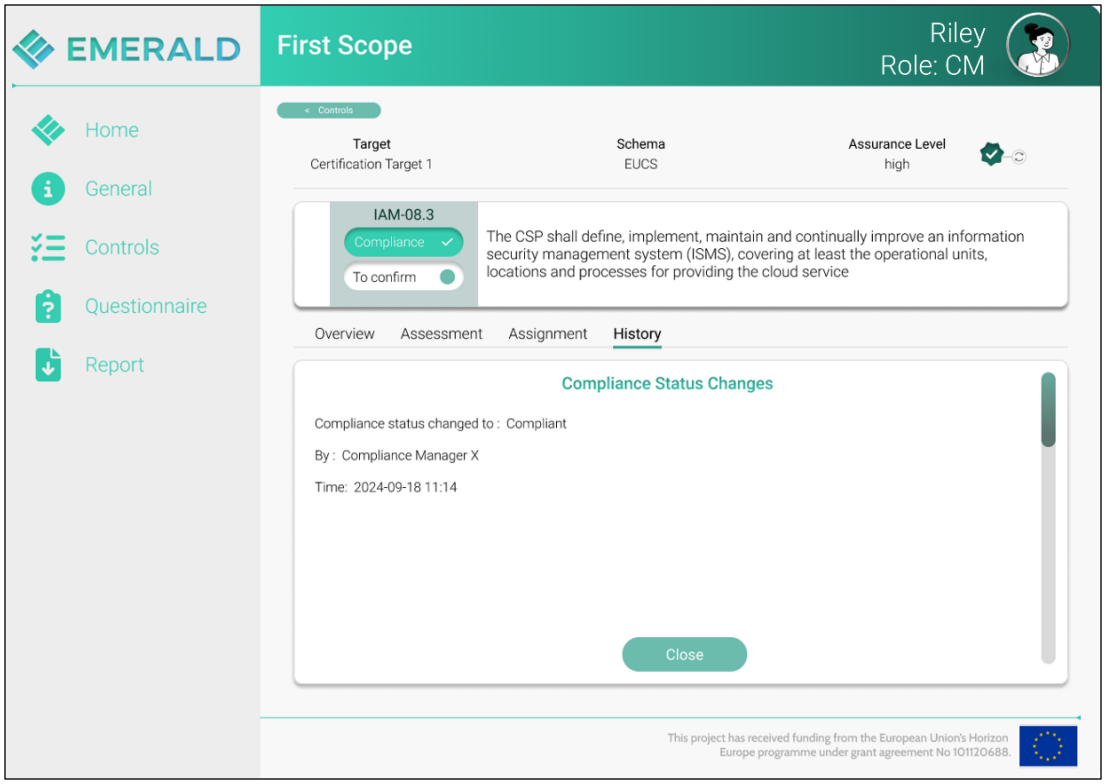

Figure 48. Audit Scope – Show history changes of a control in detail

5.2 Integration of *Assessment and Management of Organisational Evidence* (*AMOE*) into the EMERALD UI

AMOE is designed to extract evidence based on metrics from policy documents. After the extraction process, the evidence can be inspected by a user in the EMERALD UI. Once the results have been reviewed by a user, the evidence results can be forwarded to the EMERALD framework.

The *AMOE* component is mostly related to the visualisation streams 1 and 2. It needs to present the following major functionalities in the EMERALD UI: first, the UI needs to allow the upload of policy documents. During the upload it should allow to define which metrics should be extracted from the respective document. Second, the EMERALD UI should present the assessment hints provided by *AMOE*. It should allow to open the respective policy document and see where the evidence extracted comes from. Additionally, the UI should allow to set the compliance status for a metric based on the hints provided by *AMOE*.

5.2.1 Results of Workshop 1

The first workshop with the *AMOE* component owner (FABA) was held on the 31st of July 2024. For this workshop, a Miro board was prepared and used to guide the discussion and to track the insights gained. Additionally, the workshop was recorded via Teams and later revisited. The overall goal of this workshop was to get a better understanding of *AMOE* in general and how its integration into the EMERALD UI could look like. The workshop was structured as follows:

- ***AMOE* functionality:** At the beginning of the workshop, we discussed with the participants what the *AMOE* functionality is all about from the WP4 point of view. This was necessary to clarify any possible ambiguities or misunderstandings and to be sure that the purpose of *AMOE* is clear to all involved parties right from the beginning. A respective frame was prepared in the Miro Board, presenting a short summary with the most relevant functionalities of the *AMOE* component that was used for the discussion.
- **"Set-up" *AMOE*:** There are no concrete settings to be taken before *AMOE* can be used.
- **"Working with" *AMOE*:** As *AMOE* is dealing with evidence extraction from policy documents and how to present the results and provide access to the documents and found evidence, the discussion focused more on the topic of how and where to integrate *AMOE* into the EMERALD UI.

During the whole workshop, all participants were invited to add sticky notes directly to the Miro board (see Figure 49, yellow sticky-notes). And afterwards, the WP4 team went through the recording again and added further notes to the board (see Figure 49, violet sticky-notes).

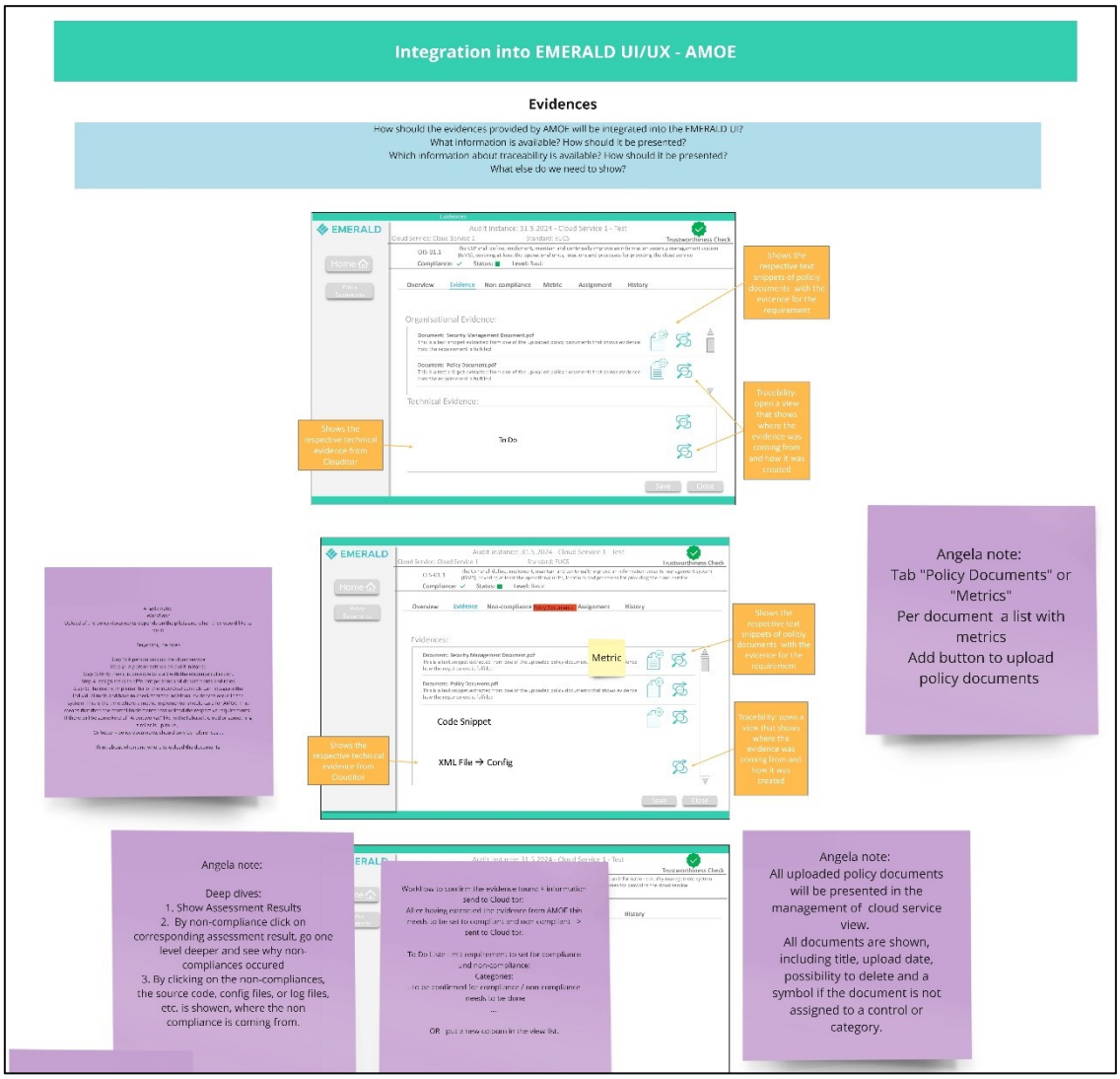

Figure 49. AMOE - Screenshot of the Miro Board with yellow and violet sticky-notes to capture the functionality and features for AMOE

5.2.2 Results of Workshop 2

The second workshop with the *AMOE* component owner took place on the 22nd of August 2024. In this workshop, the status of the clickable mock-ups, gained insights, and open questions were discussed. So far elicited insights have been implemented in the current version of the clickable mock-ups, however, there is still some further room for improvement.

5.2.3 Functionality and clickable prototype of *AMOE*

From both workshops, we were able to derive the following list of functionalities that have been considered for integrating *AMOE* into the EMERALD UI:

"Setup" *AMOE*:

- *AMOE* itself needs no real settings that need to be entered via the EMERALD UI to function.

"Working" with *AMOE*:

- **Upload policy documents and assign metrics**: There need to be two places where the upload of policy documents should be available: during the setup and management of certification targets and during the management of audit scopes. Additionally, whenever a policy document is uploaded, it should be possible to define which metrics should be extracted from the respective document. Both opportunities have been implemented in the EMERALD UI, in the certification target in Section 5.1.1, as shown in Figure 34 and Figure 35, and in the audit scope in Section 5.1.2, as shown in Figure 44 and Figure 45.
- **Show evidence extraction results**: For each metric, the assessment hint and the evidence derived from *AMOE* should be shown. This functionality is implemented in the audit scope in Section 5.1.2 and shown in Figure 43 and Figure 44. Additionally, it should be possible to open the policy document and see where the extracted evidence has been found, e.g., the respective text in the respective paragraph.

We are aware that *AMOE* has some further functionalities (e.g., a view that shows the extracted evidence in the document) that need to be considered for the UI, however, this is work in progress.

5.3 Integration of *Clouditor-Orchestrator* into the EMERALD UI

The *Clouditor* is the central component of the EMERALD framework, and comprises four sub-components named: *Orchestrator*, *Evidence Store*, *Assessment*, and *Evaluation*. It orchestrates the certification process (collection, assessment, and evaluation of evidence) and connects multiple components. It holds all dynamic information about the current audit process including the certification target, the evaluated cloud services, the assessment results, and the final certification state.

Clouditor-Orchestrator is mostly related to the visualisation streams 1 and 2 (see Figure 29). In the EMERALD UI it needs to present the following major functionalities: first, when setting up a certification target it allows to select the available certifications schemes (from *RCM*); second, it allows to view the assessment results from all evidence extractors; and third, it is responsible for making the final certification decisions.

5.3.1 Results of Workshop 1

The first workshop with the *Clouditor-Orchestrator* component owner (Fraunhofer) was held on the 31st of July 2024. For this workshop, a Miro board was prepared and used to guide the

discussion and track the insights gained. Additionally, the workshop was recorded via Teams and later revisited. The overall goal of this workshop was to get a better understanding of the *Clouditor-Orchestrator* in general and how its integration into the EMERALD UI could look like. The workshop was structured as follows:

- ***Clouditor-Orchestrator* functionality:** At the beginning of the workshop, we discussed with the participants what the *Clouditor-Orchestrator* functionality is all about from the WP4 point of view. This was necessary to clarify any possible ambiguities or misunderstandings and to be sure that the purpose of *Clouditor-Orchestrator* is clear to all involved parties right from the beginning. In the Miro Board a respective frame was prepared, presenting a short summary with the most relevant functionalities of the *Clouditor-Orchestrator* that was used for the discussion.
- **"Set-up" and "Working with" the *Clouditor-Orchestrator*:** There are no concrete settings to be taken before the *Clouditor-Orchestrator* can be used. As this component is an orchestrator for the whole certification process and combines multiple components, the discussion focused more on the topic of where in the UI the *Clouditor-Orchestrator* should provide which information.

During the whole workshop, all participants were invited to add sticky notes directly to the Miro board (see Figure 50, yellow sticky-notes). And afterwards, the WP4 team went through the recording again and added further notes to the board (see Figure 50, violet sticky-notes).

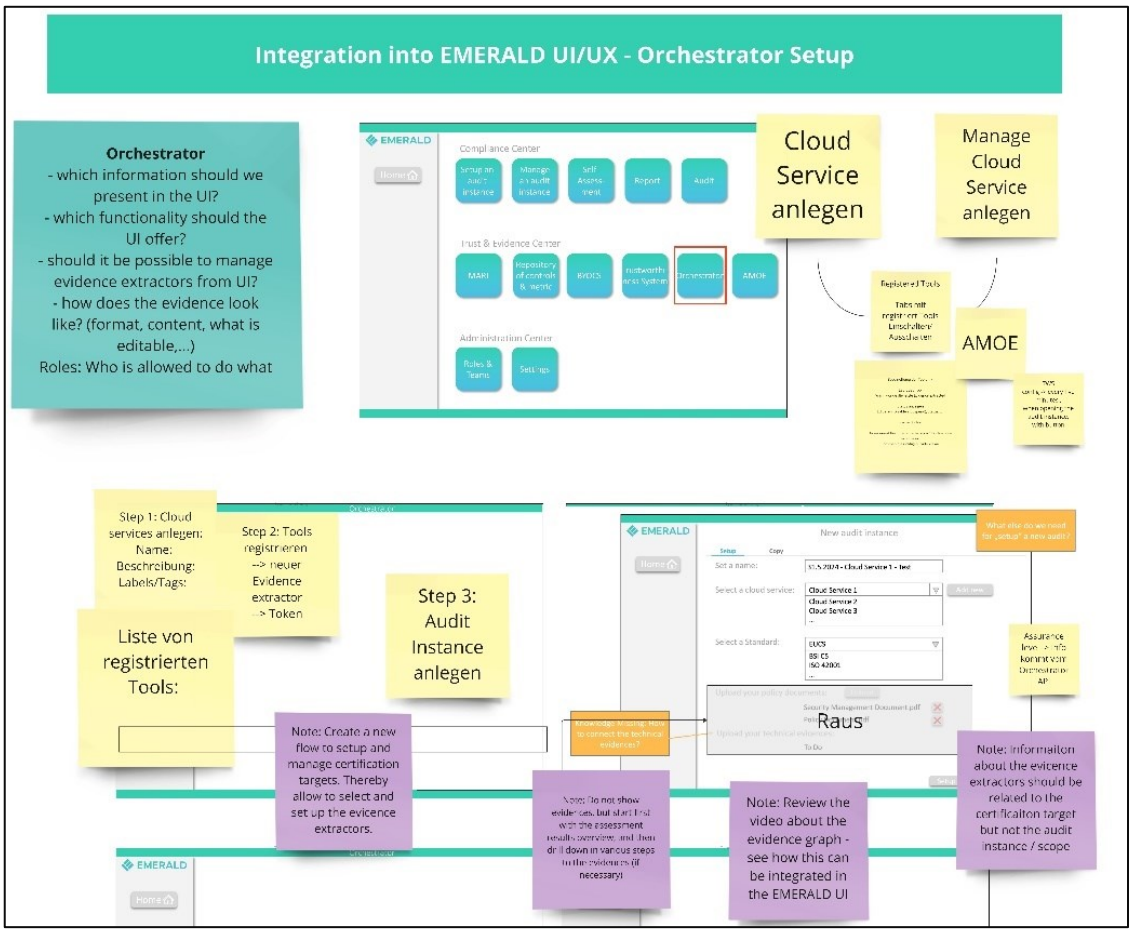

Figure 50. Orchestrator - Screenshot of the Miro Board with yellow and violet sticky-notes to capture the functionality and features for the Orchestrator

5.3.2 Functionality and clickable prototype of *Clouditor-Orchestrator*

From the first workshop, we were able to derive the following list of functionalities that need to be considered regarding the *Clouditor-Orchestrator* in the EMERALD UI:

"Working" with *Clouditor-Orchestrator*:

When working with *Clouditor-Orchestrator*, the EMERALD UI needs to offer the following functionalities.

- **Evidence Extractors**: *Clouditor-Orchestrator* is responsible for managing the evidence extractors regarding certification targets; thus, *Clouditor-Orchestrator* is involved when setting up a certification target and assigning the respective extractors as presented in Section 5.1.1.
- **Assessment Results and Evidence**: *Clouditor-Orchestrator* is responsible for managing assessment results and evidence. Therefore, whenever the EMERALD UI is presenting assessment results *Clouditor-Orchestrator* is involved, as already presented in Section 5.1.1 and Section 5.1.2. Whenever an assessment result is shown, a user should have the possibility to drill-down from the assessment result down to the evidence. Additionally, for technical evidence there will be available a certification graph as presented in Figure 51, where for each resource all properties and collected evidence can be displayed.

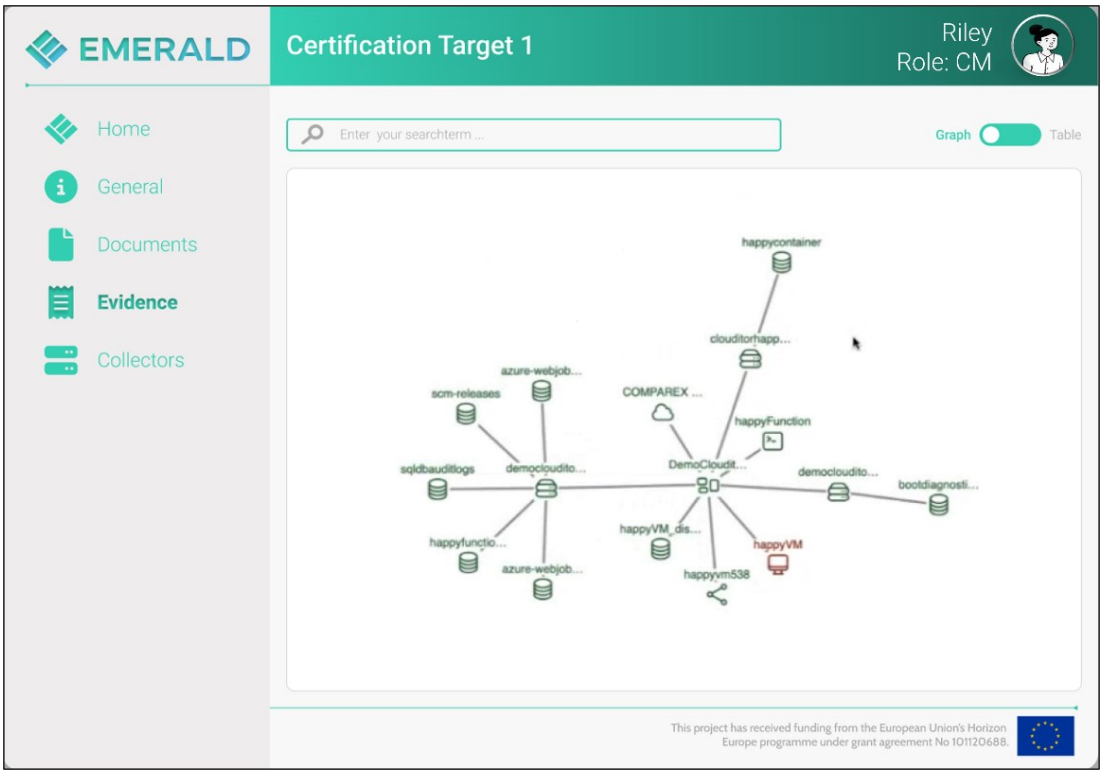

Figure 51. Clouditor-Orchestrator – Resource Graph showing all technical evidence

We are aware that the *Clouditor-Orchestrator* has many more functionalities that needs to be considered for the UI, however, this is work in progress and will therefore not be presented in this deliverable.

5.3.3 Results of Workshop 2

The second workshop with the *Clouditor-Orchestrator* component owner took place on the 11th of October 2024. In this workshop, the status of the clickable mock-ups, gained insights, and open questions were discussed, and the results will be subsequently implemented in the upcoming months. Therefore, these improvements are not presented in this deliverable.

5.4 Integration of the *Mapping Assistant for Regulations with Intelligence* (*MARI*) into the EMERALD UI

The *Mapping Assistant for Regulations with Intelligence* (*MARI*) component is an intelligent system that automatically selects suitable metrics for demonstrating compliance with certification schemes. It leverages advanced AI techniques, including Natural Language Processing (NLP), to analyse security controls and recommend optimal metrics.

MARI is related to the visualisation stream 3. It needs to present the following three major functionalities In the EMERALD UI: First, the EMERALD UI should show the metrics that are automatically assigned by *MARI* to a control of a respective certification scheme. Second, the EMERALD UI should present how controls of a certification scheme corresponds with controls of other certification schemes. Third, the EMERALD UI should allow to take over control-metric assignments from existing audit scopes.

5.4.1 Results of Workshop 1

The first workshop with the *MARI* component owner (CNR) took place on the 23rd of July 2024. For this workshop a Miro board was prepared and used to guide the discussion and to track

the insights gained. Additionally, the workshop was recorded via Teams and later revisited. The overall goal of this workshop was to get a better understanding of the *MARI* component in general and how its integration into the EMERALD UI could look like. The workshop was structured as follows:

- ***MARI* functionality:** At the beginning of the workshop, we gave the participants a short summary of what the *MARI* component is doing from the WP4 point of view. This was necessary to clarify any possible ambiguities or misunderstandings and to be sure that the purpose of the *MARI* component is clear to all involved parties right from the beginning. In the Miro Board a respective frame was prepared, presenting a short summary with the most relevant functionalities of the *MARI* component that was used for the discussion.
- **"Set-up" of *MARI*:** There are no concrete settings to be taken before the *MARI* component can be used. The only setting that needs to be taken during the mapping between the controls and metrics is the number of metrics to suggest for a specific control.
- **"Working" with *MARI*:** During the discussions it became clear that the *MARI* component should support two major functionalities that need to be represented in the EMERALD UI: the mapping of a set of metrics to respective controls of a certification scheme, and the mapping of controls across different certification schemes.

During the whole workshop, all participants were invited to add sticky notes directly to the Miro board (see Figure 52, yellow sticky-notes). And afterwards, the WP4 people went through the recording again and added further notes to the board (see Figure 52, violet sticky-notes).

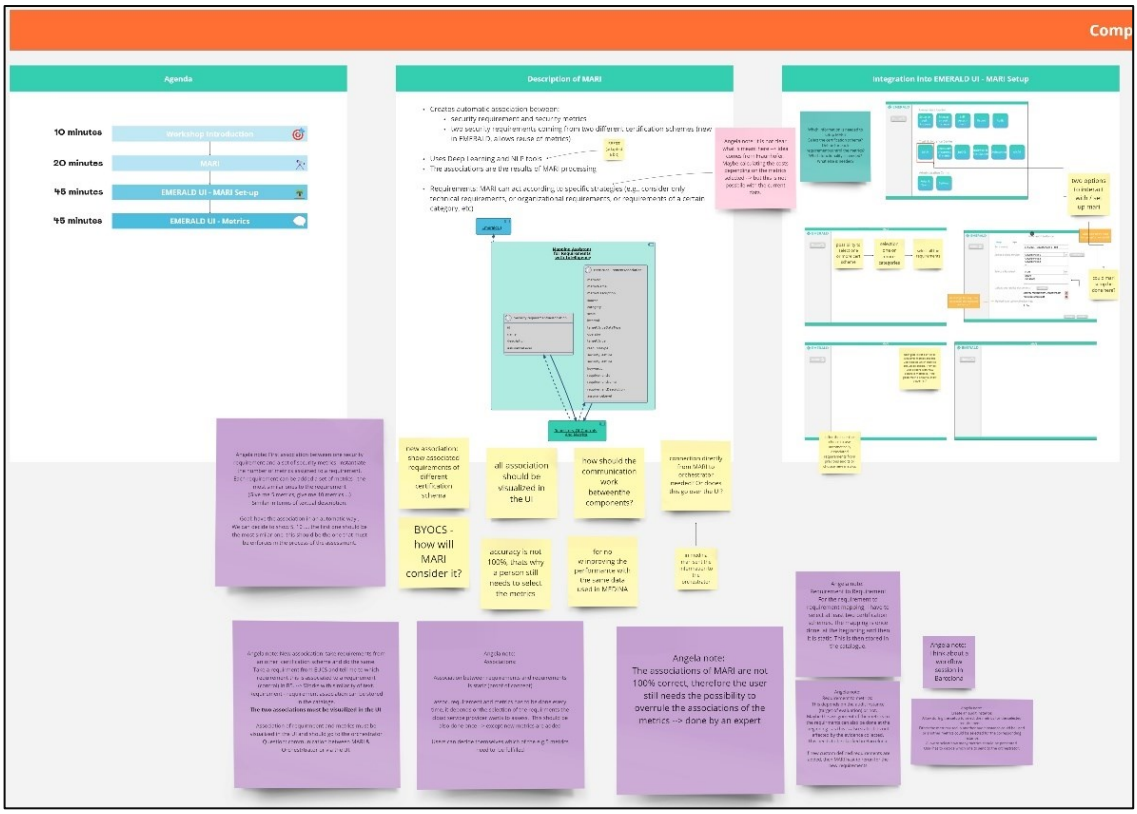

Figure 52. MARI - Screenshot of the Miro Board with yellow and violet sticky-notes to capture the functionality and features for the MARI component

5.4.2 Functionality and Clickable Prototype of *MARI*

From the first workshop, we were able to derive the following list of functionalities that need to be considered regarding the integration of the *MARI* component into the EMERALD UI:

"Set-up" of *MARI*:

- *MARI* needs no real setting to function. The only functionality that needs to be available in the EMERALD UI so far is to state how many metrics should be maximally suggested for a control when mapping controls to metrics (not implemented in the clickable prototype yet).

"Working" with *MARI*:

When working with *MARI*, the EMERALD UI needs to offer the following functionalities.

- **Mapping between metrics and controls:** The EMERALD UI needs to show for a control all the metrics that were mapped to the control by *MARI*. Thereby the metrics need to be sorted regarding the results of their matching. The better the match between the metric and the control, the higher the metric will be shown in the list. As the mapping algorithm is not 100% accurate, the user should be able to adapt the metrics per control according to their needs.
  Remark: the mapping between metrics and controls needs always to be related to an audit scope.
- **Mapping of controls between different certification schemes**: The EMERALD UI needs a view that allows to see the mapping of controls between different schemes. This

means that the user should be able to select a control from a certification scheme and then be shown which control(s) from other schemes correspond to the one selected.

- **Allow to take over control-metric assignments from existing audit scopes**: The EMERALD UI should offer an easy-to-use interface that allows users to take over the mapping of controls and metrics from other audit scopes (not yet implemented).

The above-mentioned functionalities are implemented as follows.

5.4.2.1 Mapping between metrics and control

When entering the "Certification Schemes" area, it is possible to enter the views for the mapping of controls and metrics as depicted in Figure 53, point 1 per scheme or to enter the view for mapping controls between different schemes as depicted in Figure 53, point 2.

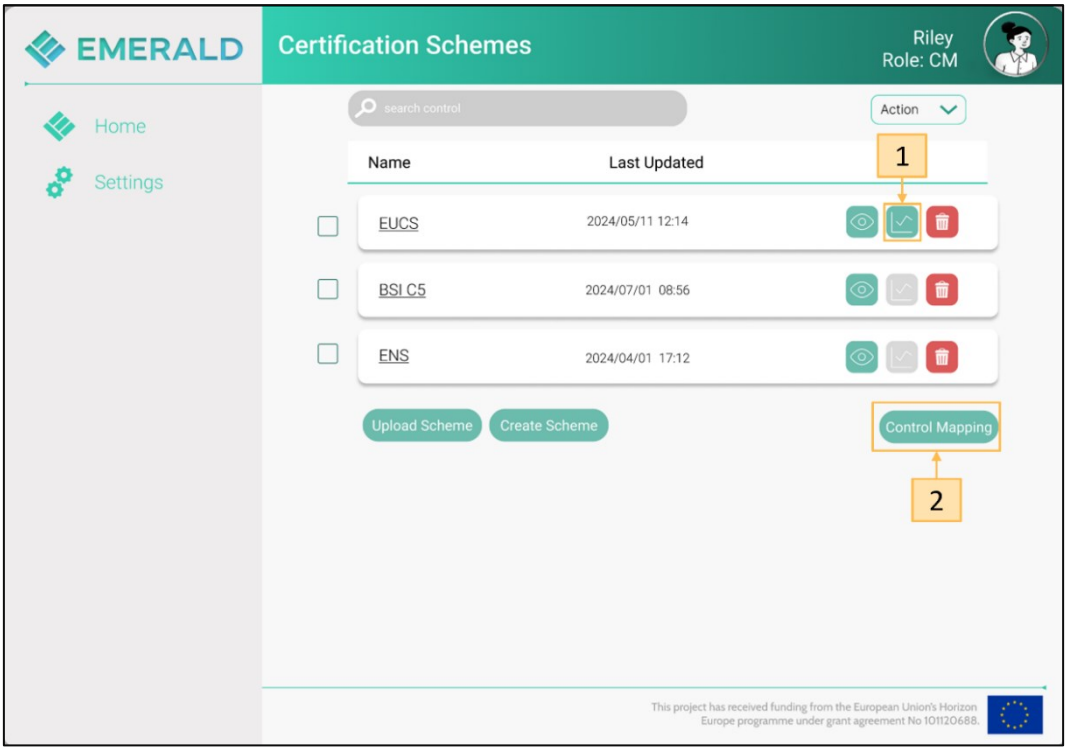

Figure 53. Certification Scheme - Overview page

When clicking on the button for mapping metrics and controls of a scheme (Figure 53, point 1), another view is opened showing the respective categories and controls of the respective schema (Figure 54). When opening a category and selecting a control, the corresponding metrics that were suggested by *MARI* are shown, see Figure 54, on the right side. The metrics are sorted according to their relevance for the control; the most relevant ones are on top of the list and presented with a darker background than those that are not so important.

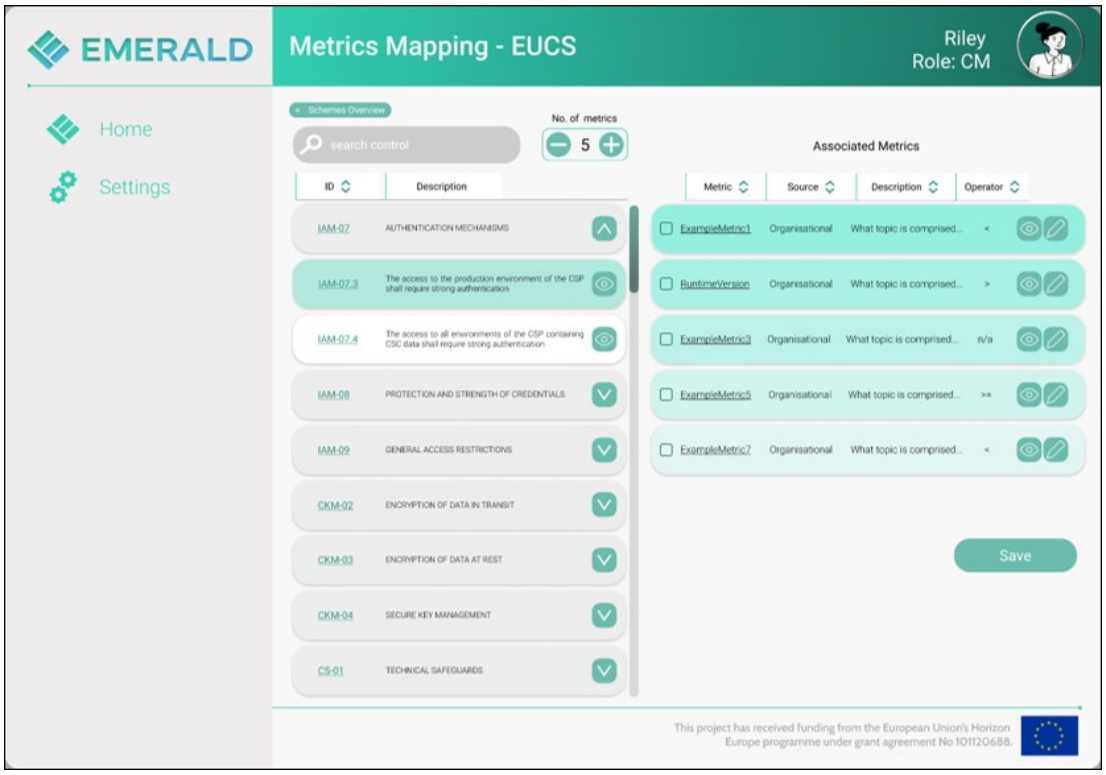

Figure 54. MARI - Overview of controls and mapped metrics

For each metric, the user has then the possibility to view the metric definition, edit the metric, or delete the metric. Figure 55 presents the view of a metric including its attributes.

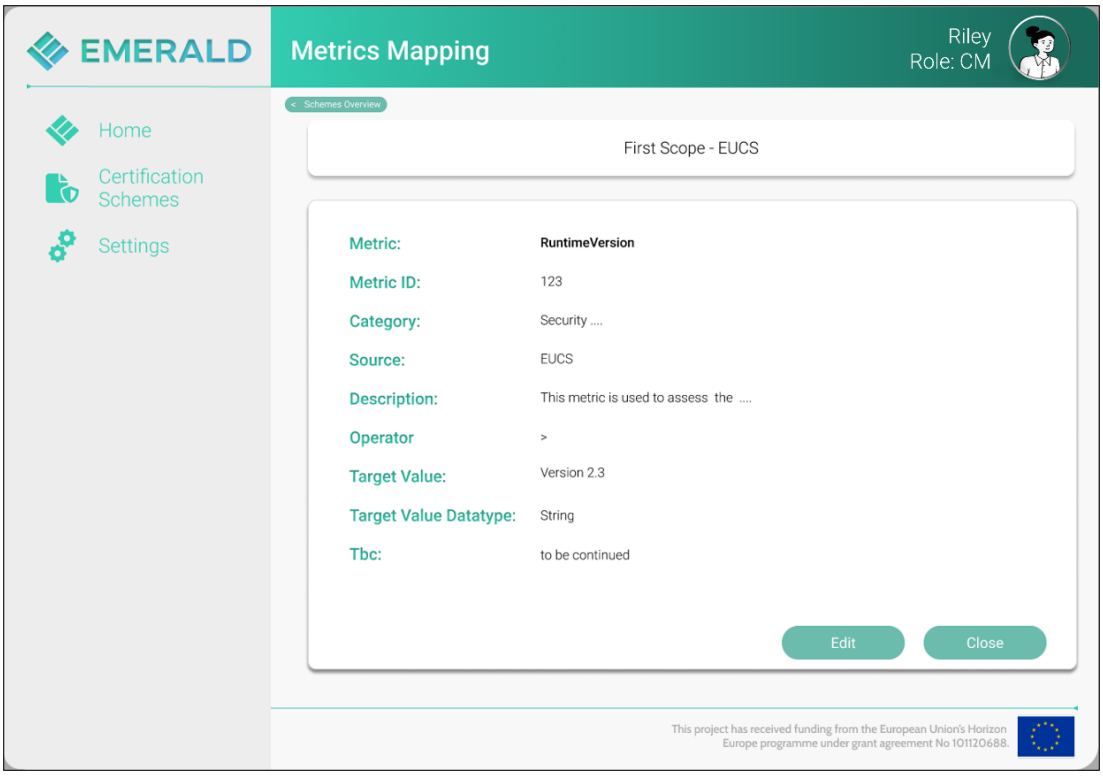

Figure 55. MARI - Presentation of a metric definition

5.4.2.1 Mapping between controls of different schemes

When entering the "Certification Scheme" area, it is possible to enter the view for mapping controls between different schemes as depicted in Figure 53, point 2 above. Before being able to map controls of different schemes with each other, the user must select at least two different schemes as presented in Figure 56.

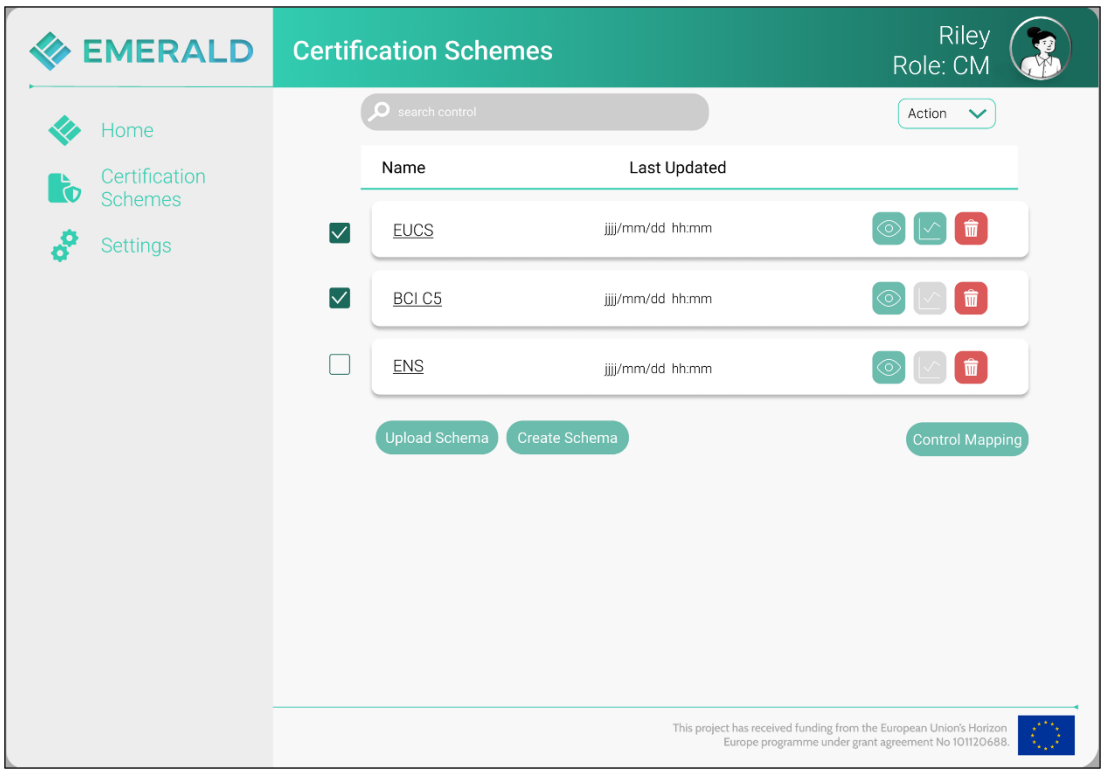

Figure 56. MARI - Select two or more schemes for mapping their controls

After clicking on the “Control Mapping” Button, the mock-up shows an overview with the two selected schemes as depicted in Figure 57. When entering this view, all EUCS Controls are shown. When clicking on a control e.g. ISP-02, as shown in Figure 57, the corresponding controls of BSI C5 are presented.

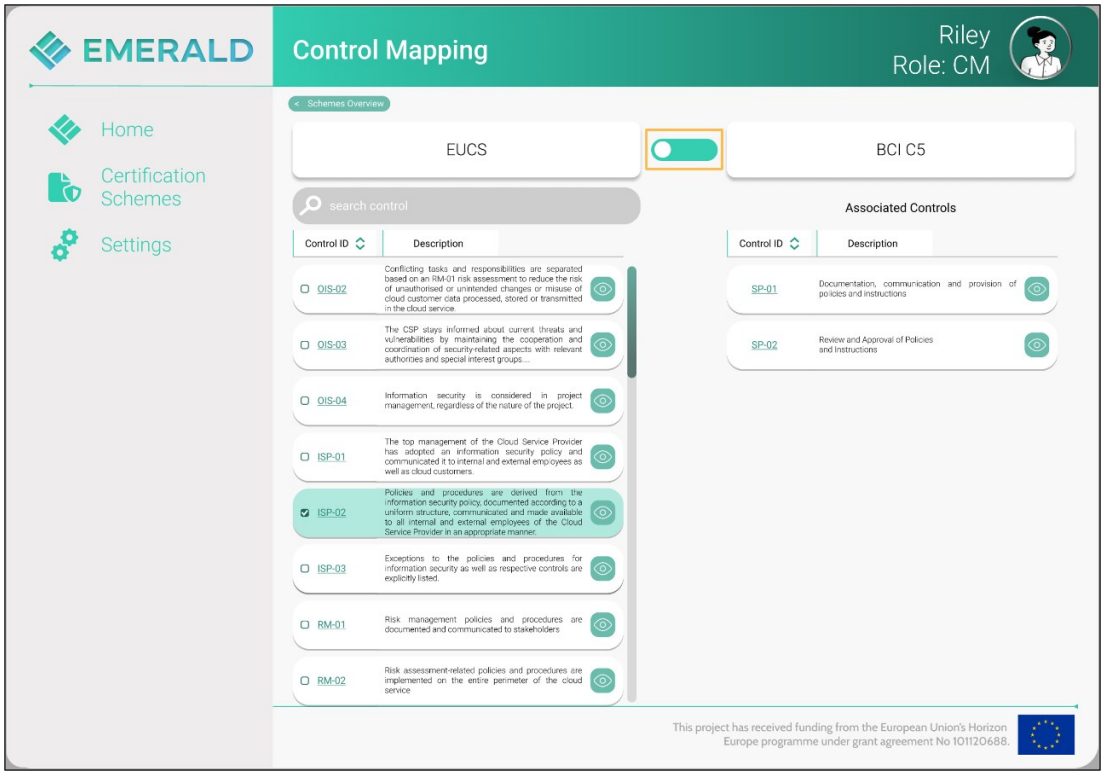

Figure 57. MARI - Mapping controls from EUCS to BSI C5

To change the mapping direction from EUCS - BSI C5, to BSI C5 - EUCS a user can switch the slider between the two certification schemes, as marked in orange in Figure 57. As presented in Figure 58, now all the BSI C5 controls are shown – when clicking on one of these controls the corresponding controls of EUCS are presented.

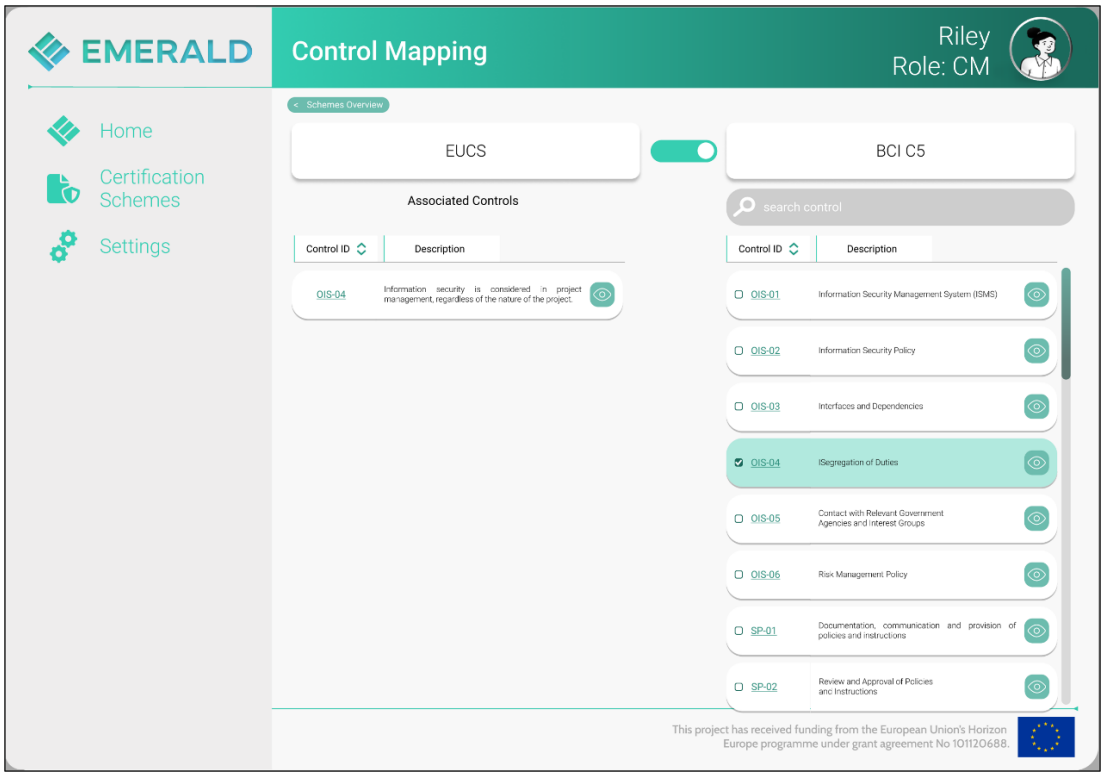

Figure 58. MARI - Mapping controls from BSI C5 to EUCS

5.4.3 Results of Workshop 2

The second workshop with the *MARI* component owner took place on the 9th of October 2024. In this workshop, the status of the clickable mock-ups, gained insights, and open questions was discussed, and the results will be subsequently implemented in the upcoming months. Therefore, these improvements are not presented in this deliverable.

5.5 Integration of the *Repository of Controls and Metrics* (*RCM*) into the EMERALD UI

The *Repository of Controls and Metrics* (*RCM*) serves as a catalogue of controls and metrics where the certification schemes are stored and managed. It consists of a repository capable of containing different certification schemes, including the information of each scheme categorized by classes (e.g., categories, controls, assurance levels, etc.) and supporting multi-scheme and multi-level certification. The *RCM* also incorporates the definition of the metrics used in EMERALD to assess evidence.

The *RCM* is related to the visualisation stream 3 (see Figure 29). In the EMERALD UI it needs to present the following three major functionalities: First, the EMERALD UI should allow to browse through the different catalogues. Second, the EMERALD UI offer an opportunity to upload a new certification scheme. Second, the EMERALD UI should present the self-assessment questionnaires for audit scopes related to EUCS, to allow users to track their implementation status.

5.5.1 Results of Workshop 1

The first workshop with the *RCM* component owner (TECNALIA) took place on the 24th of July 2024. For this workshop a Miro board was prepared and used to guide the discussion and to track the insights gained. Furthermore, the workshop was recorded via MS Teams to be revisited if needed. The overall goal of the workshop was to get a better understanding of *RCM* in general and how its integration into the EMERALD UI could look like. The workshop was structured as follows:

- ***RCM* functionality**: At the beginning of the workshop, we gave the participants a short summary of what *RCM* is doing from the WP4 point of view. This was necessary to clarify any possible ambiguities or misunderstandings and to be sure that the purpose of *RCM* is clear to all involved parties right from the beginning. In the Miro Board a respective frame was prepared, presenting a short summary with the most relevant functionalities of *RCM* that was used for the discussion.
- **"Set-up" of *RCM***: There are no concrete settings to be taken before *RCM* can be used.
- **"Working" with *RCM***: During the discussion it became clear that the EMERALD UI needs to support the following functionalities. First, it needs to allow to browse through the respective security schemes. Second, for each control it should present the implementation guideline, and if no guideline is available it should allow to add a guideline (depending on the role of the user). Third, the EMERALD UI should offer the possibility to upload a new scheme, either from a .csv file or an OSCAL file. Fourth, the EMERALD UI should present a self-assessment questionnaire in the audit scope view (only for EUCS).

During the whole workshop, all participants were invited to add sticky notes directly to the Miro board (see Figure 59, yellow sticky-notes). And afterwards, the WP4 people went through the recording again and added further notes to the board (see Figure 59, violet sticky-notes).

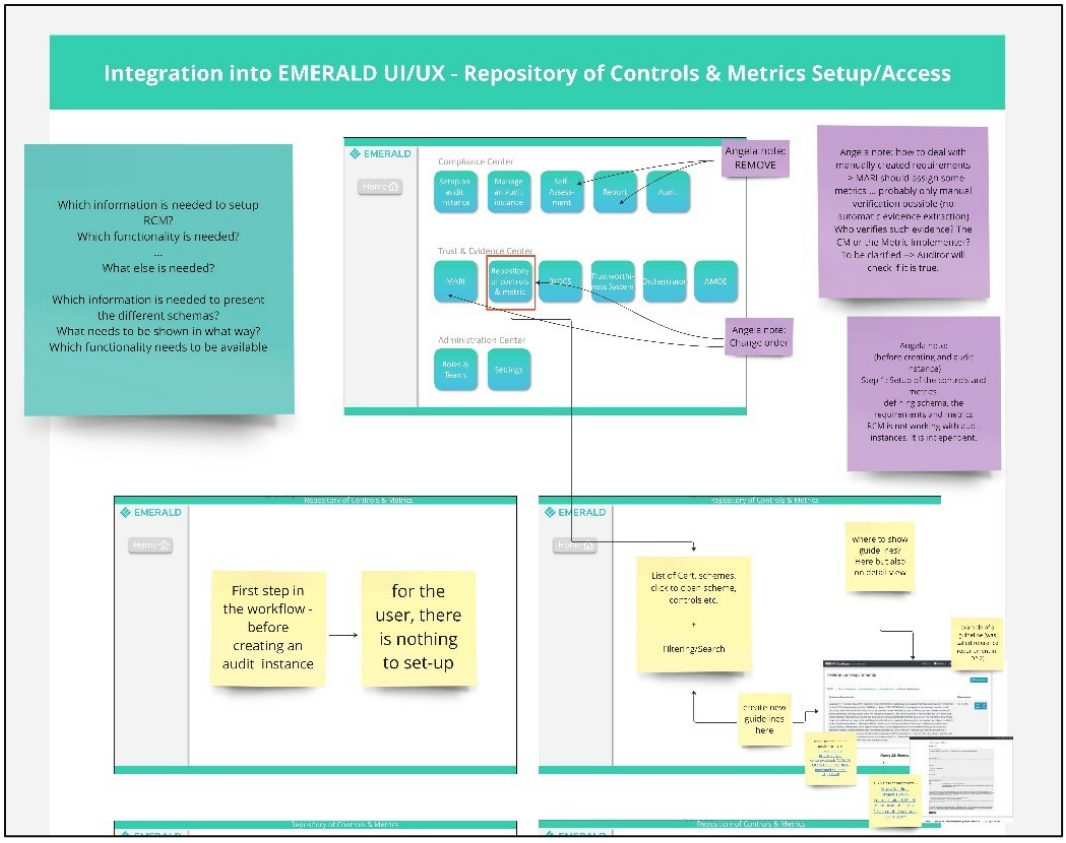

Figure 59. RCM - Screenshot of the Miro Board with yellow and violet sticky-notes to capture the functionality and features for RCM

5.5.2 Functionality and clickable prototype of *RCM*

From the first workshop, we were able to derive the following list of functionalities that need to be implemented in the EMERALD UI regarding *RCM*:

"Set-up" of *RCM*:

- *RCM* itself does not need any settings to function.

"Working" with *RCM*:

When working with *RCM*, the EMERALD UI needs to offer the following functionalities.

- **Browsing the catalogue**: For each of the available certification schemes, the EMERALD UI should offer the functionality to browse through them. Thus, it should be possible to enter a scheme, to view all categories and the respective controls, including their detailed descriptions.
- **View and edit guidelines for controls**: For each of the controls, the EMERALD UI should offer the possibility to view and edit an implementation guideline. It needs to be clearly defined which EMERALD roles will be allowed to implement the guidelines (partly implemented).
- **Upload new scheme**: To add a new certification scheme to the EMERALD framework, the EMERALD UI needs to provide the functionality of uploading a scheme. Thereby, the scheme must be available either in a .csv format or in OSCAL format.
- **Create a new scheme**: The EMERALD UI needs also to allow the creation of a self-defined scheme consisting of categories and controls from different already existing

certification schemes. Furthermore, it should offer the possibility to add self-defined controls (not implemented yet).

- **Self-assessment questionnaire**: The self-assessment questionnaire will be reachable in the audit scope view and only if the audit scope is related to the EUCS compliance. The questionnaire will present different questions that need to be answered along the EUCS categories and controls. It will also provide an overview that allows to assess the status of the implementation, and for each category and control (not implemented yet).

The above-mentioned functionalities are implemented as follows.

5.5.2.1 Browsing the catalogue

When entering the "Certification Schemes" area, a list of all available schemes is presented as shown in Figure 60.

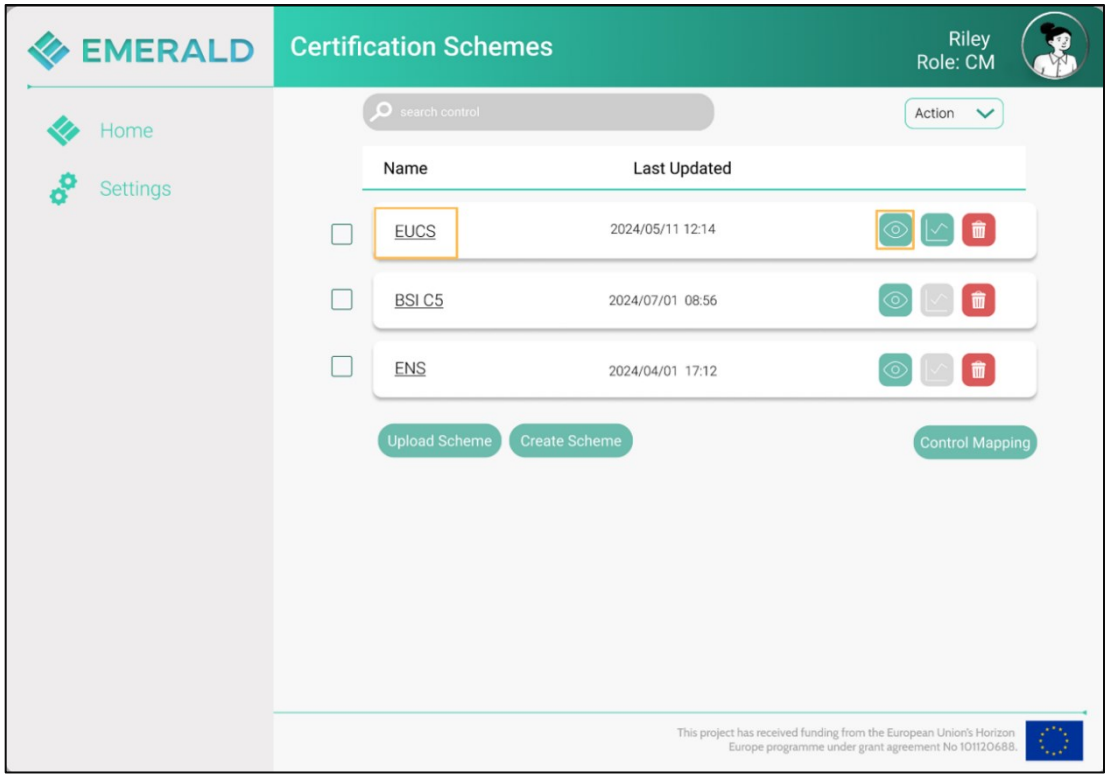

Figure 60. RCM - Certification Scheme Overview page – Overview page

When clicking on the scheme title (see Figure 60, left orange box) or on the view button (see Figure 60, right orange box), the respective scheme is entered as shown in Figure 61.

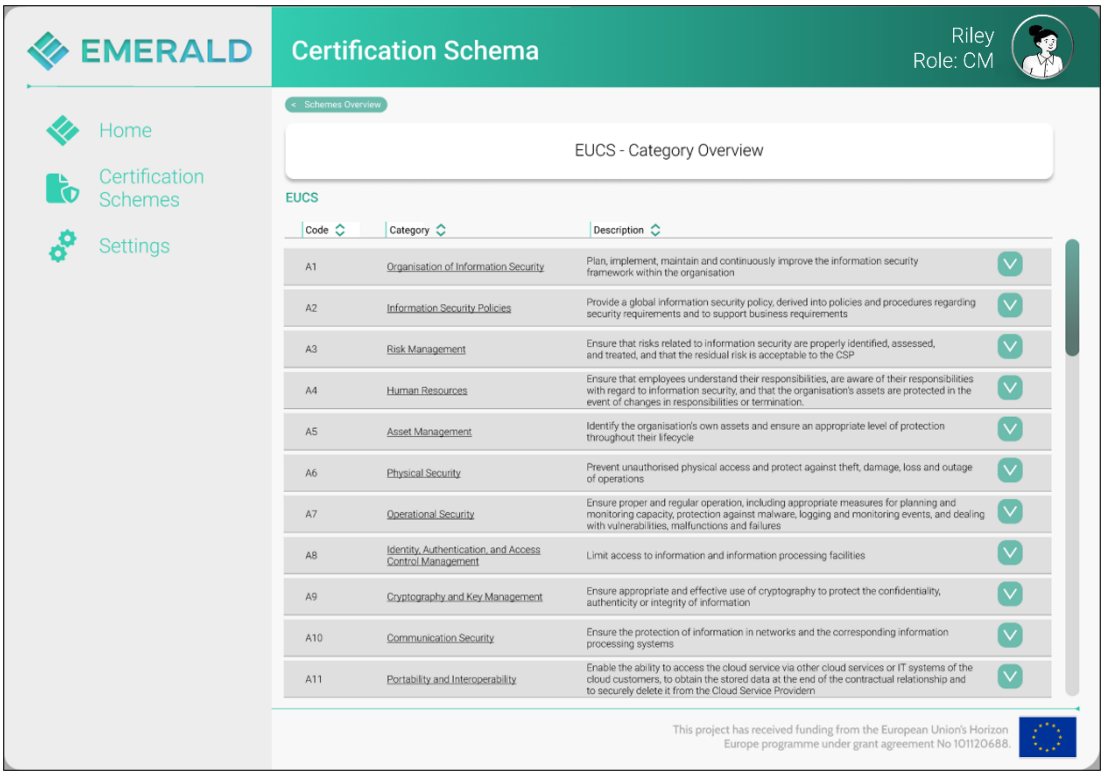

Figure 61. RCM – Browse EUCS scheme: view high level categories

When clicking on one of the high-level categories, the sub-categories belonging to the high-level categories are opened in a hierarchical way, as presented in Figure 62.

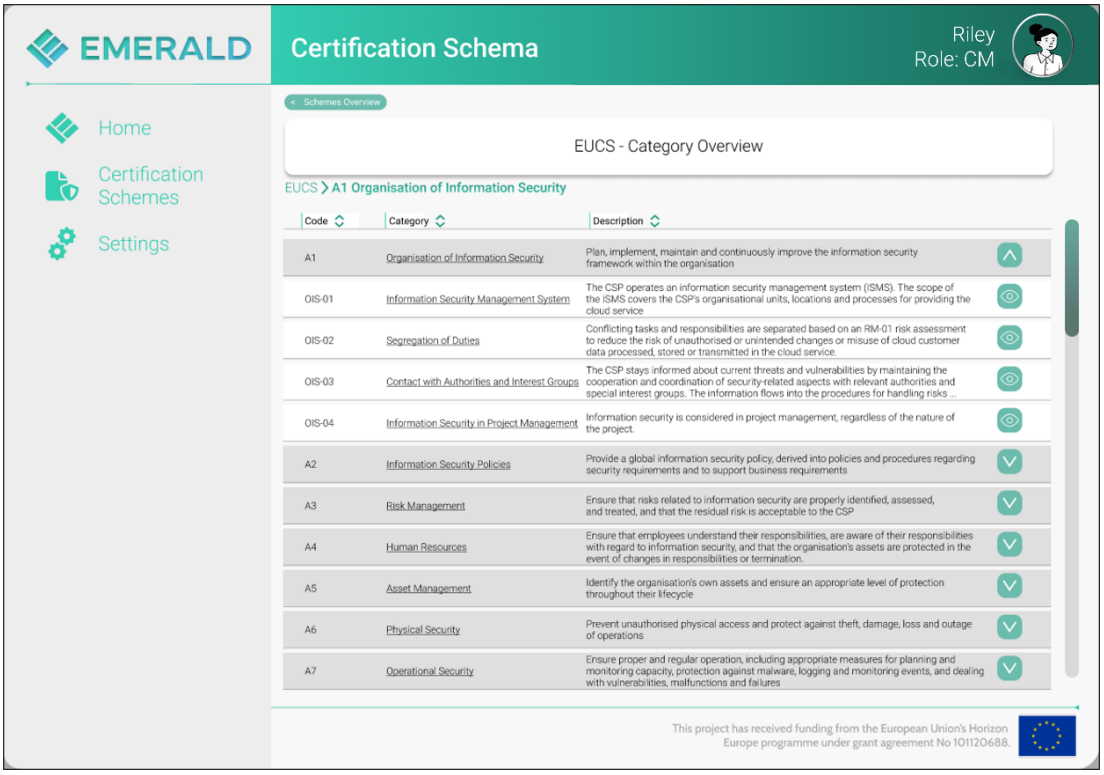

Figure 62. RCM – Browse EUCS scheme: view sub-categories

When clicking on one of the categories, the respective controls are shown, as depicted in Figure 63. For each control, the description, the assurance level, as well as the assigned metrics are shown.

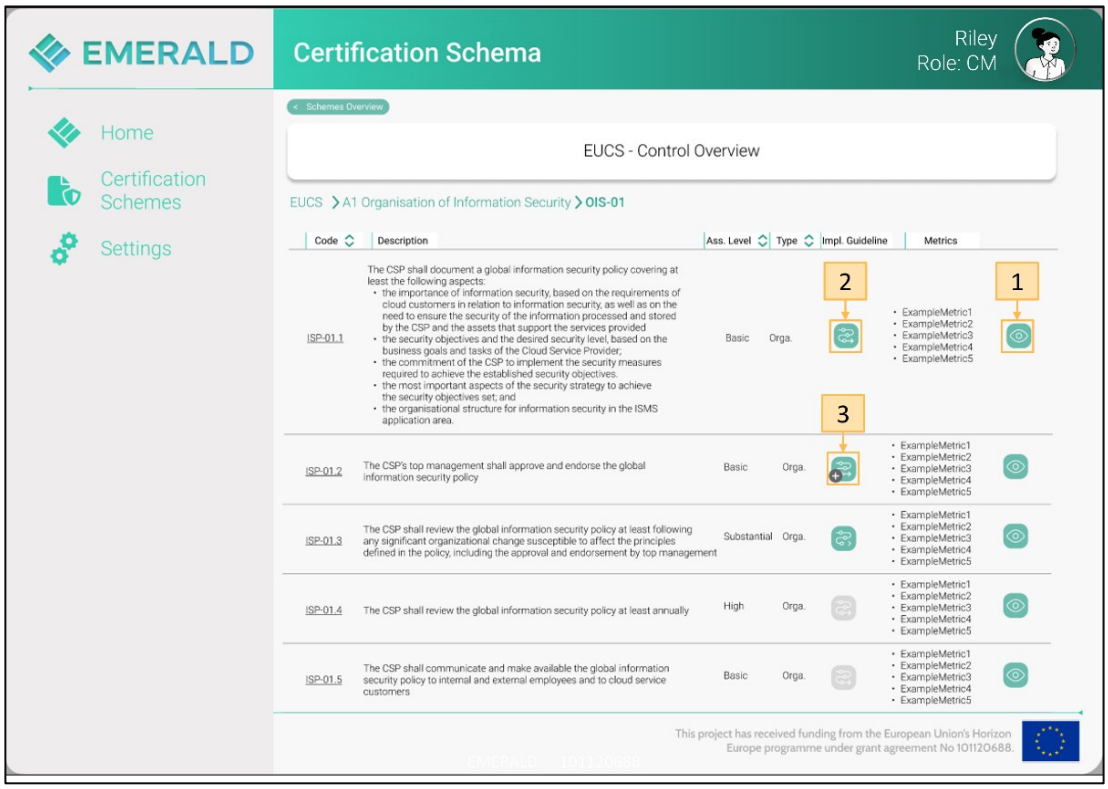

Figure 63. RCM - Overview of the controls belonging to a category

When clicking on the view button for a control as shown in Figure 63 point 1, more information about the respective metrics of the control are presented, see Figure 64. When clicking on the view button of one metric in Figure 64 , the information about the metric is presented as shown in Figure 55.

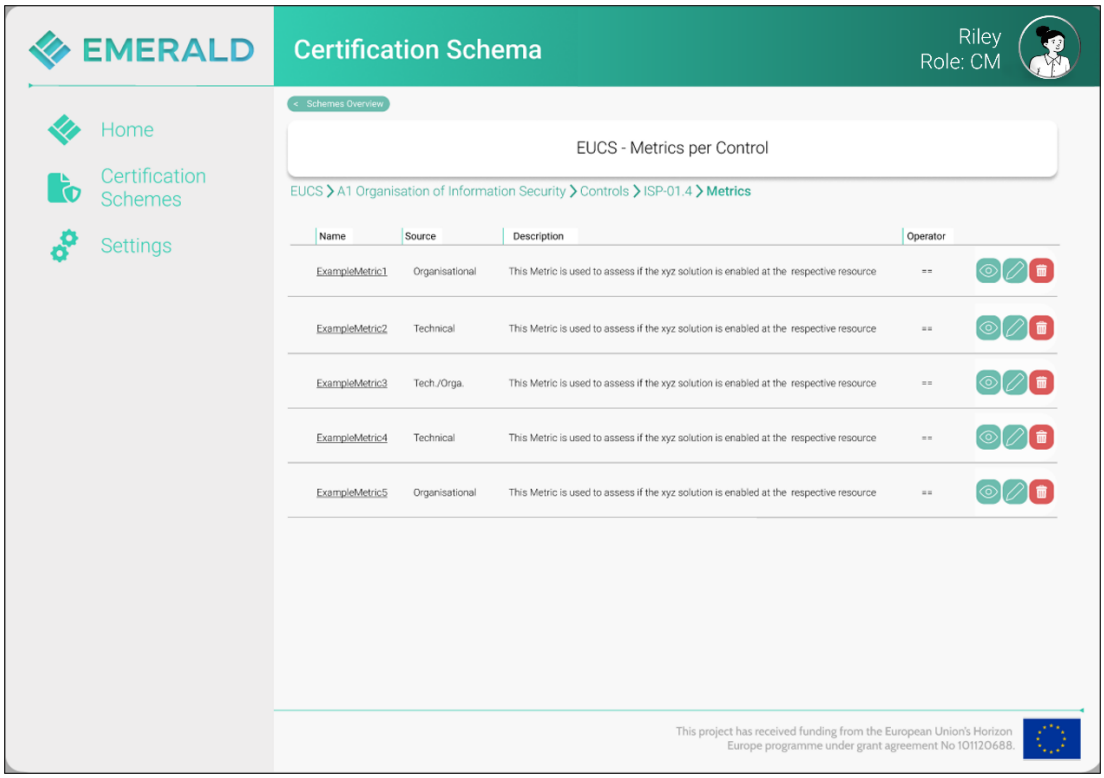

Figure 64. RCM - Overview of the list of metrics assigned to a control

When clicking on the guideline button for a control as shown in Figure 63, point 2, the guideline for implementing the control is presented as depicted in Figure 65.

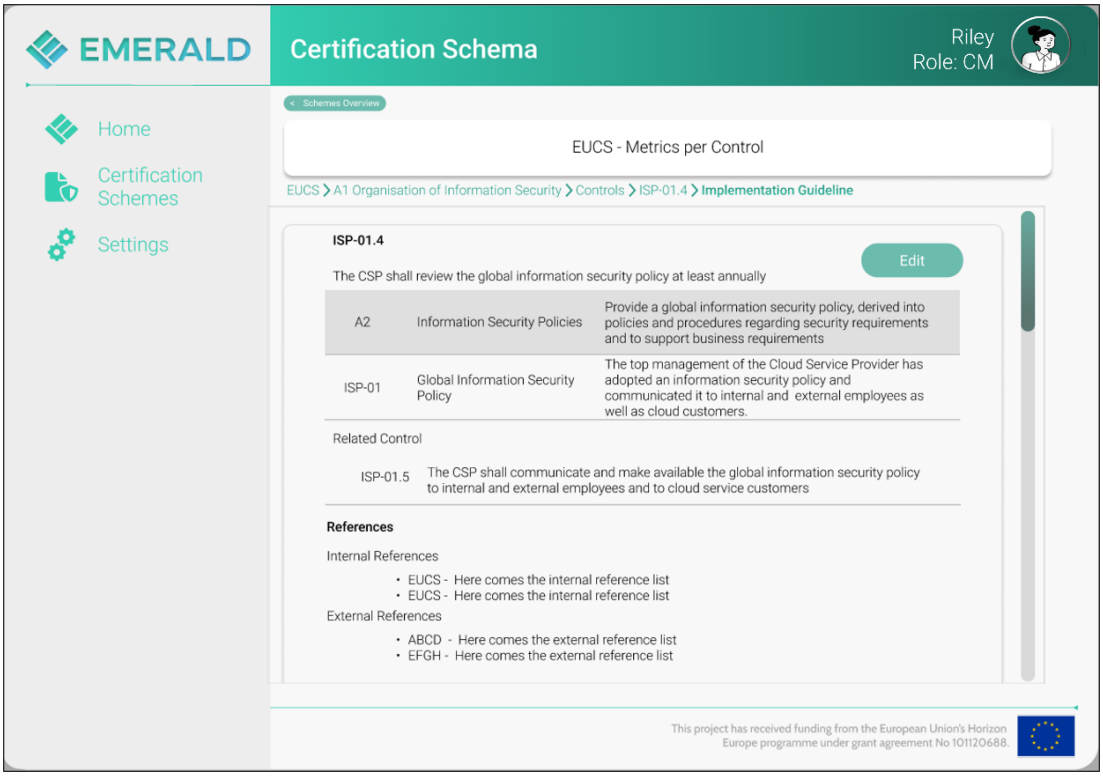

Figure 65. RCM - Presentation of an implementation guideline for a control

If a control has no implementation guideline attached, then it depends on the users' role of what is shown: either the open guideline button is disabled or a guideline button with a plus is presented that opens then the possibility to create a new description of an implementation guideline.

5.5.2.2 Upload a new catalogue

When a new security scheme is published, it should be possible to easily import this scheme into EMERALD, thus, into the *RCM* and make it available for the EMERALD users. Therefore, this scheme needs to be made available either as a .csv or OSCAL.

Remark: It is important to note that this functionality will only be available for specific roles – like a very experienced compliance manager or administrator who know how the file format must look like.

When clicking on the "Upload scheme" button as shown in Figure 60, a view opens that allows to upload a new scheme as shown in Figure 66. Only .csv files or OSCAL files are allowed for being uploaded. When the new scheme is successfully uploaded it will be listed in the list of certification schemes like the ones presented in Figure 60.

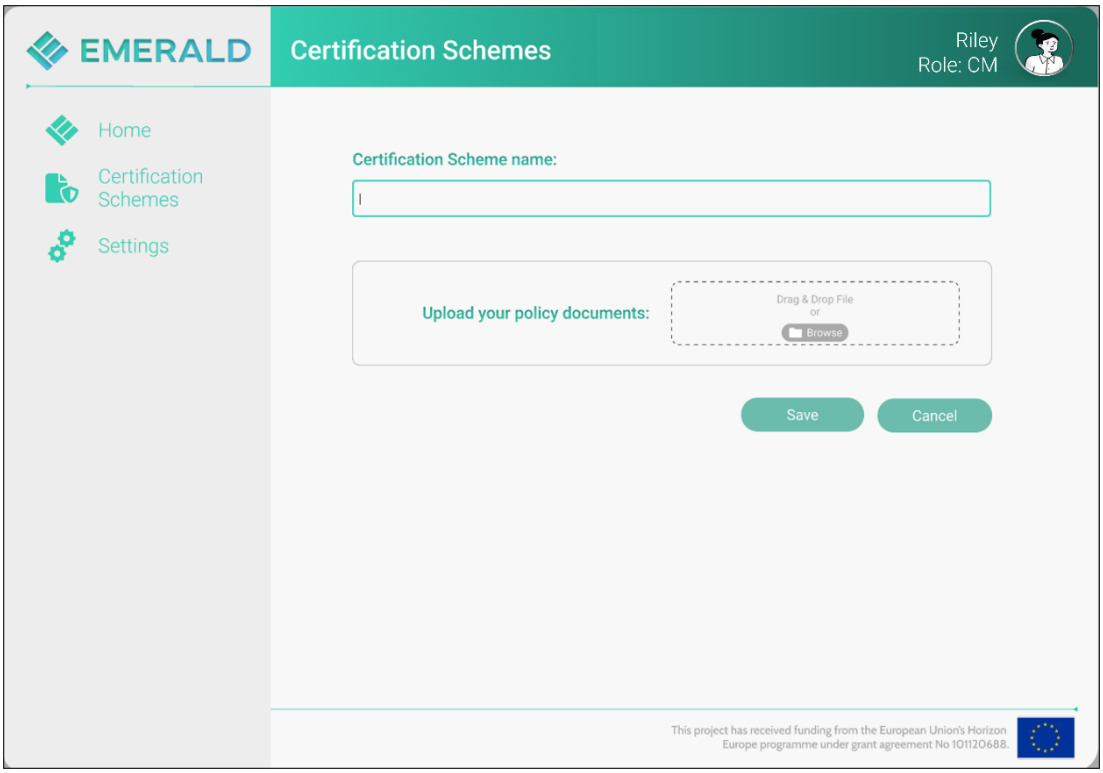

Figure 66. RCM - Upload a new certification scheme

5.5.3 Results of Workshop 2

The second workshop with the *RCM* component owner took place on the 10th of October 2024. In this workshop, the status of the clickable mock-ups, gained insights, and open questions was discussed, and the results will be subsequently implemented in the upcoming months. Therefore, these improvements are not presented in this deliverable.

5.6 Integration of the *Trustworthiness System* (*TWS*) into the EMERALD UI

The *Trustworthiness System* (*TWS*) provides a secure mechanism for EMERALD to maintain an audit trail of evidence and assessment results. Its goal is to enhance the integrity and transparency of the certification process, and to ensure the reliability of the evidence and evaluation outcomes by implementing a general-purpose Blockchain network. Using blockchain technology, *TWS* guarantees the integrity of all data and acts during the certification process in a verifiable way thereby increasing the auditors' level of trust.

Regarding the *TWS*, the EMERALD UI needs to show the integrity status of the evidence and assessment results. More specific, the EMERALD users need to see at one glance in the EMERALD UI if the integrity of the evidence and assessment results is given or not.

5.6.1 Results of Workshop 1

The first workshop with the *TWS* component owner (TECNALIA) took place on the 1st of August 2024. For this workshop a Miro board was prepared and used to guide the discussion and to track the insights gained. Additionally, the workshop was recorded via Teams. The overall goal of this workshop was to get a better understanding of the *TWS* in general and how its integration into the EMERALD UI could look like.

- ***TWS* functionality**: First, we gave the participants a short summary of what the *TWS* is doing from the WP4 point of view. This was necessary to clarify any possible ambiguities or misunderstandings and to be sure that the purpose of the *TWS* is clear right from the beginning. In the Miro Board a respective frame was prepared, presenting a short summary with the most relevant functionalities of the *TWS* that was used for the discussion.
- **"Set-up" of the component**: We then discussed which features and/or functionalities are relevant for setting up the *TWS*. From these discussions, several paper-based mock-ups were added to the respective section in the Miro board.
- **"Working" with the component**: And as a third step, we discussed the features and/or functionality that needs to be available when working with the *TWS*. Again, also for these discussions, several paper-based mock-ups were added to the respective section in the Miro board.

During the whole workshop, all participants were invited to add sticky notes directly to the Miro board (see Figure 67, yellow sticky-notes). And afterwards, the WP4 people went through the recording again and added further notes to the board (see Figure 67, violet sticky-notes).

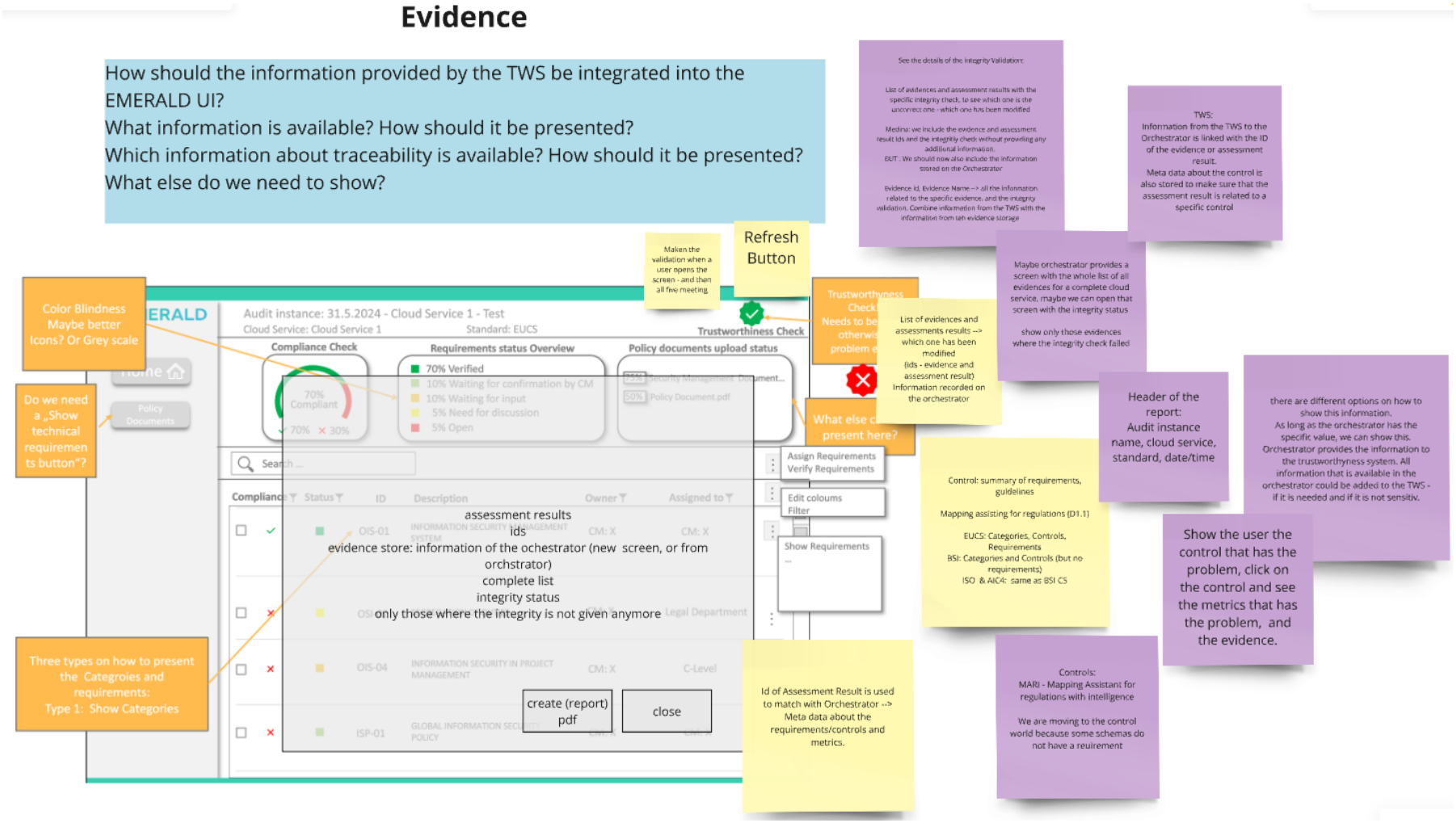

Figure 67. TWS - Screenshot of the Miro board with yellow and violet sticky-notes to capture the functionality and features for the TWS

5.6.2 Functionality and clickable prototype of the *TWS*

From the first workshop, we were able to derive the following list of functionalities that need to be considered in the EMERALD UI:

"Set-up" of the component:

- Settings: When setting up a certification target, there needs to be the possibility to define when and how often the *TWS* should be updated – automatically and/or on demand. Options that should be available are:
  - Always, when entering a respective audit scope
  - On demand by the user
  - Automatically every 1, 5, 10, or 15 minute(s).

"Working" with the component:

- When being in an audit scope, the status of the integrity check should always be visible at one glance.
  - If the integrity check is ok, the *TWS* status symbol is presented in green.
  - If the integrity check is not ok, the *TWS* status symbol is presented in red.
  - Additionally, if the integrity check is not ok, there should be the possibility to get a report highlighting due to which controls the integrity is not given any more – including the control, the respective metric, the resource name, the type, and the evidence id.
- Depending on the settings selected above, there needs to be a possibility to update the integrity check on demand.

The setup functionality was already described in Section 5.1.1 as last step of the setup regarding the certification target (shown in Figure 37).

After having entered an audit scope, on the right upper corner of the mock-up, the status of the integrity check – the verification of evidence and assessment results - is always shown. For example, in Figure 68 the integrity check is shown in green stating that the integrity of the evidence and the assessment results are given. On the right side of the green symbol, there is a kind of "Refresh" button that allows to trigger manually an integrity check.

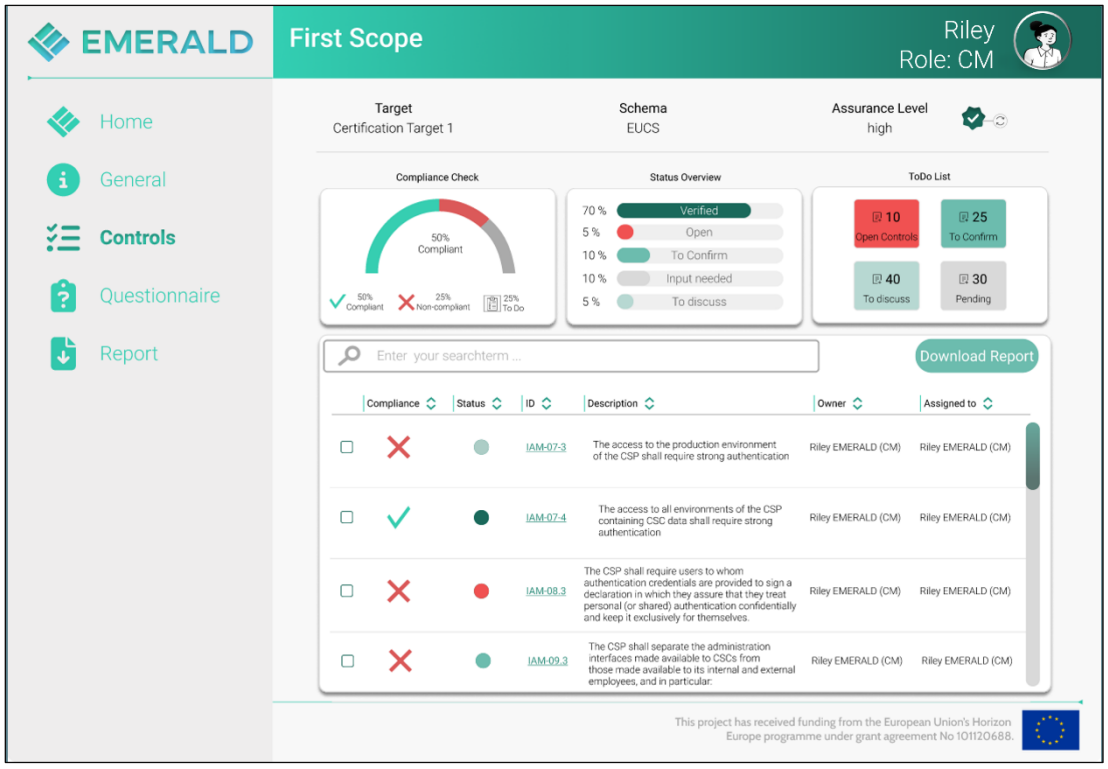

Figure 68. TWS - Screenshot of an audit scope with the "green symbol" for the integrity check

Figure 69 shows a picture where the *TWS* symbol is presented in red, meaning that the evidence and/or assessment results have been tampered with.

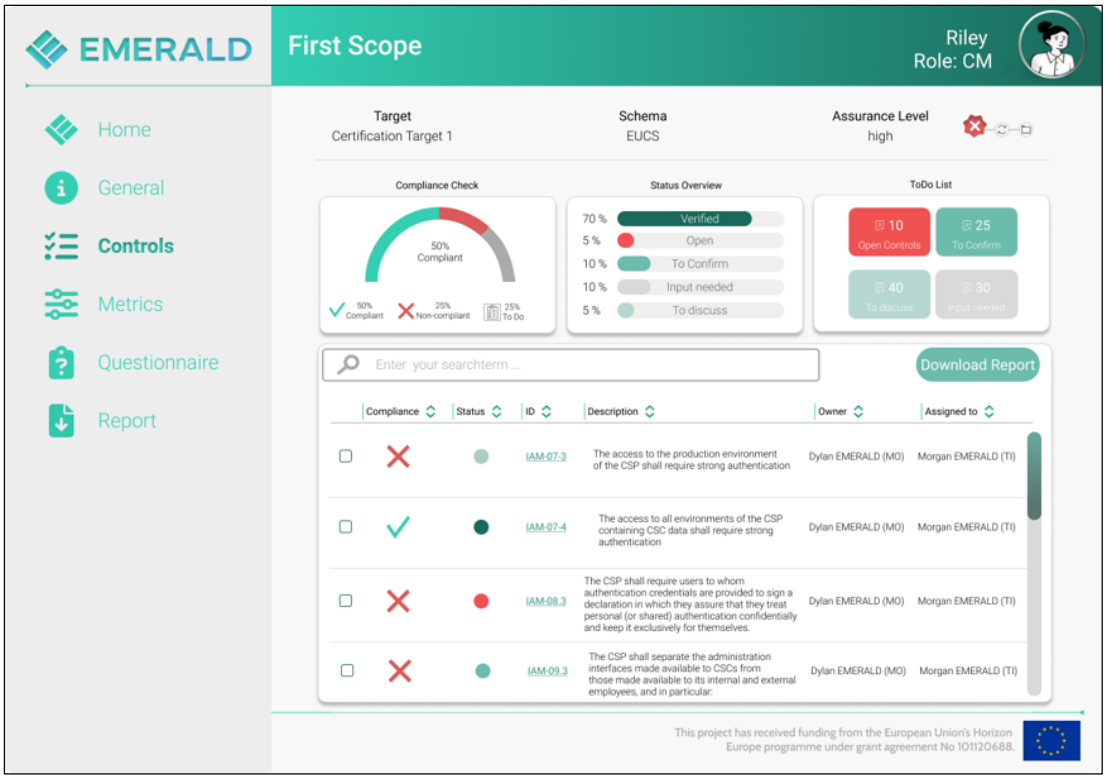

Figure 69. TWS - Screenshot of an audit scope with the "red symbol" for the integrity check

Right to the *TWS* symbol there is a folder icon. When clicking on this icon, a new window is opened showing the results of the *TWS* and where the integrity is no longer given. This information can be downloaded in form of a report as presented in Figure 70.

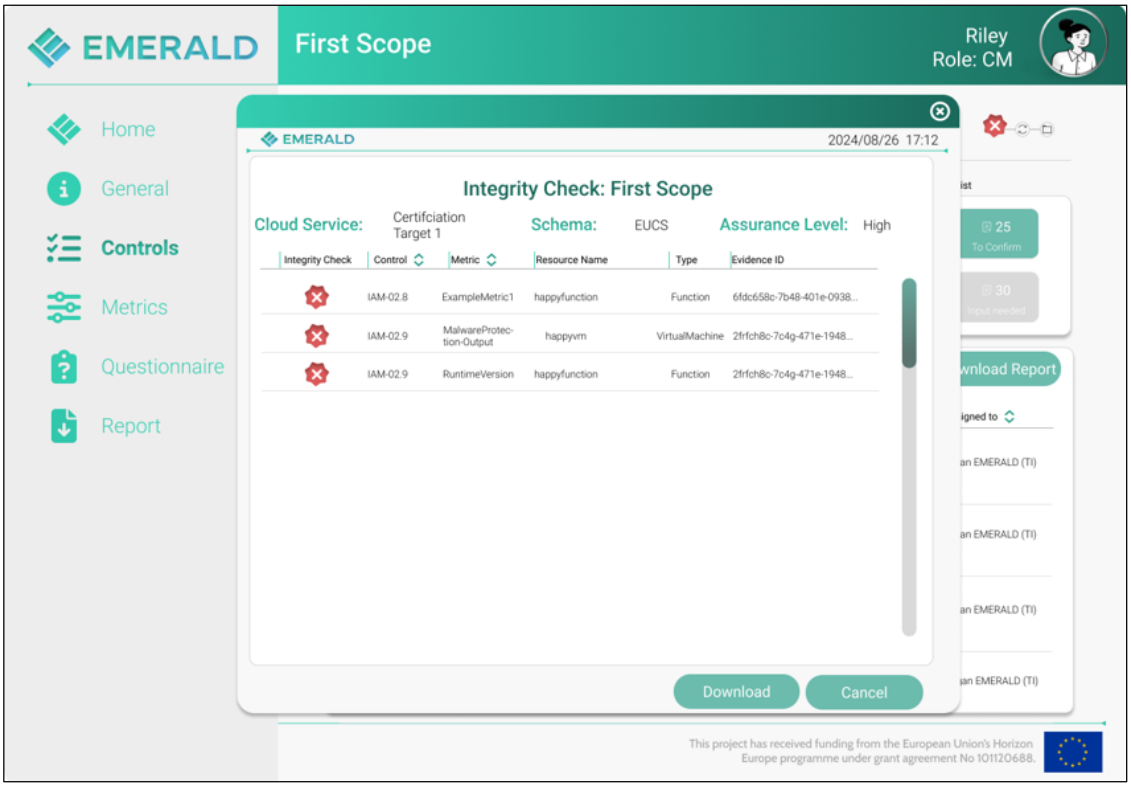

Figure 70. TWS - Screenshot of a TWS report when the data integrity is not given anymore

5.6.3 Results from Workshop 2

In the second workshop with the *TWS* component owner, which took place on the 26th of August 2024, we presented the clickable mock-ups and how we integrated the *TWS* into the EMERALD UI. The goal of this workshop was to find out if the implemented mock-ups correspond with the thoughts and needs of the *TWS* component owners and to collect their feedback and suggestions for improvement. In the case of the *TWS*, the component owner was happy with the *TWS* integration, and no further improvements were suggested during the workshop.

6 Conclusions

This deliverable has presented the methodology used in *T4.3 - Designing a user interaction and user experience concept* and the first set of paper-based and clickable mock-ups achieved by applying different methods in the context of the EMERALD project. In more detail:

- First, from the various interviews and focus groups with the pilot partners, we were able to derive a first set of paper-based mock-ups.
- Second, from the development of personas, scenarios, and user journeys, we were able to enhance the existing paper-based mock-ups to allow concrete user interactions that the EMERALD UI needs to fulfil.
- Third, with the different workshops with the EMERALD component owners, we were able to start the development of the first clickable prototype of the EMERALD UI.

As all results presented in this deliverable are work in progress, we will continue working on them until M24. In more detail:

- We will continue the interview and focus groups with the pilot partners, to get further insights on which features and functionalities are needed for the EMERALD UI.
- We will continue with the development of the personas, scenarios, and user journeys - as so far not all relevant EMERALD roles have been considered so far – to continuously improve and refine the EMERALD UI so that it supports the needs of all EMERALD stakeholders.
- We will continuously meet with the different component owners to implement all mandatory UI elements and functionalities.
- Additionally, we will regularly ask all EMERALD partners to try out the clickable prototype and provide valuable and necessary feedback to be able to continuously improve the EMERALD UI, to allow for a seamless user experience for continuous auditing in the cloud cybersecurity domain, offering easy-to-use, explainable workflows to support the auditors' work and the audits conducted.

This document is the first version of the results of the EMERALD UI/UX. In M24 of the EMERALD project, we will provide an updated version of this document (D4.4 User interaction and user experience concept–v2 [2]) with in-depth work processes and a final set of the requirements for the UI/UX.

7 References

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[17] EMERALD Consortium, D1.3 EMERALD solution architecture-v1, 2024.

8 APPENDIX A: Mock-ups derived from the interviews

In this appendix, we present all other mock-ups that we have derived from the interviews with pilot partners, including a short description for each of them.

8.1 Mock-ups for managing an audit scope

In the following we present several mock-ups for managing audit scopes. Figure 71 presents the possibility to select an existing audit scope.

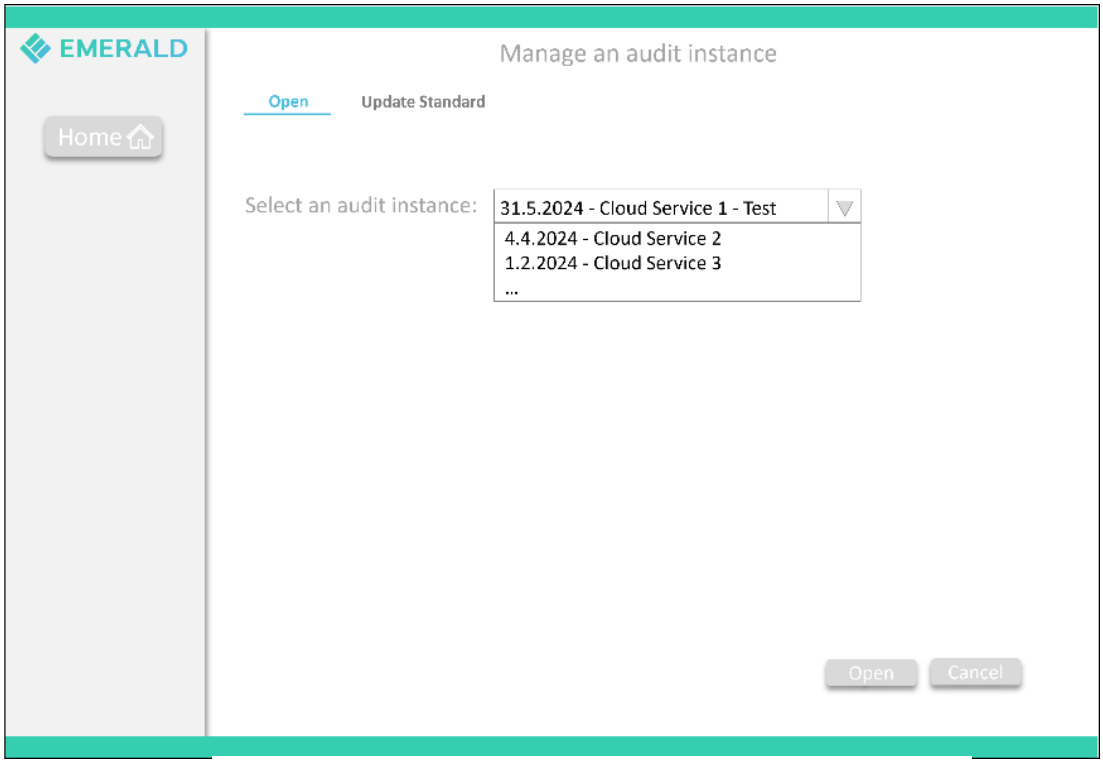

Figure 71. Paper-based Mock-ups - Open an existing audit scope

Figure 72 presents a mock-up on how to update an existing audit scope when a new certification scheme is available.

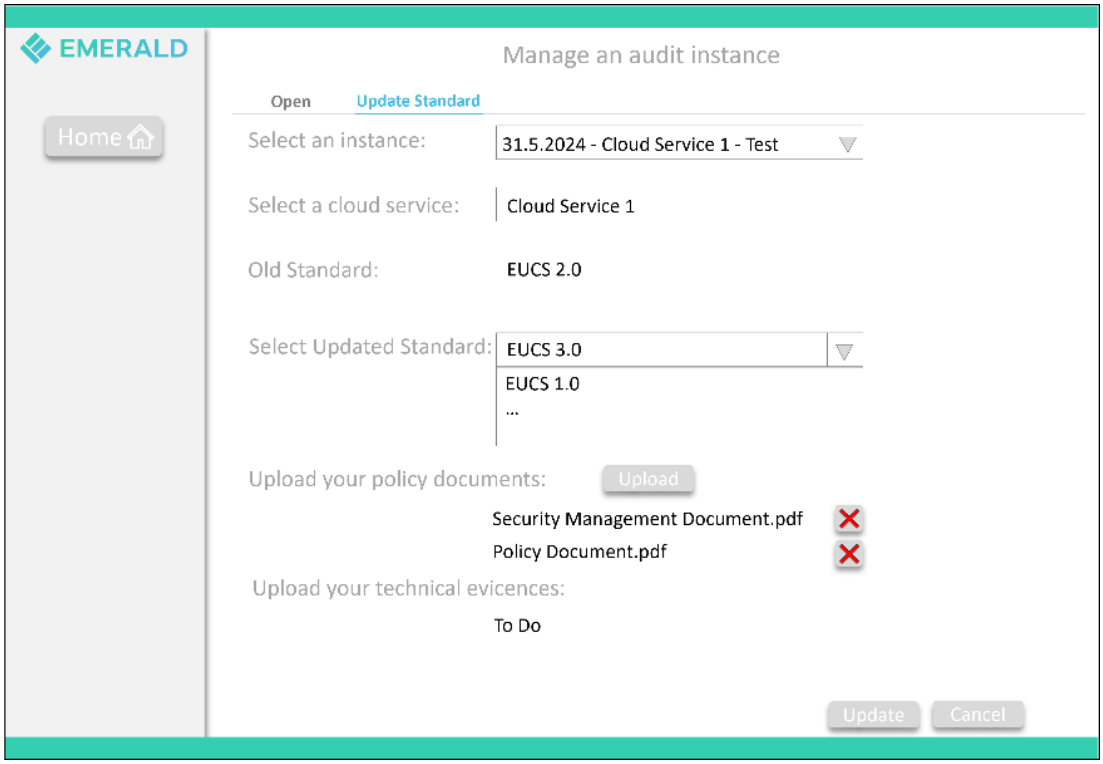

Figure 72. Paper-based Mock-ups – Update the certification scheme of an existing audit scope

Figure 73 presents a mock-up that allows to copy an existing audit scope to create a new one.

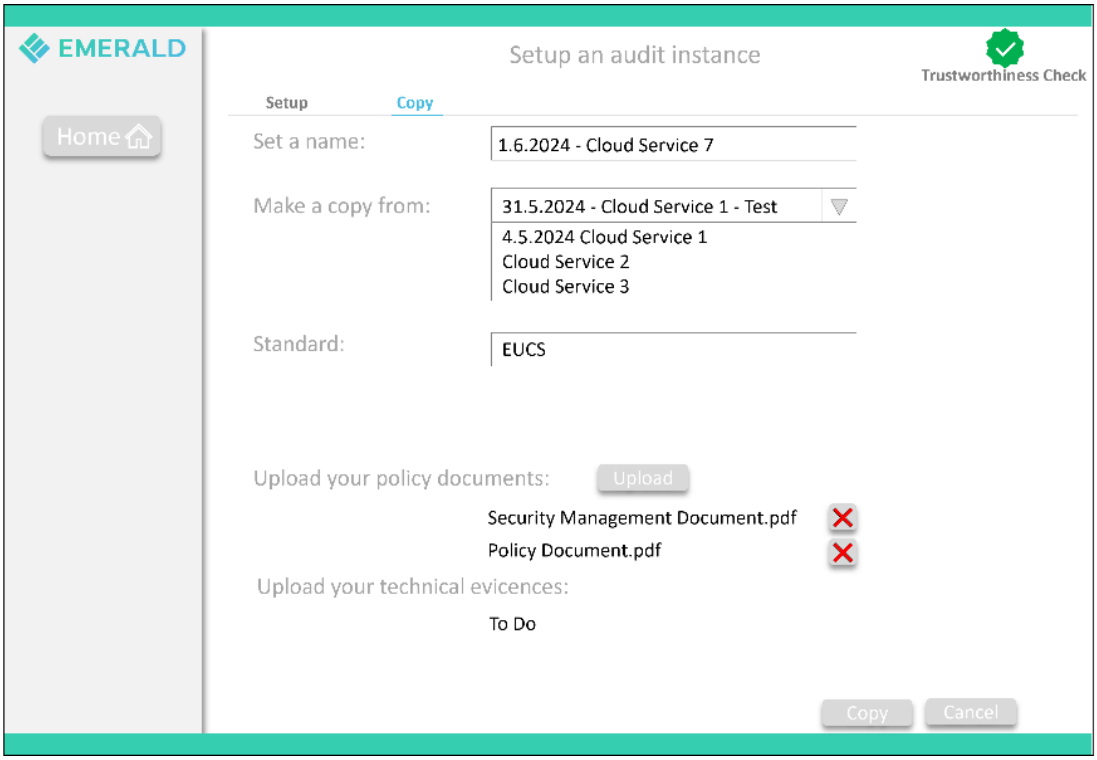

Figure 73. Paper-based Mock-ups - Make a copy of an existing audit scope

8.2 Mock-ups presenting the overview of an audit scope

In the following, several mock-ups are presented on what an overview page of a selected audit scope might look like.

Figure 74 presents an overview of an audit scope showing the categories of EUCS as an example. Clicking on a category would show the corresponding controls of the category.

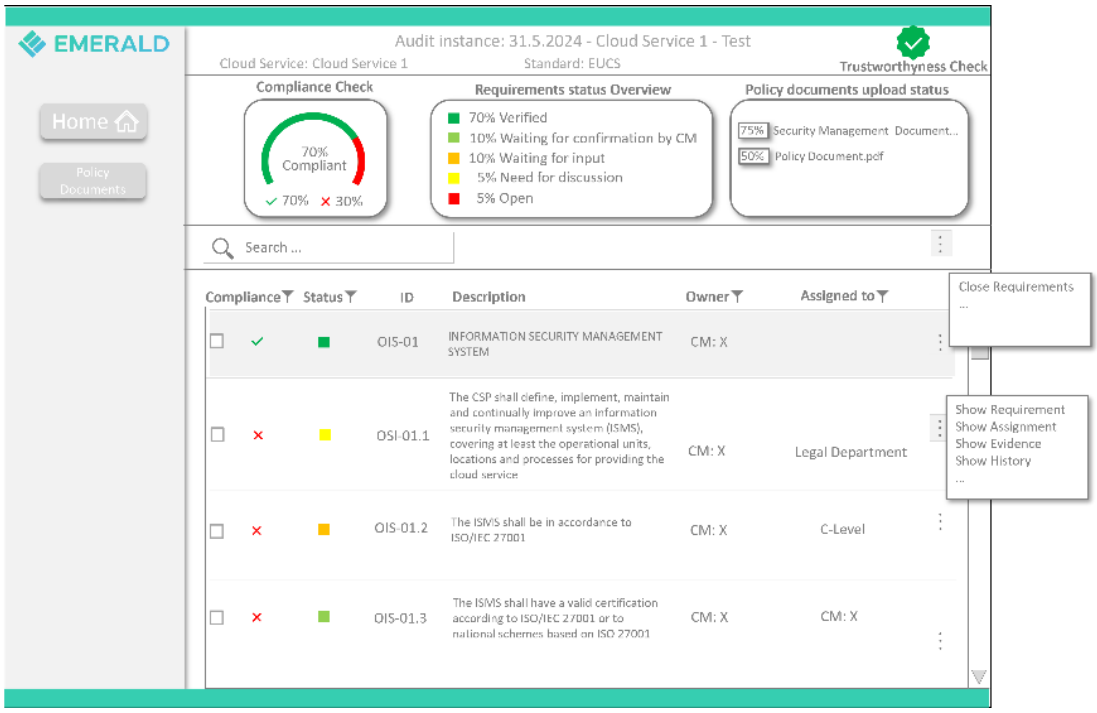

Figure 74. Paper-based Mock-ups - Show overview of a category and the respective controls

Figure 75 presents the overview of an audit scope showing only controls (without any categories).

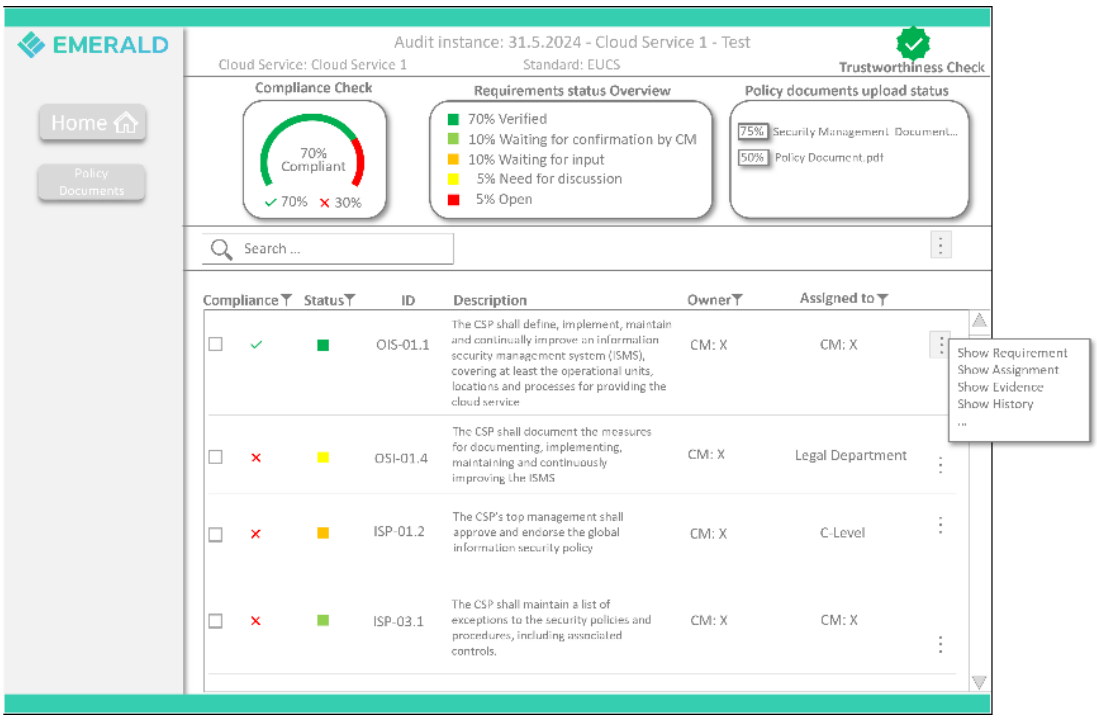

Figure 75. Paper-based Mock-ups - Show an overview of the controls only (without categories)

8.3 Mock-ups presenting the controls

In the following, several mock-ups are presented showing which information could be presented regarding individual controls of a certification scheme.

For each control a lot of information needs to be shown. Figure 8 in Section 3 presents an example of showing some general information about a control. Figure 76 shows how possible evidence extracted for the current control could be presented where organisational and technical evidence is divided into two parts.

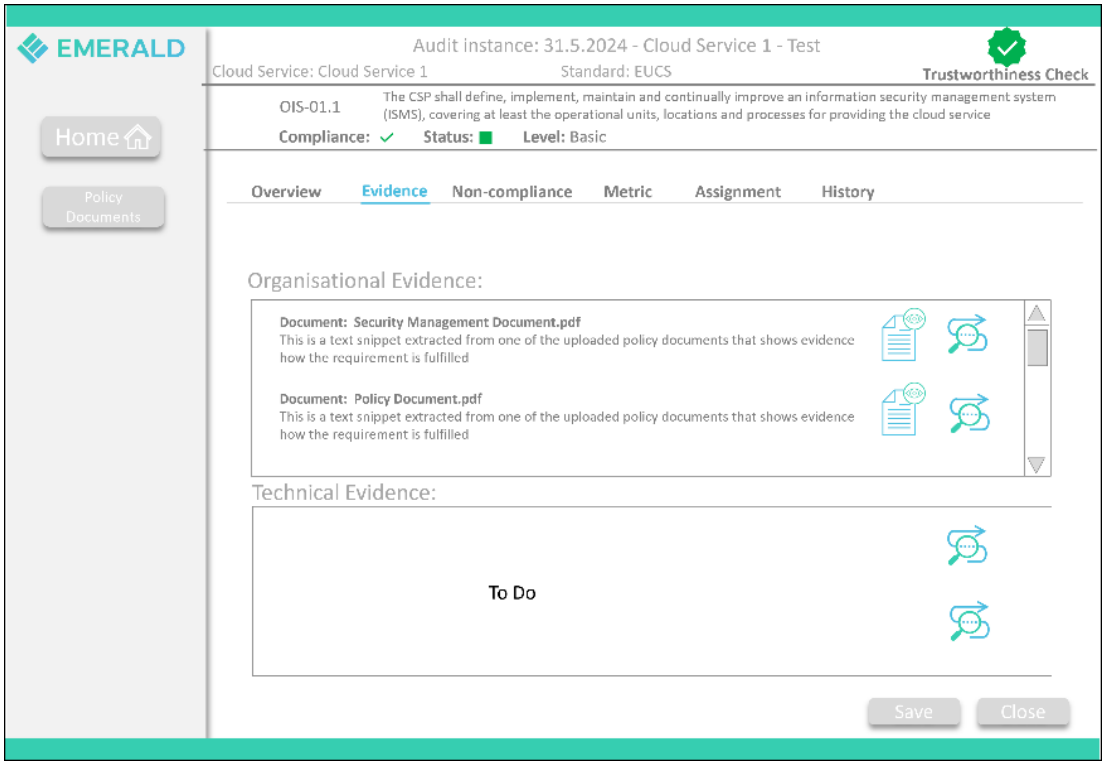

Figure 76. Paper-based Mock-ups - Suggestion of how to present different types of evidence for a control (v1)

Figure 77 shows how possible evidence extracted for the current control could be presented, where organisational and technical evidence are shown in a combined view.

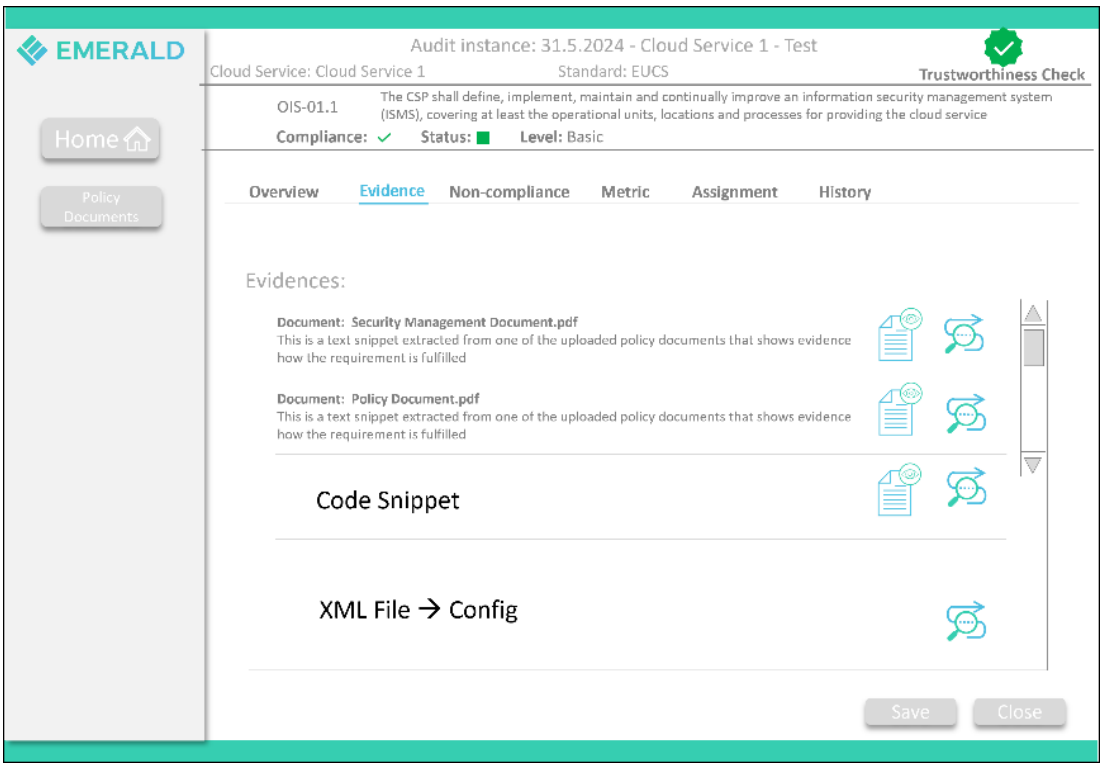

Figure 77. Paper-based Mock-ups - Suggestion of how to show different types of evidence for one control (v2)

Figure 78 presents a suggestion of how information on possible non-compliances detected can be presented for the respective control.

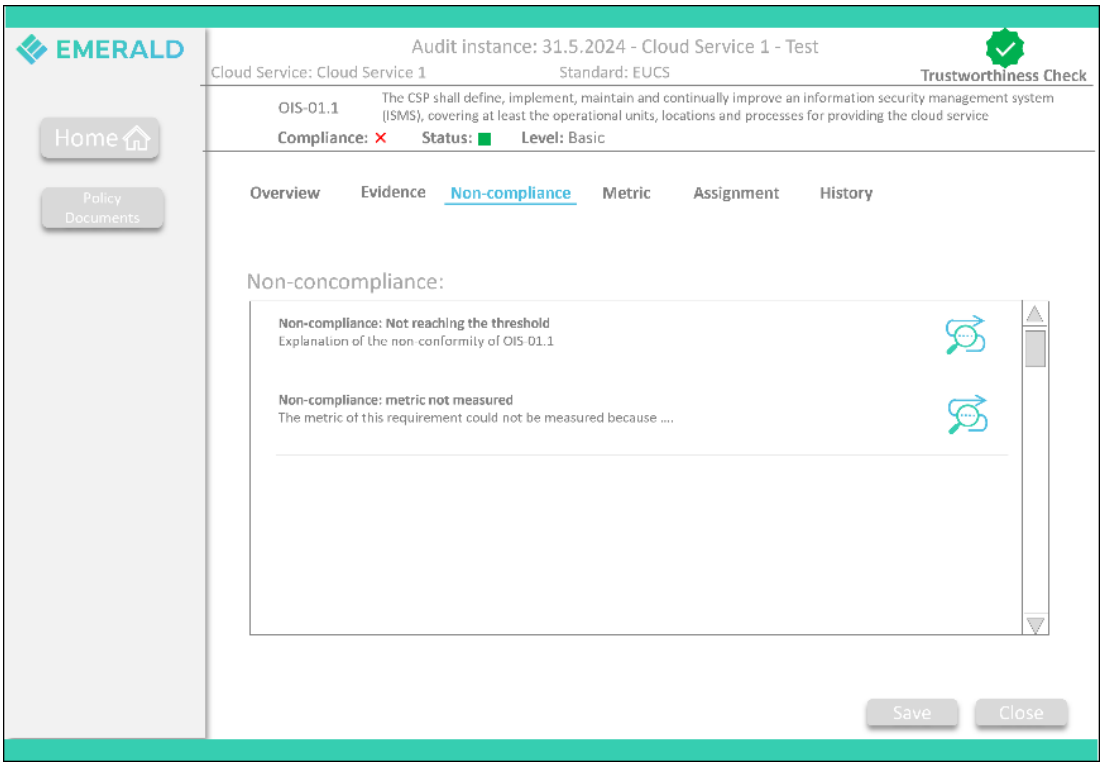

Figure 78. Paper-based Mock-ups - Suggestion of how to present information about non-compliances

Figure 79 presents a mock-up of what an assignment of a control to either an individual person or to a whole department might look like.

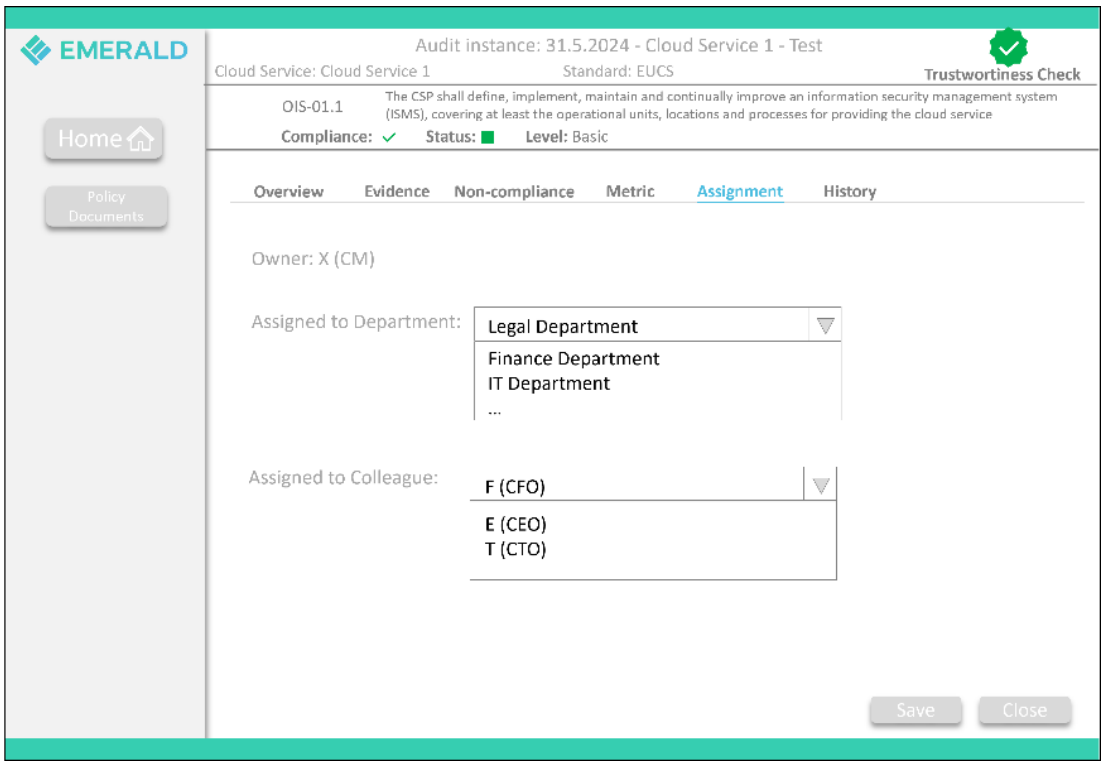

Figure 79. Paper-based Mock-ups - Suggestion of how to assign a control to a colleague or a whole department

Figure 80 shows what a control history, showing all changes of the control, might look like in the EMERALD UI.

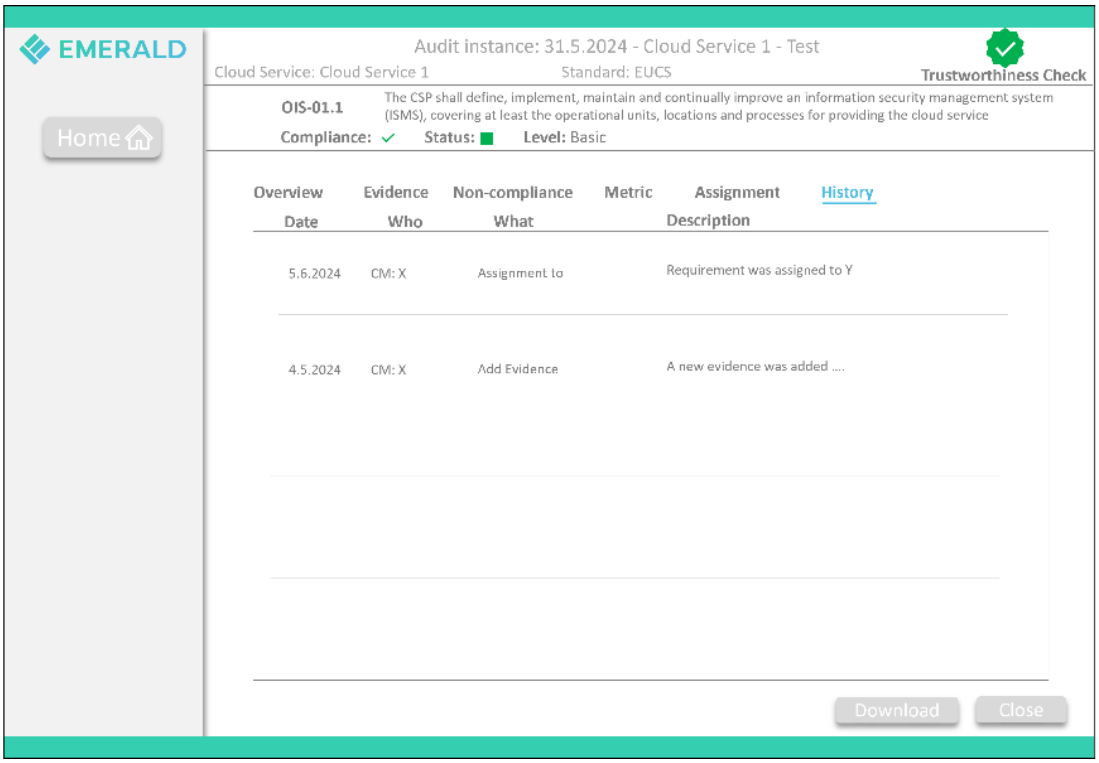

Figure 80. Paper-based Mock-ups - Suggestion of the history log information view of a control

9 APPENDIX B: Mock-ups derived from the user journeys

9.1 Additional Mock-ups developed for User Journey 1

Figure 81 presents again the landing page of the EMERALD UI. When clicking on the BYOCS button a new certification scheme can be created or an existing own-defined certification scheme can be edited.

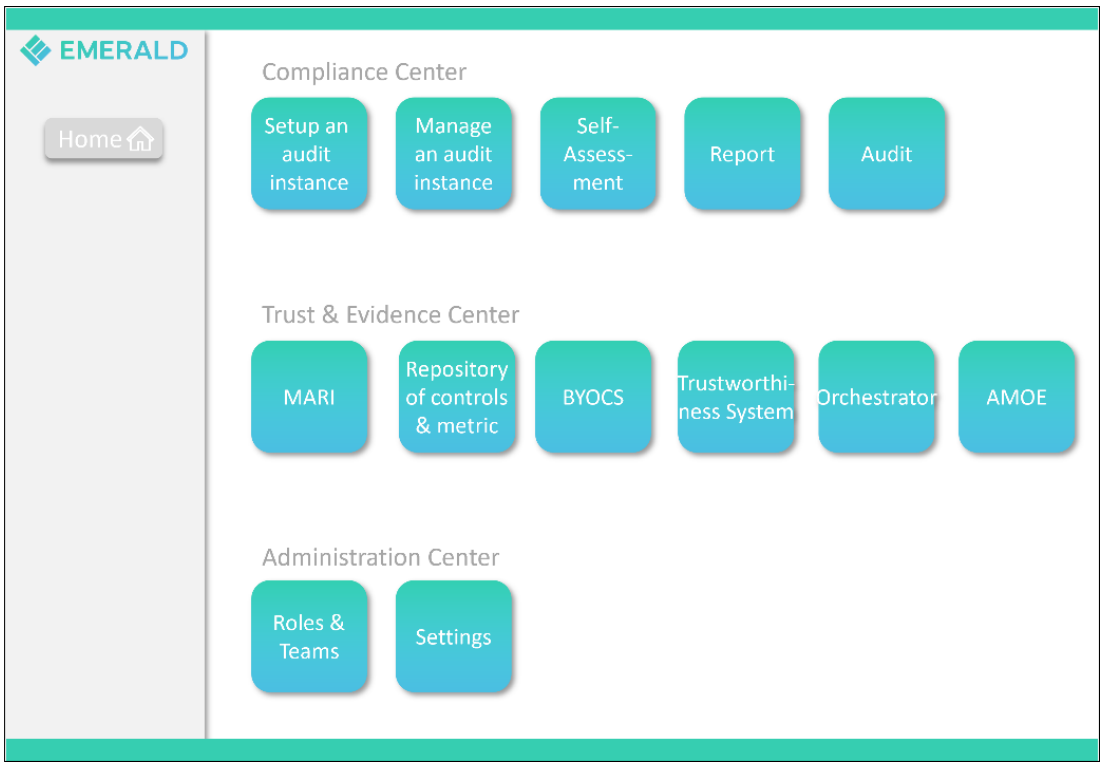

Figure 81. Paper-based Mock-ups - User Journey 1: Updating a self-defined scheme

Figure 82 presents how to select an existing self-defined certification scheme that should be changed.

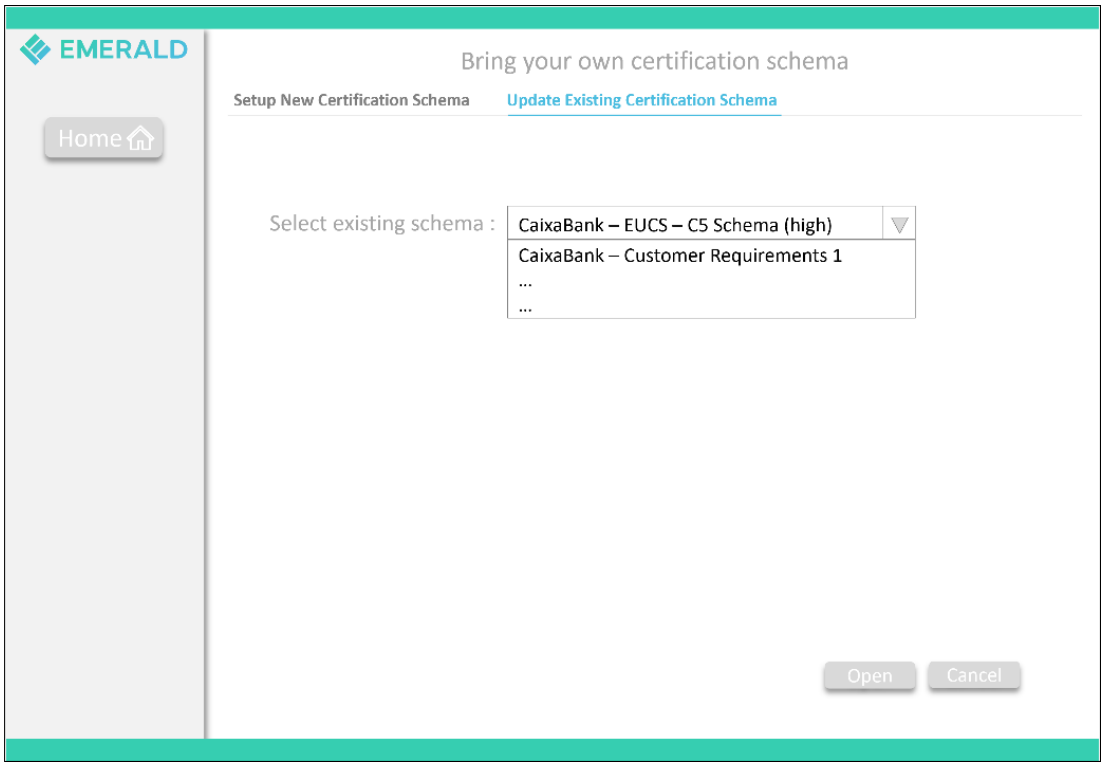

Figure 82. Paper-based Mock-ups - User Journey 1: Select an existing self-defined certification scheme

Figure 83 shows how to edit a self-defined certification scheme in the EMERALD UI.

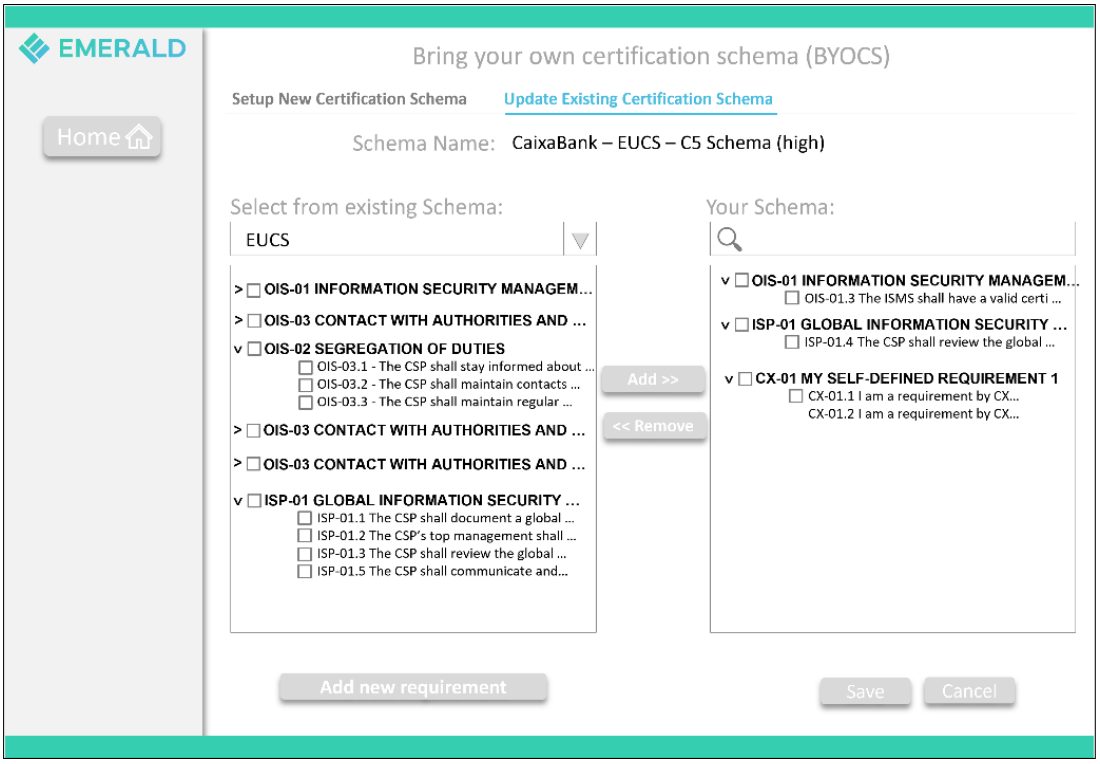

Figure 83. Paper-based Mock-ups - User Journey 1: Edit an existing self-defined certification scheme