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1 Introduction

1.1 Purpose and Scope

This document provides an overview of the SCHUMANN Resonance usage from the user's perspective. The document consists in a series of step-by-step guides which allow Resonance members to perform basic tasks within the tool.

1.2 Document Structure

sIn brief, the document is structured as follow:

Chapter 1 Introduction

Chapter 2 DSSCK overview

Chapter 3 DSSCK registration and login

Chapter 4 Tier 2 component management

Chapter 5 Flight System Module management

1.3 Applicable Documents

AD1 SCHUMANN (Project 101082449) – Grant Agreement (October 2022)

AD2 SCHUMANN Consortium Agreement, version 2.1 (October 2022)

1.4 Reference Documents

N/A

1.5 Acronyms

API	Application Programming Interface
DSSCK	Design and Specification for Satellite Construction Kit
DVVP	Design, Verification and Validation Plan
EC	European Commission
FSM	Functional Spacecraft Module
TRL	Technology Readiness Level

2 DSSCK overview

2.1 Software overview

SCHUMANN Resonance is a web application which enables access to high-tech space-grade equipment for all commercial, governmental and scientific missions. Historically, space industry relies on point-to-point communication between suppliers and buyers. Resonance brings products into the information age, ensuring access to product information and provides a try-before-buy approach.

2.2 First steps for new users

SCHUMANN Resonance can be accessed from any browser at https://www.horizon-schumann.eu/resonance. The landing page is presented in the capture below:

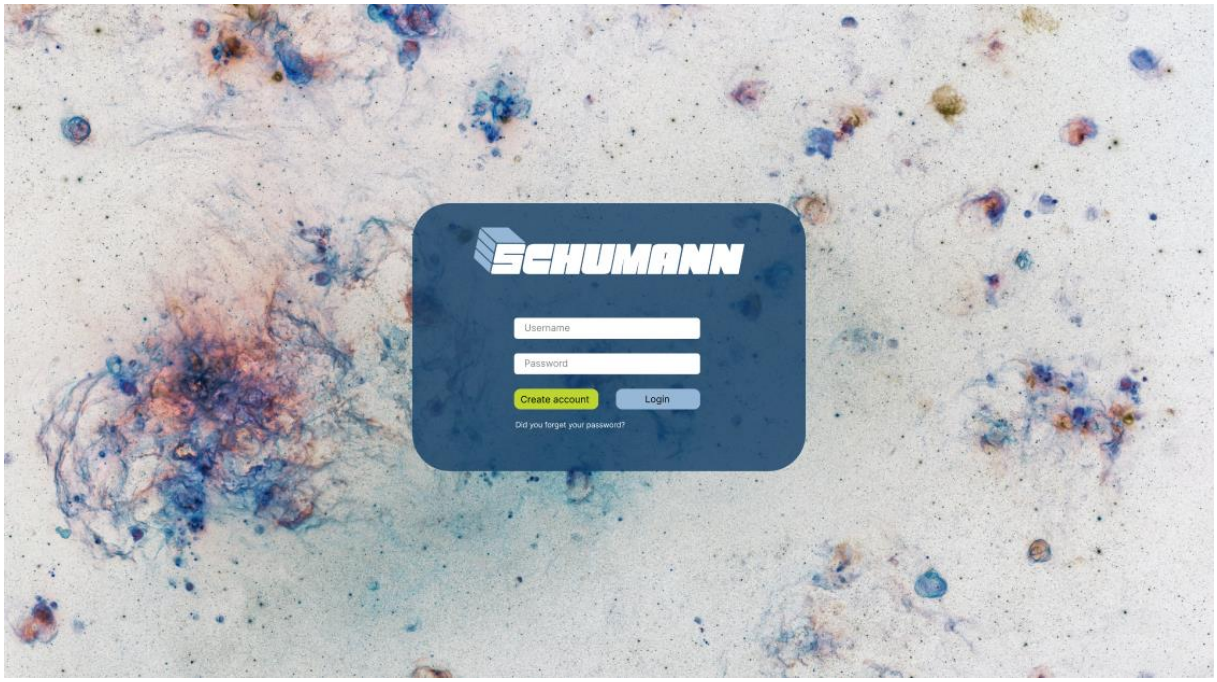

Figure 2-1

The software brings users directly to a login screen. From here, users can either register an account or login using their credentials. The software does not support anonymous users, thus, no features are available for unregistered users. All FSM/Tier2 component browsing features, editing and creation functionality require a user registration as well as confirming the credentials with the SCHUMANN Resonance Administration Group.

The users can access the software via Google Chrome, Mozilla Firefox, Opera or Chromium-based browsers. The address provided in this document is tentative and subject to change. Furthermore, development restricts access to a test-group usage only, thus public exploitation is not available at the time of writing.

3 DSSCK registration and login

SCHUMANN Resonance requires users to register using their email address and a password. The software enables users to register two types of accounts which offer different levels of accessibility towards the market place and publication features of the software.

The registration screen is presented below.

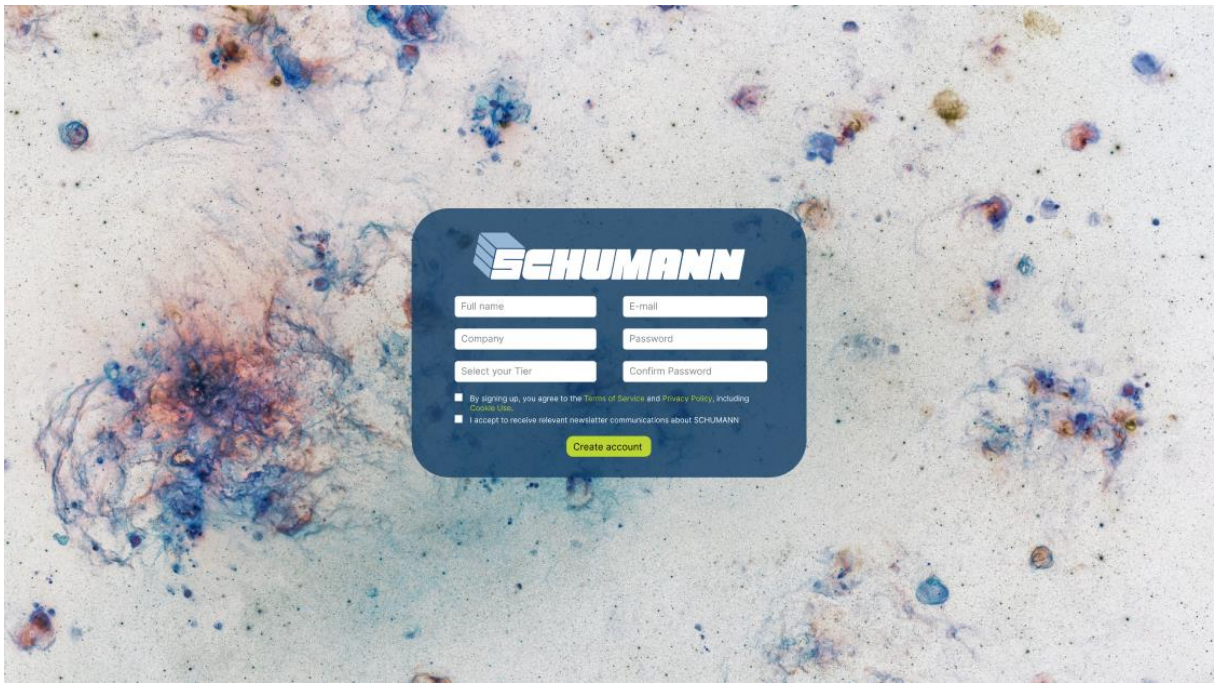

Figure 3-2 Registration page

The software requires several details for their users which include:

- Name
- Email address (work domain)
- Company or organization name
- Password
- Password confirmation

The user must agree to the Terms of Service, Privacy Policy and Cookie Use terms, as defined by the SCHUMANN Consortium, in accordance with international regulations.

The user can also opt in for a newsletter subscription, which provides information regarding software updates, and marketplace entries.

As previously mentioned, the account type dictates the level of accessibility to the software features. The detailed description of the scope and use of the accounts is presented in the next sections

3.1 Standalone accounts

The SCHUMANN Resonance software allows limited access to registered personal user accounts, referred to as Standalone Accounts. In this state, the users are able to browse the public marketplace

items (Tier 2 and FSM). A personal user account presents the advantage of not needing a SCHUMANN Administration Group confirmation, which means, once the automated email is received and account activated the users shall be able to browse the limited-scope features of the software immediately.

3.2 Organization accounts

Organization accounts can be considered as full-access accounts and allow users to browse, add, edit and remove Tier2 components and FSMs within their own user space. This type of account requires a confirmation of credentials with the SCHUMANN Administration Group. This process can take several business days, since it requires a human-in-the-loop interaction from the Admin Group side.

The Organization Accounts offer the following features, which are furthered detailed in the subsequent sections:

- The software registers a user space for the organization, in which public and private Tier 2 components and FSMs can be stored.
- The software allows the organization owner to invite or remove members, tailoring the account access and permissions.
- Organizational Accounts own the Tier2 and FSMs models, thus they are independent of the users who create or edit them.

The Organization Accounts are suited for the sector of users which aims to publish FSM and Tier 2 products on the SCHUMANN Resonance marketplace to increase their outreach in the space-sector supply chain ecosystem.

3.2.1 Creating an organization

The Resonance software allows users to register with their organization’s domain. The software checks against existing registered domains to avoid duplication. An automatic confirmation email is sent as soon as the user requests a new account. Due to the high sensitivity of product information stored on the website, the process requires Organization Owners to accept and agree with data processing and storage terms and conditions. Although SCHUMANN Consortium does not facilitate the acquisition process between buyer and supplier, space-industry product information represents an confidential privilege agreement between the two entities.

Once the organization has been registered the Resonance online market place is available, along with the full-spectrum of software features to add, edit and remove FSM/Tier 2 components.

3.2.2 Adding users to the organization

SCHUMANN Resonance enables Organization Owners to add, remove and manage permissions of multiple users within their organization. A registration email is sent automatically to the address added by the Organization Owner.

Users within an Organization can add, remove and manage Tier 2 components and FSM configurations, in a public or private space. The purpose of the private space is to allow for modifications without impacting the marketplace available to all SCHUMANN Resonance users. Therefore, prototyping, modeling, and testing activities are highly encouraged to be performed within the private organizational space.

Note, some email services might mark the confirmation email as Spam or Junk. Users are strongly encouraged to check all Spam, or Bin folders.

3.2.3 Removing users from the organization

Once a user is no longer part of the modeling or maintenance efforts for an FSM or Tier2 component, the Organization Owner can easy revoke their access, delete their credentials and remove their identification information from the SCHUMANN Resonance software. To remove members from an Organization, the Owner accesses Settings - > Organization Management.

Since FSMs and Tier 2 components are solely owned by organization, user management does not affect in any way the validity or ownership of the configurations.

3.2.4 Deleting the organization

If a SCHUMANN Resonance user decides to remove their products from the marketplace permanently, they can delete their Organization Account, by requesting a removal from the SCHUMANN Administration Group.

This process requires a confirmation with the administration team as it impacts not only the information provided by the user but also any product that pulls information from this organization. Therefore, this process is performed in two steps:

1. The Organization Owner request an account deletion via the settings interface. The user can request complete information removal from the website, or can leave their products in the market place.
2. After the account deletion is confirmed, regardless of the user's choise, the software triggers a warning to all FSM or Tier 2 component owners which pulled any information into their models from the deleted organization

The Organization Account access is removed as soon as the Administrator confirmation is complete. FSMs and Tier 2 components published by the deleted organization shall remain active in the market place for 30 days, marked as obsolete.

If the Organization Owner decided to completely remove their products from the website, the SCHUMANN Resonance will scrub any data pertaining to their products from the database. It is important to note, this will break any external products that pull FSMs or Tier 2 components from the deleted organization. **It is the responsibility of each FSM or Tier 2 owner to maintain their product configuration, and replace all obsolete components, if any, within the time interval specified by the SCHUMANN Resonance warning.**

4 Tier 2 component management

This section provides an overview of the Tier 2 component management system in Resonance. Tier 2 components are the building blocks of the marketplace and provide the first level of FSM configuration. Organizations can publish Tier 2 components in the marketplace and allow other users to pull their information and use them in further products, encoraging a self-sustaining supply chain.

Resonance allows users to add, edit and remove Tier 2 products. The following sections detail these processes.

4.1 Adding new components

Adding a new component is a straight-forward process. The FSM Editor provides a pop-up screen when users click on the Request New T2 Component. The wizard guides (shown below) the user through the process, quering the SCHUMANN standard information. The user needs to input:

- Name (or Designation) of the component.
- Description
- SCHUMANN Rating Request
- Delivery time
- TRL claim
- API repository
- Tags

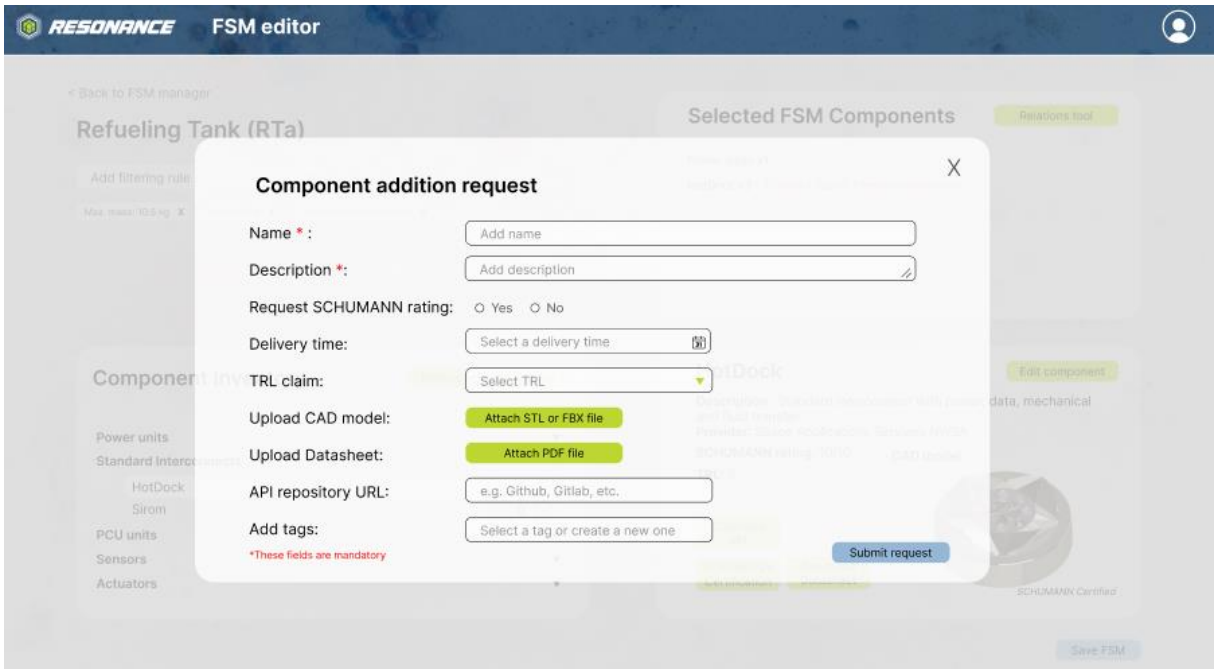

Figure 4-3 Component addition request pop-up window

These field are used to identify the product when other users pull it. Name (designation) allows users to set their product's marketing identity, Description field provides a human readable summary for the component. Products within Resonance marketplace can request and apply for a SCHUMANN standard rating value which provides insight into the viability of the product. Products are not required to hold a SCHUMANN Certification, in order to be accessible on the public marketplace. The Certification is a badge of quality, which signals to potential buyers the product is trusted within the marketplace

community. Resonance aims to provide a qualitative product ecosystem, which allows the supply chain to build trust between the buyer and manufacturer. Delivery time is an estimated time from purchase order to product deliver. This is an estimative time, since the supply chain of Tier 2 components may experience variations in prices and availability depending on external factors. TRL claim field allows product owners to define their tehnological level, based on ESA's guidelines. API repository is applicable for products which offer software services or are reusing some open-source codebase. Tags are human readable keywords which are can be used by the query engine to optimize the search.

Once the mandatory fields are complete, the user can submit the request. After the Administration Group will provide feedback and the component is complaint with SCHUMANN standard for Tier 2 products, the item shall be listed on the public marketplace.

4.2 Editing existing components

Resonance allows users to edit their Tier 2 products to update the marketplace models based on the product specifications. A Tier 2 product owner can edit the component properties and interfaces, adding, removing or changing them.

Resonance does not push changes immediately to the public market place to avoid creating conflicts in FSM configurations. The software publishes a notice to all users who pulled the edited Tier 2 component in their FSM and informs them about the changes. Normally, changes take 30 days to take effect, giving FSM owners time to update their models.

The Adminsitration screen, showcased below provides an overview of the UI used to edit and manage Tier 2 components. The user selects from the Requests drop down menu to display the Tier 2 component list. Each component can be accessed by clicking the name, and Resonance will open a pop-up screen to allow the user to update the Tier 2 component specifications.

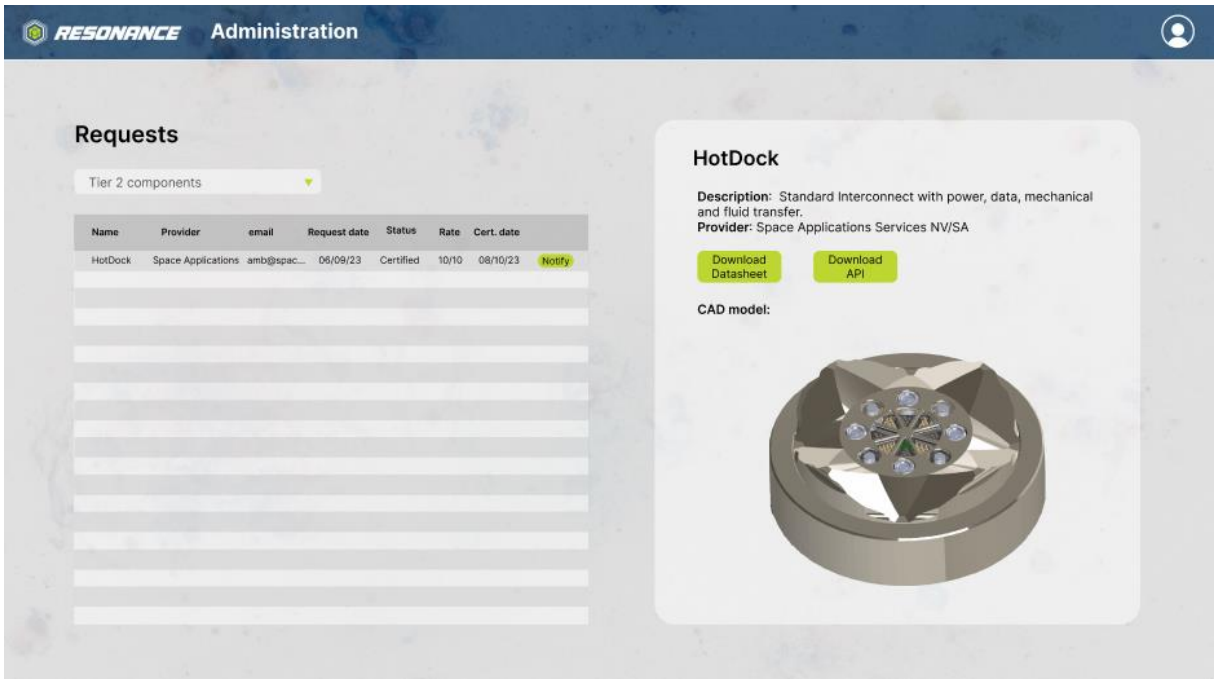

Figure 4-4 Administration page (showing the component list menu)

4.3 Deleting existing components

Resonance allows users to take Tier 2 components off the market place. Once a component is removed, the software initializes the same notification process as for editing components. Users are notifies a component in their FSM configuration will be unavailable in 30 days and will be marked as obsolete. FSM owners are responsible for finding an alternative suppliers, or changing their FSM architecture. Resonance encourages a dynamic marketplace and as stakeholders enter or exit the supply chain, FSM manufacturers are required to keep updated with the market state.

4.4 Warnings and errors

Resonance implements basic sanity checks in the Tier 2 Component Request, to ensure the validity of data types provided. The software also provides an error and bug reporting channel, directly to the SCHUMANN Administration Group. All users (restricted or full-access) are encouraged to report any issues at schumann@spaceapplications.com

5 Flight System Module management

This section describes the user perspective of creating a new FSM configuration, managing and editing an existing FSM configuration and deleting an FSM configuration. Important to note, these features are only available through an Organizational Account.

5.1 Adding a new FSM to DSSCK

One of the main use-case of SCHUMANN Resonance enables users to create a new empty FSM configuration, or base a new FSM configuration on existing presents. The FSM Manager (figure below) provides a simple User Interface which allows defining a new product model with minimal steps.

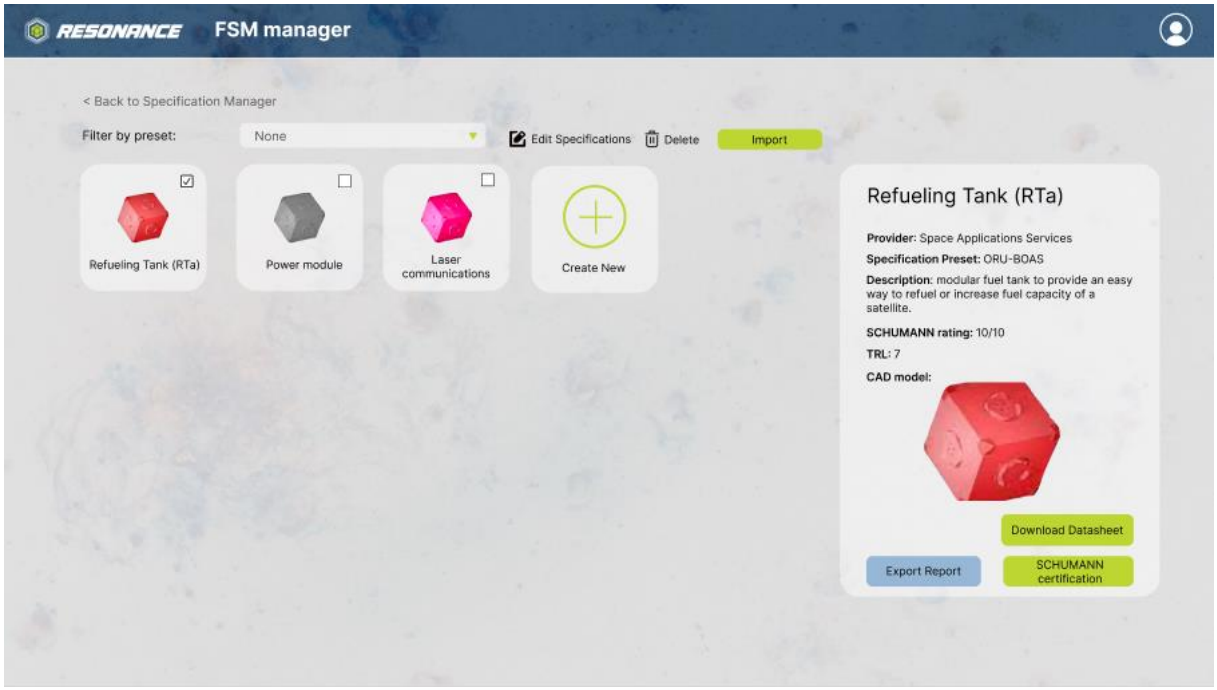

Figure 5-5 FSM Manager page

The FSM Manager utility allows users to access their own products (private or public) and perform the following operations:

- Edit FSM Specification
- Delete FSM
- Import from file
- Access FSM model by downloading the data sheet, exporting a SCHUMANN report or accessing the SCHUMANN certification

The user can add a new configuration to their list, by clicking the Create New button on the screen. Resonance redirects to the Specification Manager, an optional step which users can use to filter the FSMs and components, customizing their experience. With Specification Manager the user can take advantage of the market place ecosystem and model their FSM based on existing presents. Presets allow products to increase connectivity using standardized interfaces based on existing frameworks. Basic system-level attributes such as Size, Weight and Power (SWaP) budgets can be defined as an initial estimate of the FSMs specifications. Furthermore, the Specification Manager aims to reduce the human-in-the-loop workload by suggesting tags relevant to the product. Tags are human readable key-

words which help Resonance members to more easily access the range of solutions they are looking for within the marketplace.

Frameworks and standard interconnects are directly ties to FSM standardization efforts. FSMs are complex products which require software to manage internal processes. Communication between FSMs can be facilitated by providing reusable software packages which standardize the coding practices.

On the right of the Specification Manager screen the user can inspect their FSM model settings. Once done, the user can select Next to be redirected back to the FSM Manager.

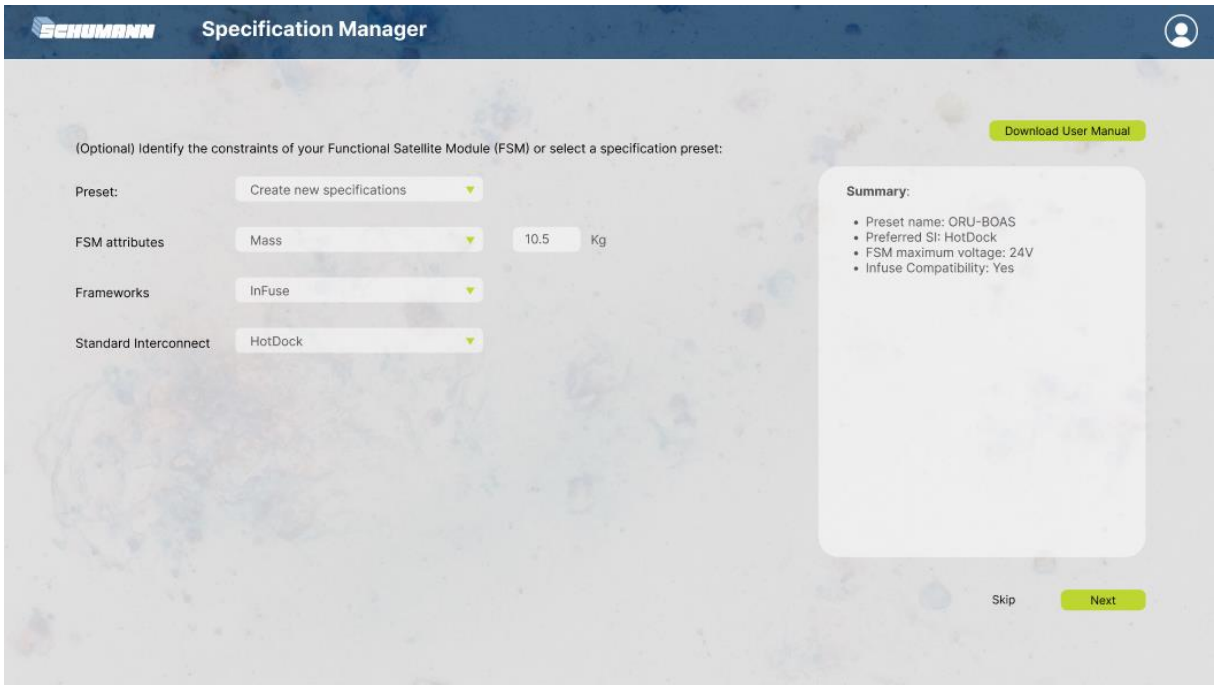

Figure 5-6 Specification manager page

The table below presents a step-by-step process in which the user can add optional FSM specifications using the Specification Manager.

Step Number	Description	Comment
Step 1	Access the Specification Manager from the Landing Page	
Step 2	Select the Create new specification option from the Preset drop menu	
Step 3	Configure the system level properties (size, weight and power) from the FSM attributes drop menu, as follows: • Mass: 10.5 kg • Power: 28 Watts • Size (length): 1500 mm • Size (width): 700 mm • Size (height): 840 mm • Framework: Infuse • Standard Interface: HotDock	The Specification Manager updates the summary table with the configured values, for easy tracking.

Step 4	Click the Next button on the lower right corner of the screen.	

Table 5-1 Step-by-step guide for adding an FSM Specification

This concludes adding an FSM thought the Specification Manager. Next section provides an overview of the FSM Editor which allows users to manage the internal configuration of their products.

5.2 Editing an existing FSM

Resonance allows FSM owners to edit and update their models, to reflect the product changes during development life-cycle, or to mitigate for Tier 2 marketplace changes and supplier availability. The process is similar to adding a new FSM.

Firstly, Resonance opens the Specification Manager menu (explained in the previous section), to allow users to change any of the system-level parameters of the FSM. As before this step is optional and can be skipped. Once the user updates the target attributes of the model, they can navigate to the FSM Manager and edit their products.

Then, Resonance redirects the user to the FSM Editor. The FSM Editor is one of the most commonly used tools as it provides the functionality to manage existing configurations or to populate the newly created products. The screen is divided into several sections which allow users to inspect and track the validity of their model.

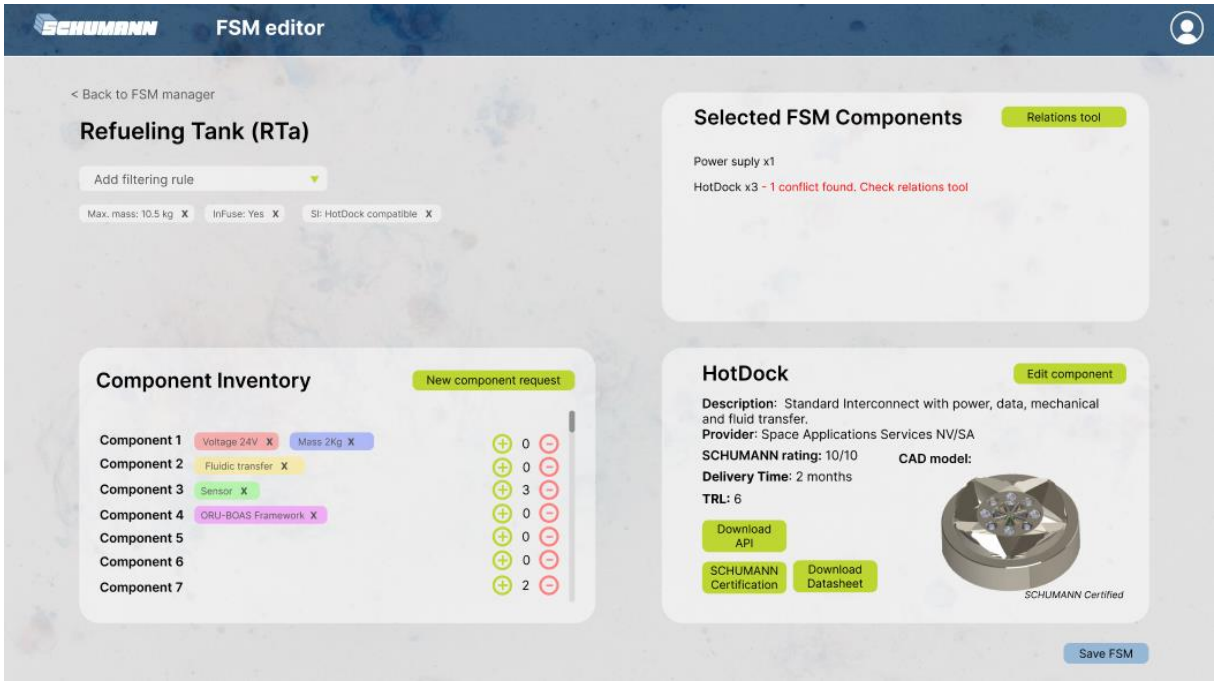

Figure 5-7 FSM Editor page

This section presents a simplified example to demonstrate the process from a user perspective. Each step is defined in the table below:

Step Number	Step Description	Comment
Step 1	To create a new FSM, the user selects the target product in the FSM manager screen.	
Step 2	Select query filter values as follows: • Voltage: 24 V • Mass: 2 kg	
Step 3	Select Component 1 from the query results list. Add or remove components of the same type by clicking the + or – buttons.	Resonance automatically deletes components which have zero units in the configuration.
Step 4	Repeat the process from Step 2 to pull a new Tier 2 product into the FSM Editor	
Step 5	Navigate to the Relations Tool and inspect the component connections.	The software shows nominal status. This is an example procedure which allows the user to test the features.
Step 6	Close the Relations Tool, add a new component and re-inspect the connection status	Resonance requires users to iteratively inspect their models, during configuration and editing process.
Step 7	Select a component in the FSM configuration list and inspect the technical summary on the bottom-right screen section.	The screen showcases a summary section of the selected component. The user can download both the manufacturer product sheet, and the SCHUMANN Certificate. An Edit Component button allows users to access the Tier 2 component configuration, if the product is owned by the FSM editor's organization.
Step 8	Click the Save FSM button on the lower-right corner to close the editor and return to the FSM Manager.	

Table 5-2 Step-by-step guide to create an FSM

For completeness, the manual provides an overview of the Relation Tool troubleshooting process. As previously mentioned, Resonance checks the connection validity. If two or more components are not compatible, the software issues a warning. The user is responsible for inspecting each conflicting interface, and decide between adopting the Relations Tool suggestion or resolving the conflict manually, by deleting components and replacing them using the process described above.

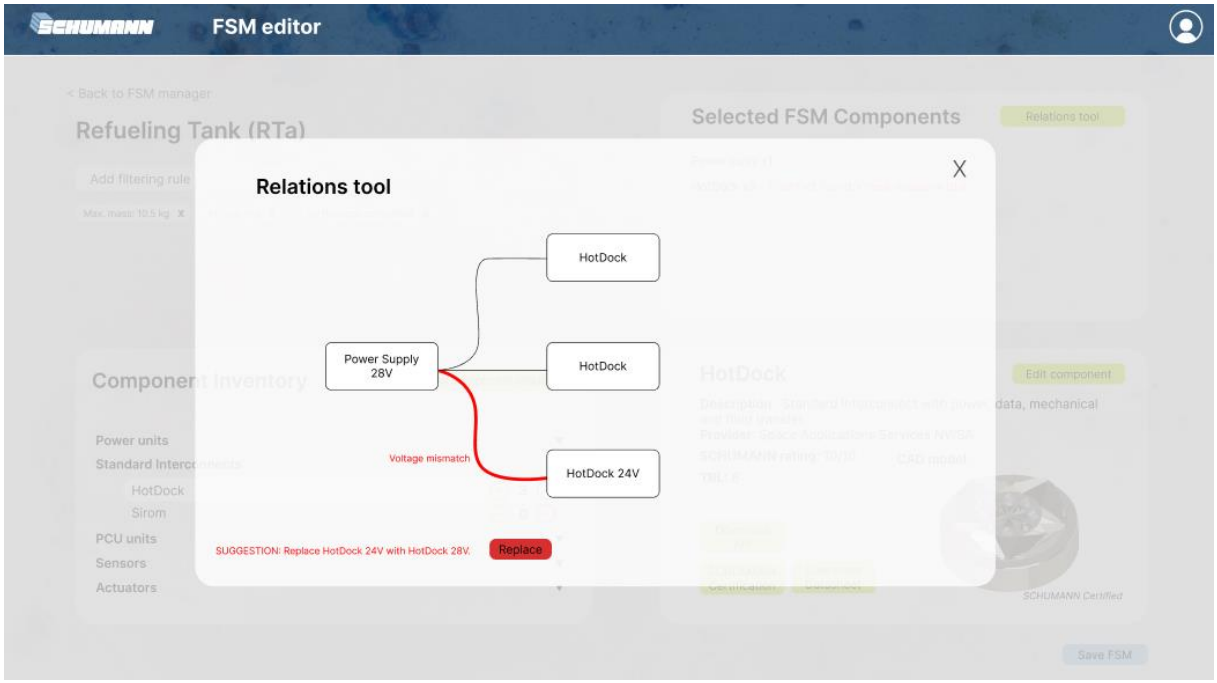

Figure 5-8 Relations Tool page

5.3 Deleting an existing FSM

The final FSM management capability is to remove FSM model from the user space. The organization owns the configuration, regardless of which member created or edited it. Therefore, removing FSM models requires elevated permissions, which are granted by the Organization Owner or Organization Moderator. A user which can completely remove FSM configurations (such as a Project Manager, Team Leader or Project Controller) can access the Settings -> Organization Management.

The menu presented allows the user to access a list of FSMs and their meta-data (such as creation date, last modified date, last user which accessed or edited the configuration etc). To delete an FSM simply request click on the X-button and confirm the deletion.

A notification is sent by the SCHUMANN Resonance software to all external users who make use of the FSM within their configuration. The marketplace is updated and shows the FSM as obsolete and to be deleted in 30 days.

It is important to note elevated privileges of this role may require confirmation from a third party, to avoid accidental removal of valid FSMs.

5.4 Warning and errors

This section provides an overview of common errors and warning SCHUMANN Resonance notifies users of. The warnings and errors are focused on configuration conflicts between interfaces and user-side notifications with respect to public marketplace updates.

5.4.1 Conflicting interfaces

Conflicting interfaces present one of the most common sources of mismatches and can present difficulties during debugging of the configuration. The SCHUMANN Resonance software aims to

alleviate the effort and provides, when possible a diagnostic of the most probable attribute conflict. For example, manufacturers may present the same functional product with a wide range of interfaces, in order to address different needs or budget envelopes. In that case, the power interface between two models might differ by a few Amps or Volts. In this case, an FSM owner might overlook this discrepancy in the data sheets and attempt to connect the wrong equipment. In this scenario, the Relations Tool triggers a warning, notifying the user their configuration is not feasible.

5.4.2 Marketplace update

Another common source of conflicting information originates from the evolution of the marketplace availability of Tier 2 components. Of course, it is expected that established actors of the supply-chain ecosystem to present little to no variation, while new entries will fluctuate more, depending on manufacturing capabilities and scaling options.

SCHUMANN Resonance implements a notification system which informs users of marketplace update events. These events are divided in two categories:

- Tier 2 component specification update
- Tier 2 component specification removal

In both cases, the FSM owners which pulled the component to their configuration are issued a warning informing them of the event. In case of a specification update, the FSM owner can pull the new data of the Tier 2 component and compare it to their own version. In the second case, when a component is removed, the software informs the user the specification is no longer valid, and the component is marked as OBSOLETE.

Regardless of the warning type, the SCHUMANN Resonance software allows users a 30 day period to update their FSM configuration, while keeping the version of the component specification they used originally.

As previously stated, the software is not responsible to resolve missing or incomplete FSM configurations. The FSM owner shall maintain their products, and during the tentative 30 day period, update their FSM with a similar component, or find alternative solutions.

********** End of Document **********