PROJECT DELIVERABLE REPORT

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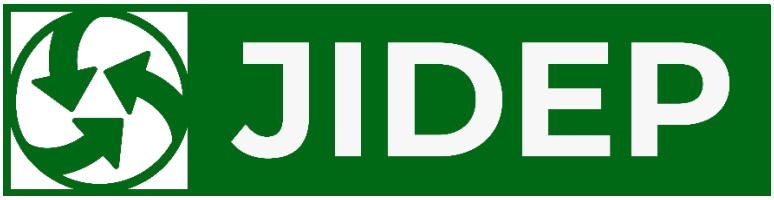

Joint Industrial Data Exchange Platform

Type: OTHER

D4.1 JIDEP tools and operation manual (Final)

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Dissemination Level		
PU	Public	✓
PP	Restricted to other programme participants (including the Commission services)	
CO	Confidential, only for members of the consortium (including the Commission services)	
SEN	Sensitive, limited under the conditions of the Grant Agreement	

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Executive Summary

This report is the final version of deliverable D4.1 for the JIDEP project. It showcases our developed tools and operational guidelines. In JIDEP, we created digital solutions tailored for industries, addressing their needs and aligning with our project goals. One essential tool, the Environmental Analytic Tool, helps organizations measure the life cycle analysis of manufacturing products, which promotes sustainable practices among our industrial partners, a core objective of the JIDEP. Another significant tool we've developed is the Material Passports. This tool provides stakeholders with essential product information, ensuring transparency and accountability throughout the product's lifecycle. Its value lies in its ability to align perfectly with the project's aims, making it an integral part of our toolkit. To promote the circular economy, we introduced the Circularity Calculator. It empowers stakeholders to make informed decisions about resource efficiency and waste management, thereby significantly contributing to the circular economy. Our Collaborative Space service helps with teamwork and efficient data sharing among stakeholders, reflecting JIDEP's emphasis on collaboration. Additionally, we developed analytical tools for composite material structures and PCB analysis. These tools cater to engineers and researchers and support JIDEP's mission to integrate advanced technology into industry practices. These innovative solutions demonstrate our commitment to technological excellence and promise to elevate businesses and industries towards a more sustainable and collaborative future under the JIDEP project.

1. Introduction

The JIDEP project represents a significant step in creating sustainable and innovative industry solutions. This report, the final version of deliverable D4.1, guides the tools we have developed and their operational manuals. These tools are designed to meet industries' changing needs while staying true to the goals of the JIDEP initiative. As part of our dedication to sustainable practices, the JIDEP project has rolled out tools designed to empower organizations across various sectors. One essential tool is the Environmental Analytic Tool, a robust platform that helps organizations measure and improve their ecological impact. This tool embodies the core values of the JIDEP project, emphasizing the importance of sustainability practices that are central to our mission.

Material Passport is crucial to ensuring transparency and accountability throughout a product's lifecycle. The Circularity Calculator, which adopts circular economy principles, helps businesses optimize processes and maximize product circularity and resource efficiency. Developing analytical tools for composite material structures and PCBs showcases cutting-edge technology integration into industry practices.

This report presents the tools developed under the JIDEP project, emphasizing their role in advancing technological excellence, sustainability, and collaboration within industries. These tools guide the transformative journey towards a more sustainable and interconnected future aligned with the JIDEP initiative.

2. Collaborative Space

2.1 Description

Individuals gain access to diverse material passports and teams upon signing up on collaborative space, while organisations enjoy a centralised platform for streamlined collaboration. Secure login credentials ensure personalised user experiences, benefiting organisations from a robust user management system. As administrators log in, they can seamlessly add, edit, or remove users, each assigned distinct access levels—Admin, Editor, or Publisher—tailored to their roles. This subtle user management and a user-friendly interface ensure efficient collaboration.

2.2 Key Features

Table 1 Key features of Collaborative Space

Feature number	Feature name
F001	User Registration: Individual
F002	User Registration: Organization
F003	User Login
F004	Add User
F005	Edit User
F006	Delete User

2.3 Operation Manual

2.3.1 User Registration

User registration is the first step to unlocking the full potential of the JIDEP Platform. It provides a personalized account, enabling access to powerful tools tailored to meet industry needs. Your registered account ensures security, traceability, and a customized user experience.

2.3.2 Individual Registration Process

Step 1: Visit the Registration Page

- Navigate to the JIDEP Platform registration page through the provided URL

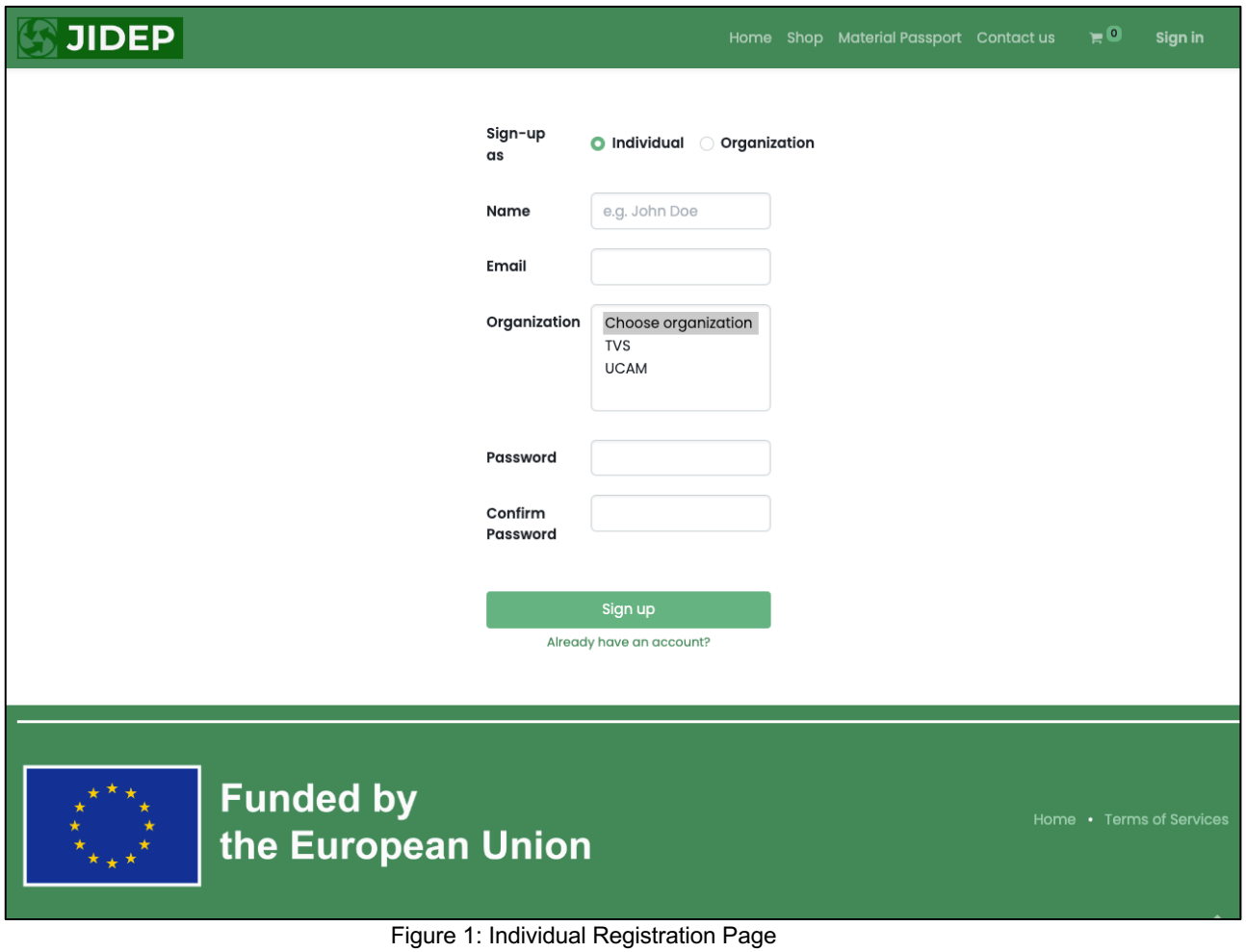


Figure 1: Individual Registration Page

Step 2: Fill in User Information

- Complete the registration form with accurate and relevant information. This typically includes your name, email address, organization and other required details.

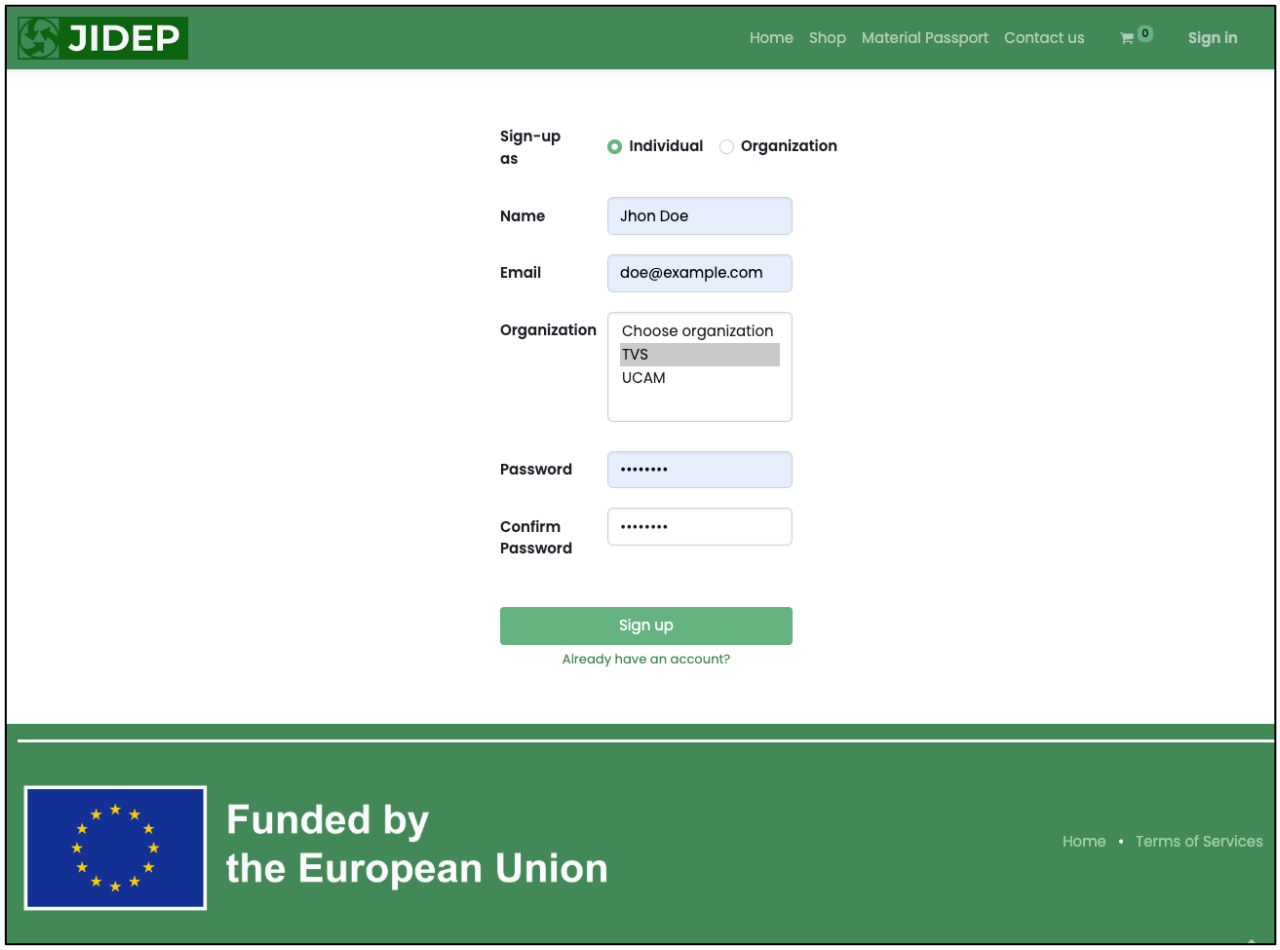


Figure 2: Fill Individual User Information

Step 3: Create a Secure Password

- Choose a strong and secure password to protect your account. Ensure it meets the specified password requirements for enhanced security.

Step 4: Click “Sign up”

- Once the valid information are entered, click the "Sign up" button to register the platform.

2.3.3 Organization Registration Process

Step 1: Visit the Registration Page

- Navigate to the JIDEP Platform registration page through the provided URL

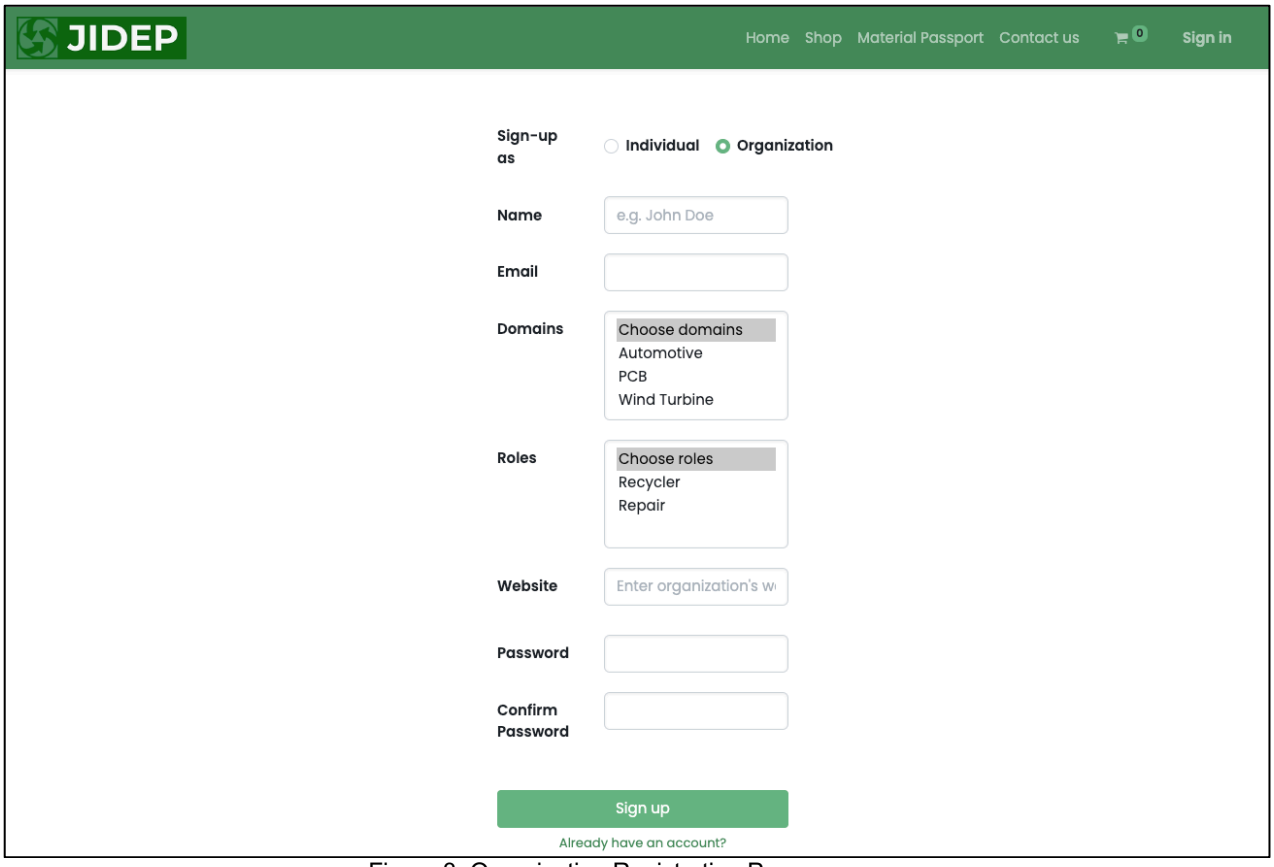


Figure 3: Organization Registration Page

Step 2: Fill in User Information

- Complete the registration form with accurate and relevant information. This typically includes your name, email address, organization, roles, domain and other required details.

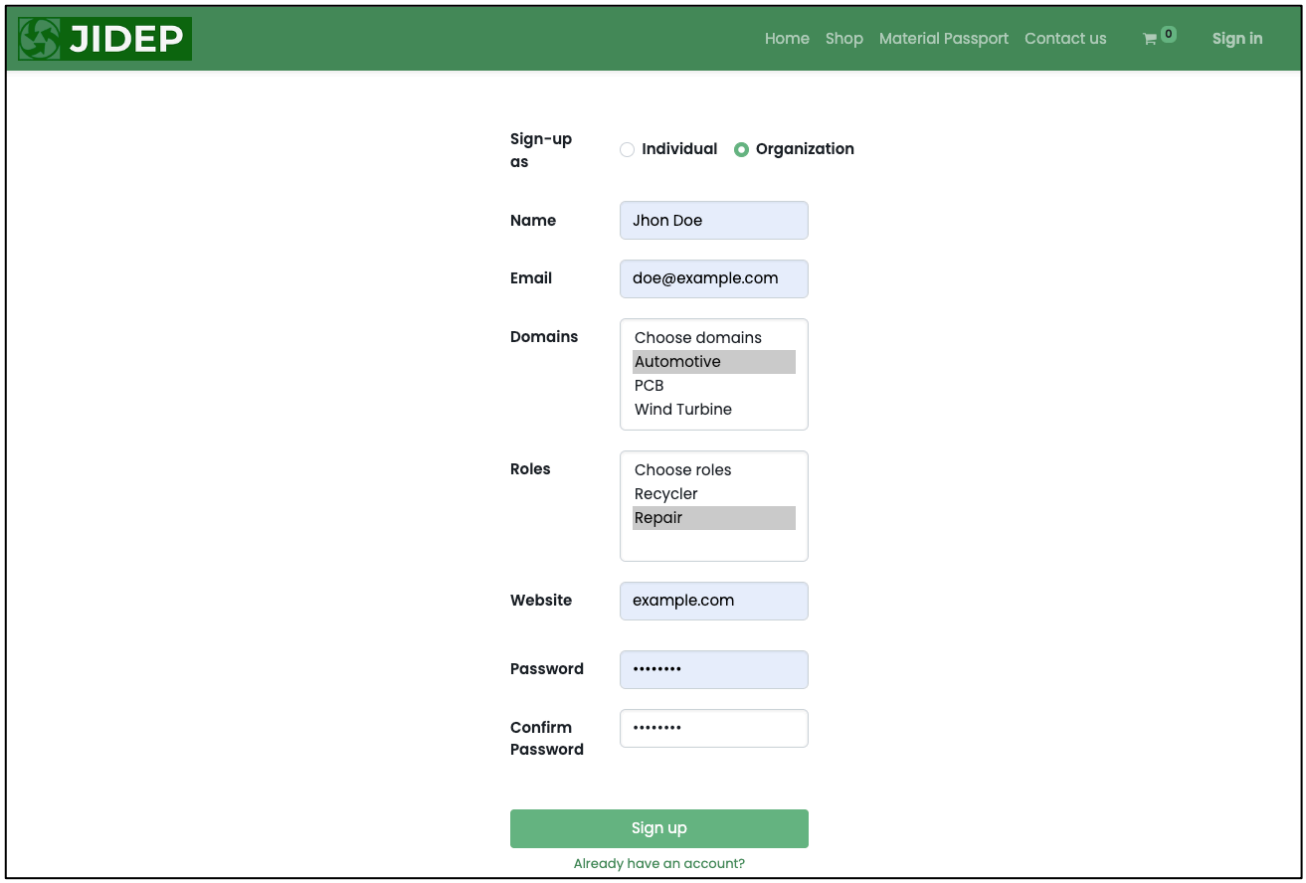


Figure 4: Fill organization user information

Step 3: Create a Secure Password

- Choose a strong and secure password to protect your account. Ensure it meets the specified password requirements for enhanced security.

Step 4: Click “Sign up”

- Once the valid information is entered, click the "Sign up" button to register on the platform.

2.3.4 User Login Process

Now that you've successfully registered, accessing the JIDEP Platform is a straightforward process. This section will guide you through the user login steps, ensuring a secure and efficient entry into the platform.

User login is a crucial step in gaining access to the JIDEP Platform, providing a secure gateway to the suite of tools and collaborative spaces. Logging in with your registered credentials ensures a personalized and protected user experience.

Step 1: Visit the Login Page

- Navigate to the JIDEP Platform login page through the provided URL

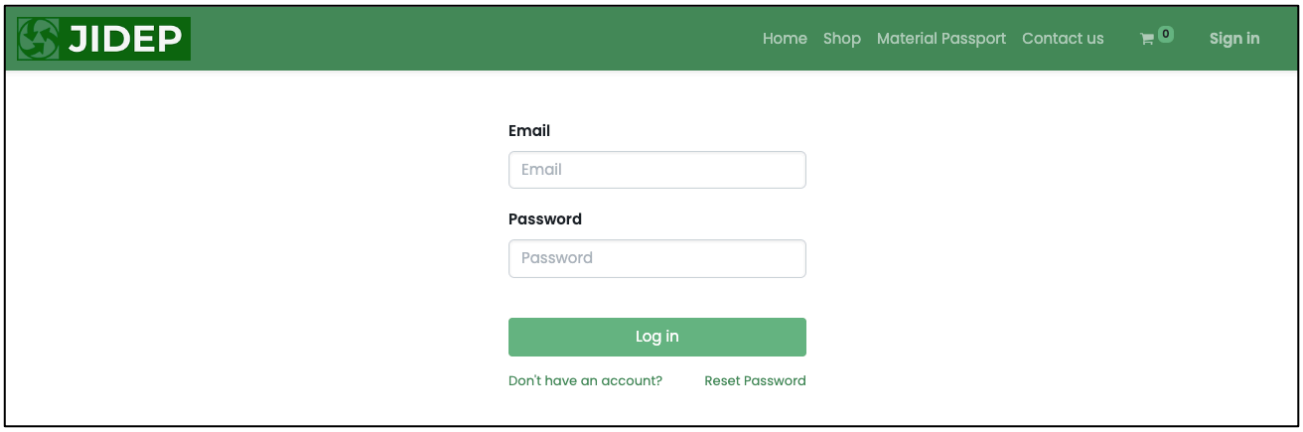


Figure 5: User login page

Step 2: Enter Registered Email

- Input the email address used during the registration process.

Step 3: Provide Password

- Enter the secure password created during registration. Ensure the password meets the specified requirements for security

Step 4: Click “Login”

- Once the email and password are entered, click the "Login" button to access the platform.

2.3.5 Add User

This operational manual provides step-by-step guidance on adding users within the organization. As an Administrator of the organisation, you can Add a user by following the below process:

Step 1: Visit the Login Page

- Navigate to the JIDEP Platform login page through the provided URL

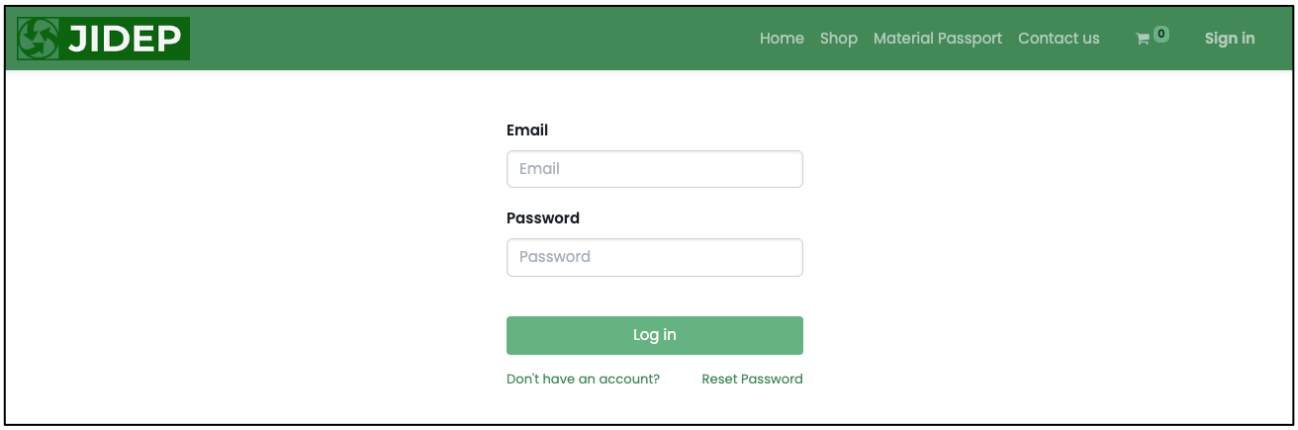


Figure 6: Add User - User login page

Step 2: Enter Registered Email

- Input the email address used during the registration process as an administrator.

Step 3: Provide Password

- Enter the secure password created during registration. Ensure the password meets the specified requirements for security

Step 4: Click “Login”

- Once the email and password are entered, click the "Login" button to access the platform.

Step 5: Navigate to the User Management

- Once logged in, navigate to the dashboard

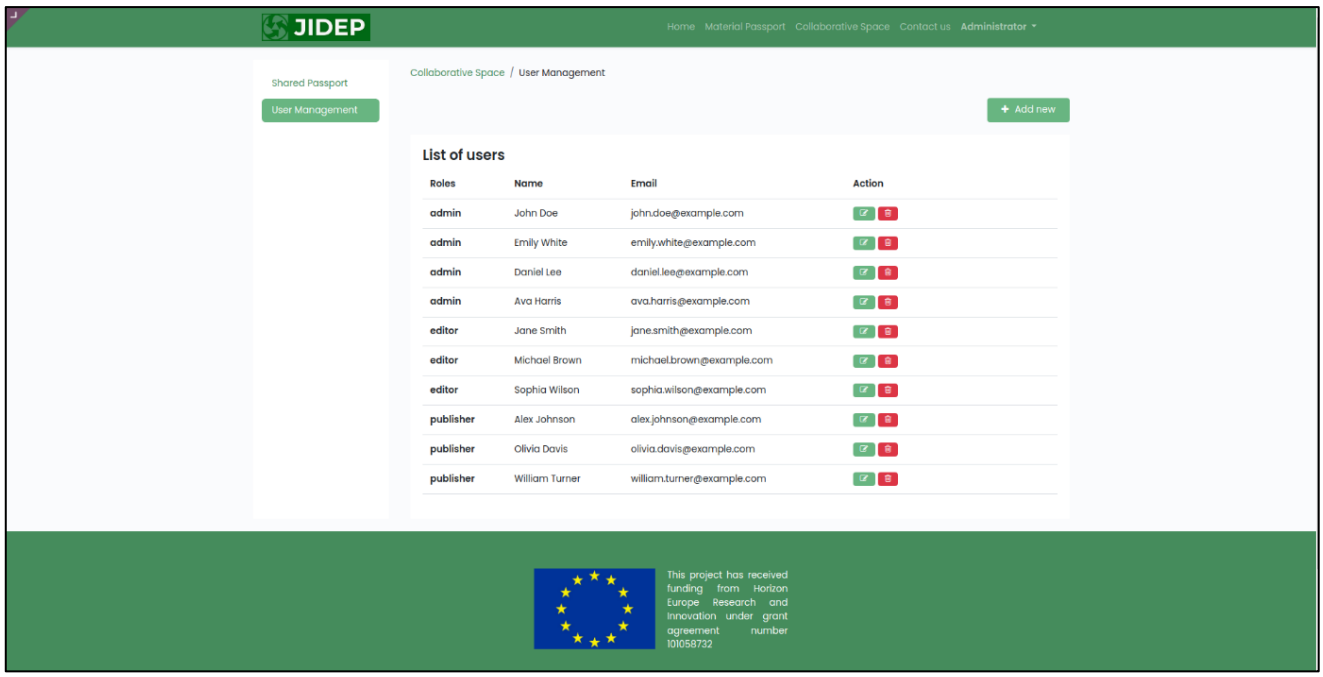


Figure 7: Add User - Dashboard

Step 6: Click the “Add new” button to start adding new user process

- Once navigate to User Management Click on “Add new”

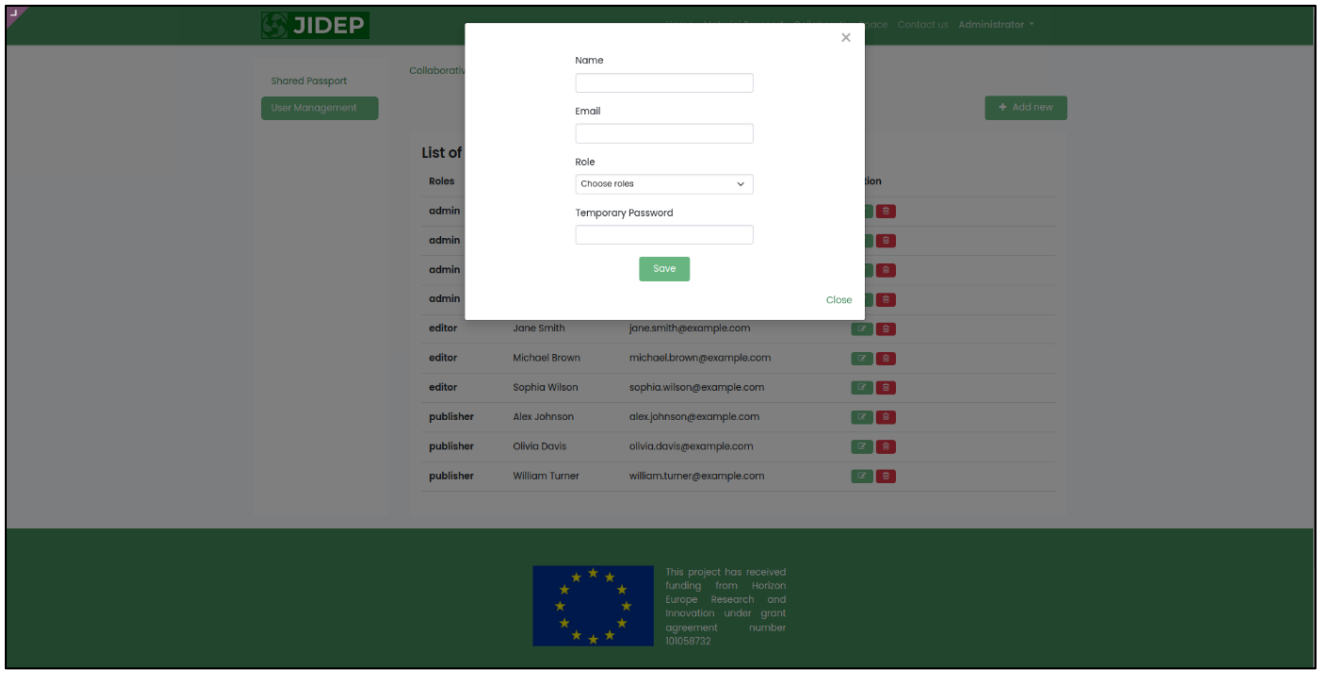


Figure 8: Add User - User Details form

Step 7: Provide valid information for adding a new user

- Fill in the required information for the new user, including name, email, and a secure password.
- Specify the user's access level by selecting "Administrative," "Editor," or "Publisher."
- Click "Save" to confirm the addition

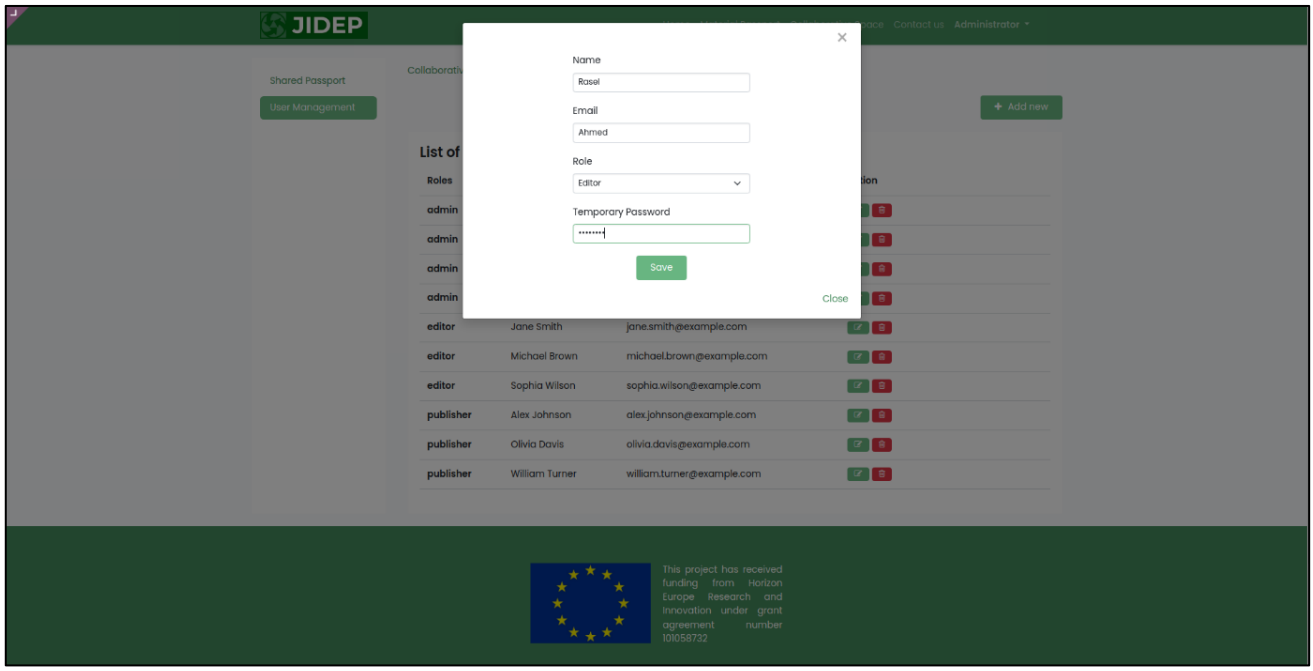


Figure 9: Add User - Fill information

2.3.6 Edit User

This operational manual provides step-by-step guidance on updating users

within the organization. As an Administrator of the organisation, you can update user details by following the below process:

Step 1: Visit the Login Page

- Navigate to the JIDEP Platform login page through the provided URL

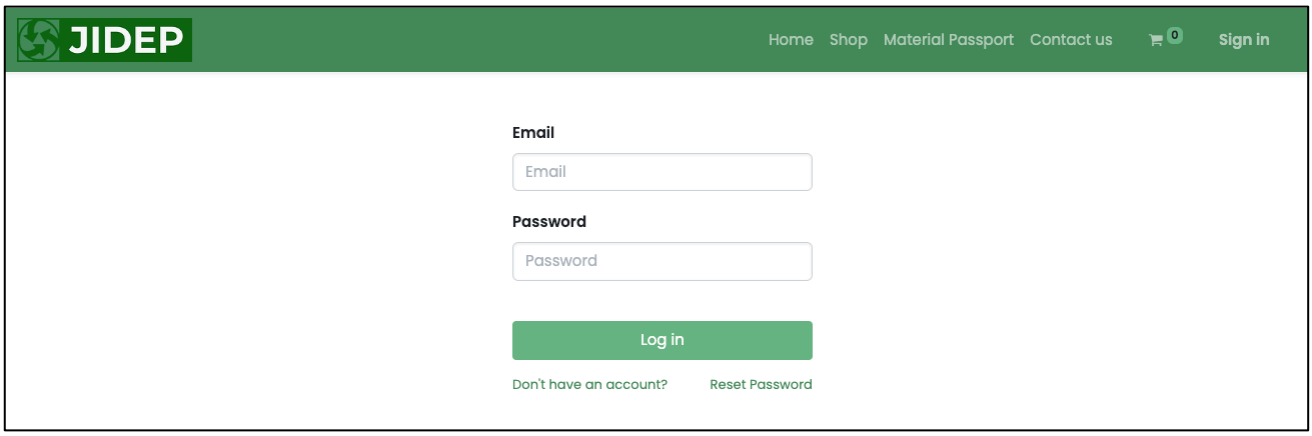


Figure 10: Edit User - User login page

Step 2: Enter Registered Email

- Input the email address used during the registration process as an administrator.

Step 3: Provide Password

- Enter the secure password created during registration. Ensure the password meets the specified requirements for security

Step 4: Click “Login”

- Once the email and password are entered, click the "Login" button to access the platform.

Step 5: Navigate to the User Management

- Once logged in, navigate to the dashboard

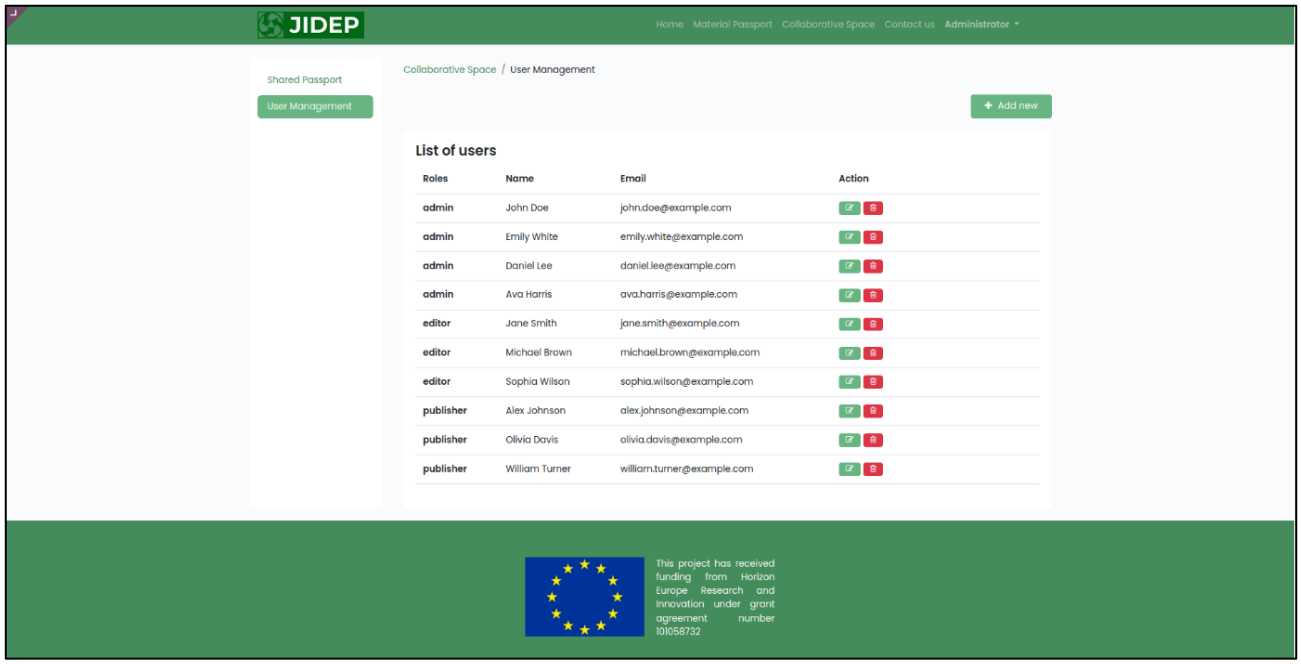


Figure 11: Edit User - Dashboard

Step 6: Click the “Edit” icon to update user details

- Once you navigate to User Management Click on “Edit Button”

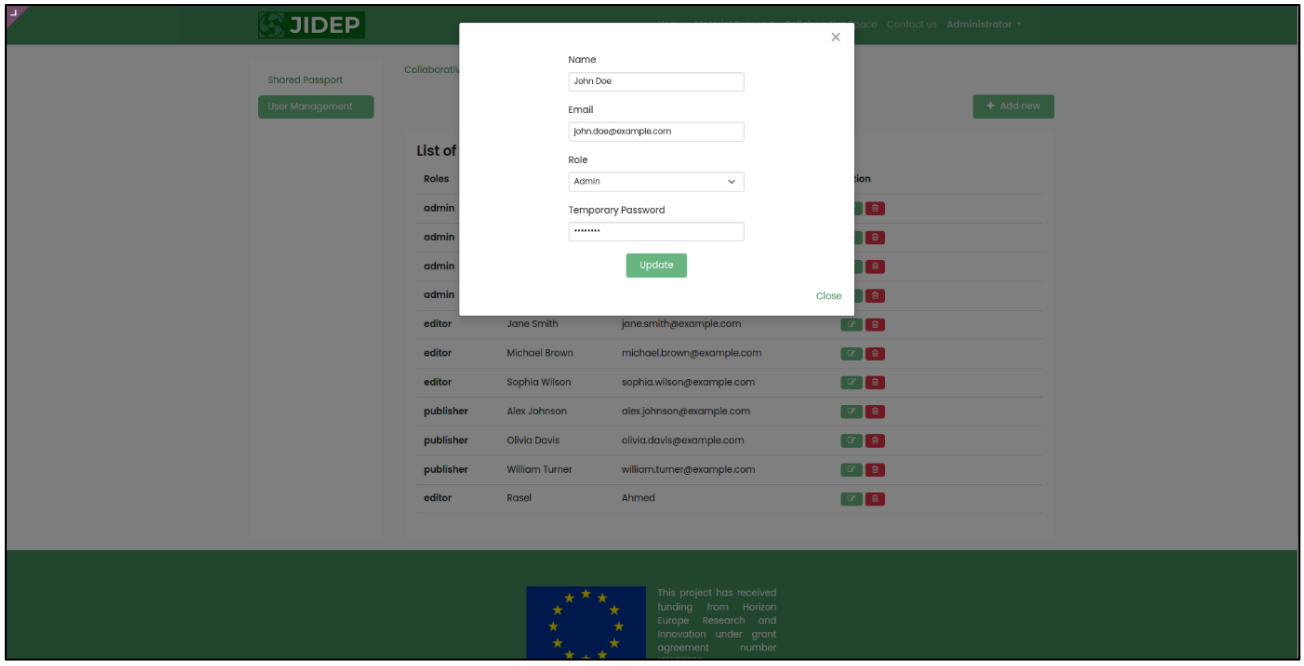


Figure 12: Edit User - User Details form

Step 7: Provide valid information to update user details

- Update the necessary details such as name, email, or access level
- Click "Update" to confirm the update

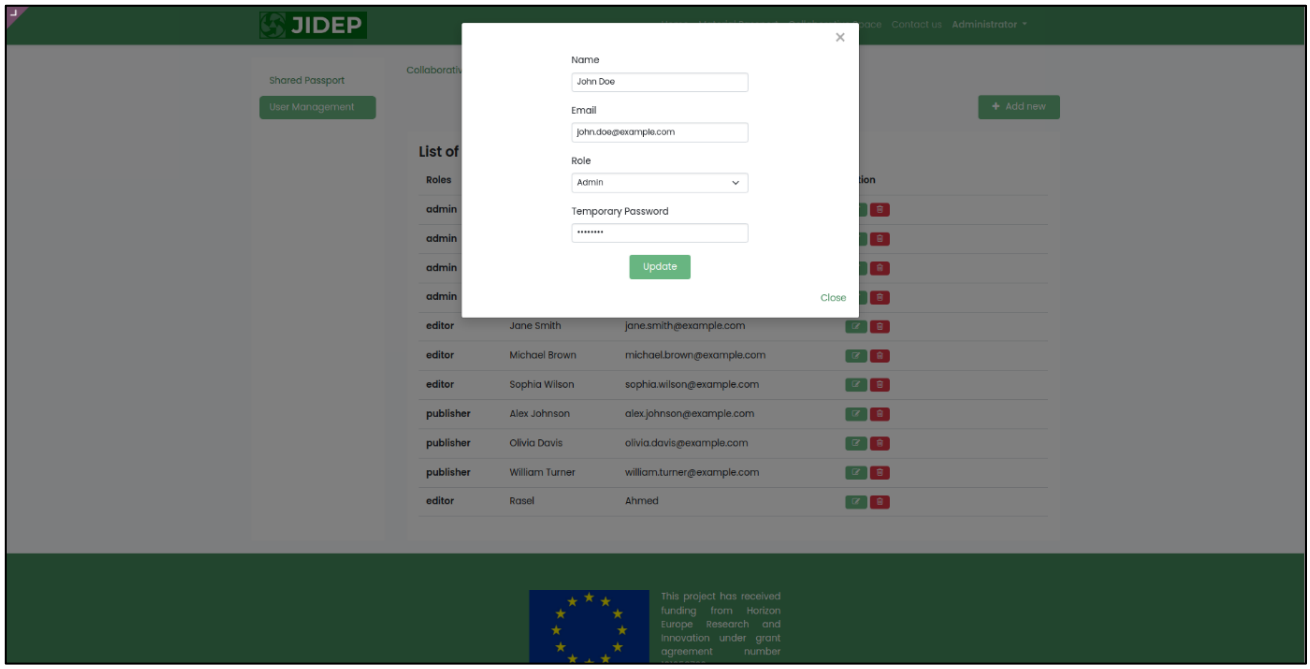


Figure 13: Edit User - Fill information

2.3.7 Delete User

This operational manual provides step-by-step guidance on deleting users within the organization. As an Administrator of the organisation, you can delete user details by following the below process:

Step 1: Visit the Login Page

- Navigate to the JIDEP Platform login page through the provided URL

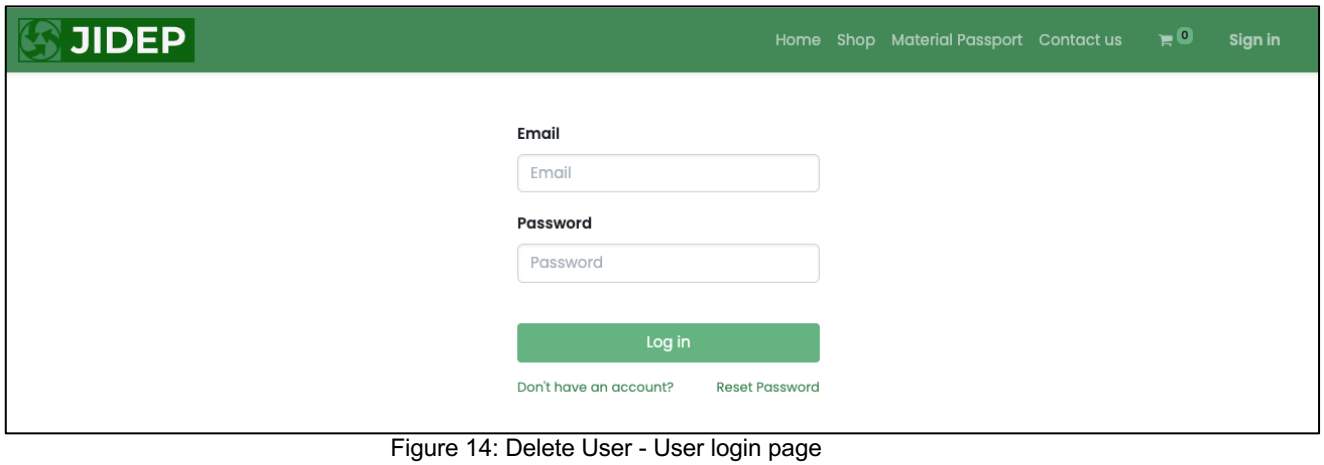


Figure 14: Delete User - User login page

Step 2: Enter Registered Email

- Input the email address used during the registration process as an administrator.

Step 3: Provide Password

- Enter the secure password created during registration. Ensure the password meets the specified requirements for security

Step 4: Click “Login”

- Once the email and password are entered, click the "Login" button to access the platform.

Step 5: Navigate to the User Management

- Once logged in, navigate to the dashboard

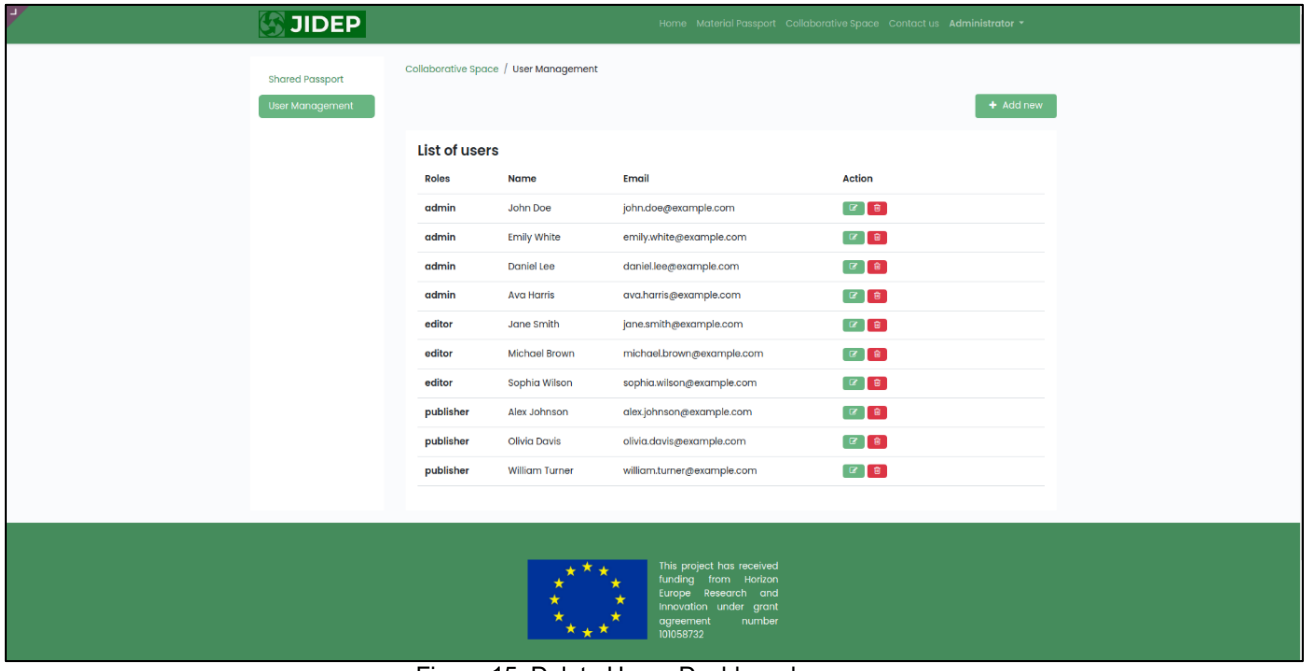


Figure 15: Delete User - Dashboard

Step 6: Click the “Delete” button to delete a user

- Once you navigate to User Management Click on the “delete Button”

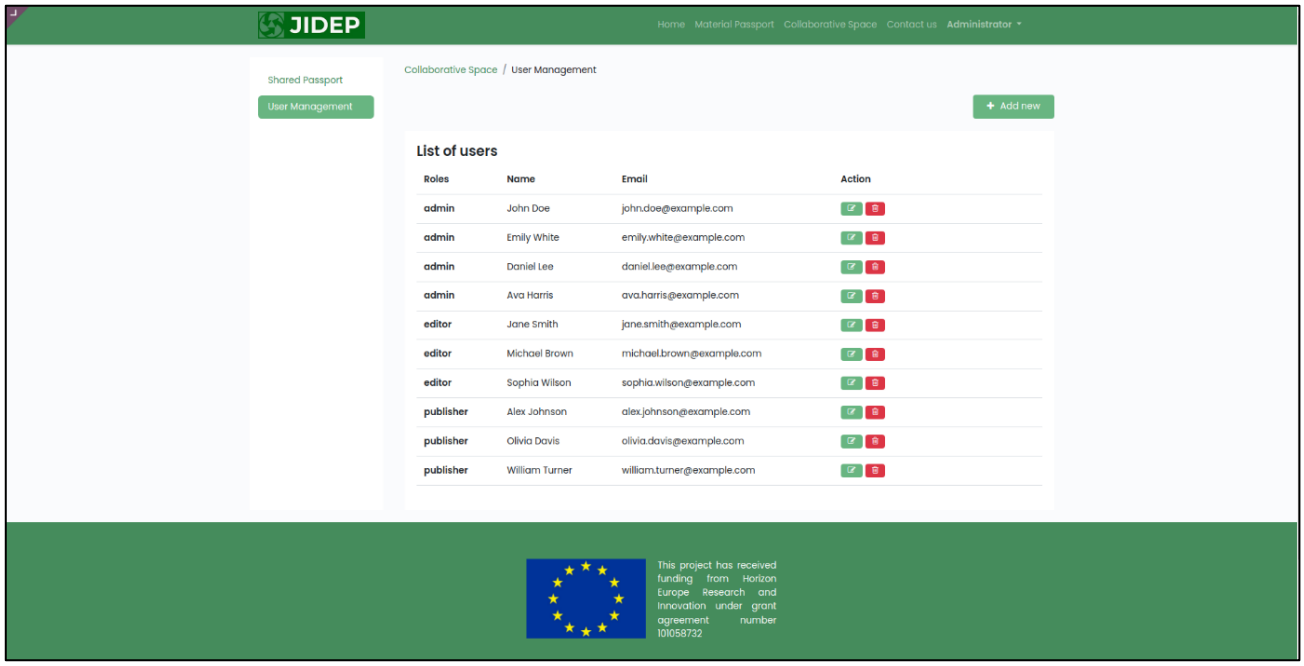


Figure 16: Delete User - User Details form

Step 7: Confirm delete to remove an user from organisation

- Click "Delete" to confirm the deletation

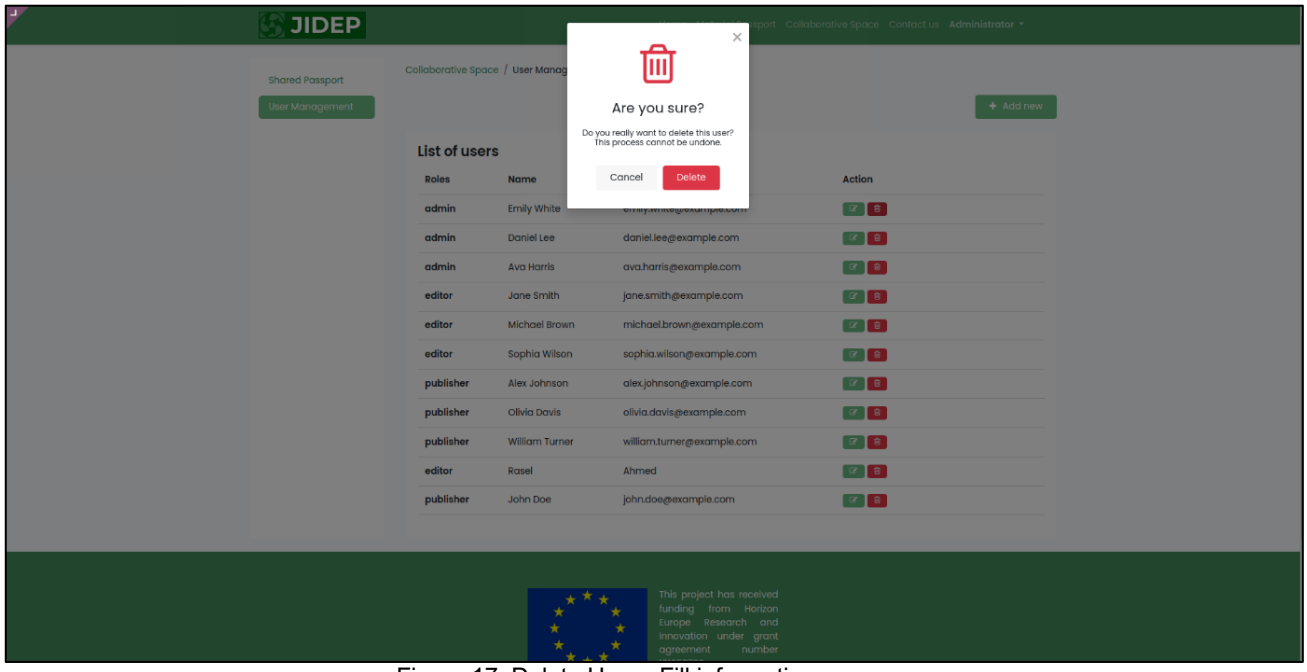


Figure 17: Delete User - Fill information

3. Material Passport

3.1 Description

The Material Passport represents a novel solution designed to improve product lifecycle management, ensuring transparency, security, and collaboration. This dynamic platform facilitates creating, updating, and

deleting product passports, capturing detailed attributes throughout a product's journey. Leveraging distributed storage ensures robust and decentralized data management, while the platform's innovative features, including blockchain verification and role-based access control, fortify the integrity and security of product information. With viewable public passports, shareable access, and QR code convenience, this streamlines communication, fosters stakeholder collaboration and elevates responsible and sustainable product management standards.

3.2 Key Features

Table 2 Key Features of Material Passport Tool

Feature number	Feature name
F001	Create Passport
F002	Update Passport
F003	Archive Passport
F004	List Passports
F005	Publish in Marketplace
F006	Publish in Catalogue
F007	Create Copy
F008	Mark as Old

3.3 Operation Manual

3.3.1 Creating Passport:

Step 1: Please visit: https://jidep.co/passports/new

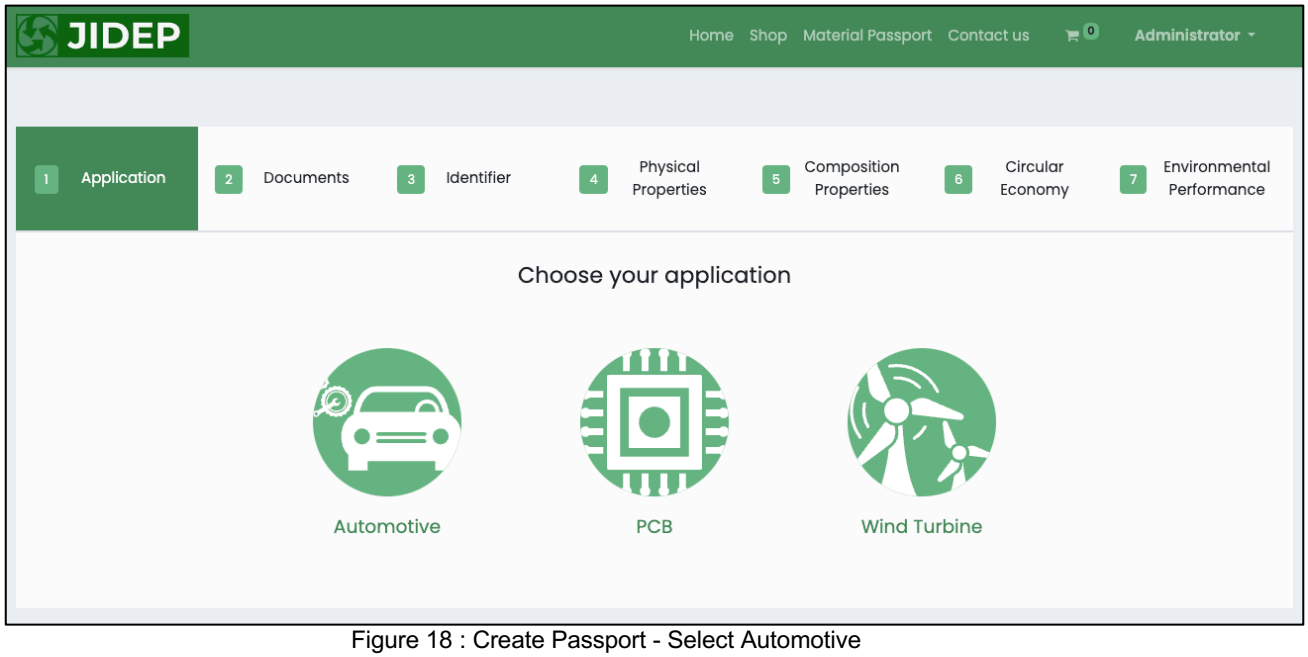


Figure 18 : Create Passport - Select Automotive

Step 2: Select your application example.: Automotive

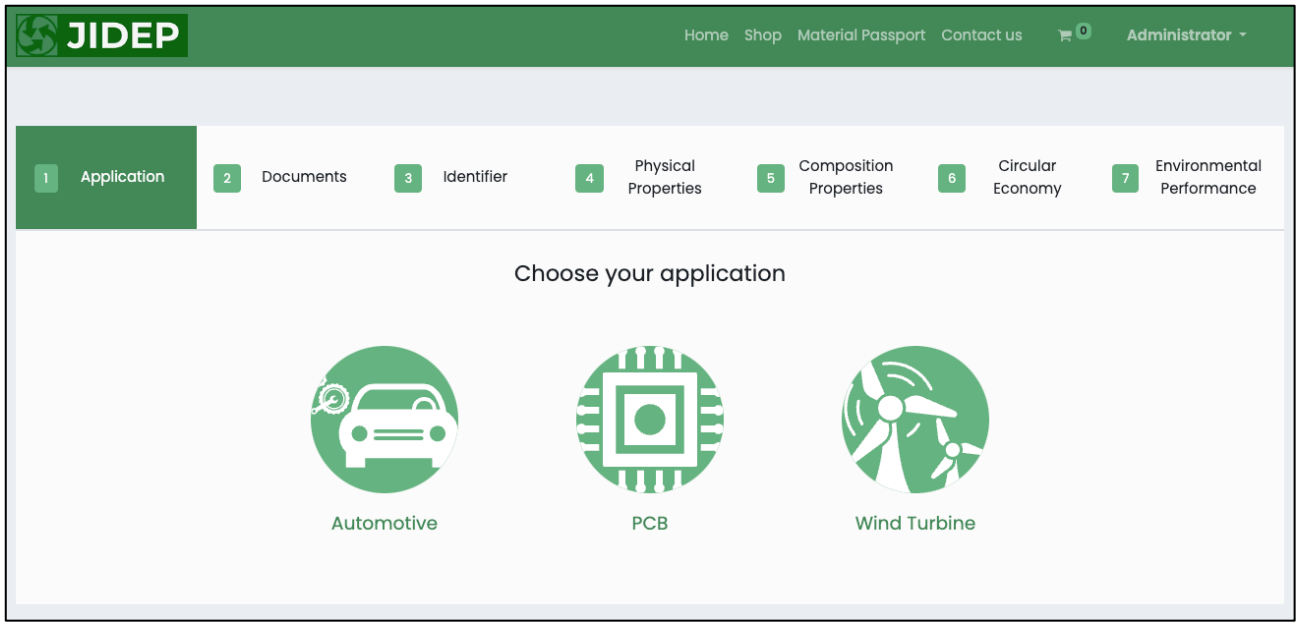


Figure 19: Create Passport - Select Automotive

Step 3: Upload documents from the range of EPD, MSDS, CE Marking, Datasheet and so on. And after uploading the documents click “Next”.

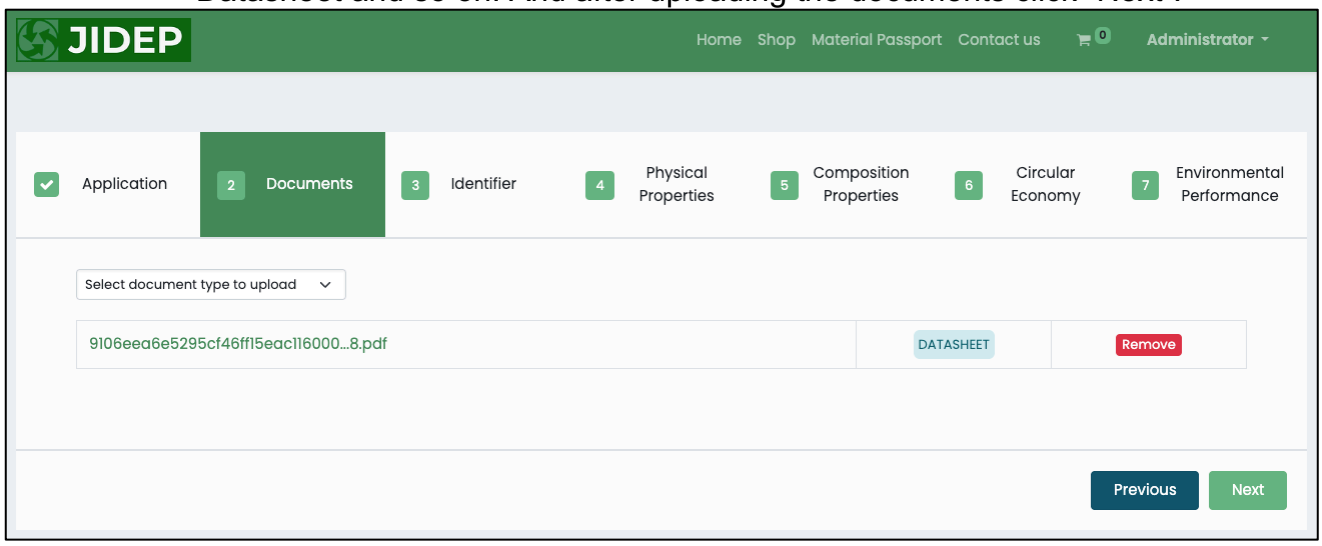


Figure 20: Create Passport - upload documents

Step 4: Provide valid and required information to proceed with the identifier section

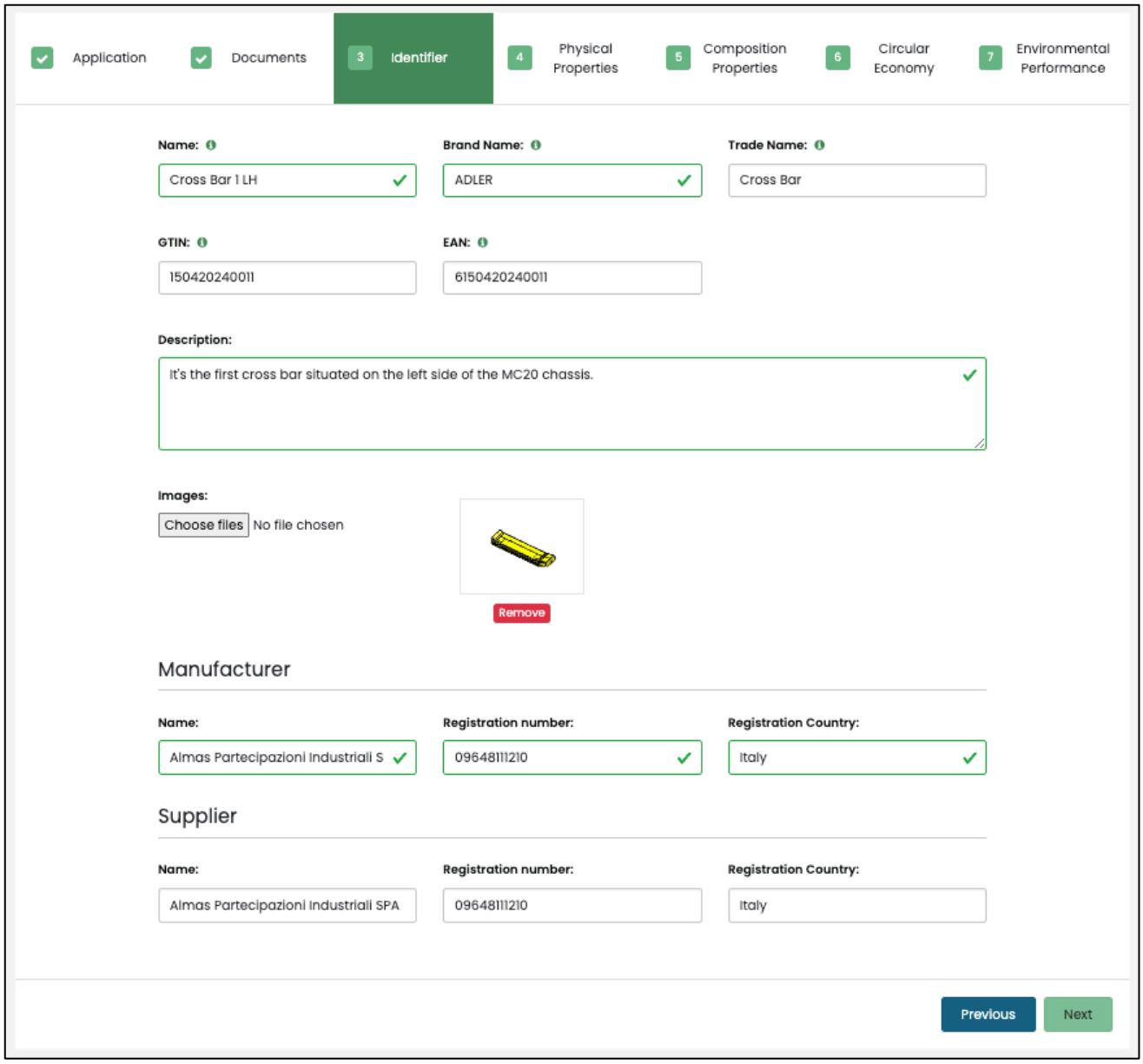


Figure 21: Create Passport - Identifier Information

Step 5: Provide valid and required information to proceed with the physical properties section

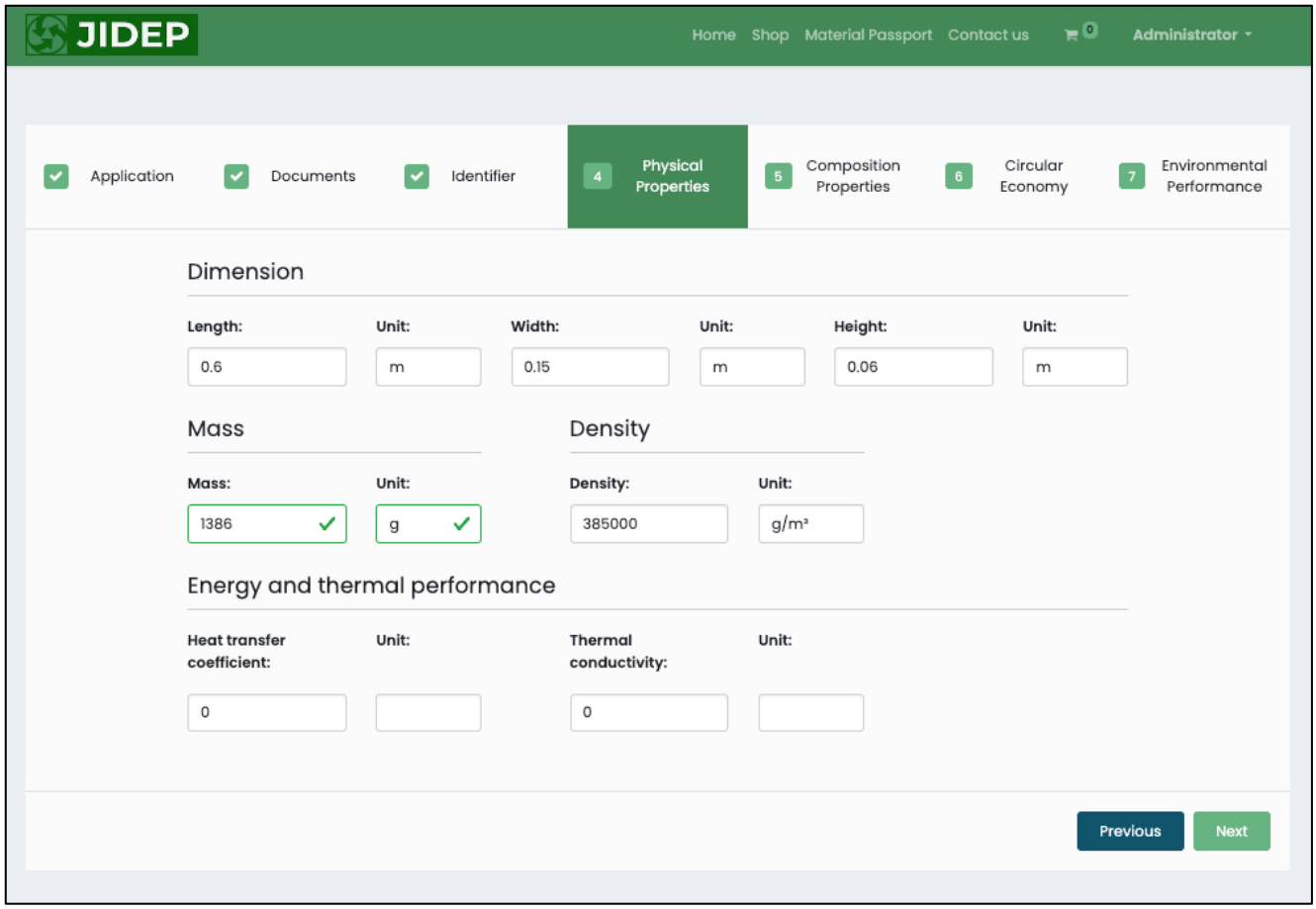


Figure 22: Create Passport - Physical Properties

Step 6: Provide valid and required information to proceed with the composition properties section

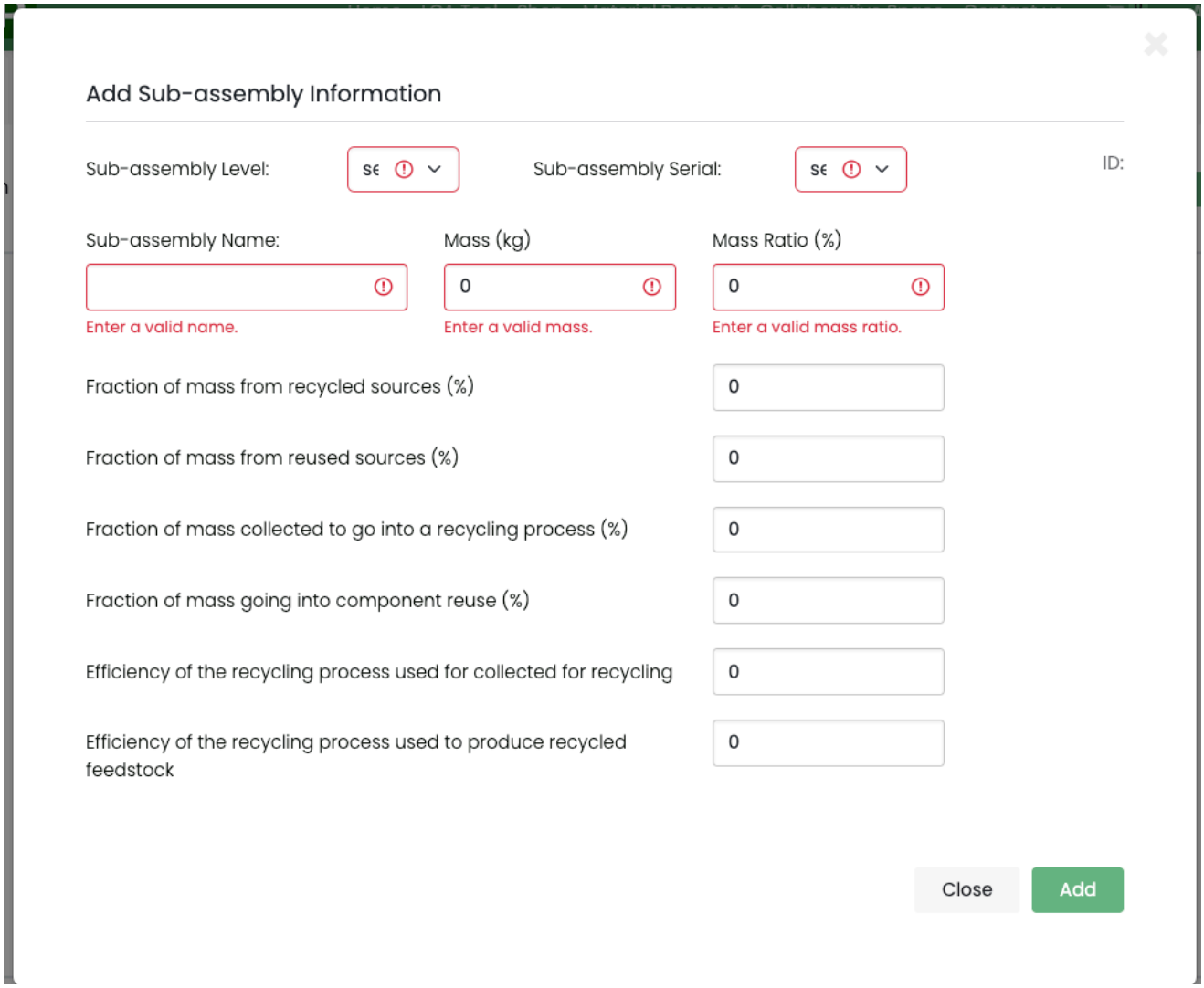


Figure 23: Create Passport - Add Subassemblies

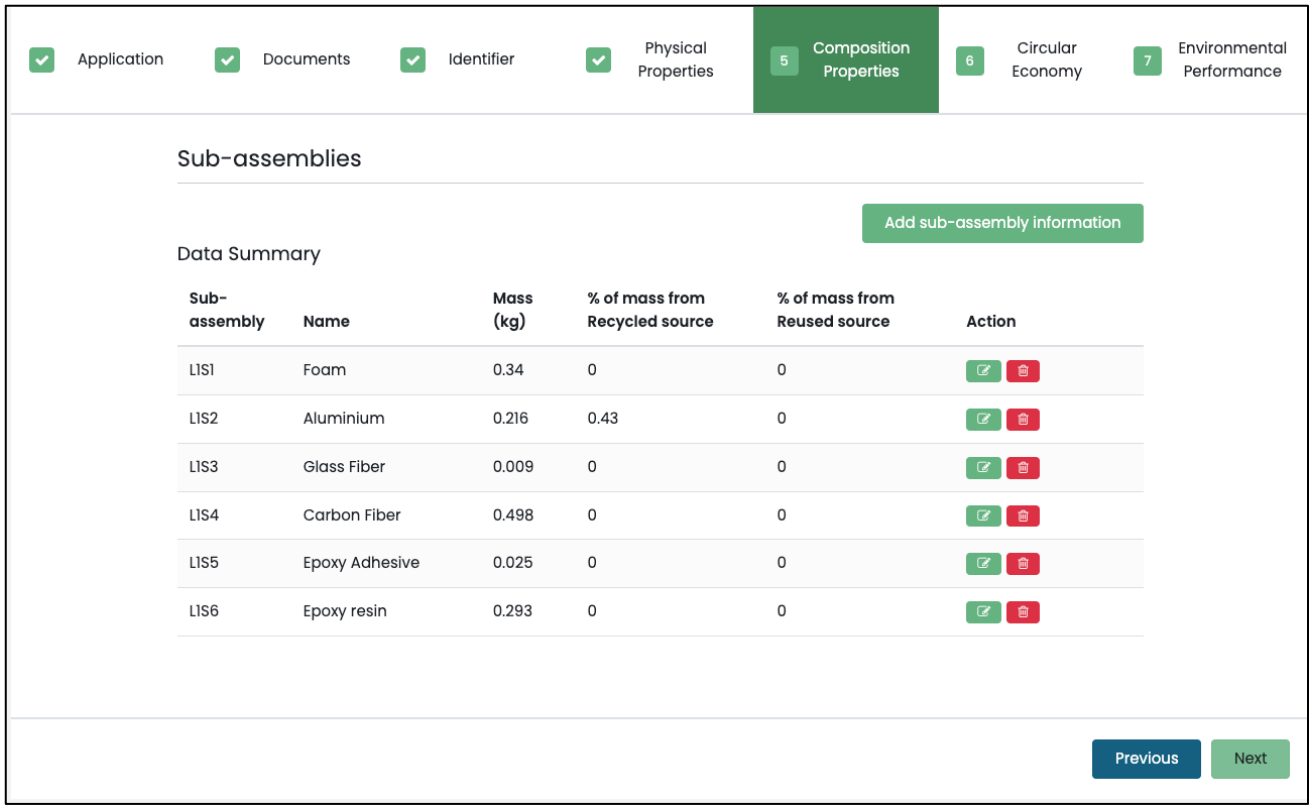


Figure 24: Create Passport - Composition Properties

Step 7: Click next to proceed with the EoL Strategy page

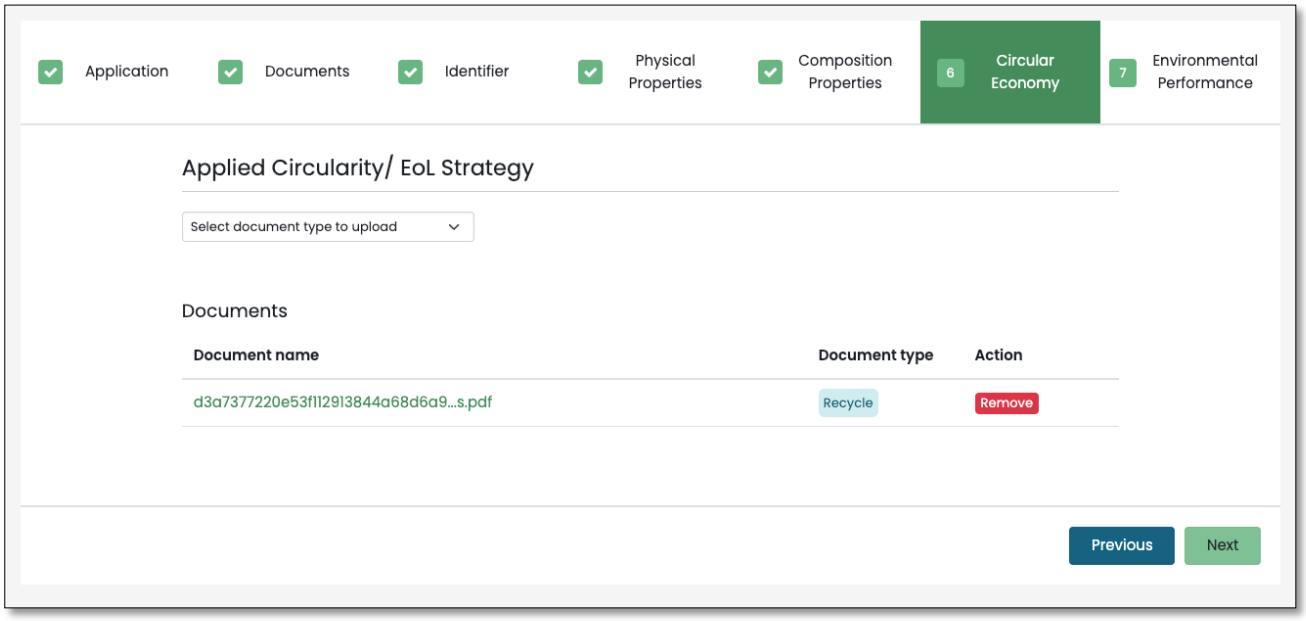


Figure 25: Create Passport - EoL Strategy

Step 8: Click next to proceed with the passport creation page

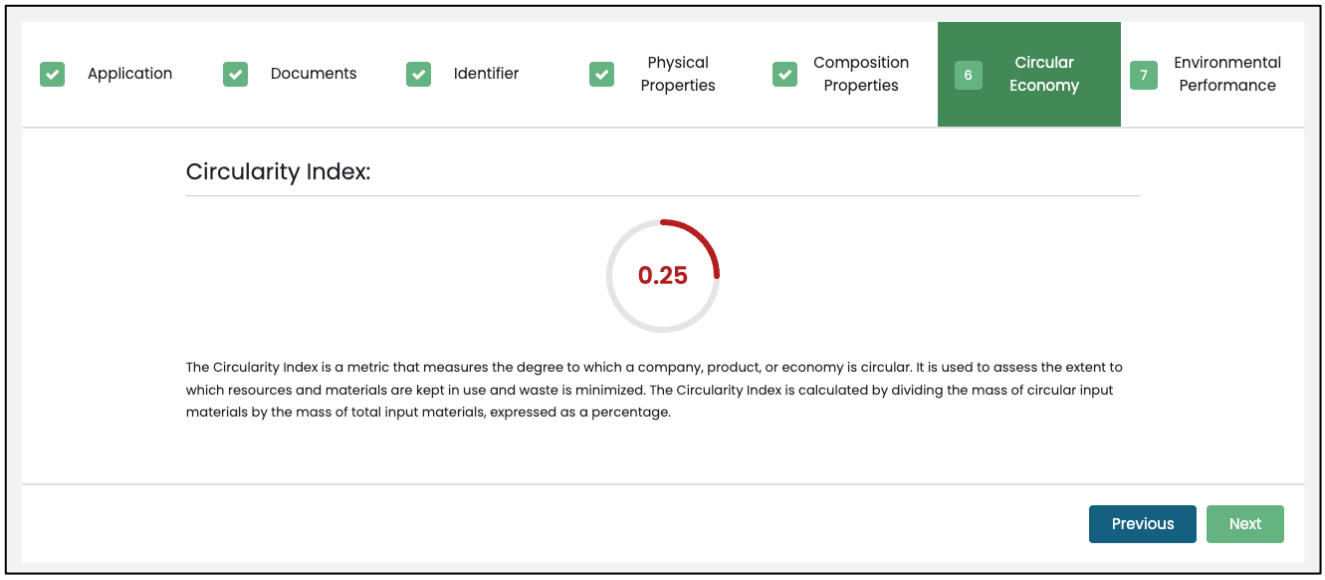


Figure 26: Create Passport - Circularity Indicator

Step 9: Click Create Passport to create a passport

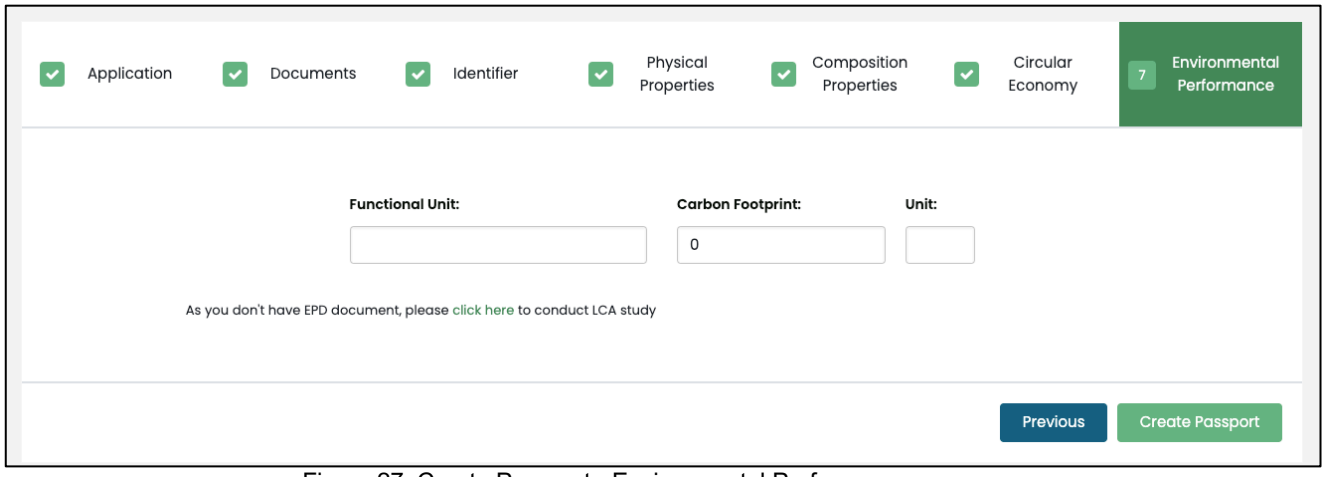


Figure 27: Create Passport - Environmental Performance

3.3.2 Updating Passport:

Step 1: Please visit: https://jidep.co/passports

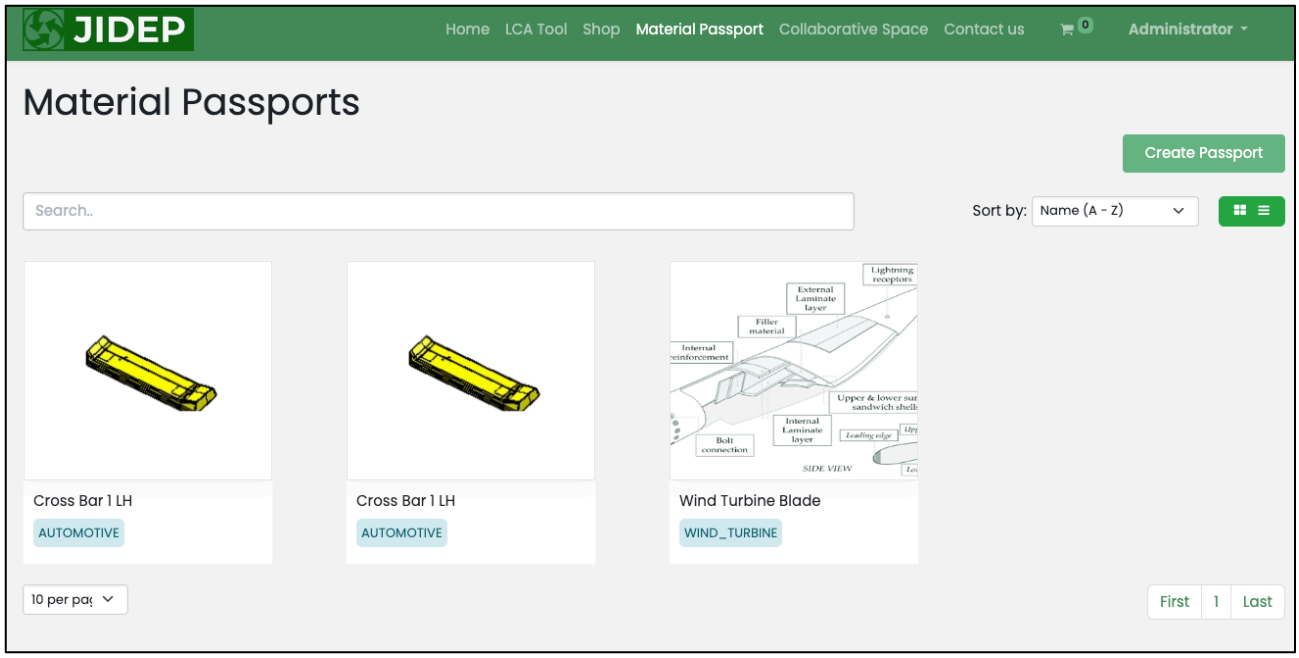


Figure 28: Update passport - passports page

Step 2: Click the “Edit” button to edit the data of the passport

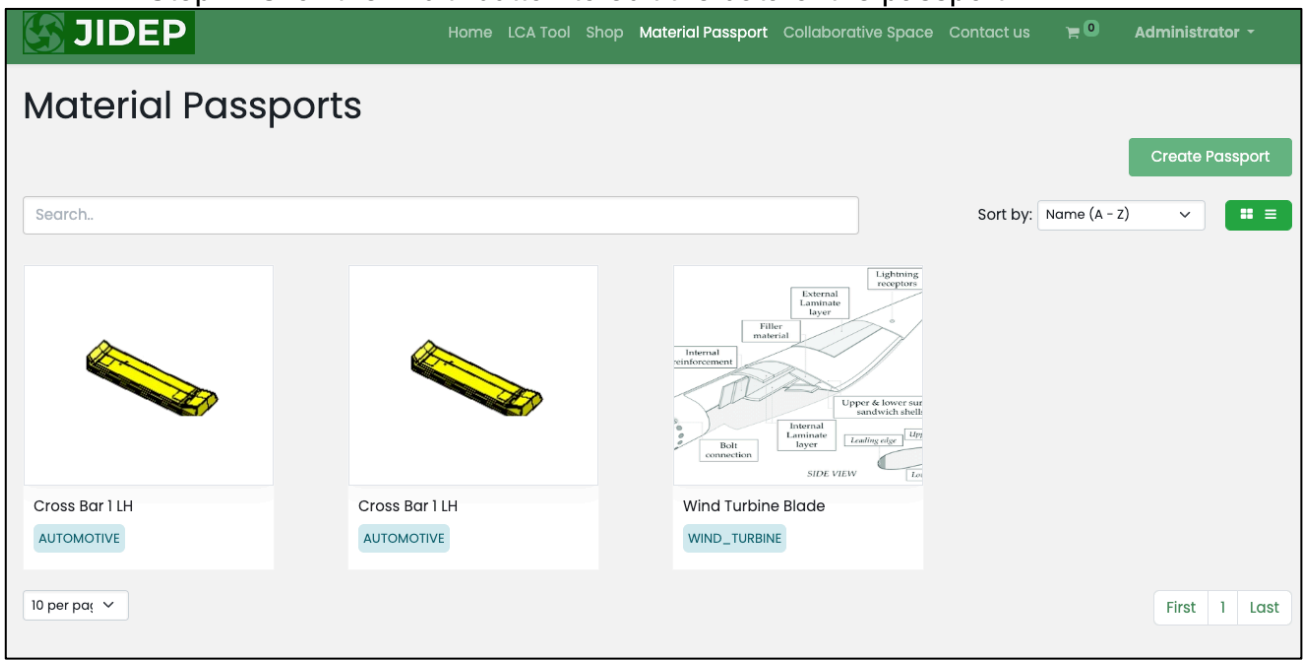


Figure 29: Update passport - edit passport

Step 3: Uploaded documents from the range of EPD, MSDS, CE Marking, Datasheet and so on. And after uploading the documents click “Next”.

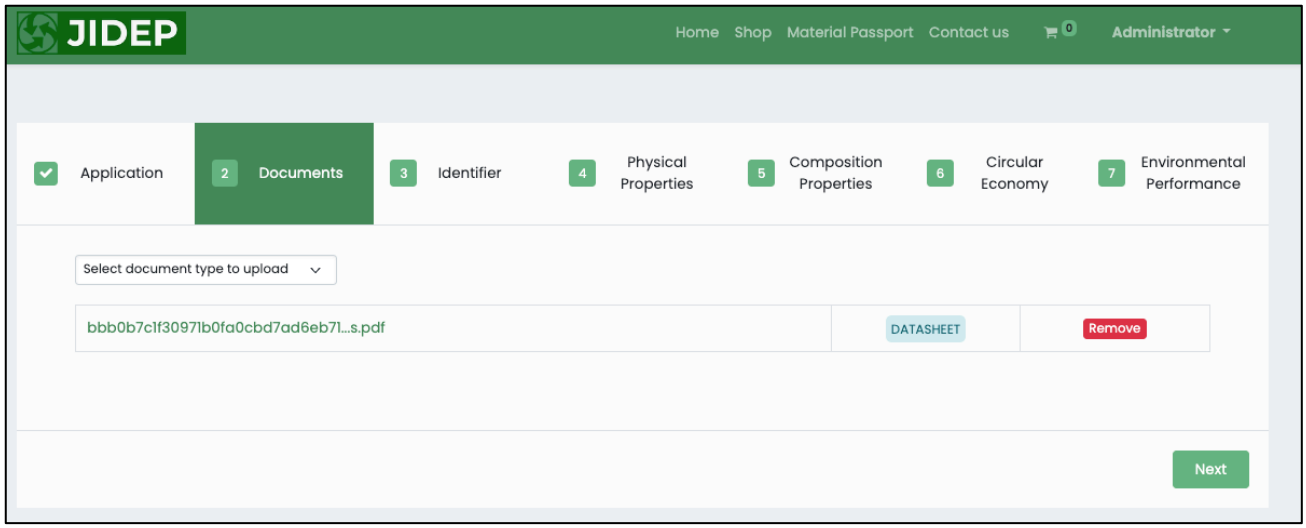


Figure 30: Update passport - documents section

Step 4: Provide valid and required information to proceed with the identifier section

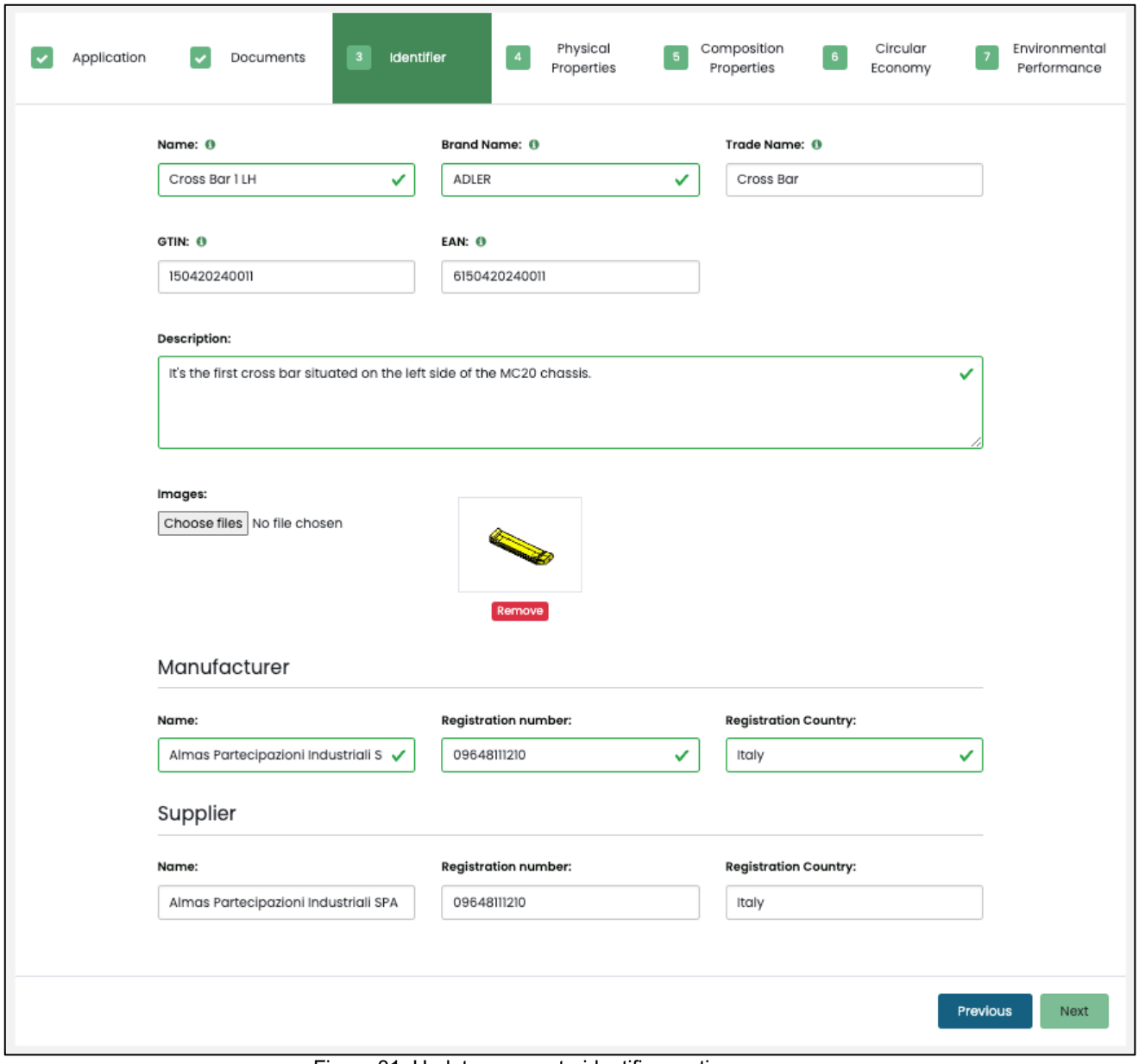


Figure 31: Update passport - identifier section

Step 5: Provide valid and required information to proceed with the physical properties section

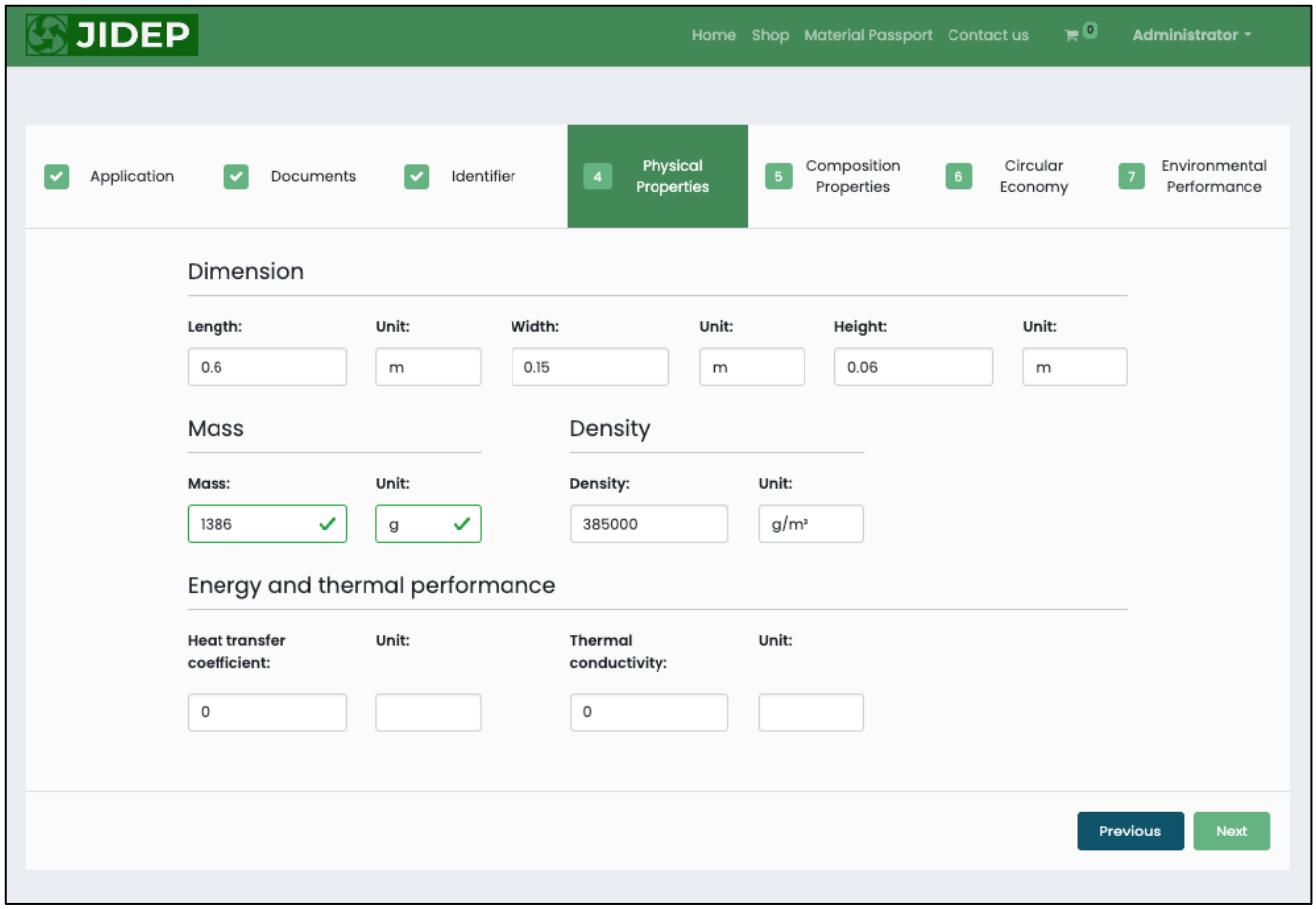


Figure 32: Update passport - physical properties

Step 6: Provide valid and required information to proceed with the composition properties section

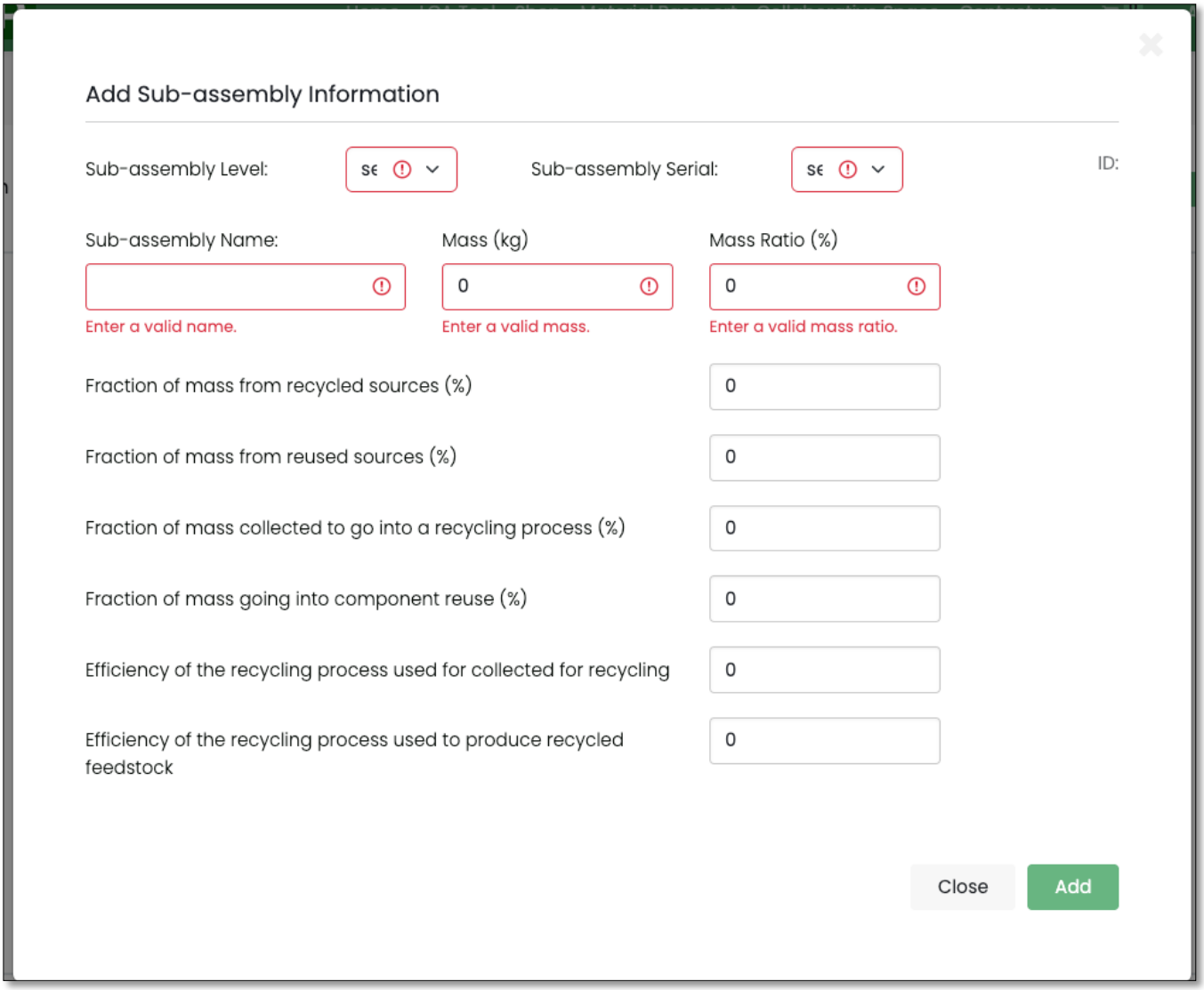


Figure 33: Update Passport - Add Subassemblies

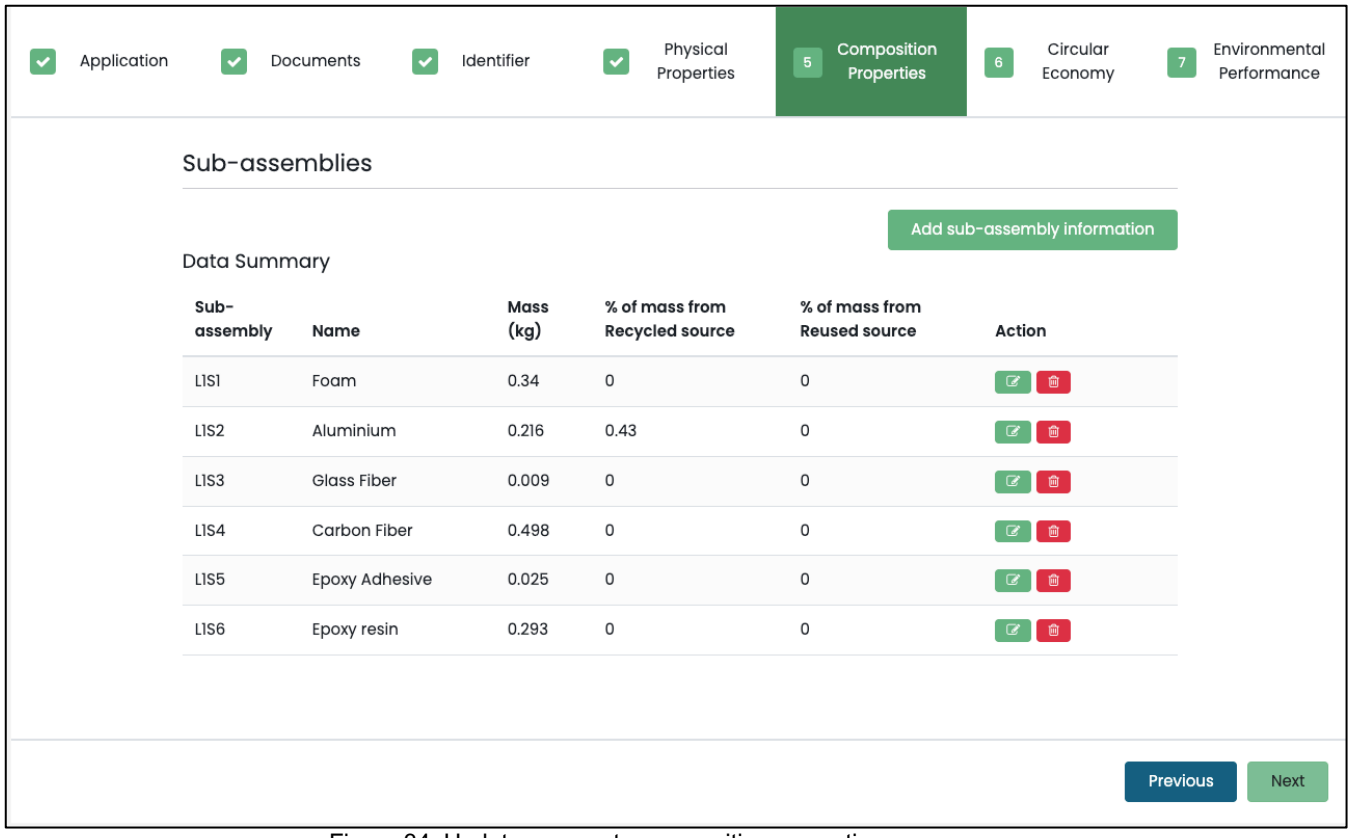


Figure 34: Update passport - composition properties

Step 7: Click next to proceed with the EoL Strategy page

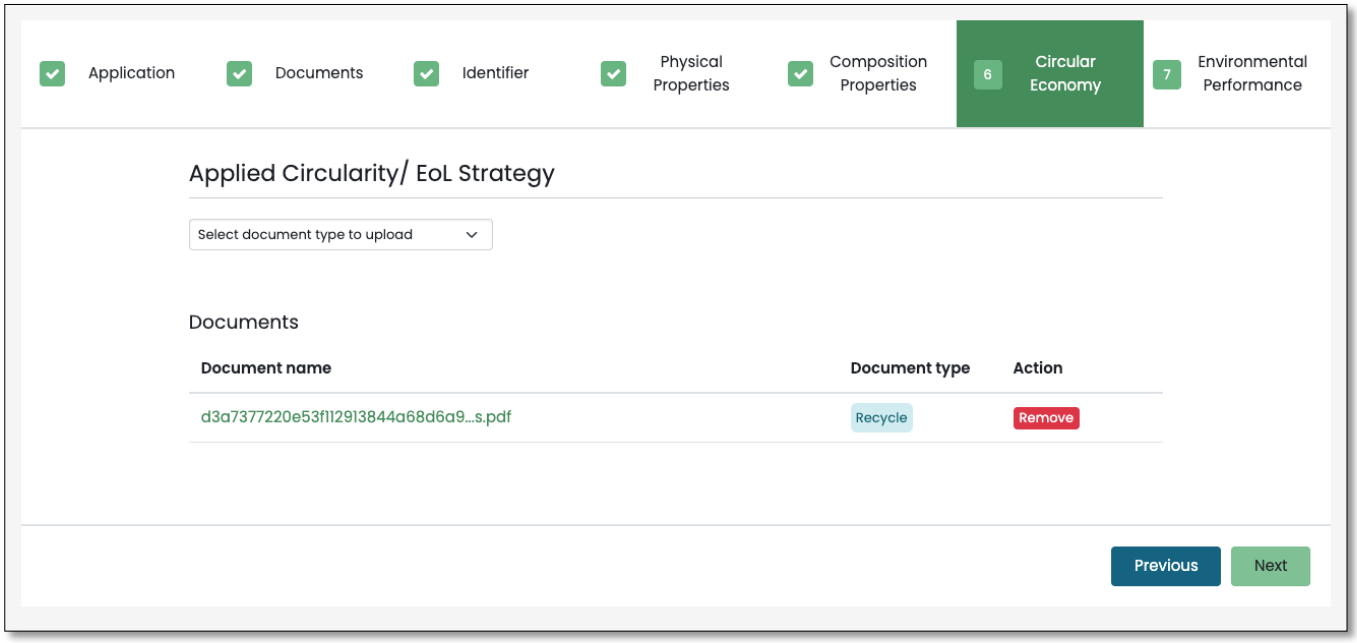


Figure 35: Update passport - EoL Strategy

Step 8: Click next to proceed with the passport creation page

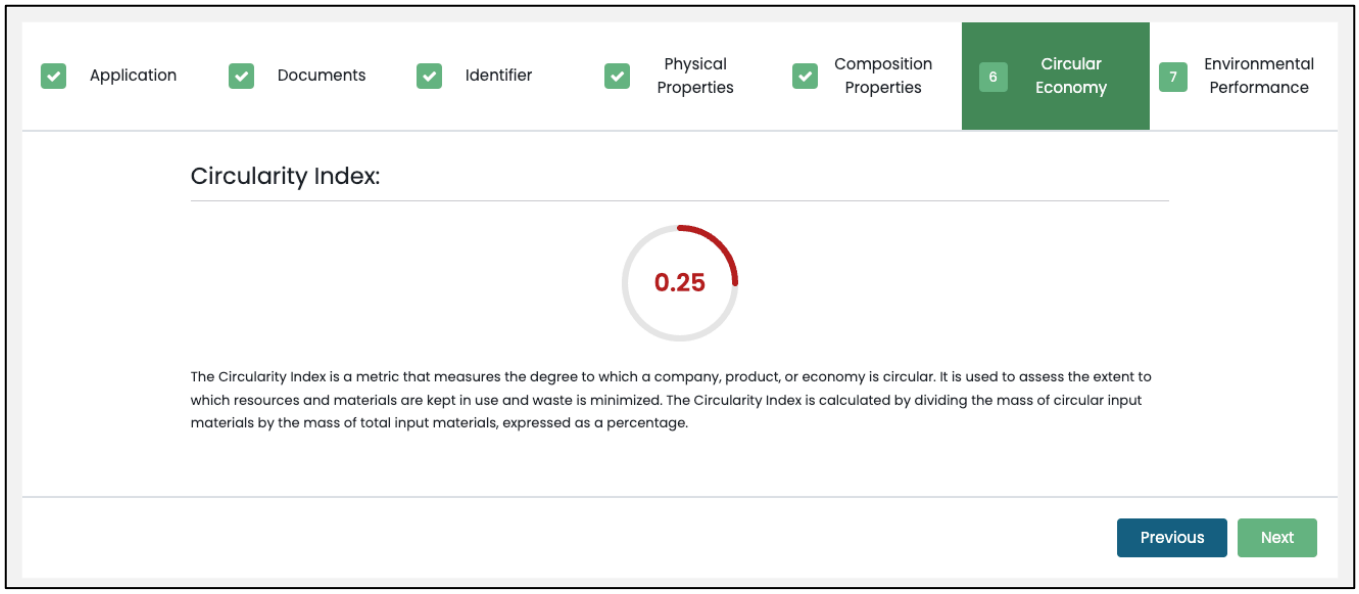


Figure 36: Update passport - Circularity Indicator

Step 8: Click “Update Passport” to update passport

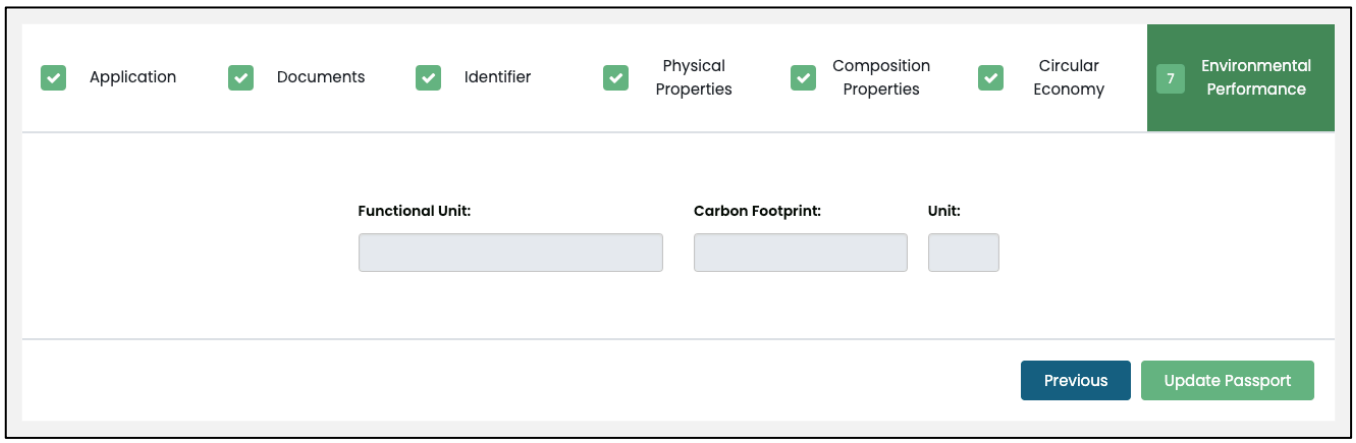


Figure 37: Update passport

3.3.3 Archiving Passport:

Step 1: Please visit: https://jidep.co/passports

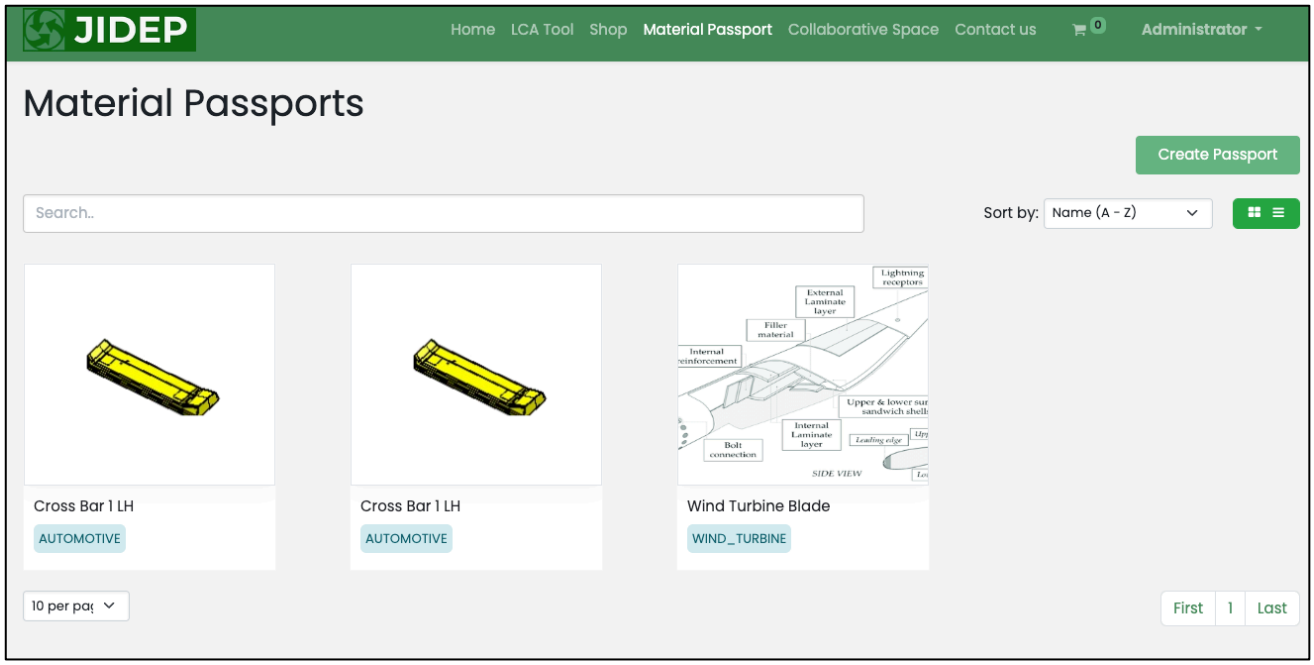


Figure 38: Archive Passport - passports page

Step 2: Click the “Archive” button to delete the passport

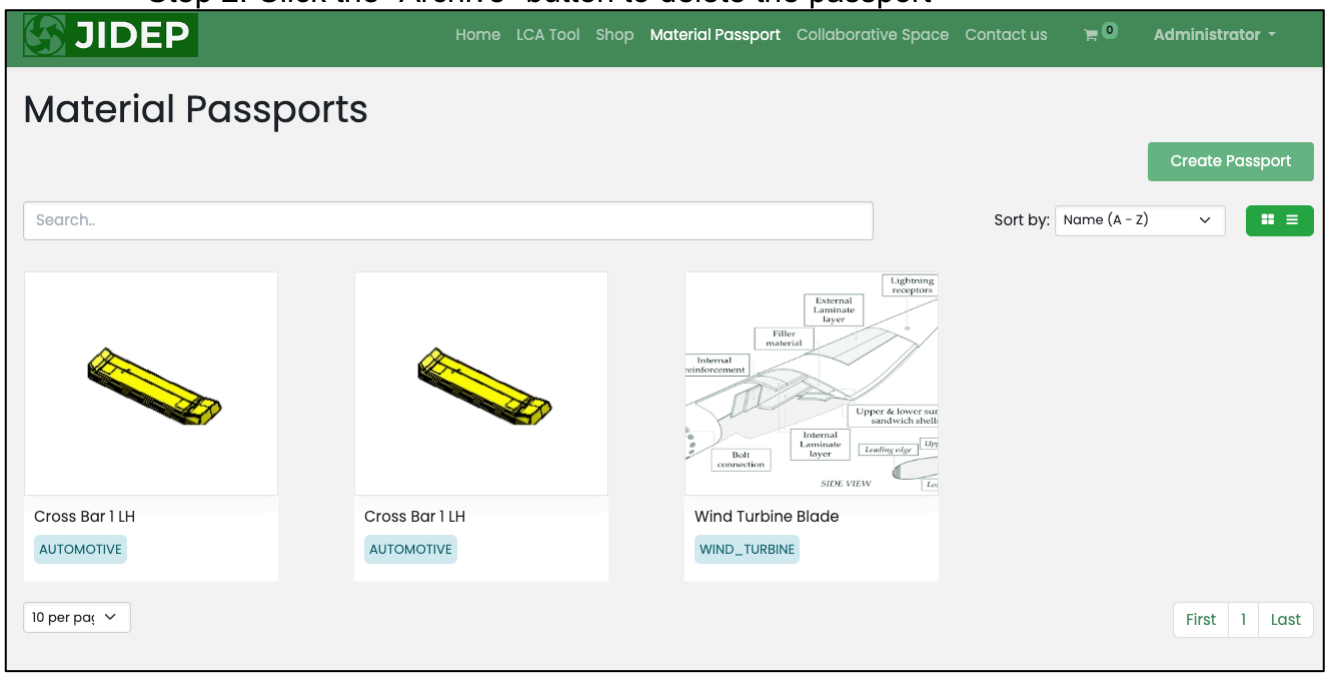


Figure 39: Archive Passport - click Archive button

Step 3: Click the “Archive” button to confirm deletion of the passport

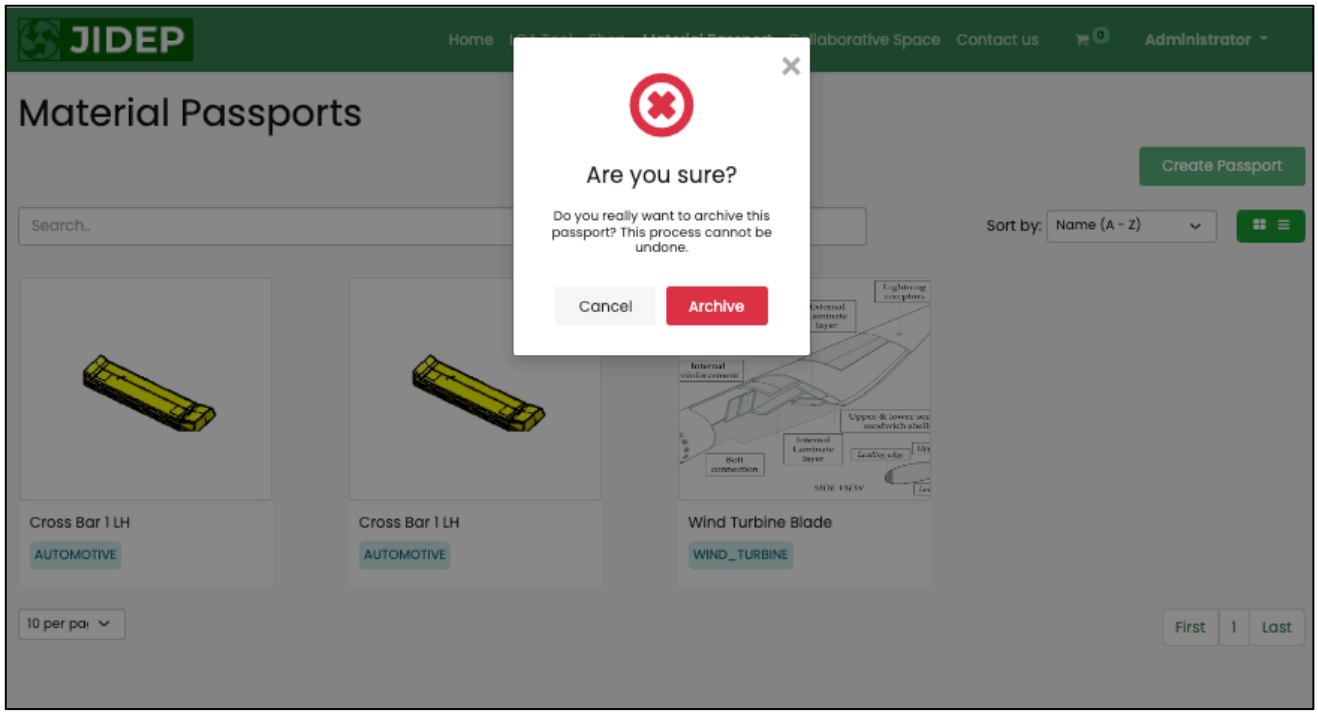


Figure 40: Archive Passport - confirm archive

3.3.4 Viewing Public Passport:

Step 1: Please visit: https://jidep.co/passports

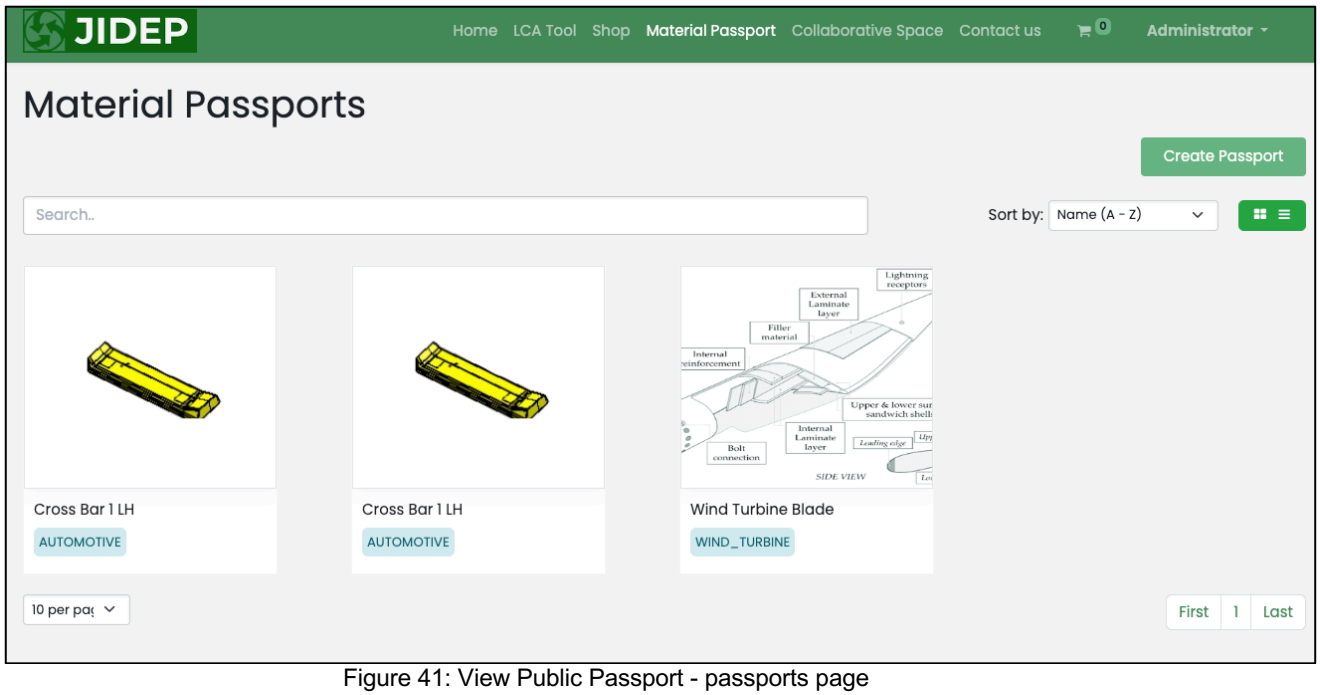


Figure 41: View Public Passport - passports page

Step 2: Click in the body of the passport to view details of the passport

Figure 42: View Public Passport - initial view page

Step 3: Click the “Click here” button to view full details of the passport

Figure 43: View Public Passport - Click here button for full details

Step 4: Check the data availability of the passport

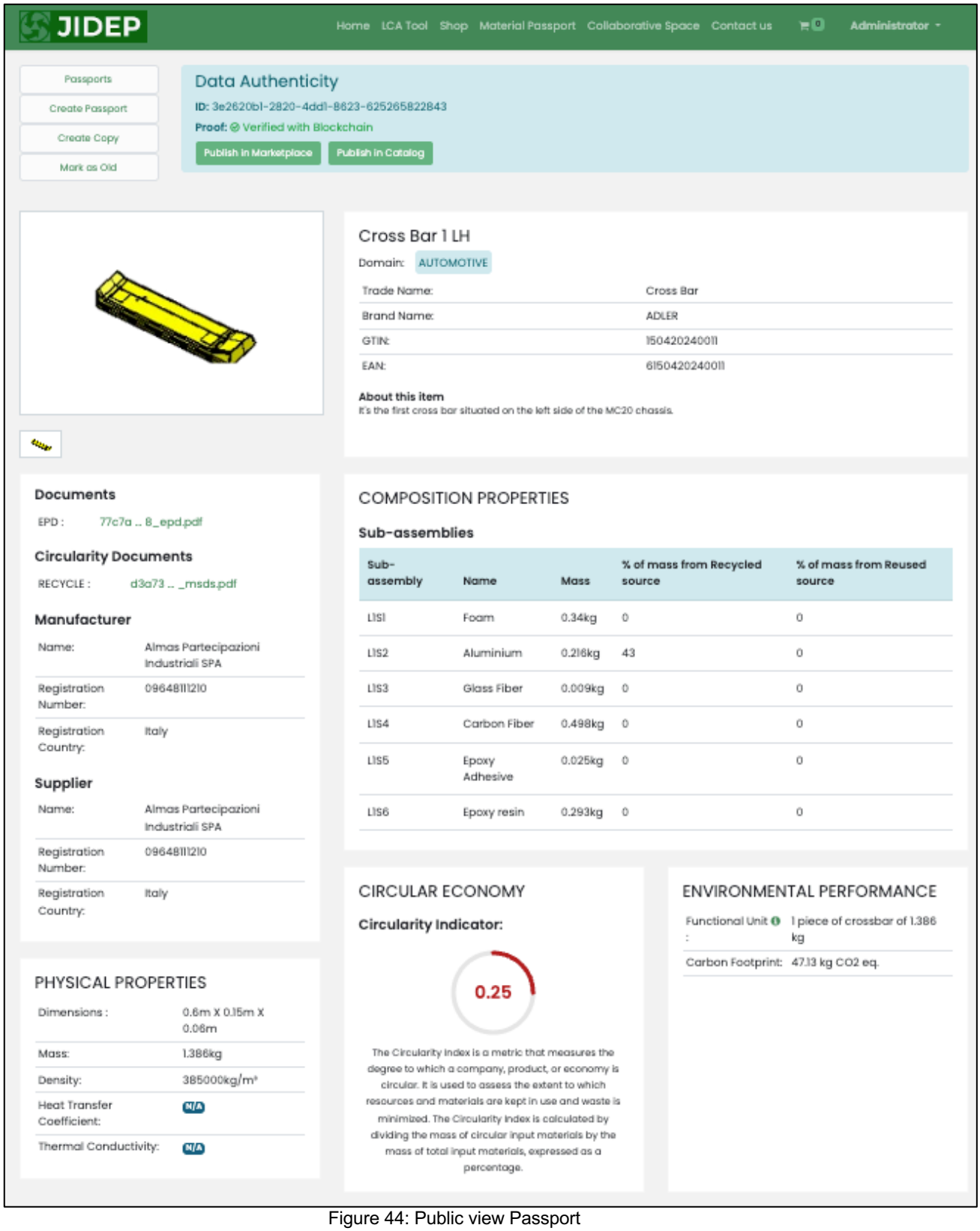


Figure 44: Public view Passport

3.3.5 Publish in Marketplace

Step 1: Please visit: https://jidep.co/passports

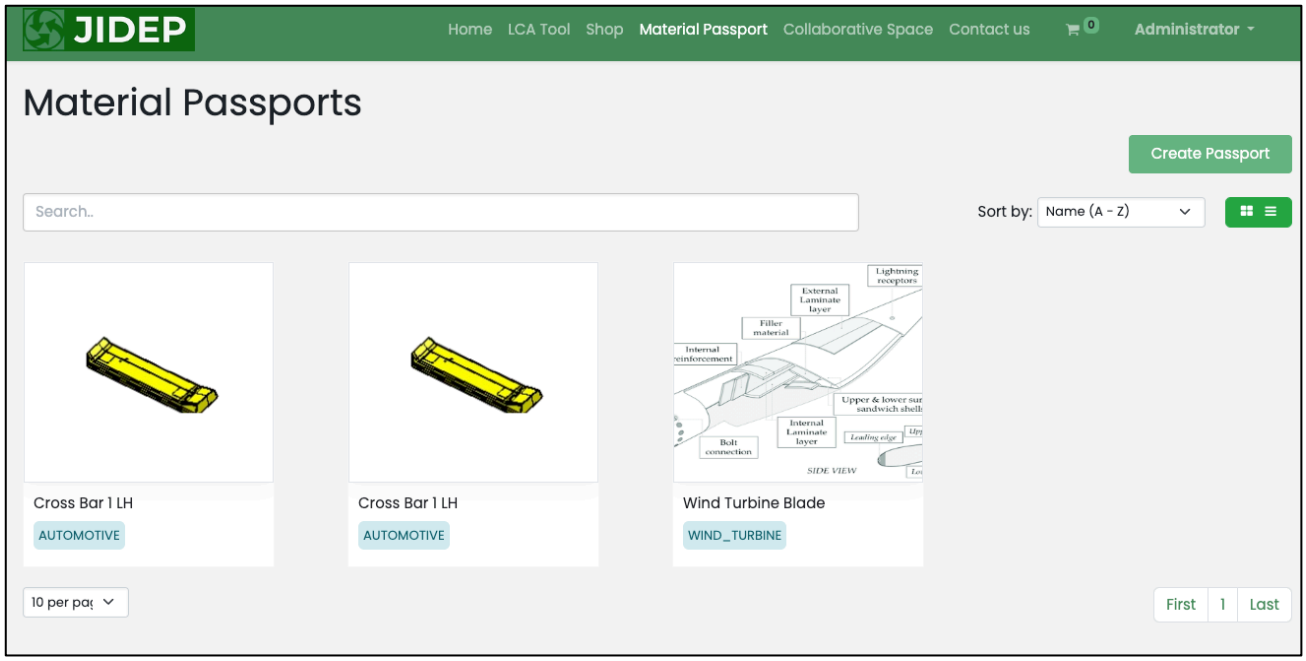


Figure 45: Publish in Marketplace - passports page

Step 2: Click in the body of the passport to view details of the passport

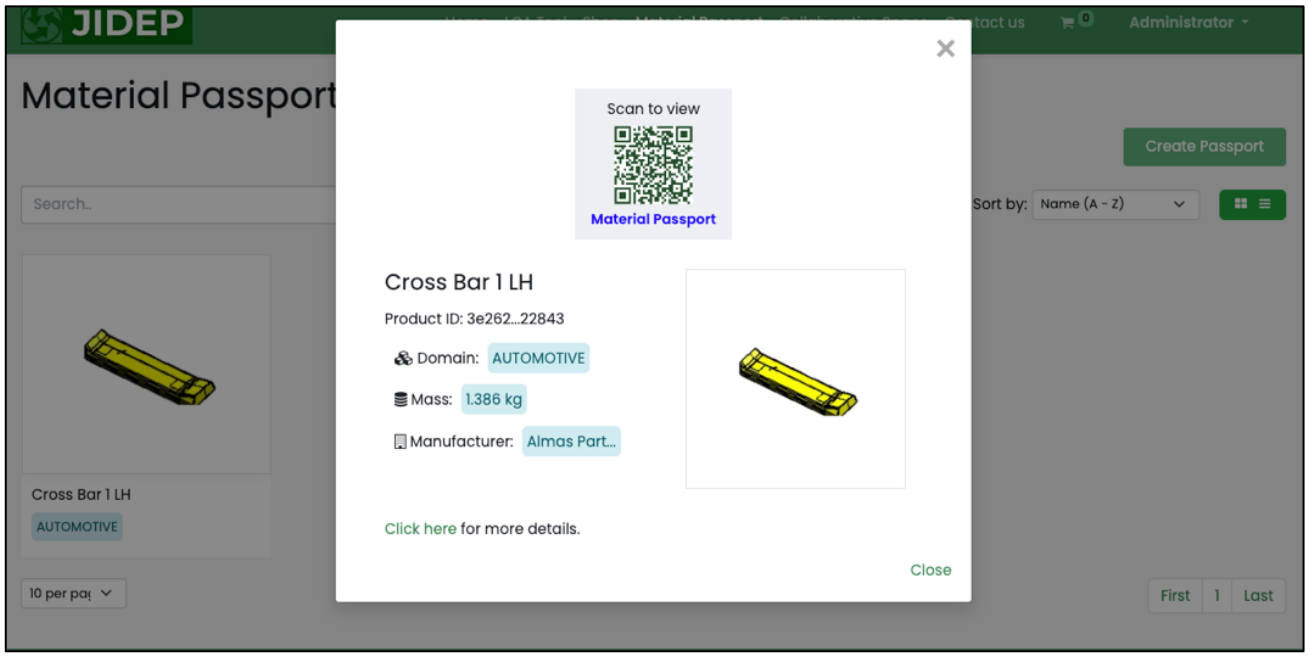


Figure 46: Publish in Marketplace - Initial View page

Step 3: Click the “Click here” button to view full details of the passport

Figure 47: Publish in Marketplace - Click here button for full details

Step 4: Click on the “Publish in Marketplace” button to make this product available for the marketplace

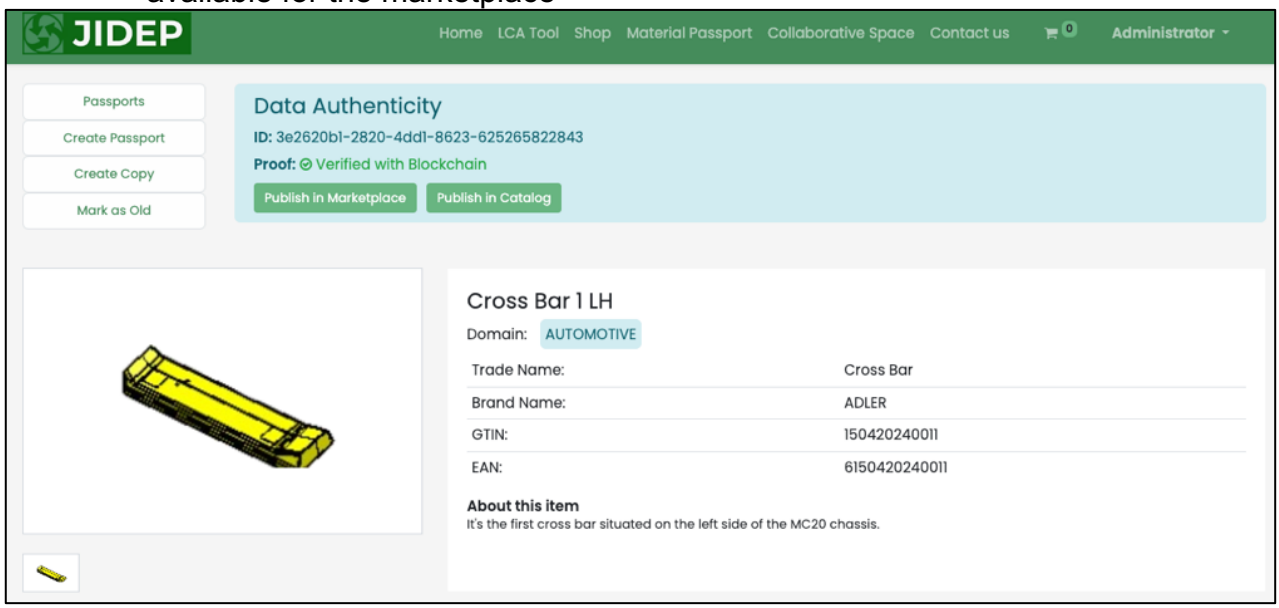


Figure 48: Publish in Marketplace - Click on Publish in Marketplace

Step 5: Click on the “Publish in Marketplace” button and set the standard price and list price of the product

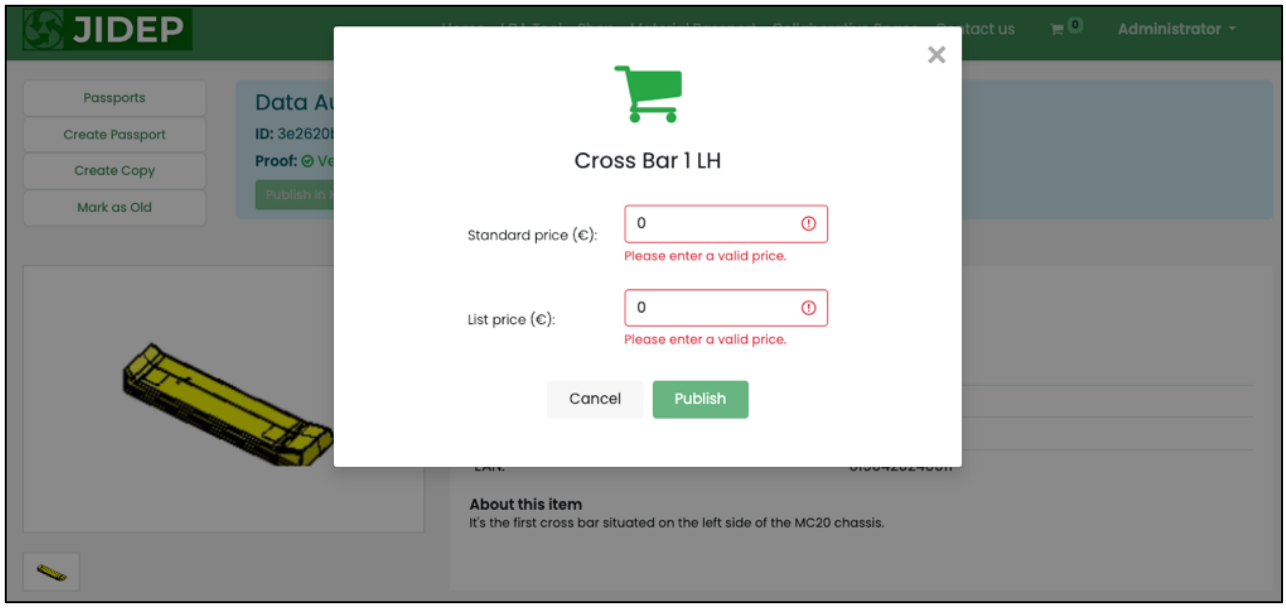


Figure 49: Publish in Marketplace - set the standard price and list price

Step 6: Click on the “Publish” button to publish marketplace

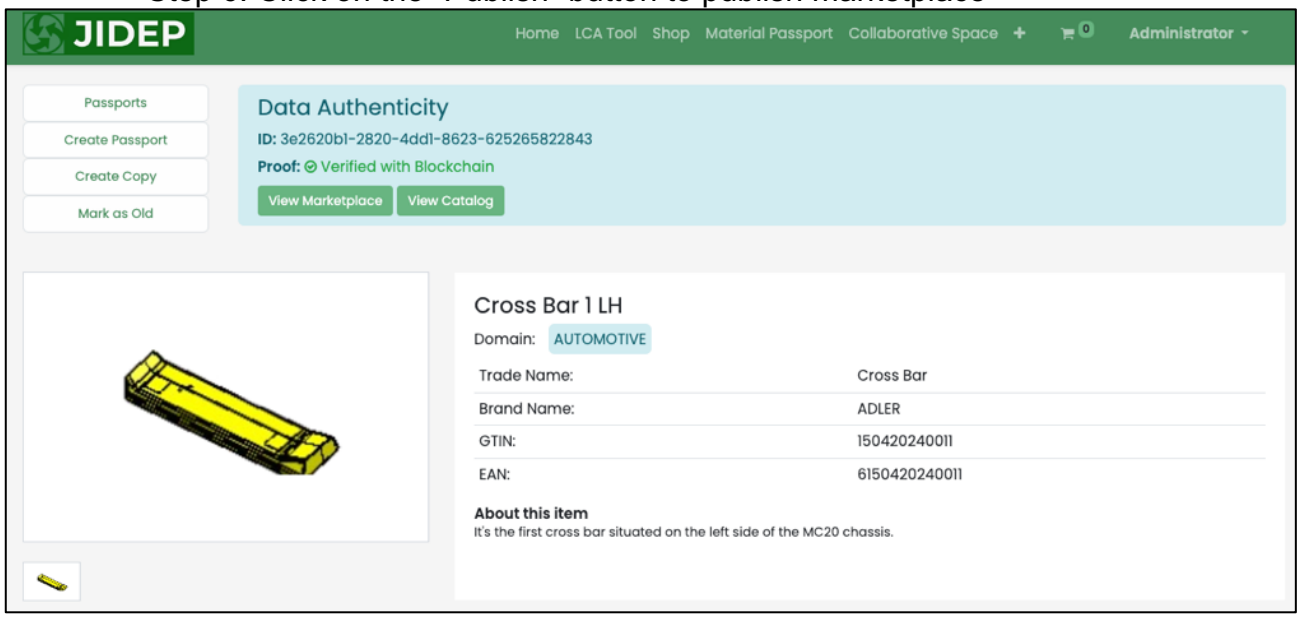


Figure 50: Publish in Marketplace - publish to the marketplace

3.3.6 Publish in Catalogue

Step 1: Please visit: https://jidep.co/passports

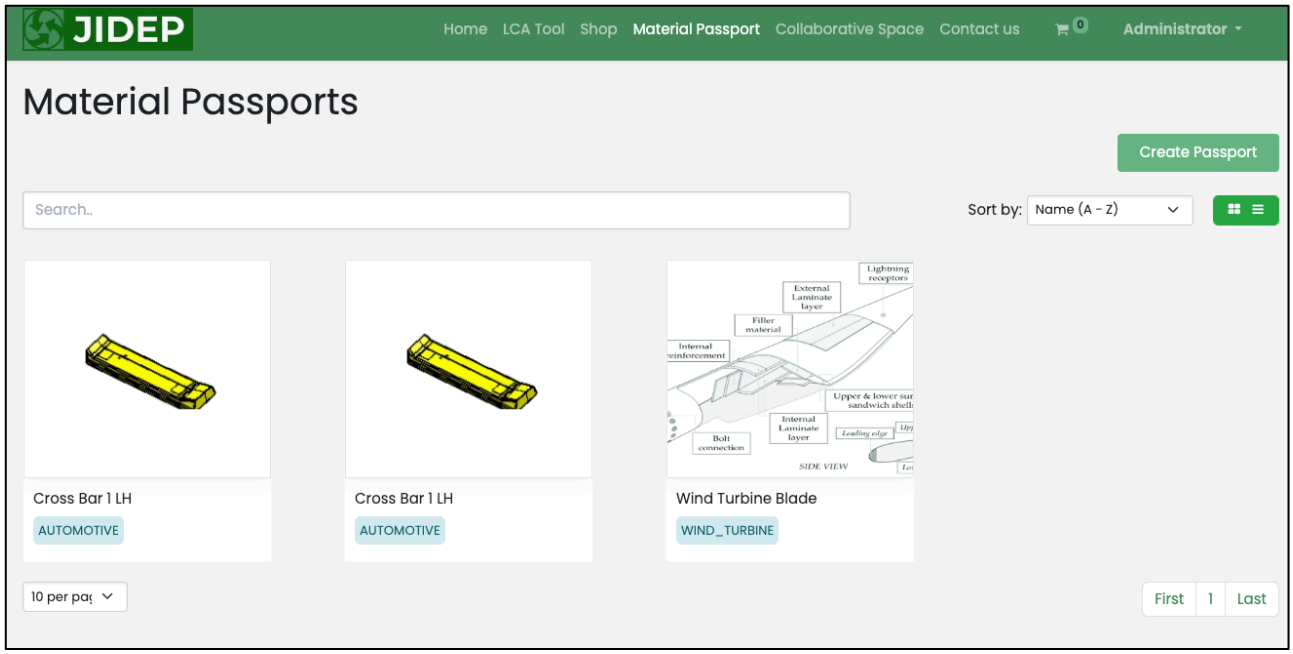


Figure 51: Publish in Catalogue - passports page

Step 2: Click in the body of the passport to view details of the passport

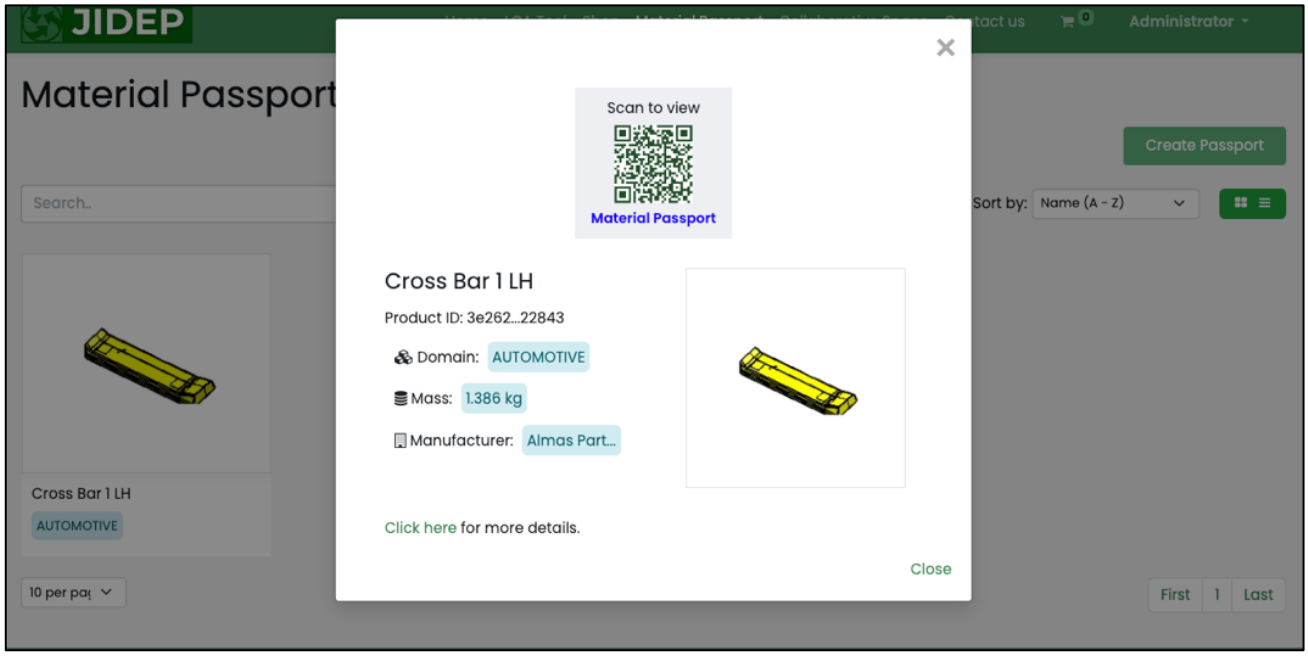


Figure 52: Publish in Catalogue - Initial View page

Step 3: Click the “Click here” button to view full details of the passport

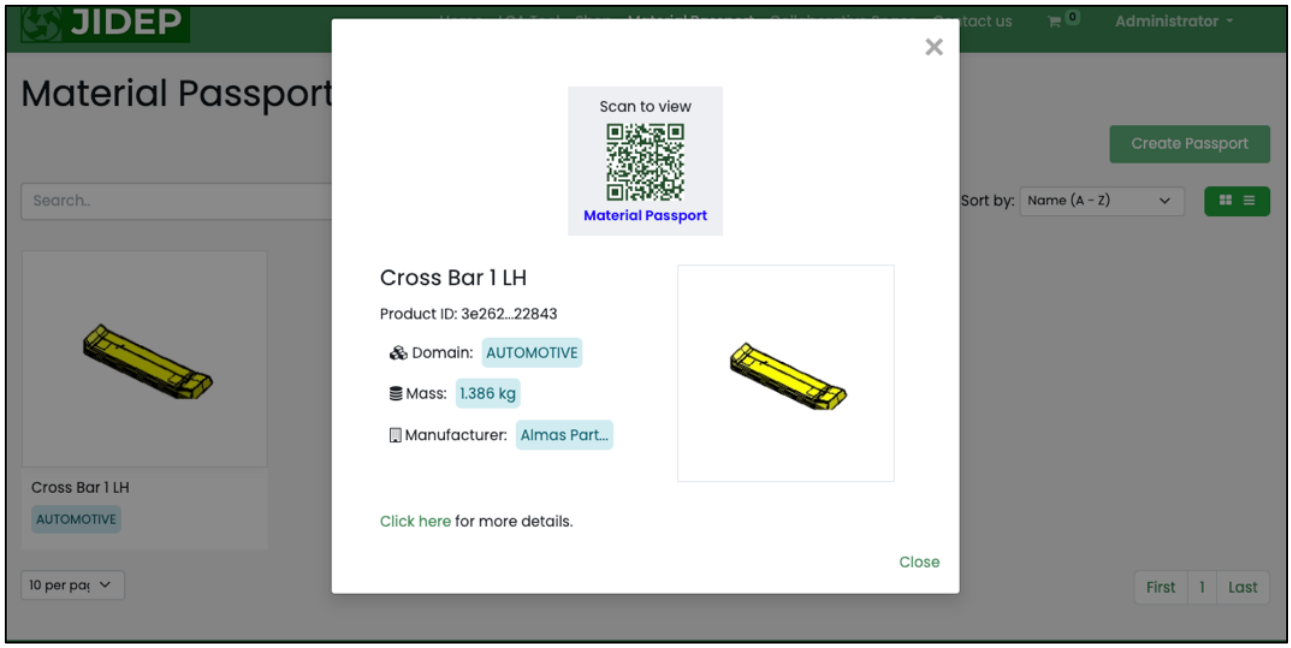


Figure 53: Publish in Catalogue - Click here button for full details

Step 4: Click on the “Publish in Marketplace” button to make this product available for marketplace

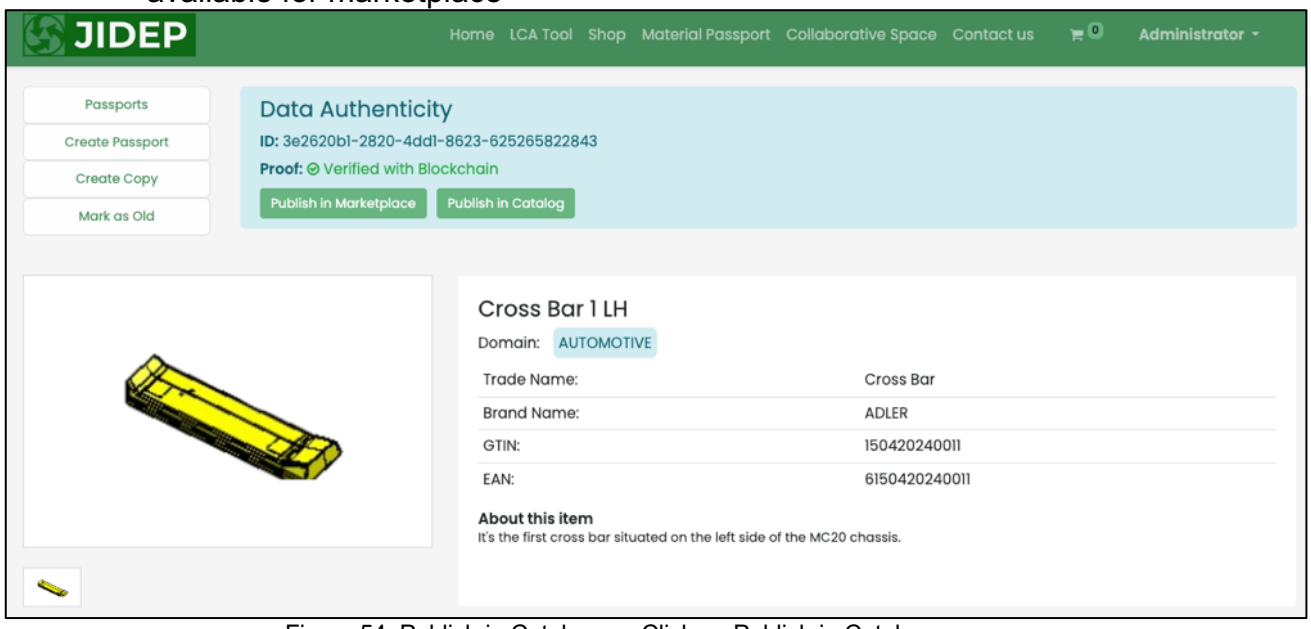


Figure 54: Publish in Catalogue - Click on Publish in Catalog

Step 5: Click on the “Publish in Catalog” button and set the standard price and list price of the product

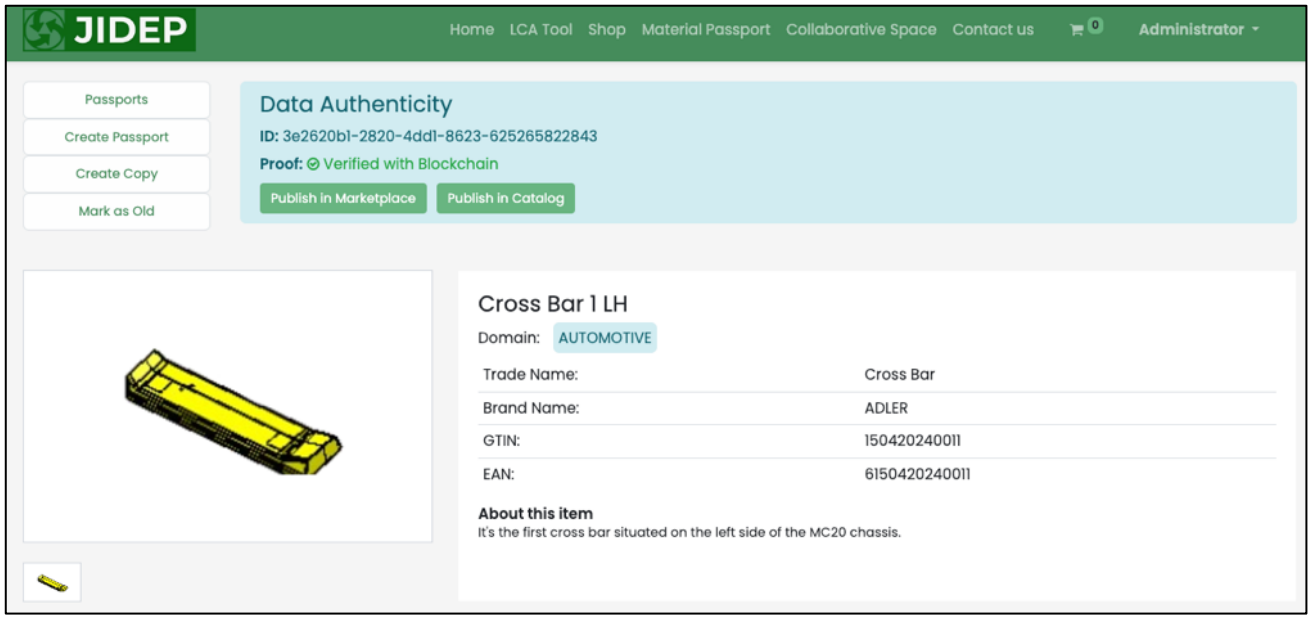


Figure 55: Publish in Catalogue - set the standard price and list price

Step 5: Check the availability of the passport's metadata in the Catalogue platform by clicking 'View Catalog"

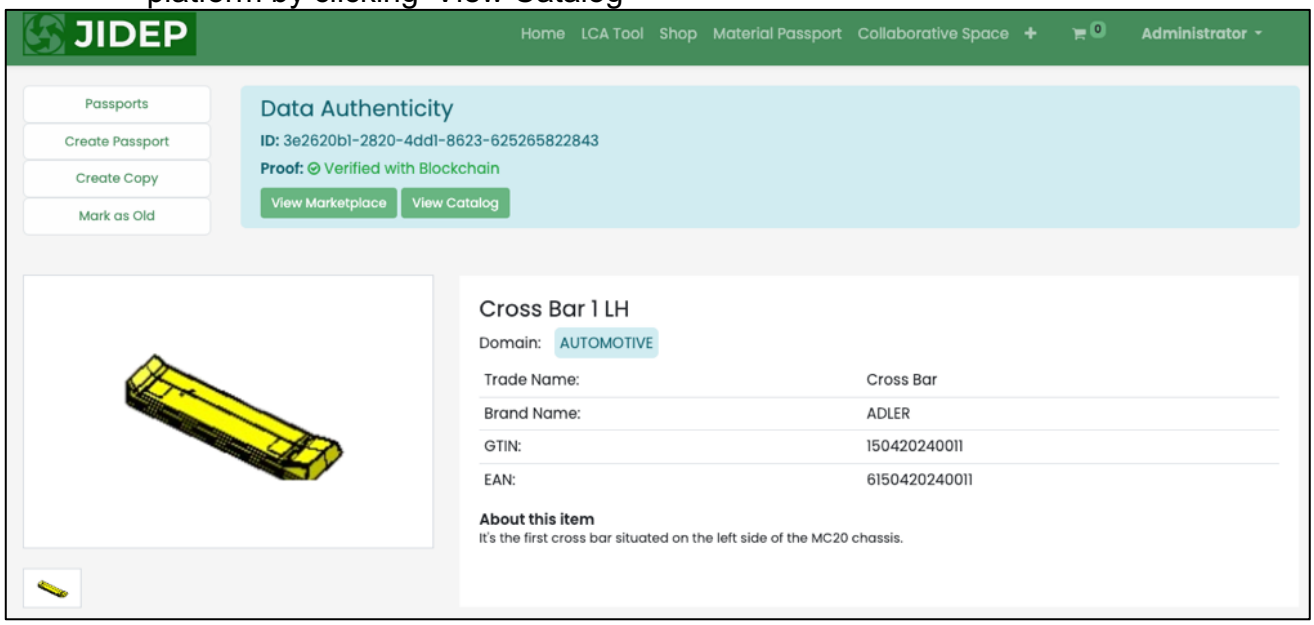


Figure 56: Publish in Catalogue – view catalogue

3.3.7 Create Copy

Step 1: Please visit: https://jidep.co/passports

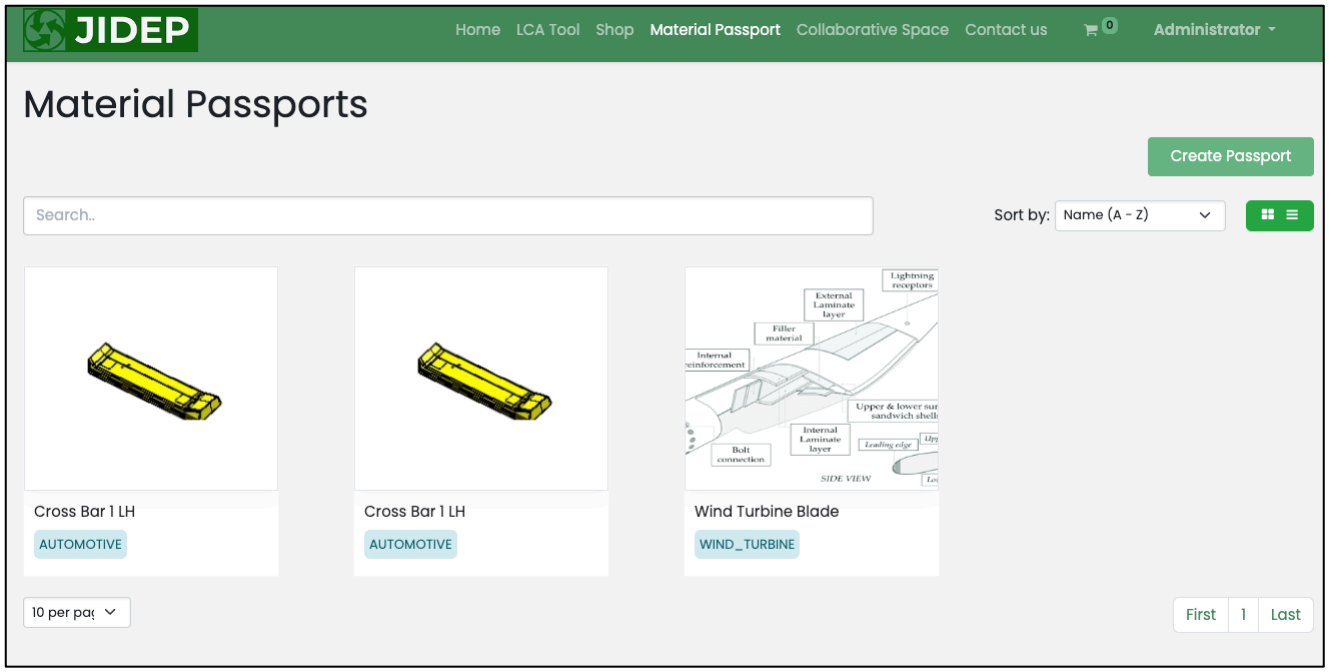


Figure 57: Create Copy - passports page

Step 2: Click in the body of the passport to view details of the passport

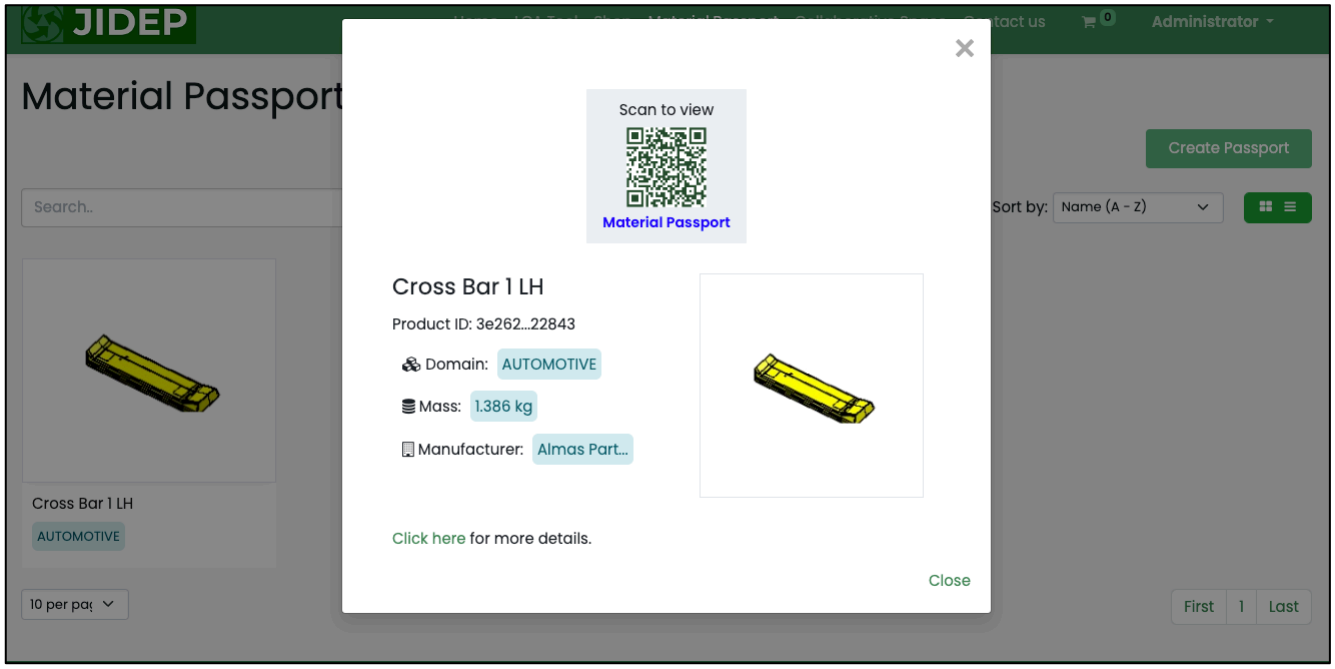


Figure 58: Create Copy - Initial View page

Step 3: Click the “Click here” button to view full details of the passport

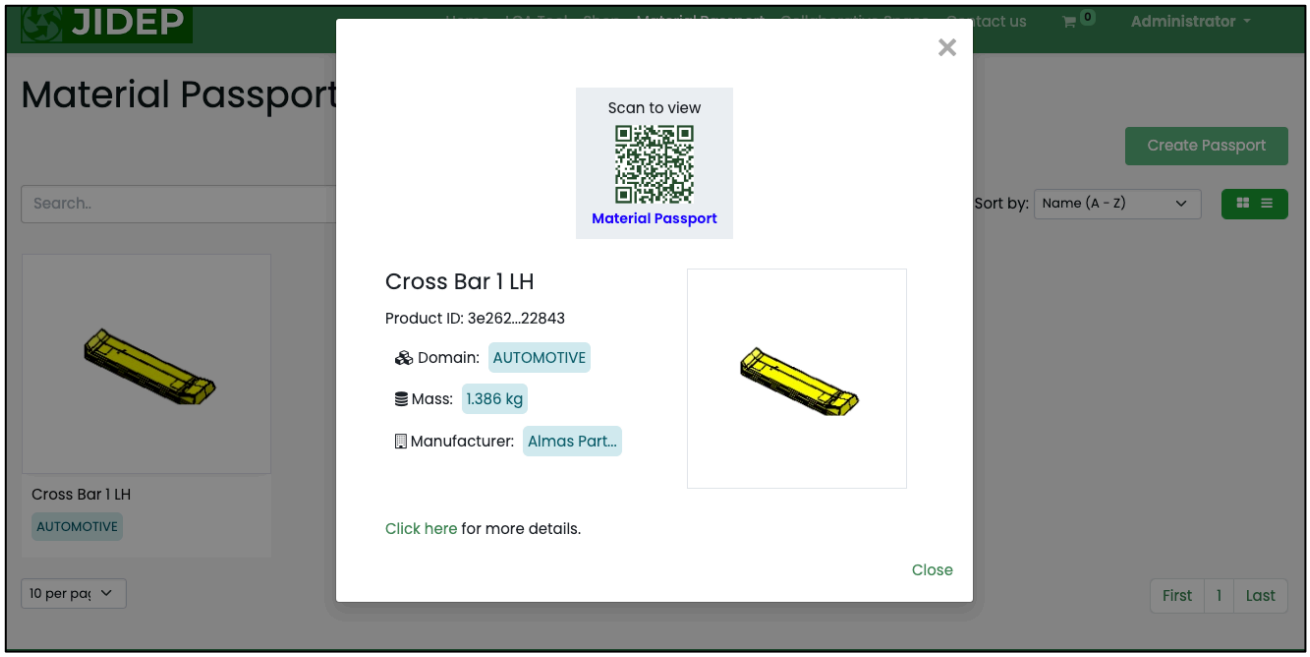


Figure 59: Create Copy - Click here button for full details

Step 4: Click on the “Create Copy” button to create a instance of this passport

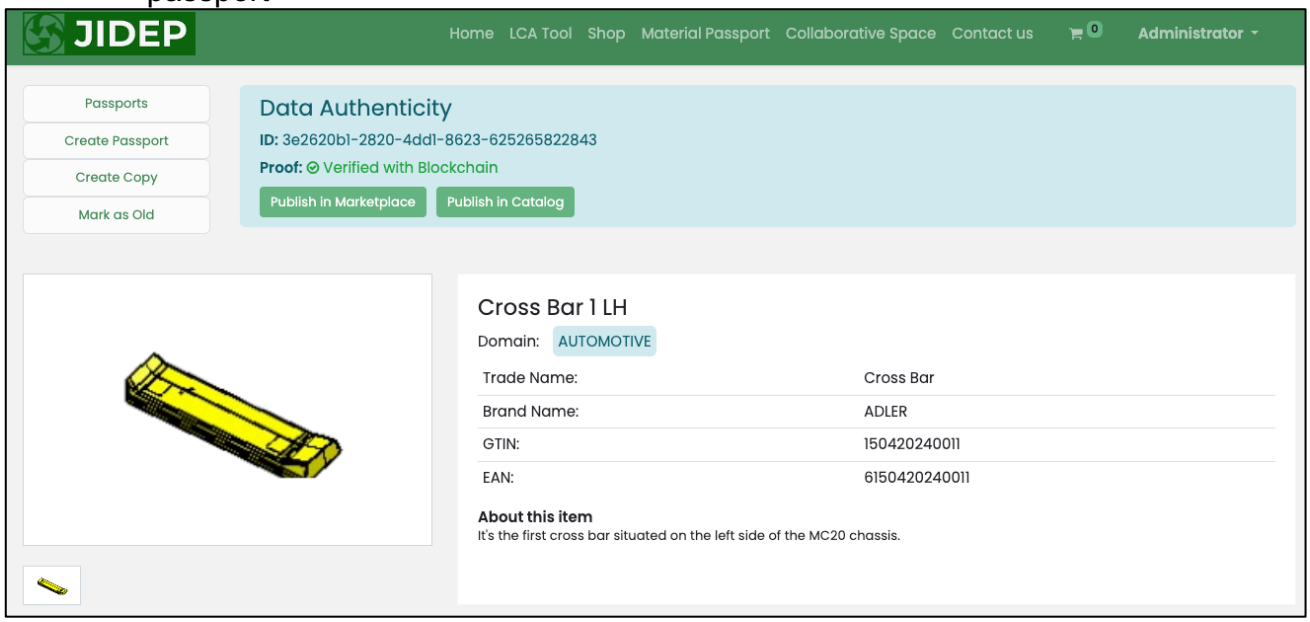


Figure 60: Create Copy - Click on Create Copy

Step 5: Uploaded documents from the range of EPD, MSDS, CE Marking, Datasheet and so on. And after uploading the documents click “Next”.

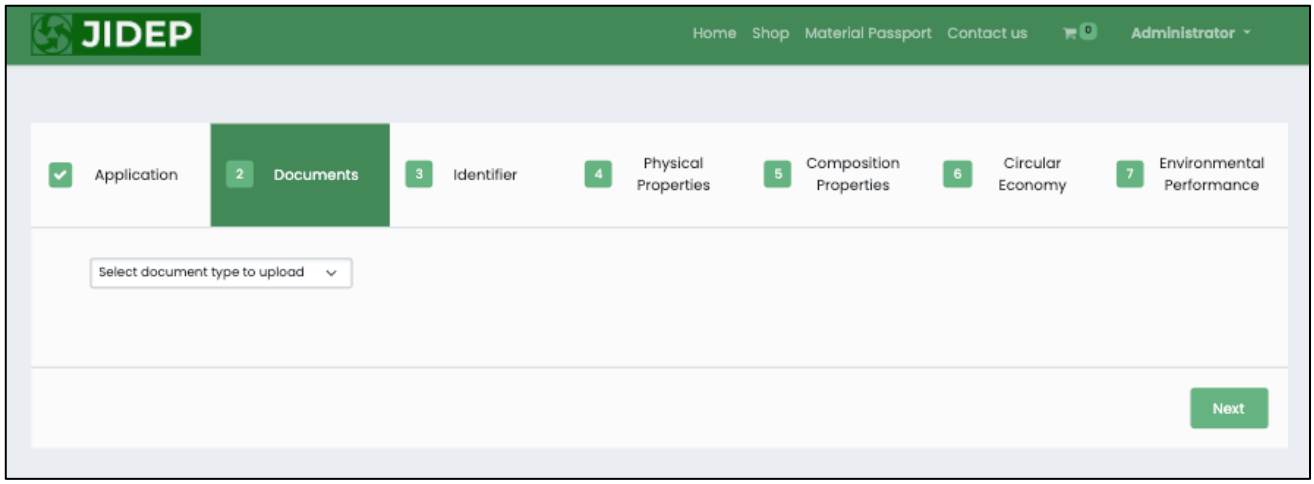


Figure 61: Create Copy - documents section

Step 6: Provide valid and required information to proceed with the identifier section

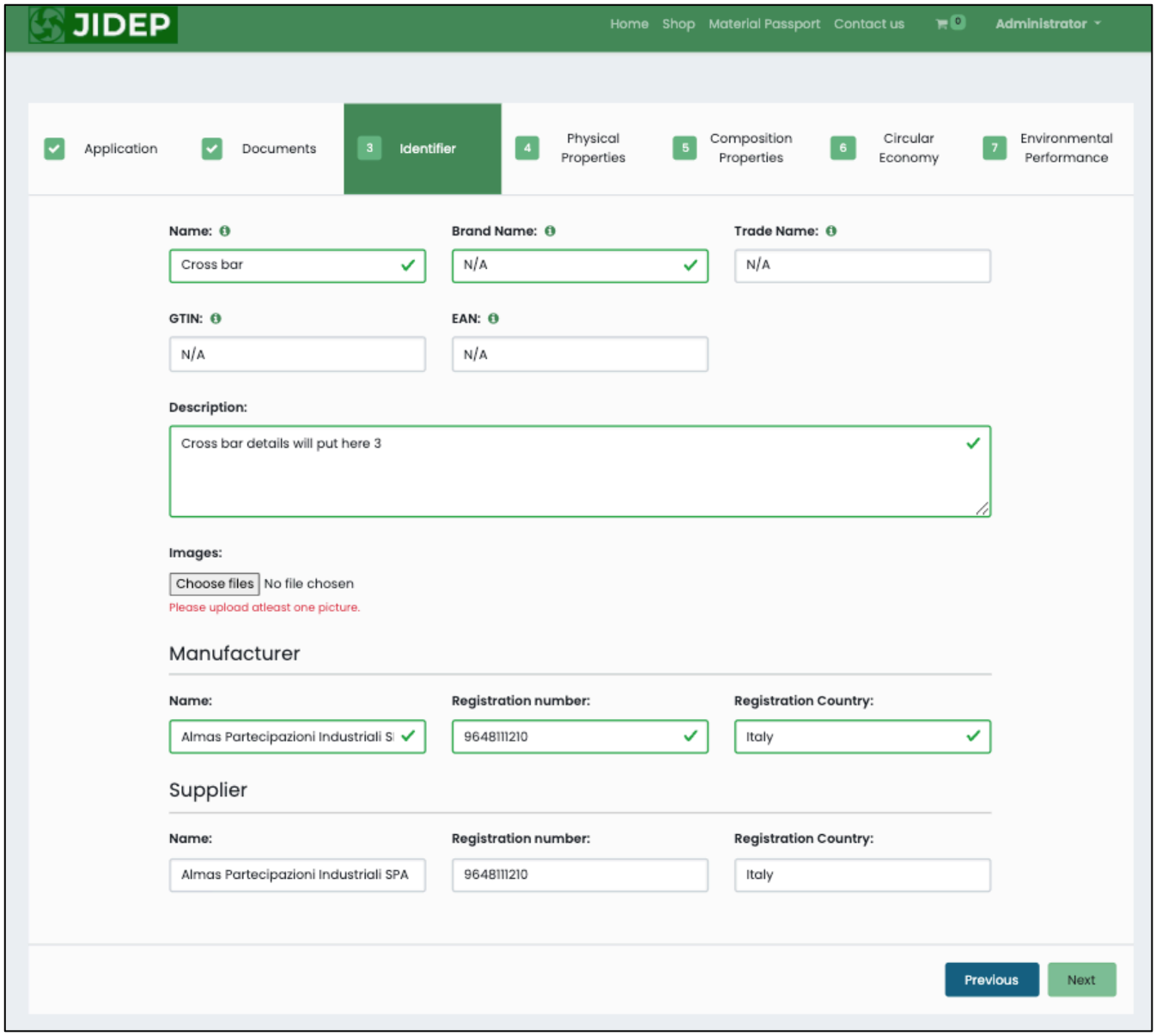


Figure 62: Create Copy - identifier section

Step 7: Provide valid and required information to proceed with the physical properties section

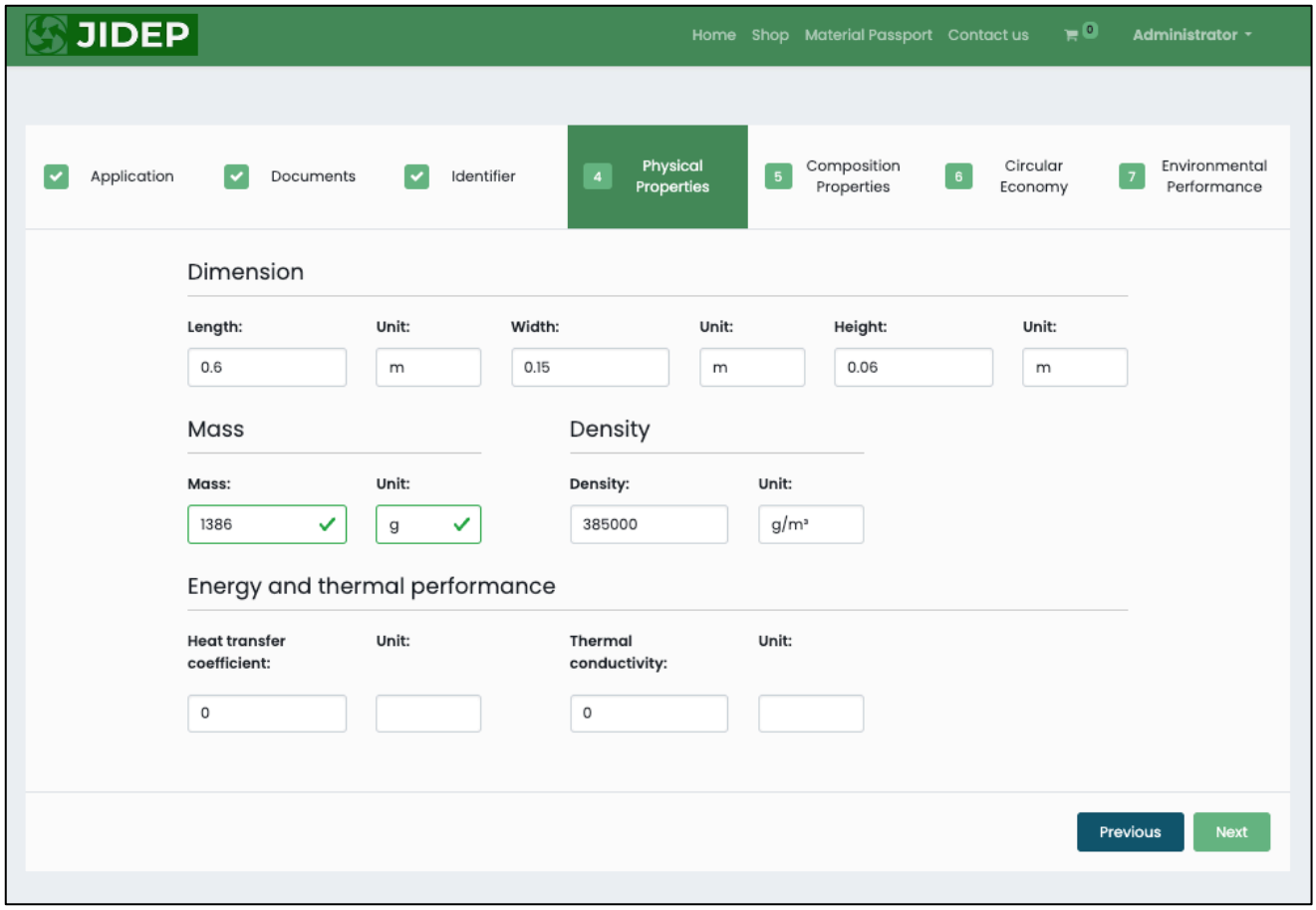


Figure 63: Create Copy - physical properties

Step 8: Provide valid and required information to proceed with the composition properties section

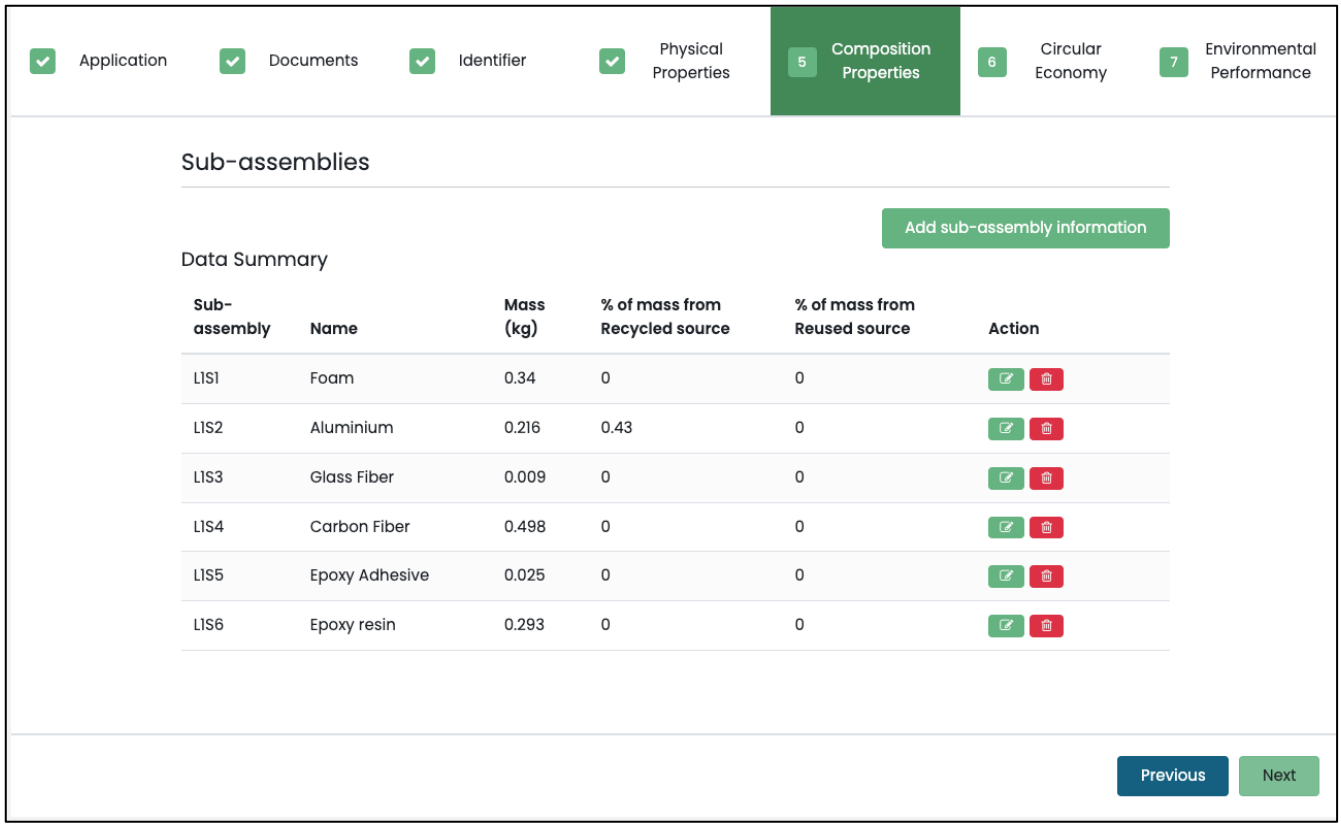


Figure 64: Create Copy - composition properties

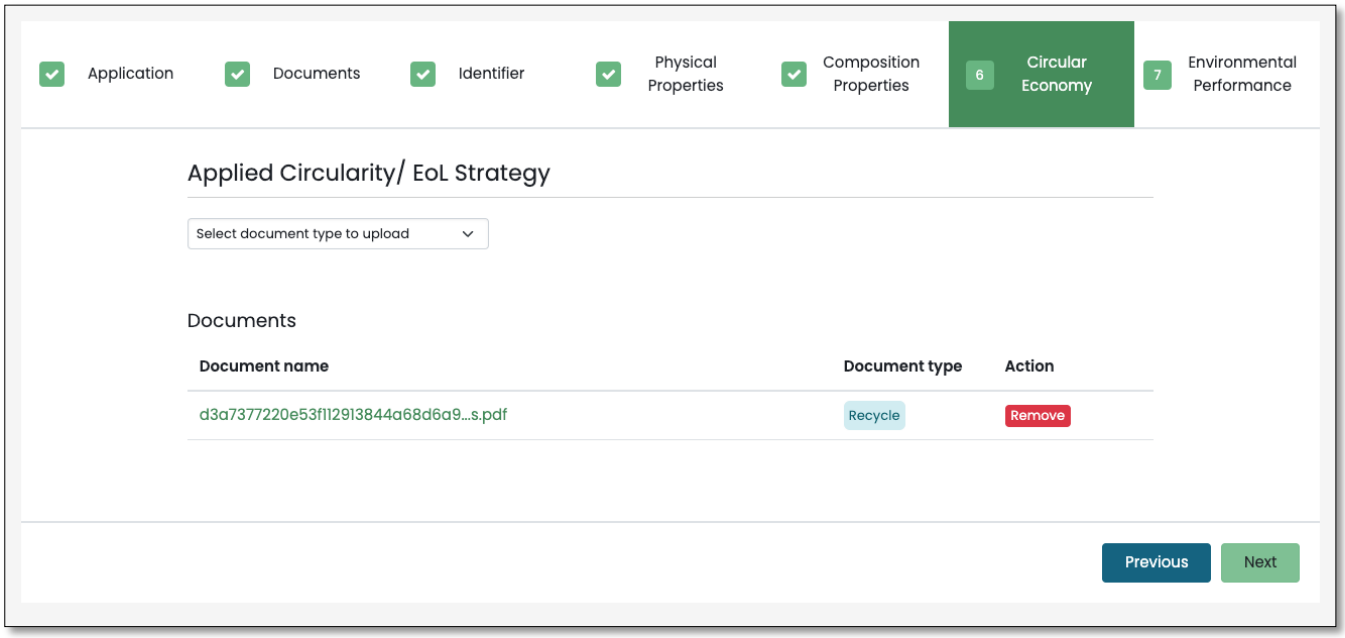


Figure 65: Create Copy - EoL Strategy

Step 9: Click next to proceed with the passport creation page

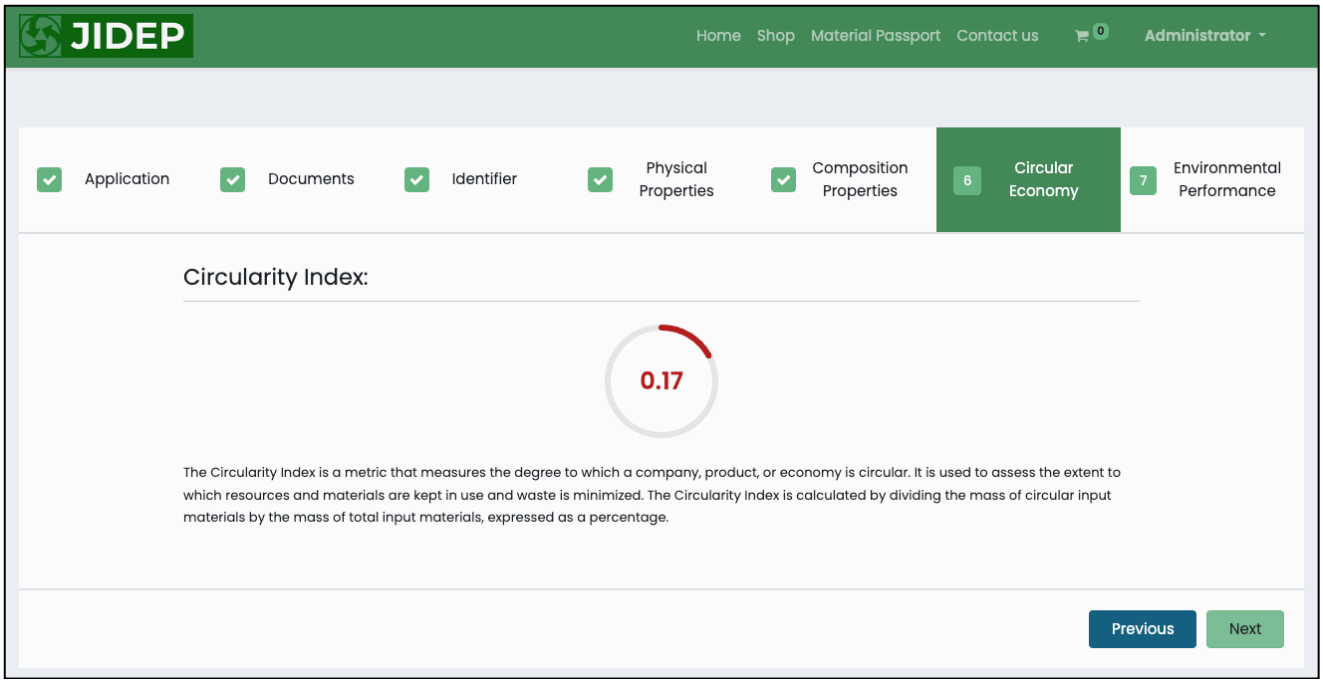


Figure 66: Update passport - Circularity Indicator

Step 10: Click “Update Passport” to complete the create copy feature

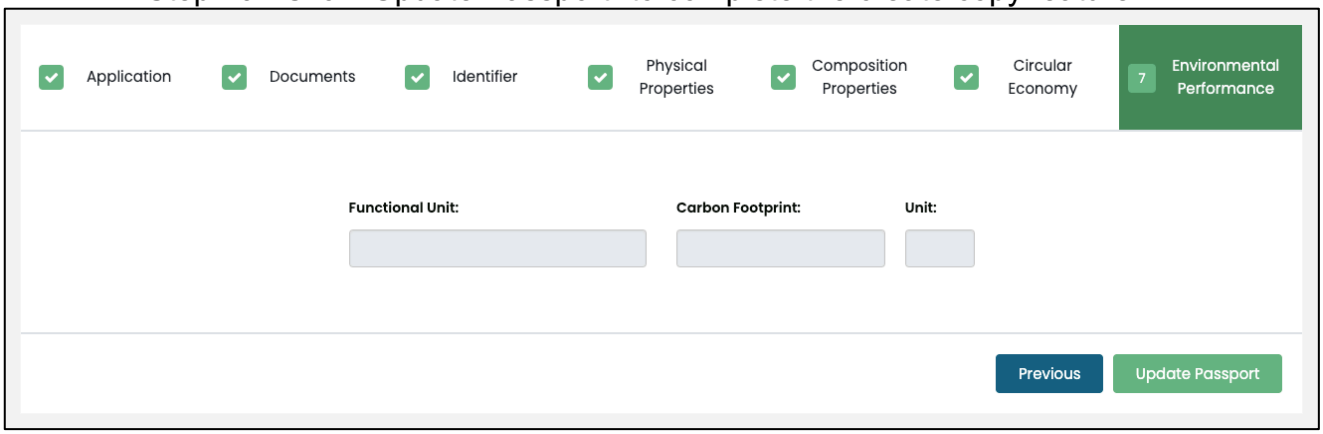


Figure 67: Create Copy - Update passport

3.3.8 Mark as Old

Step 1: Please visit: https://jidep.co/passports

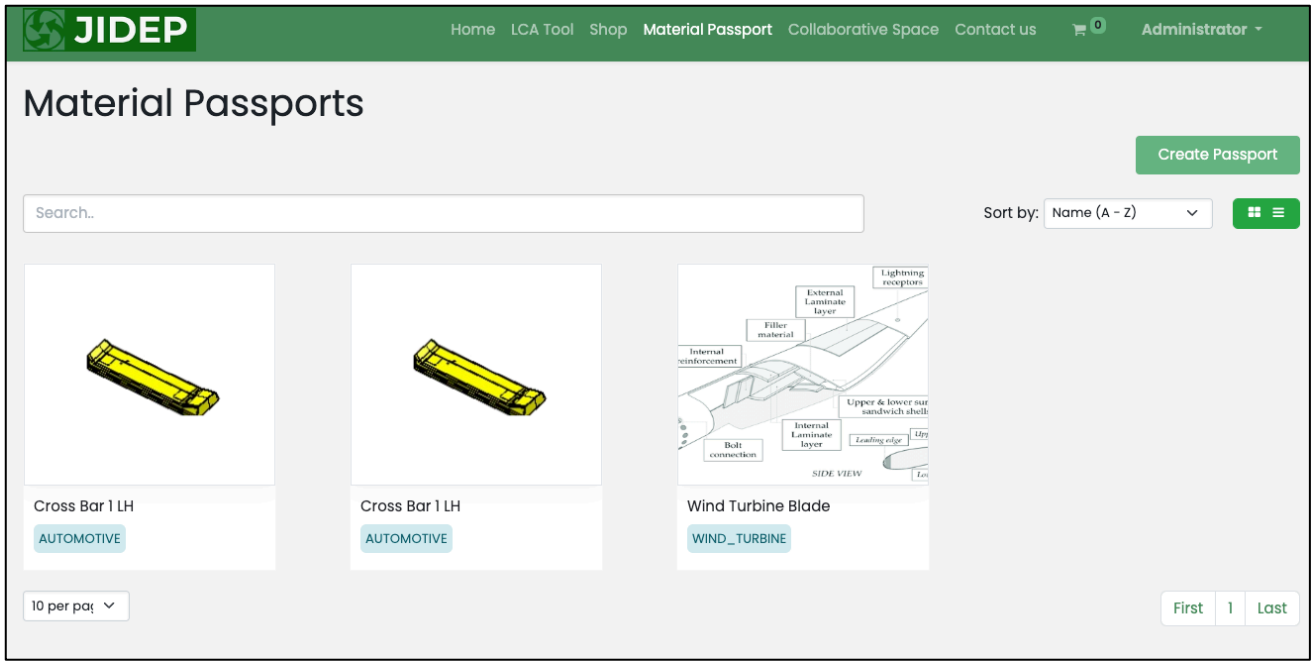


Figure 68: Mark as Old - passports page

Step 2: Click in the body of the passport to view details of the passport

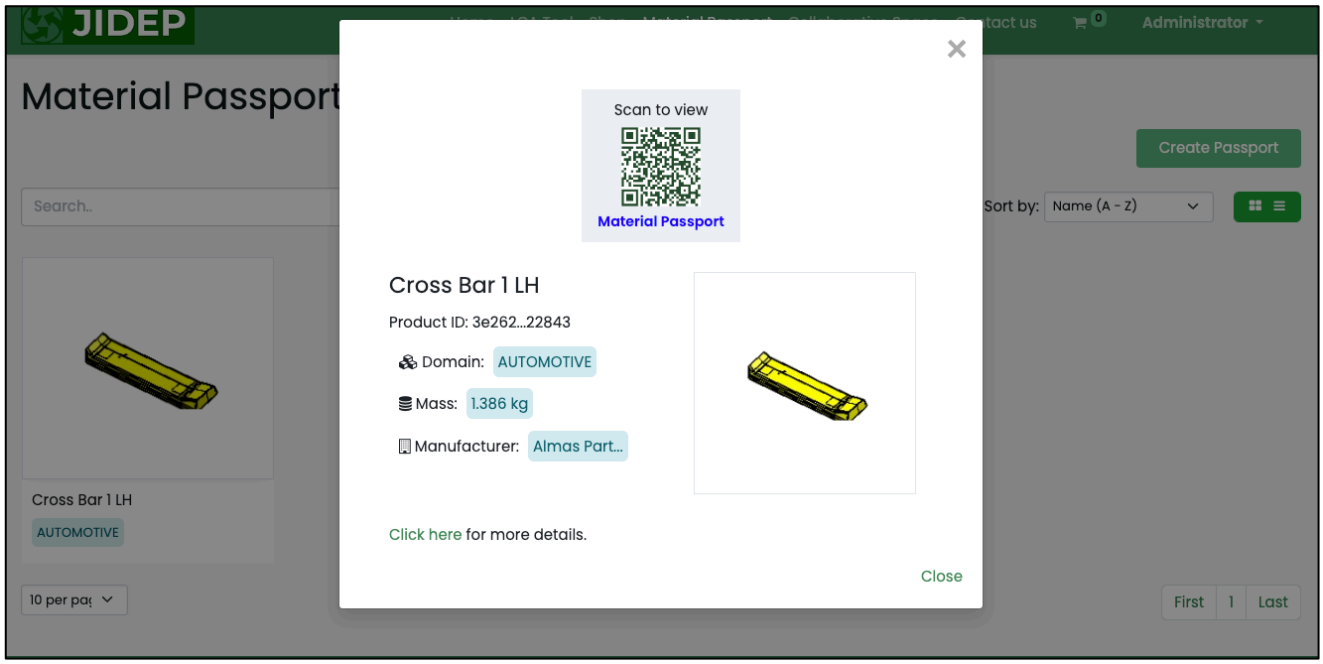


Figure 69: Mark as Old - Initial View page

Step 3: Click the “Click here” button to view full details of the passport

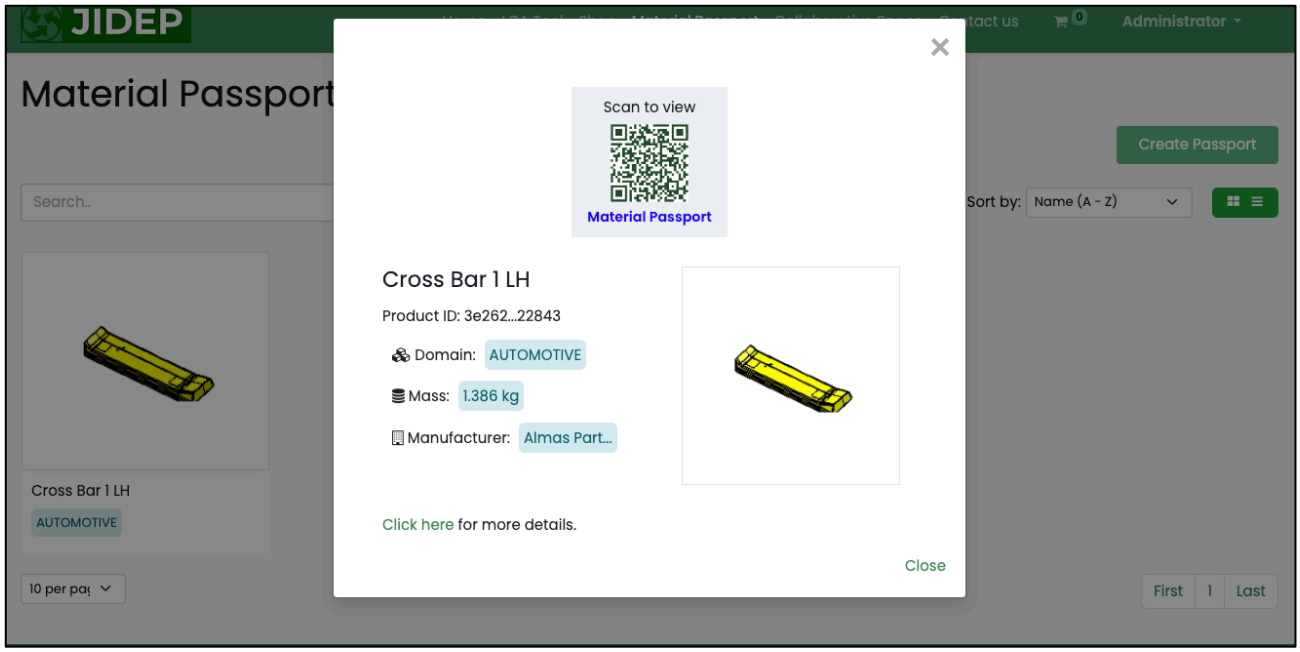


Figure 70: Mark as Old - Click here button for full details

Step 4: Click on the “Mark as Old” button to cease the passport

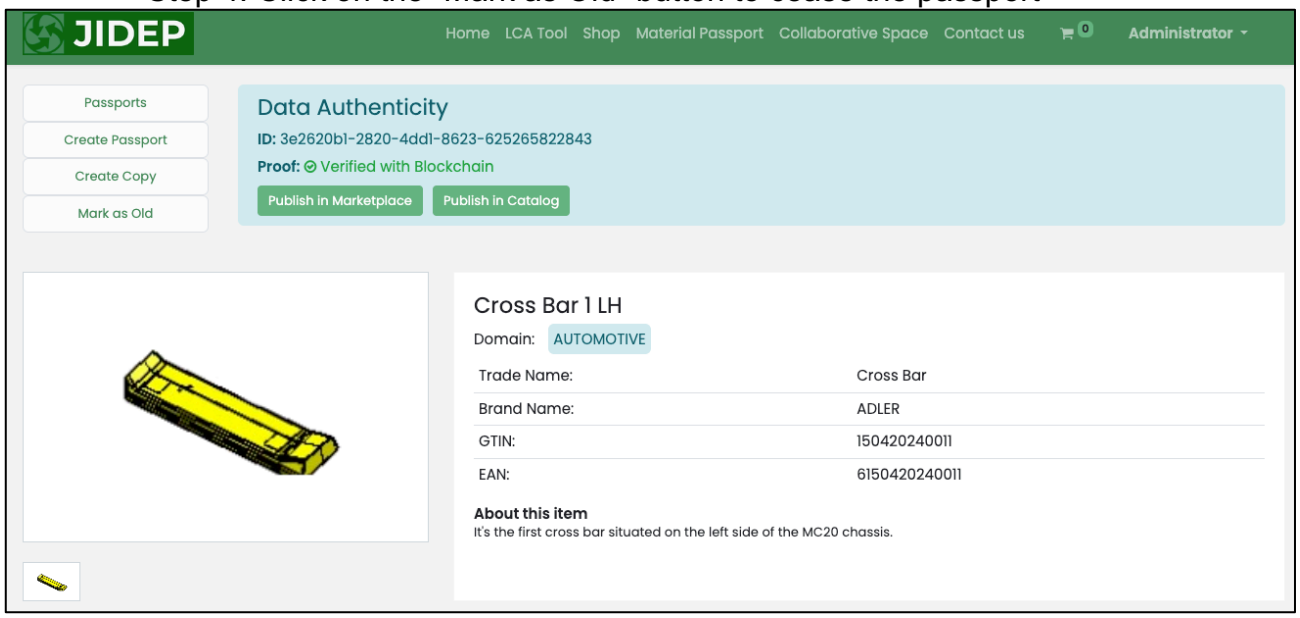


Figure 71: Mark as Old - Click on Create Copy

4. Circularity Calculator

4.1 Description

The Circularity Calculator is developed as an ontology-based software that supports different actors in the industry for deciding product’s circularity strategies by comparing different design scenarios for the products’ circularity indicators. The methodology seeks to provide the user with a frame of reference for discussing how circular a product is. We have incorporated Material Circularity Indicators (MCI) adopted from Ellen Macarthur foundation

indicator methodology[1]. The MCI is a key component of the calculator that quantifies the circularity of a product by measuring the extent to which linear flow has been minimized and restorative flow maximized for its component materials. This provides a numerical value between 0 and 1, indicating the level of circularity.

4.2 Key Features

The Circularity Calculator empowers businesses to quantify, optimize, and enhance their circular economy practices, contributing to a more sustainable and environmentally conscious approach to product development and lifecycle management.

Table 3 Key Features of Circularity Calculator

Feature number	Feature name
F001	**Material Traceability:** This feature allows users to trace the origin of materials used in the product, ensuring transparency and accountability throughout the supply chain and promoting responsible sourcing practices.
F002	**Circularity Metrics:** The tool generates key circularity metrics, including recycling rates, reuse potential, and remanufacturing feasibility, aiding businesses in understanding the circular economy potential of their products.
F003	**Compliance Tracking:** The tool helps users track compliance with circular economy regulations and standards, ensuring that businesses stay aligned with evolving sustainability requirements in their respective industries.
F004	**Circularity Indicator:** The tool generates a Circularity Indicator, quantifying the circularity of a product on a scale from 0 to 1. A value of 0 indicates that the product is not circular, while a value of 1 signifies full circularity, providing a clear and concise measure of a product's sustainability.
F005	**Flexible Calculator:** the calculator seems adaptable, offering both a whole product approach and a comprehensive approach- that considers individual components, sub-assemblies, parts, and materials. This flexibility enables users to assess circularity at various levels of granularity.
F006	**Guidelines Integration:** The integration of guidelines for reusing, repairing, and recycling materials within the calculator is a valuable addition. This ensures that users not only receive a circularity index but also practical advice on how to improve circularity through specific actions like reuse, repair, and recycling.

[1] https://www.ellenmacarthurfoundation.org/material-circularity-indicator

4.3 Operation Manual

Step 1: Provide valid and required information to calculate the circularity of the product

- Enter the name of the material, weight (in appropriate units), and the source of the material (e.g., production, recycling).
- Provide the End-of-Life (EOL) collection ratio, indicating the percentage of the material collected at the end of its life cycle.
- Specify the EOL destination, detailing where the material goes after reaching its end-of-life.

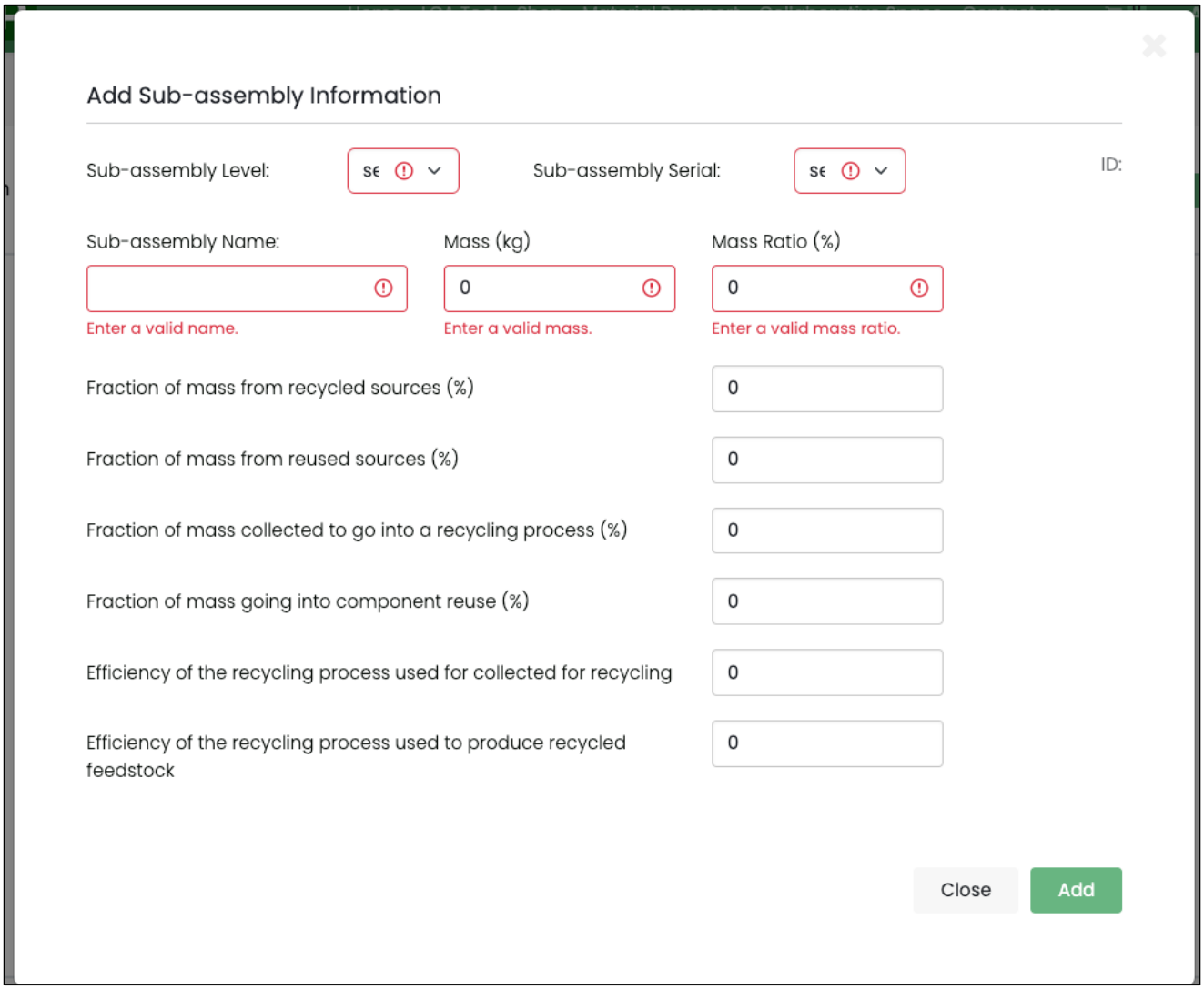


Figure 72: Circularity Calculator showing material data input form

Step 2: Provide all the materials information to calculate the circularity of the product

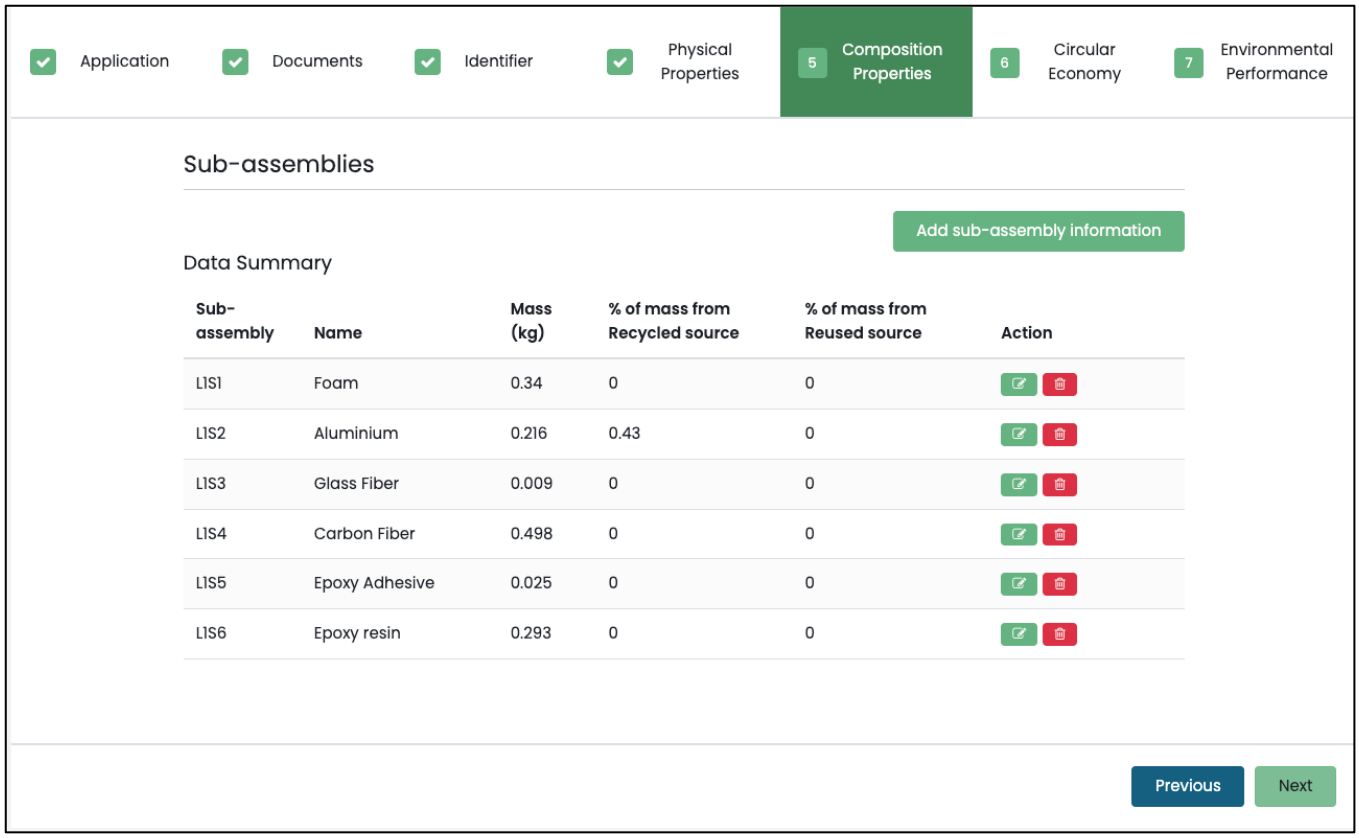


Figure 73: Circularity Calculator showing input data about constituent materials

Step 3: Click next to proceed with the passport creation page

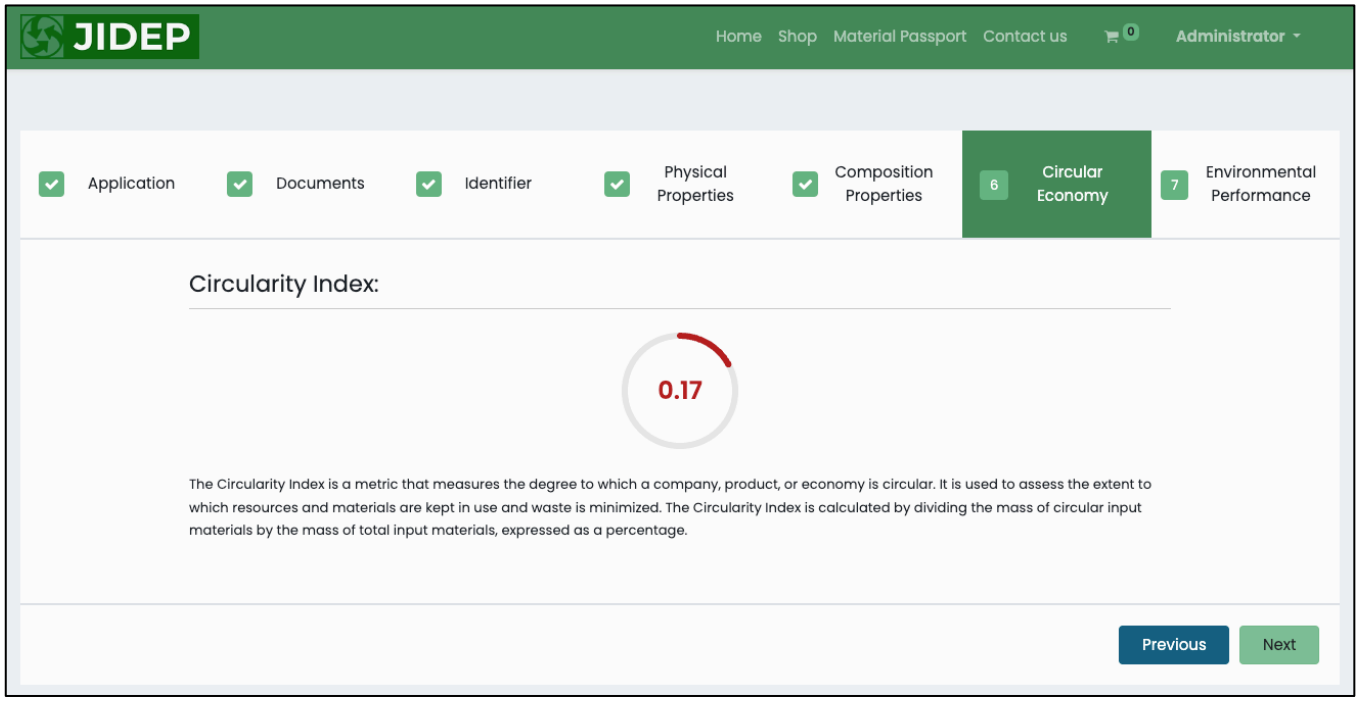


Figure 74: Circularity Calculator showing calculated circularity index.

5. Environmental Analytic Tool

5.1 Description

Life Cycle Assessment (LCA) provides a comprehensive view of the environmental impacts associated with all stages of a product's life. Here Environmental Analytic Tool helps to create LCA report more user friendly way than ever. The interface developed under this tool made easier for the end user or stakeholders to calculate LCA without having prior knowledge on Life Cycle Assesment. LCA reports offer detailed insights into various environmental impacts, resource uses, emissions, waste generation, and more, across all stages of a product's lifecycle. These reports are essential for organizations to make informed decisions aimed at reducing environmental impacts, improving sustainability, and achieving regulatory compliance.

5.2 Key Features

The reports generated from LCA can vary depending on the specific goals and scope of the assessment, here is the some key features of Environmental Analytic Tool.

Table 4: Key Features of Environmental Analytic Tool

Feature number	Feature name
F001	**Environmental Impact Reports:** Environmental Impact Reports measure the product's contribution to issues like climate change, ozone depletion, acid rain, and eutrophication. They provide data on greenhouse gas emissions, air, water, and soil pollutants, helping organizations understand and mitigate their environmental footprint.
F002	**Resource Use Reports:** Resource Use Reports quantify the total energy, water, and raw materials consumed throughout a product's lifecycle. These reports help organizations identify and optimize resource efficiency, reducing overall environmental impact.
F003	**Emissions Reports:** Emission Reports detail pollutants released into the air, water, and soil during a product's lifecycle. They provide crucial data for identifying and mitigating environmental pollution and health risks.
F004	**Waste Reports:** Waste Reports measure the amount of hazardous and non-hazardous waste produced during a product's lifecycle. They help businesses manage waste better and enhance their sustainability efforts.
F005	**Impact Category Reports:** Impact Category Reports assess the potential effects on human health, ecosystems, and resource depletion. These reports help organizations understand the broader environmental and societal impacts of their products.

F006	**Lifecycle Stage Reports:** Lifecycle Stage Reports break down the environmental impacts at each phase of a product's life, from production to disposal. These reports help identify which stages have the most significant effects and where improvements can be made.

5.3 Operation Manual

Step 1: Provide valid and required information to get report of LCA

- Enter the country of origin from the list.
- Provide component/product name
- Specify the functional unit and number of sub-assembly

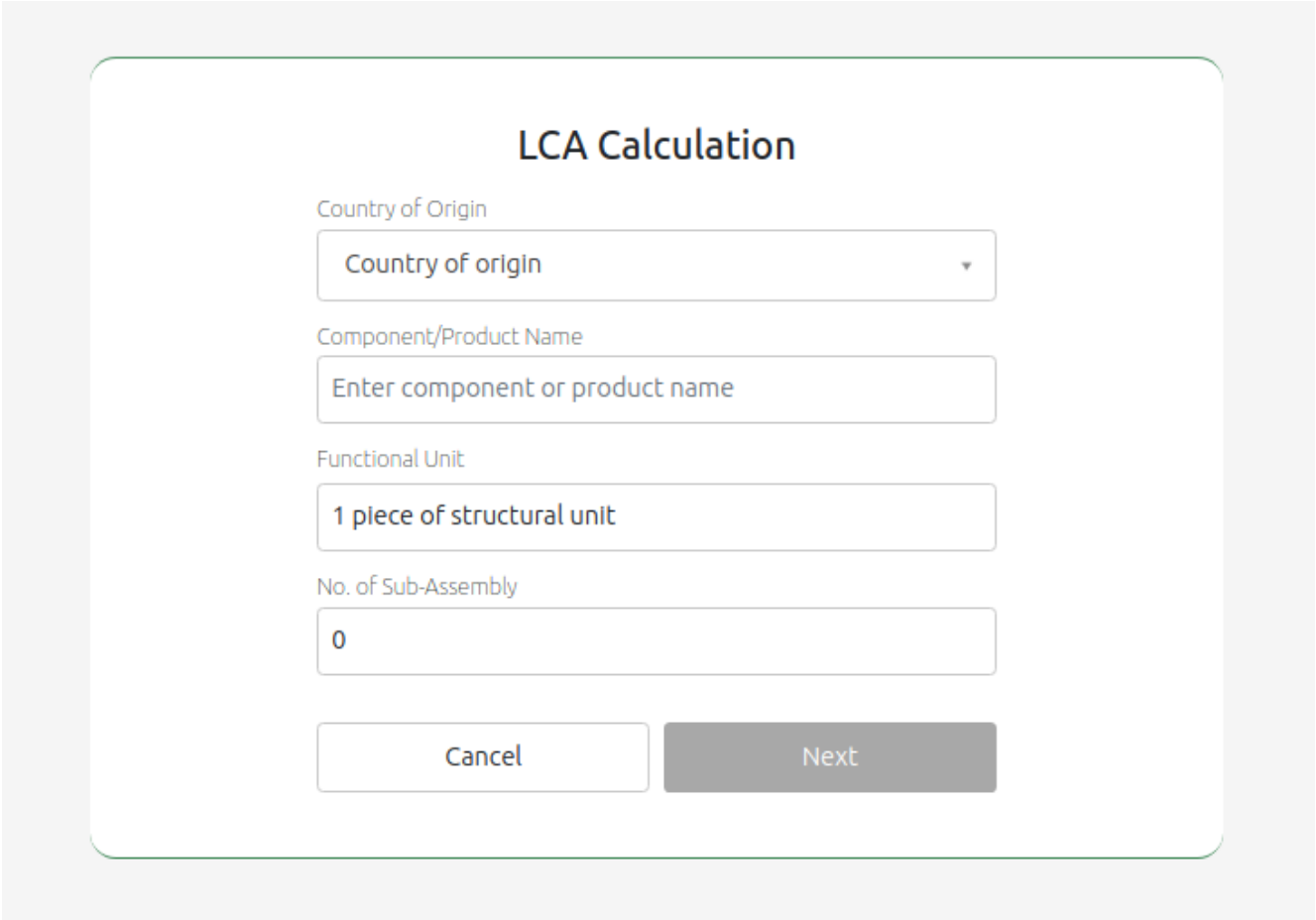


Figure 75: LCA Calculation - Step 1

Step 2: Add material details of sub-assemblies for calculating LCA

Select Product Category:

- Choose a category from the list.

Select Sub-Category:

- Choose a sub-category under the selected category.

Select Material:

- Pick a material based on the selected category and sub-category.

Enter Amount:

- Provide the amount and select the unit.

Enter Transport Distance:

- Input the distance for road transport.
- Input the distance for marine transport.

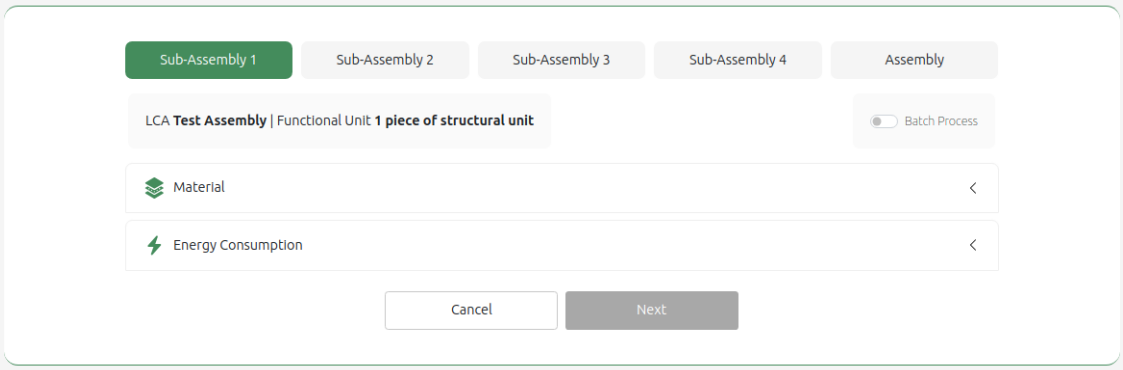


Figure 76: LCA Calculation - Step 2

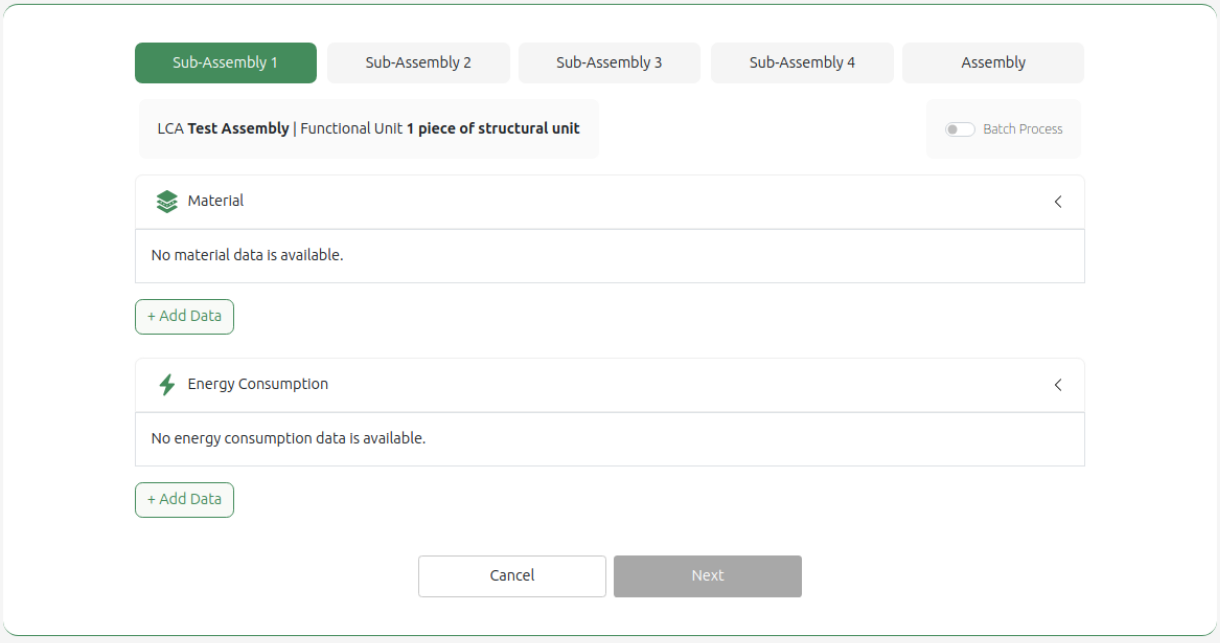


Figure 77: LCA Calculation - Sub-Assembly Add data

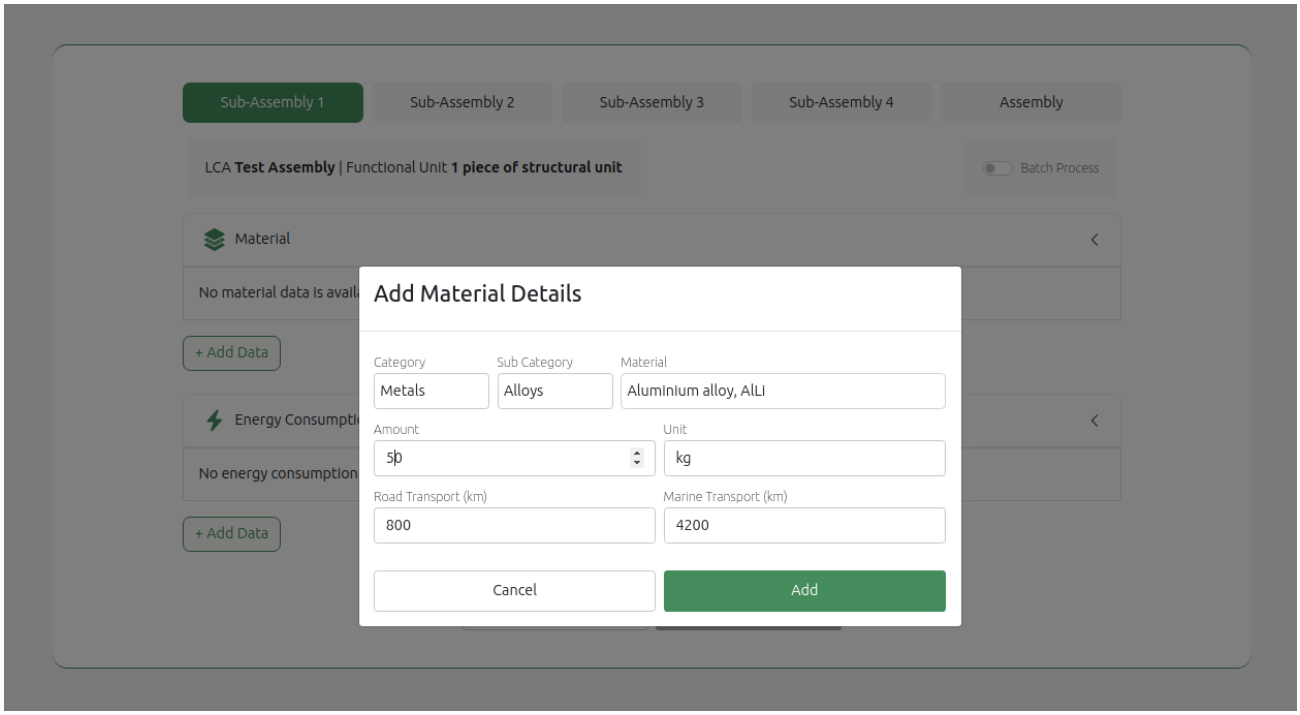


Figure 78: LCA Calculation - Sub-Assembly - Add Material Details

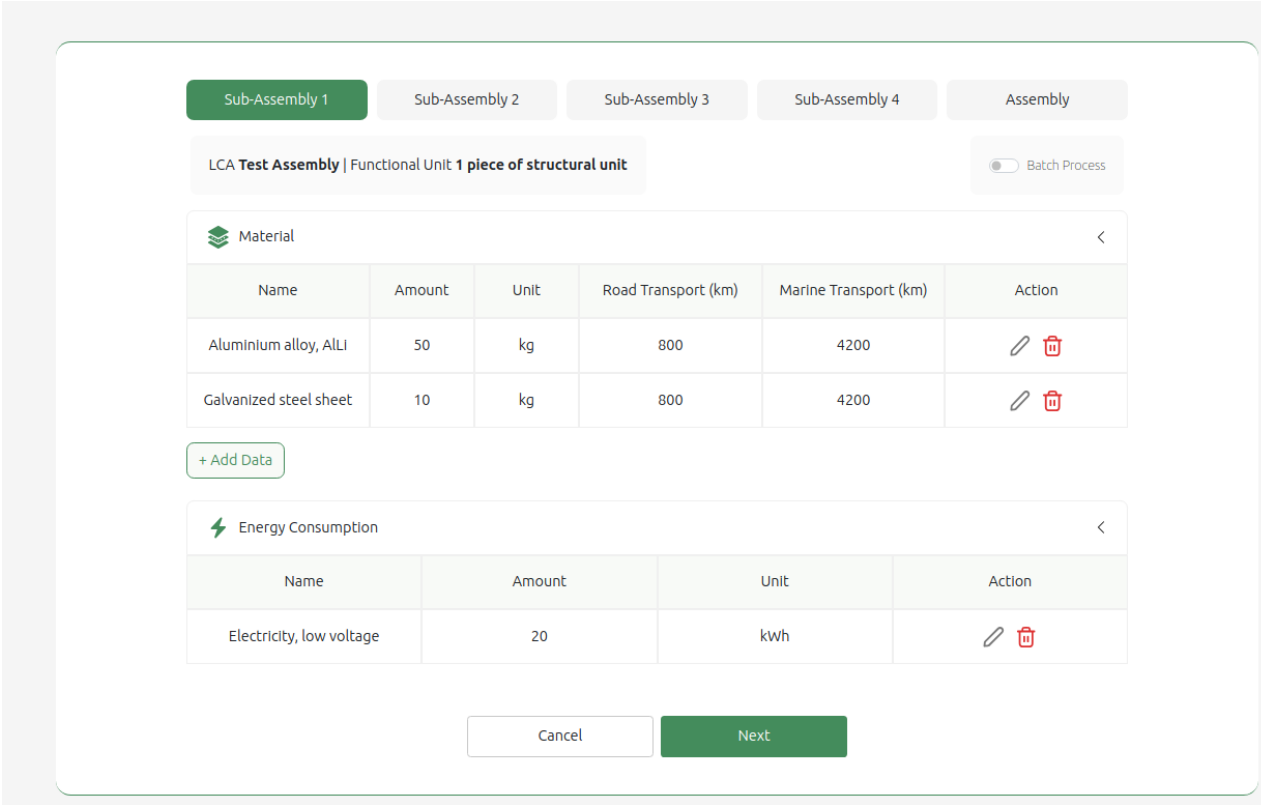


Figure 79: LCA Calculation - Sub-Assembly - List of Materials

Step 3: Select LCA calculation Methodology

- Select methodology for the LCA calculation

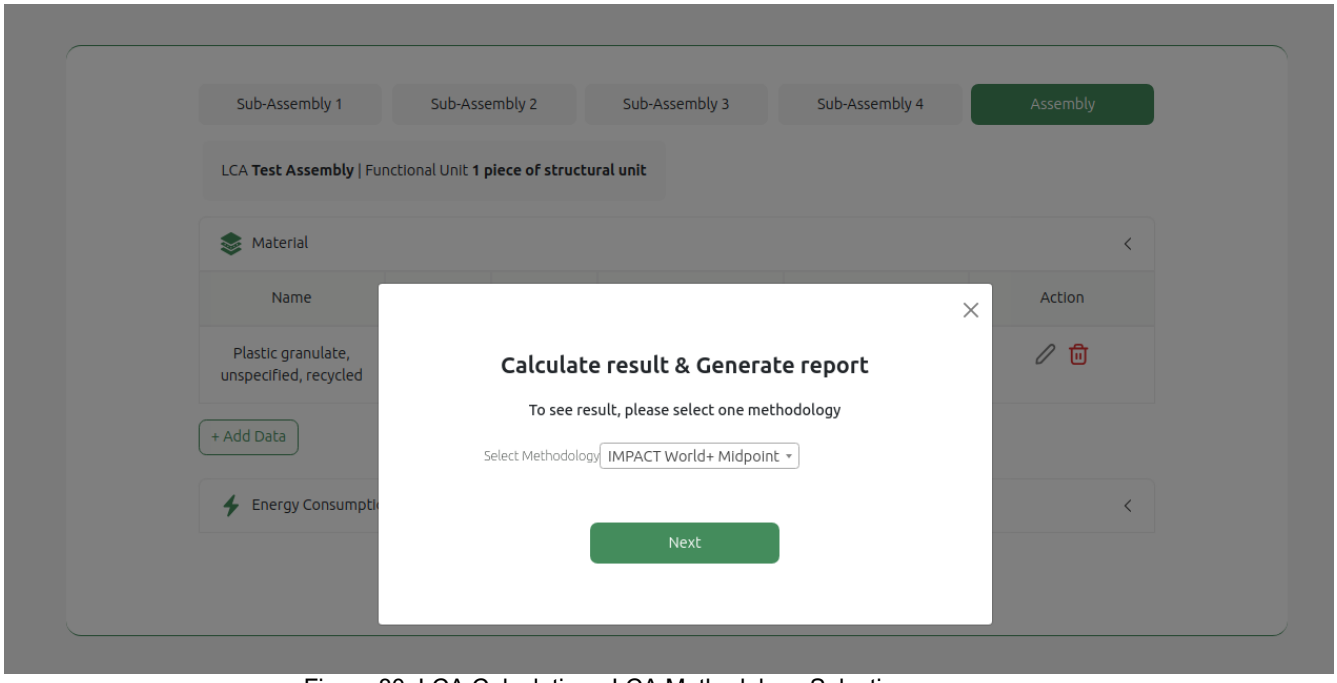


Figure 80: LCA Calculation - LCA Methodology Selection

Step 4: Generated LCA report

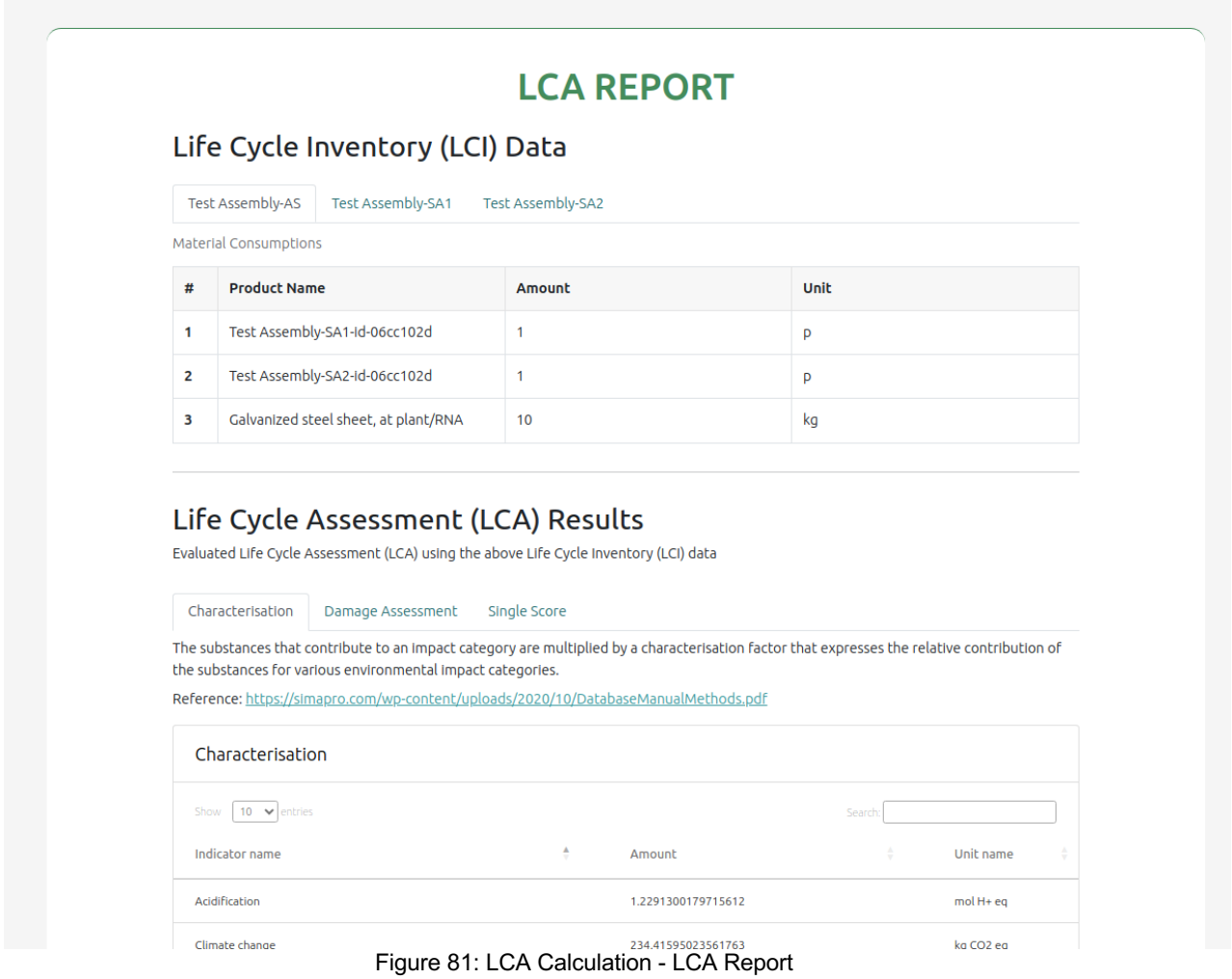
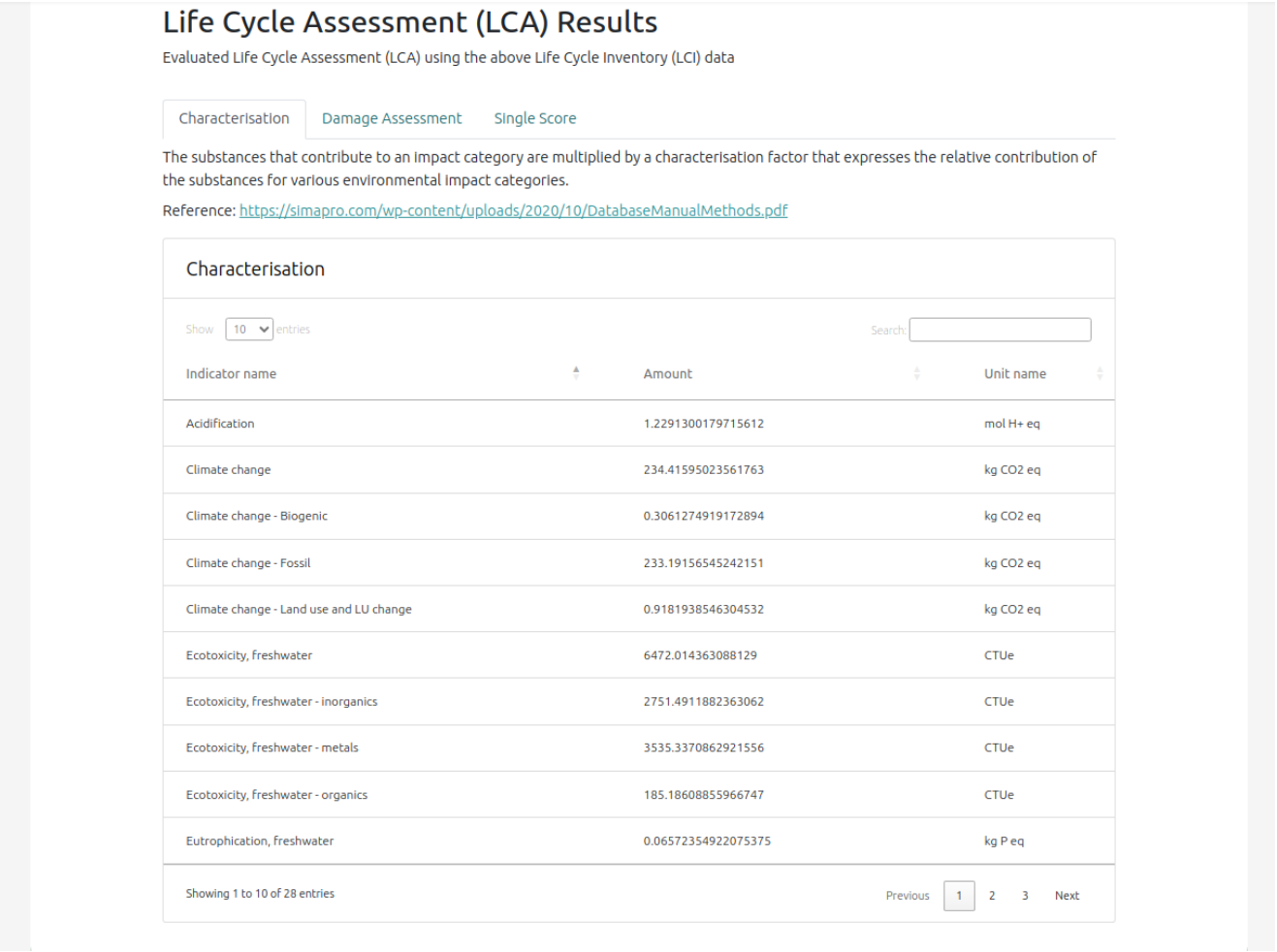


Figure 81: LCA Calculation - LCA Report



Life Cycle Assessment (LCA) Results

Evaluated Life Cycle Assessment (LCA) using the above Life Cycle Inventory (LCI) data

Characterisation | Damage Assessment | Single Score

The substances that contribute to an impact category are multiplied by a characterisation factor that expresses the relative contribution of the substances for various environmental impact categories.

Reference: https://simapro.com/wp-content/uploads/2020/10/DatabaseManualMethods.pdf

Characterisation

Show 10 entries Search:

Indicator name	Amount	Unit name
Acidification	1.2291300179715612	mol H+ eq
Climate change	234.41595023561763	kg CO2 eq
Climate change - Biogenic	0.3061274919172894	kg CO2 eq
Climate change - Fossil	233.19156545242151	kg CO2 eq
Climate change - Land use and LU change	0.9181938546304532	kg CO2 eq
Ecotoxicity, freshwater	6472.014363088129	CTUe
Ecotoxicity, freshwater - inorganics	2751.4911882363062	CTUe
Ecotoxicity, freshwater - metals	3535.3370862921556	CTUe
Ecotoxicity, freshwater - organics	185.18608855966747	CTUe
Eutrophication, freshwater	0.06572354922075375	kg P eq

Showing 1 to 10 of 28 entries Previous 1 2 3 Next

Figure 82: LCA Calculation - LCA Report

6. Analytical Tool for Composite Material Structures

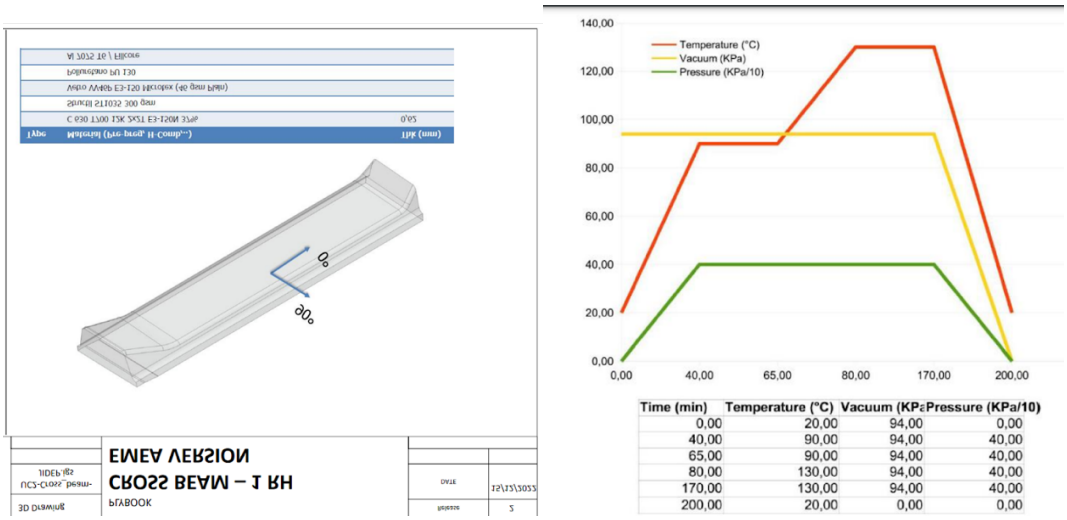
6.1 Description

The analytical tool for composite materials is based on the ESI PAM Composites suite of simulation software for composite material manufacturing processes. These software modules provide tools to assess the manufacturing process of a composite part and optimise it to reduce time and cost whilst maintaining quality prior to mass production. For these simulations, a large number of material characteristic data (such as density, thermal conductivity, stiffness etc.) are typically required, which are usually obtained from time-consuming and expensive coupon tests.

One of the benefits of the JIDEP material passport is the ability to store information from previous material characterisation tests and store them for use in future projects. This aims to save time and cost for material characterisation on new projects and help optimise the manufacturing process to increase efficiency and sustainability. The analytical tool and the material passport have been developed together to ensure that

the relevant material characteristics are stored and in a usable format for the manufacturing simulations, as will be demonstrated in this manual.

The test case that is demonstrated in the JIDEP project is the simulation of curing for an automotive composite floor beam for end user Adler (see Figure 1). The part is a composite floor beam which is comprised of a foam core with metallic and fibreglass inserts surrounded by a skin of carbon fibre prepreg. The part components (core, inserts and wet carbon fibre prepreg skin) are assembled in a mould with a 0/90/0/90/0/90/45/-45/0/90/45/-45 stacking sequence for the prepreg laminate. Afterwards, it is placed in an oven to apply heat and pressure to cure based on parameters supplied by Adler (see Figure 1). The simulation test case here will give an example of how the analytical tool works to simulate the curing behaviour of the part with the provided manufacturing parameters.



Time (min)	Temperature (°C)	Vacuum (KPa	Pressure (KPa/10)
0,00	20,00	94,00	0,00
40,00	90,00	94,00	40,00
65,00	90,00	94,00	40,00
80,00	130,00	94,00	40,00
170,00	130,00	94,00	40,00
200,00	20,00	0,00	0,00

Figure 83: JIDEP composite analytical tool test case: composite crossbeam (left) and manufacturing parameters (right)

6.2 Key Features

The composite analytical tool aims to provide a simplified and efficient way for end users to quickly assess how the chosen manufacturing parameters (temperature, pressure, etc.) affects the part and how it impacts the manufacturing process (time and energy required). To allow this, the tool has the following features:

Table 5 Key Features of Composite Material Structures

Feature number	Feature
F001	Allow assessment of part behaviour (in this case curing) during the manufacturing process based on chosen parameters (temperature, pressure etc.). This allows the adjustment of the parameters to find optimum values.
F002	Accepts material characteristics data from the JIDEP material passport to reduce the need for characterisation tests.
F003	Readily accepts end-user CAD data and can tolerate minor gaps and intersections between parts without the need to fix geometry.
F004	Has an automated meshing workflow to defeature complex geometry and create tetra mesh that is suitable for the curing simulation.

F005	Provides complete visualisation of manufacturing parameters and curing behaviour of the part during the manufacturing process period.

6.3 Operation Manual

The operation of the tool can be split into 5 steps:
(1) importing parts and meshing,
(2) defining process conditions,
(3) defining materials,
(4) defining heat transfer interfaces, and
(5) analysis and results.
These steps will be detailed below, and a video version is available by clicking this link. Importing parts and Meshing

1. The tool readily receives CAD files of parts and assemblies in several formats. However, to avoid importing errors in the geometry, it is recommended to use the .igs format.

2. Start by opening the ESI PAM composites suite and going to the Visual Mesh module. Create a new file, import parts through file append, and select the CAD file. The part will be imported as a geometry, as shown in Figure-71.

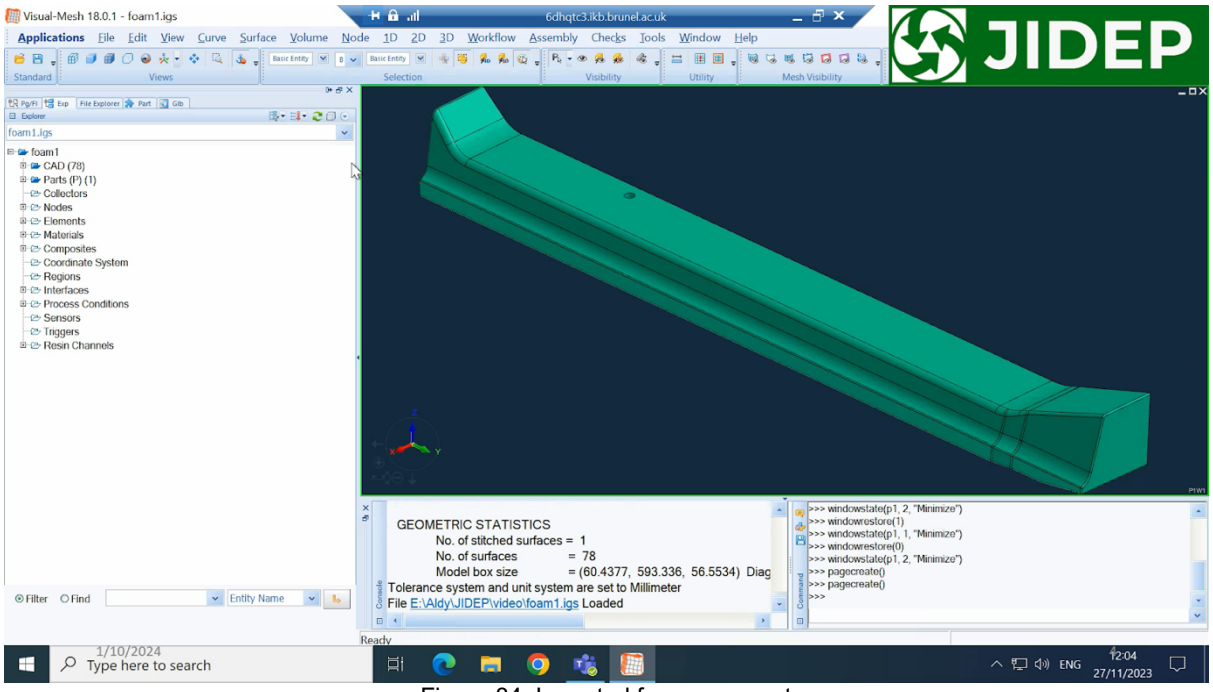


Figure 84: Imported foam core part

3. To mesh the part, go to the workflow tetra mesh process. This will show the workflow window on the left panel of the screen (see Figure 72). To start the process, click the play button at the bottom of the workflow. A window will pop up with the meshing parameters, as shown in Figure 72. For this case, the element size is 4mm with simple topology simplification (which defeats the geometry if it is too complex to mesh). Click OK, and the part will be meshed automatically.

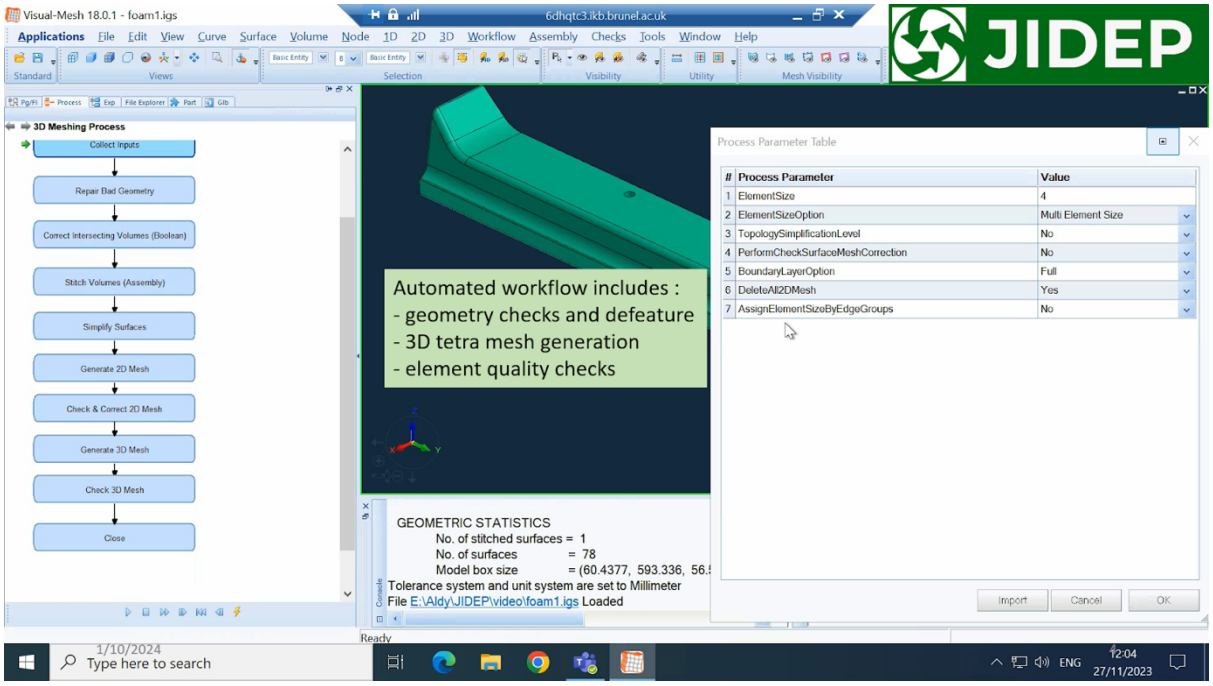


Figure 85: Tetra mesh workflow

4. Complete the process for all parts (including mould). This can be done in 1 file or by creating separate files for each part and then appending them together after meshing. For the test case, the meshed part and mould are shown in Figure 73 and Figure 74.

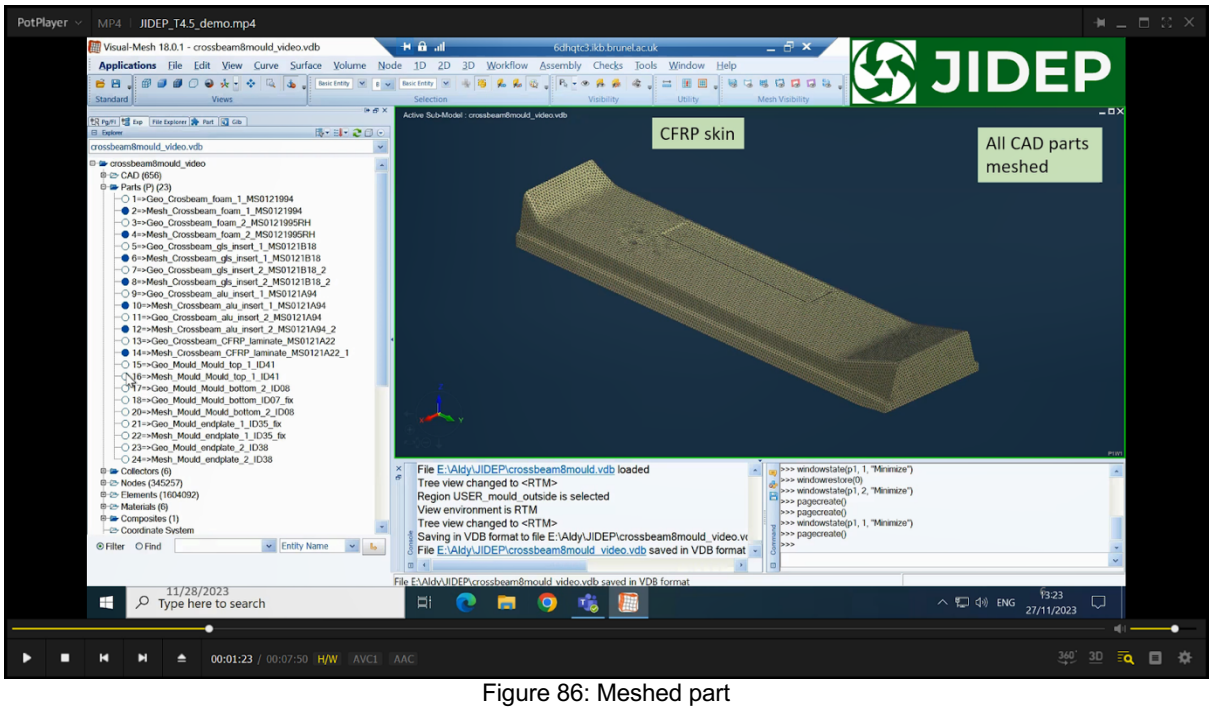


Figure 86: Meshed part

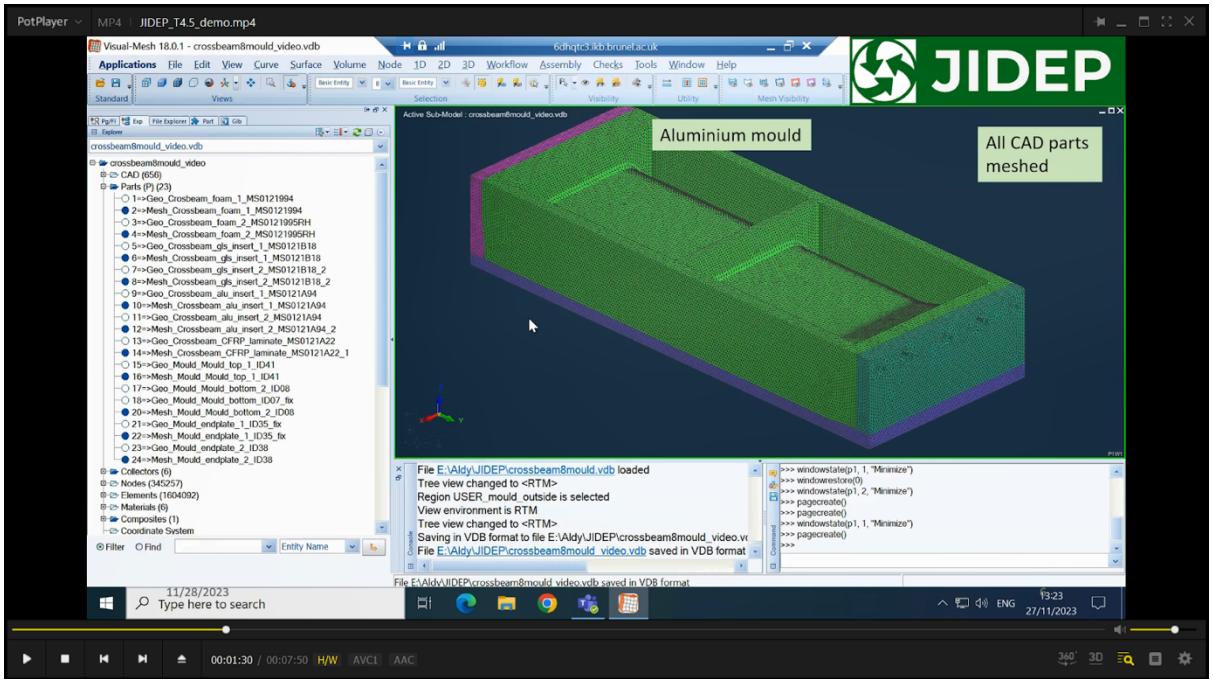


Figure 87: Mould

6.3.1 Defining Process Conditions

1. Once the part and mould are meshed, we need to define the process conditions we subject them to. In this case, the provided parameters (temperature and pressure) are given in Figure 72. Since the curing process is thermochemical, only the temperature profile will be applied to the part and mould.

2. To do this, switch to the Visual RTM module and go to RTM □ simulation parameters (see Figure 75). Select the simulation type as curing and then define the simulation time In Figure 1, the process is 200 minutes or 12000 seconds. Here, we define the time as 24000 seconds to give an extra period after heating to see how the part behaves. Select the resin which corresponds to the matrix of the carbon fibre prepreg (here, it is labelled as resin c). If it is not yet defined, it can be created in the materials tab (as will be shown in the next section on defining materials).

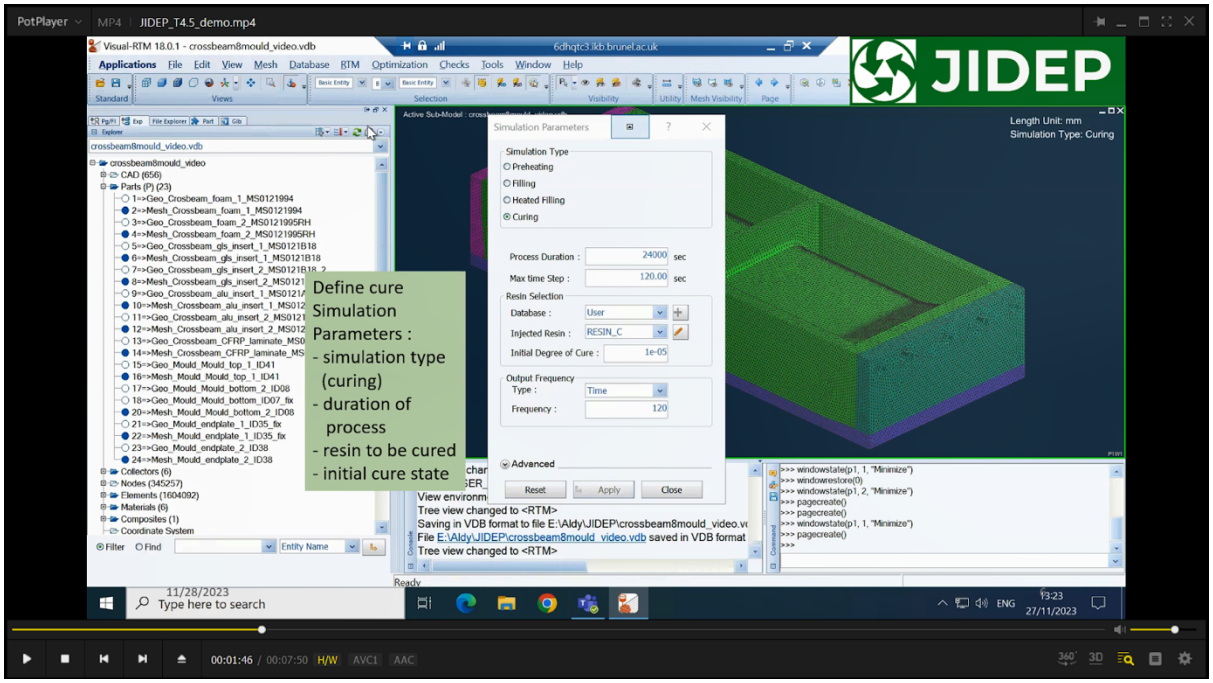


Figure 88: Setting simulation parameters in Visual RTM

3. Next, define the process parameters to apply to the part. To apply temperature, go to the process condition section on the simulation tree (on the left) and double-click convection to create a convection heating condition (see Figure 76). Click region to define the surface where the temperature will be applied, which in this case, is the outside of the mould as highlighted in red. The convection coefficient of the mould can be found in the material passport (under Aluminium). The temperature profile in Figure 76 can be entered in a tabular fashion at the bottom of the window.

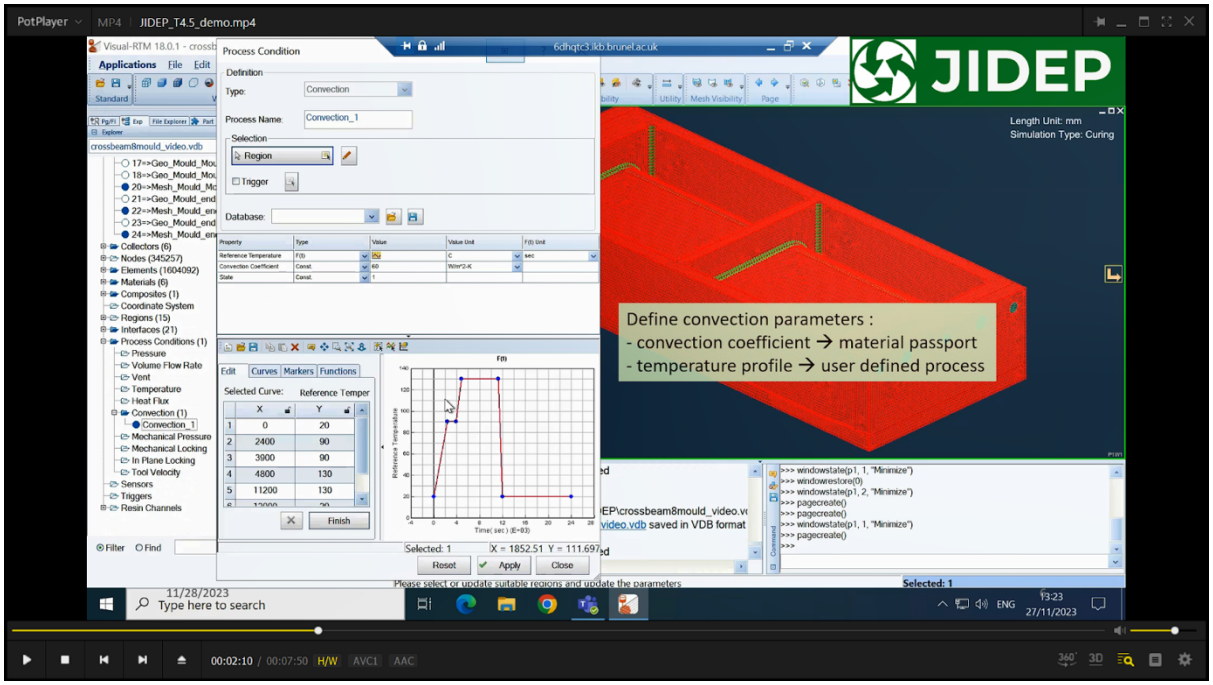


Figure 89: Defining convection parameters

6.3.2 Defining Materials

1. Once the manufacturing process conditions have been defined, it is time to define the materials of the various components in the model. In general, for curing simulations, there are 2 types of materials: curing and non-curing. Curing materials are ones that, throughout the simulation, will transition from a liquid/viscous state into a solid state due to the process conditions applied (in this case, the carbon fibre prepreg skin). Non-curing materials are the other materials that do not cure and just propagate the temperature that is being applied (in this case, the aluminium mould, foam core, as well as the glass fibre and aluminium inserts).

2. To define the materials, go to database materials. This will show all the materials in their respective categories. The non-curing materials can be defined in the mould materials section, as shown in Figure 77. To create a new material, double-click the mould section on the tree on the left. For non-curing materials, there are 2 tabs of material properties: general (density) and thermal (conductivity and specific heat). These values can be found in the JIDEP material passport for all the materials.

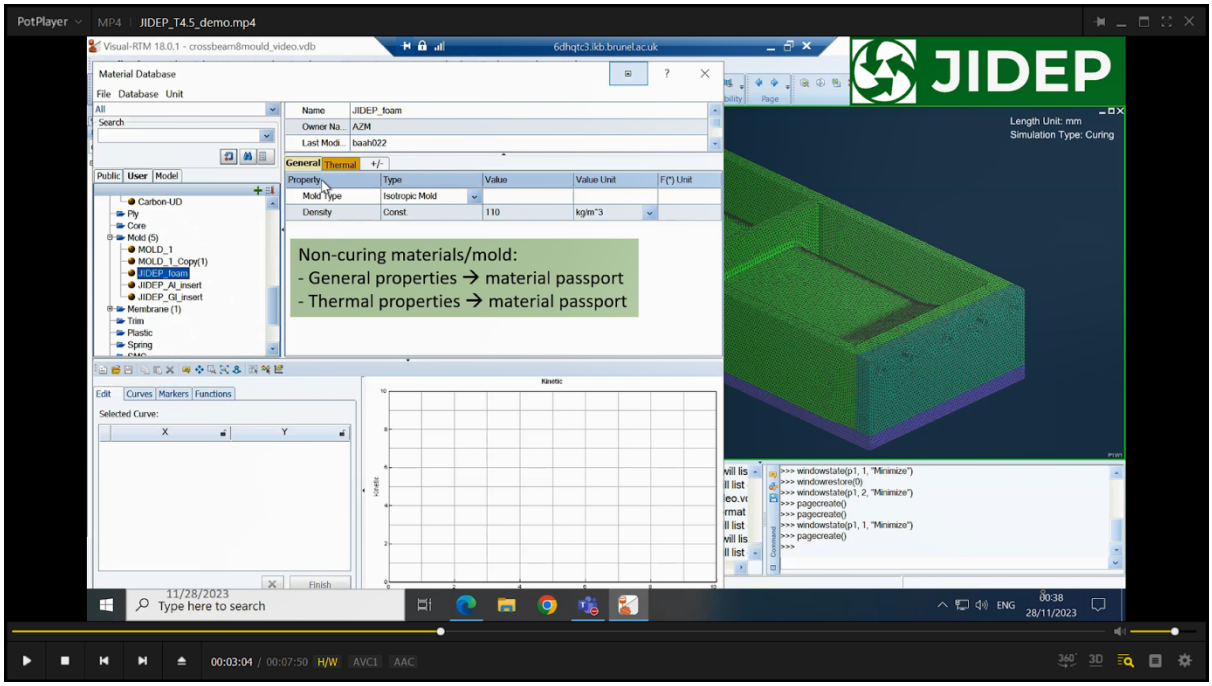


Figure 90: Non-curing material tab

3. For the carbon fibre prepreg skin, there are 2 components: the carbon fibres and the resin matrix. The carbon fibres can be defined under the reinforcements section of the material database (see Figure 78). For reinforcements, there are also 2 tabs of material properties: general (density) and thermal (conductivity and specific heat). These values can be found in the JIDEP material passport for carbon fibre. Other inputs, such as permeability, can be left empty.

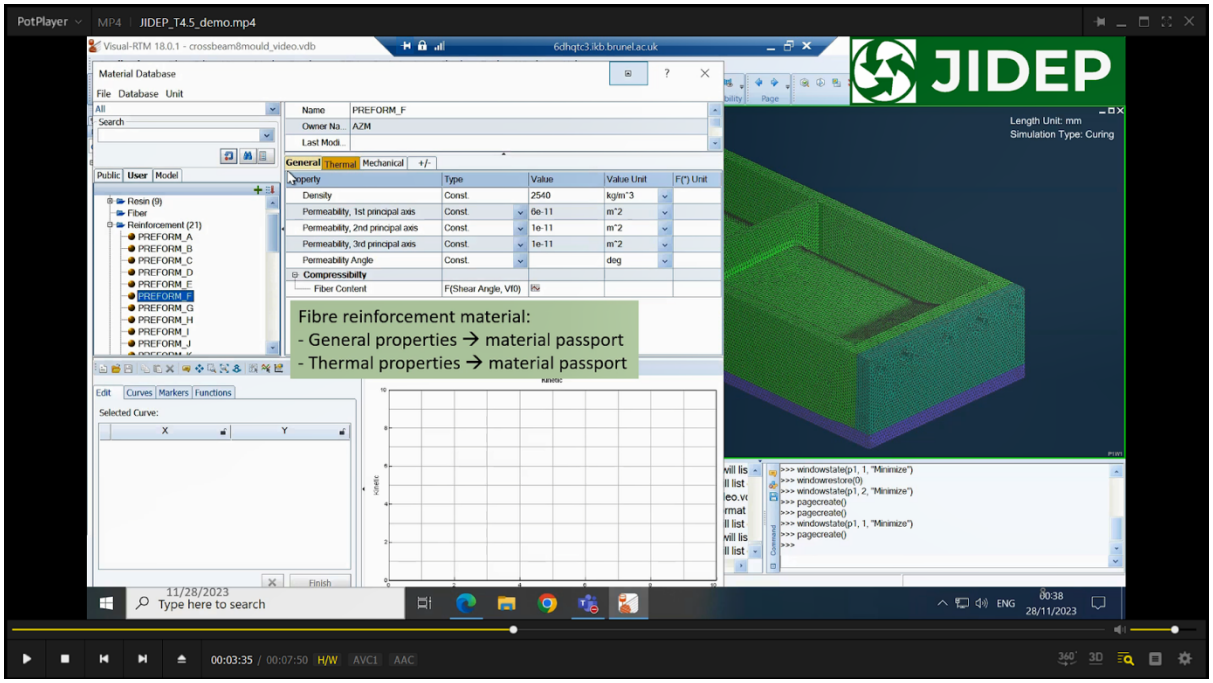


Figure 91: Reinforcement material tab

4. The resin component of the carbon fibre prepreg can be defined in the resin section of the material database (see Figure 79). For the resin, there are the same general (density) and thermal (specific heat and conductivity) material characteristics tabs as the non-curing materials. However, there is an additional chemical properties tab which includes the properties that control the thermochemical behaviour of the resin as it cures (enthalpy and kinetic profile). All of these values are available in the JIDEP material passport.

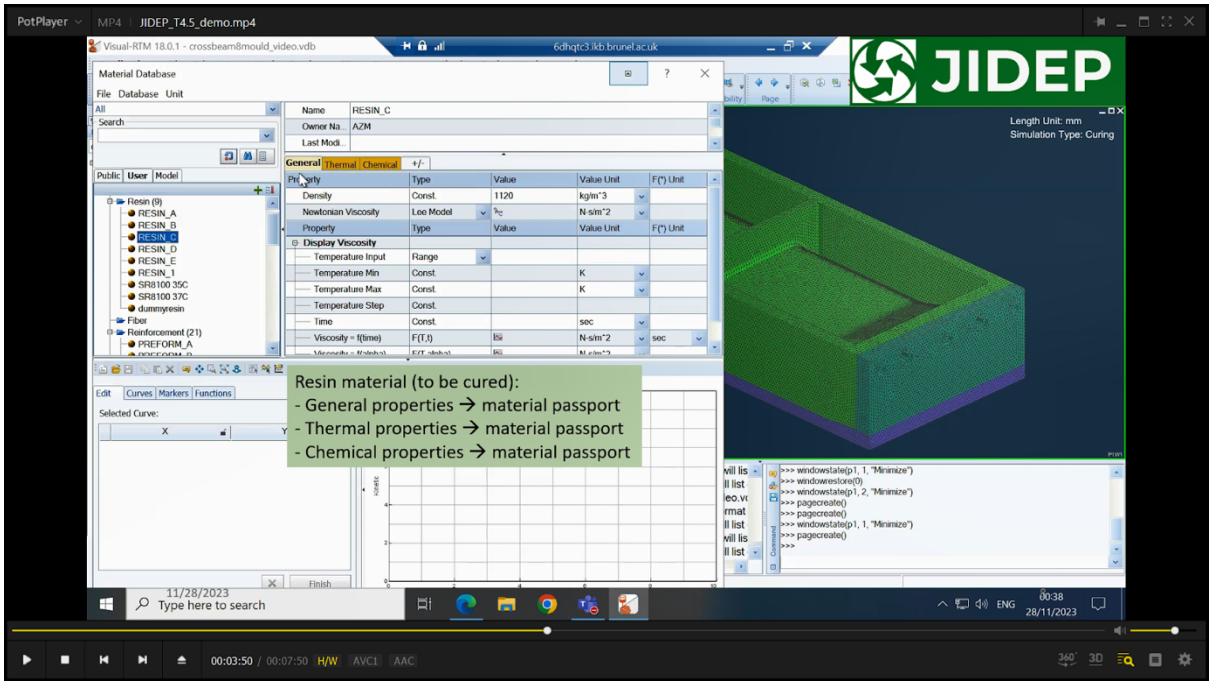


Figure 92: Resin material tab

5. Once the materials have been defined, it is time to assign them to the parts in the model. To assign the non-curing materials, go to the RTM part manager

(see Figure 80). Here it is possible to assign the materials defined previously to each part in the model.

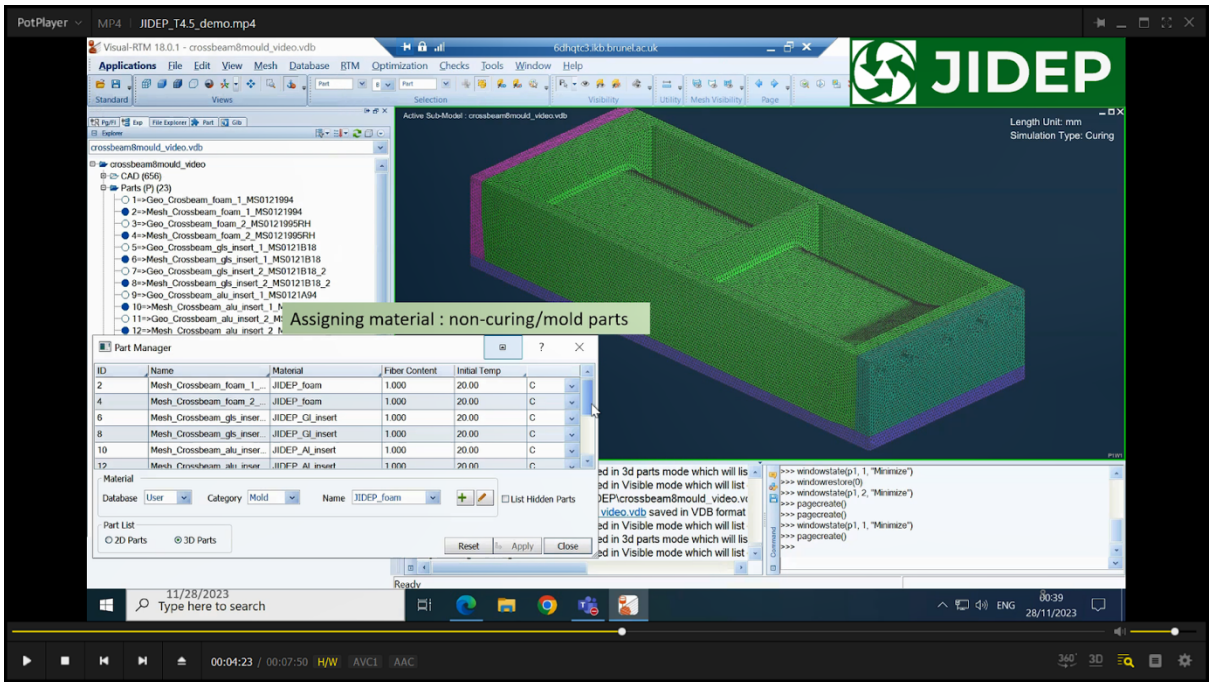


Figure 93: Assignment of non-curing materials

6. To assign the carbon fibre prepreg material to the skin, first go to RTM □ part orientation and define the reference coordinates for the fibres. Then go to the RTM □ layer design manager to define the individual layers of the carbon fibre prepreg laminate and which part it is assigned to (see Figure 81). The thickness and fibre content are available in the JIDEP material passport.

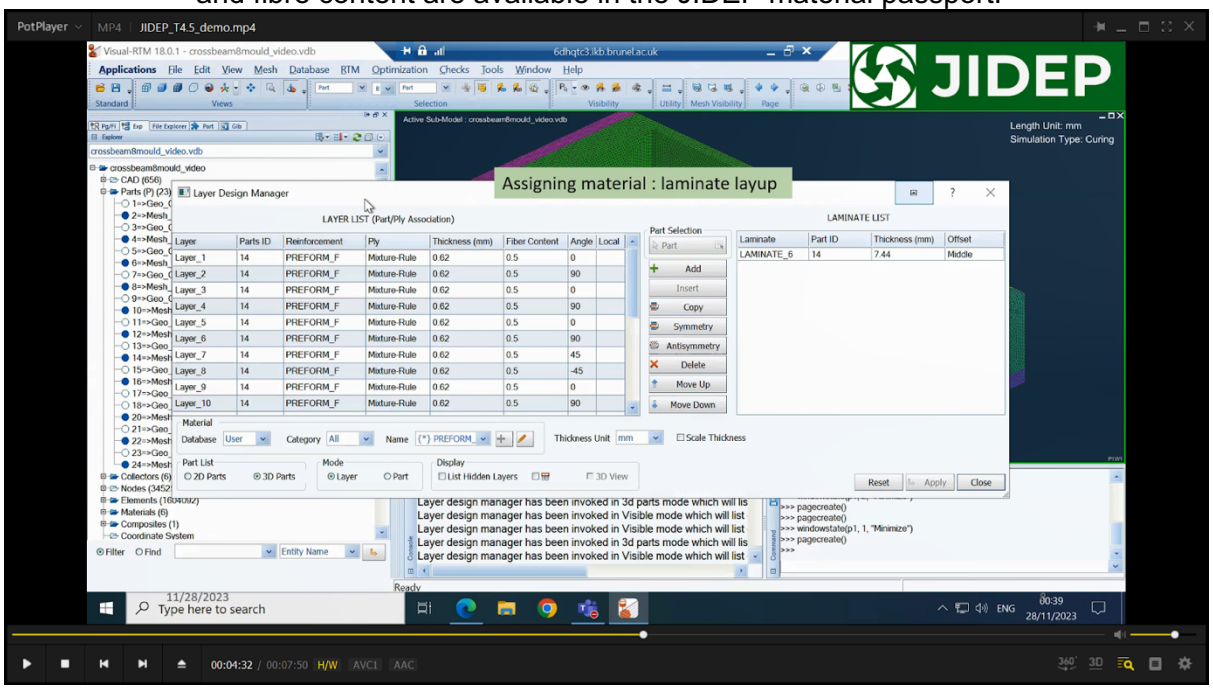


Figure 94: Layer design manager

6.3.3 Defining Heat Transfer Interfaces

1. Once the materials and process conditions have been defined, it is time to define the heat transfer interfaces which control the propagation of heat between parts. To define an interface, go to the interfaces section on the tree on the left and select the thermal non-coincident interface (see Figure 82). The non-coincident interface provides a coupling between surfaces that do not necessarily need to be in contact and have coincident meshes. This is useful when the CAD is not completely aligned (gaps or overlap), possibly due to manufacturing or other considerations (see Figure 83).

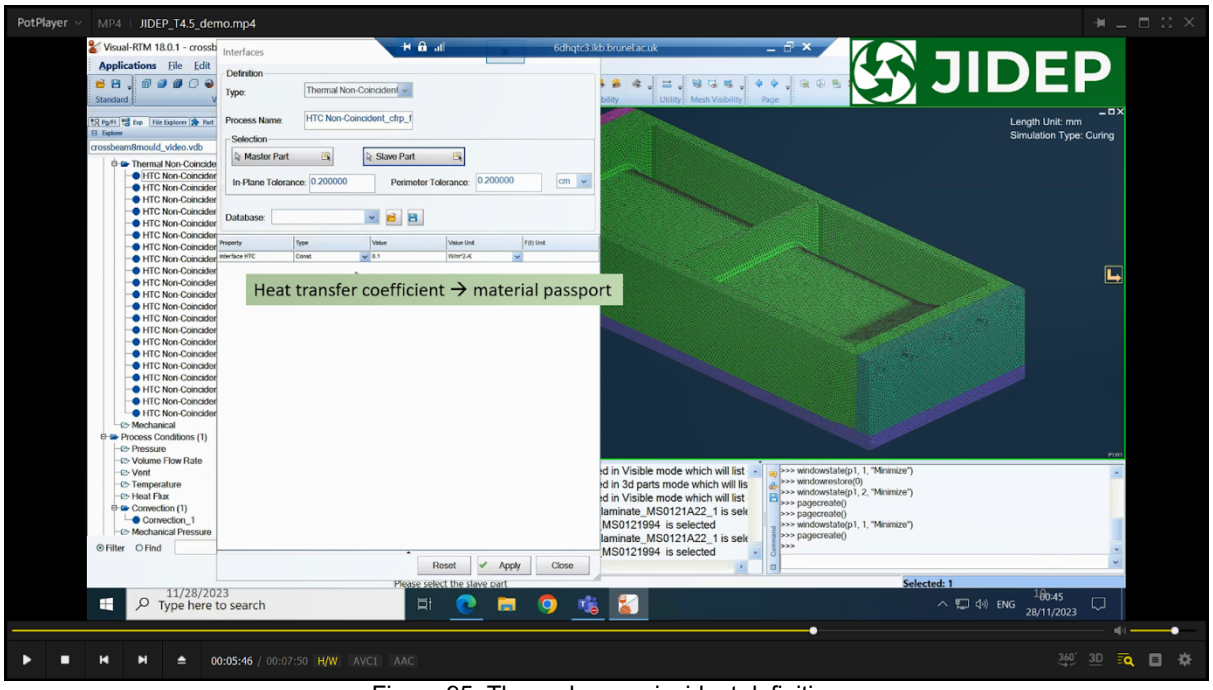


Figure 95: Thermal non-coincident definition

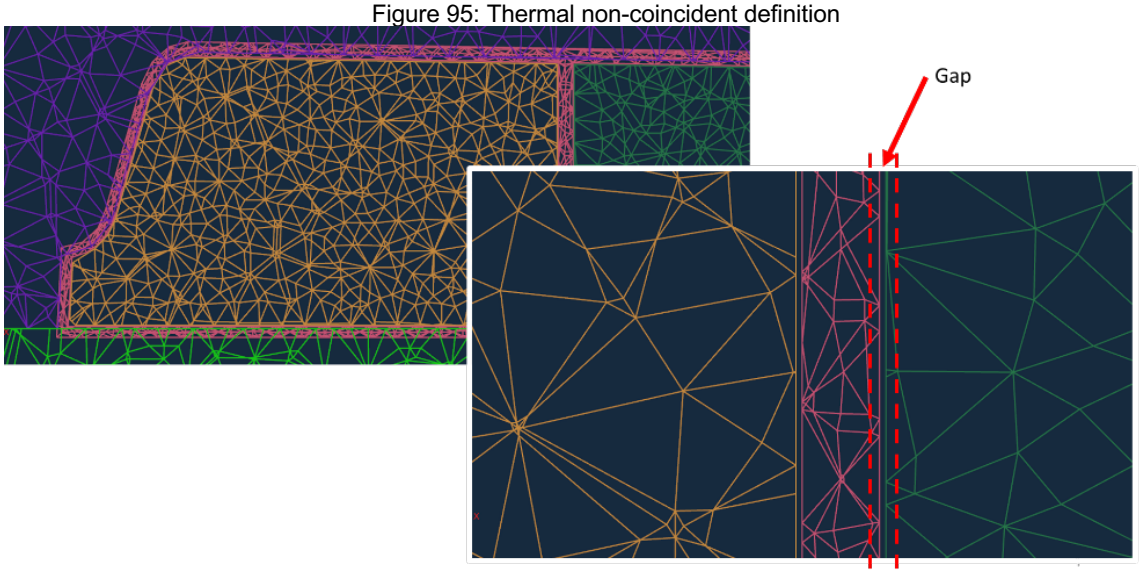


Figure 96: Example of mesh non-coincidence in test case

2. To define the interface, first, the surface pair between the parts need to be selected (Figure 82). Then, the tolerance values are needed, which are commonly half of the element size used (see meshing section) or the magnitude of misalignment (overlap or gaps) between meshes. Finally, a heat transfer coefficient between the materials of the parts in the interface is needed, which can be found in the JIDEP material passport.

3. The interface needs to be defined between each contact pair of the parts in the model to appropriately simulate the heat transfer in the assembly (see Figure 82).

6.3.4 Analysis and Results

1. Once all the interfaces have been defined, the model is complete, and the simulation is ready to run. To do so, go to RTM run simulation, and it will open the start simulation. When the simulation is started, a log can be displayed that shows the progress of the simulation (see Figure 84).

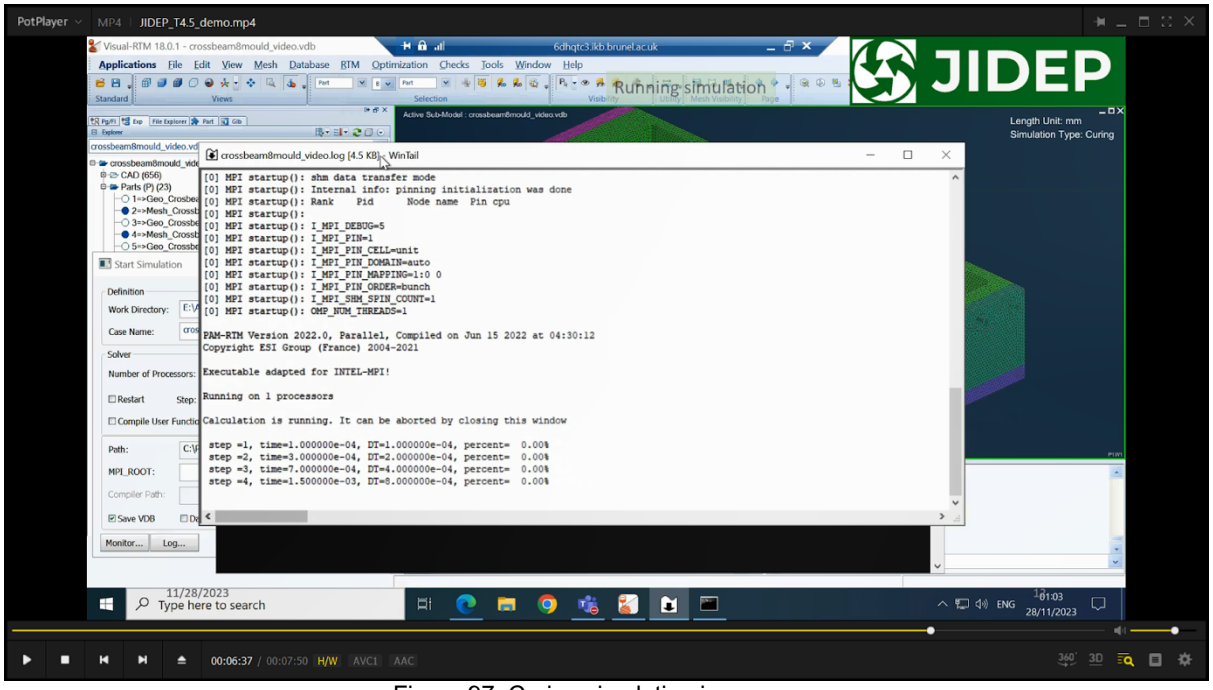


Figure 97: Curing simulation in progress

2. When the simulation is complete, the results can be accessed by going to RTM Load results, which will switch the module to Visual Viewer (see Figure 15)

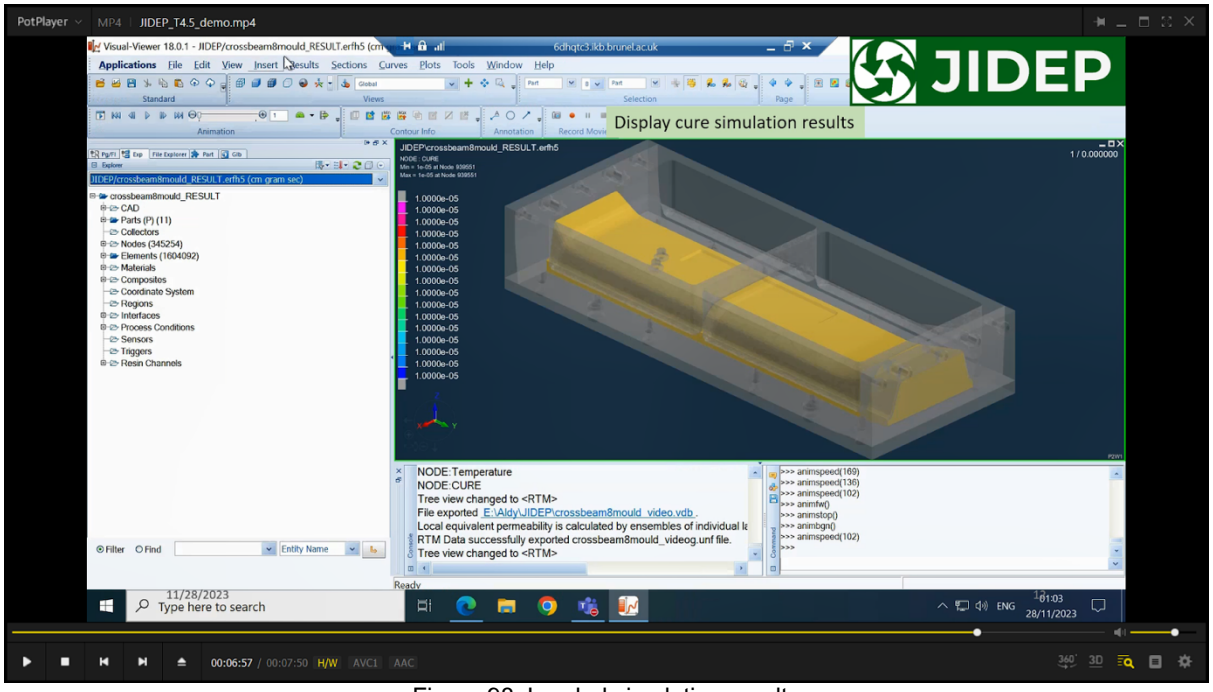


Figure 98: Loaded simulation results

3. To view the results, go to results contour, and a list of available results will be displayed. To view the curing condition, choose the CURE option (see Figure 86). This should display the cure condition of the part at the start of the simulation (time 0s, see Figure 86).

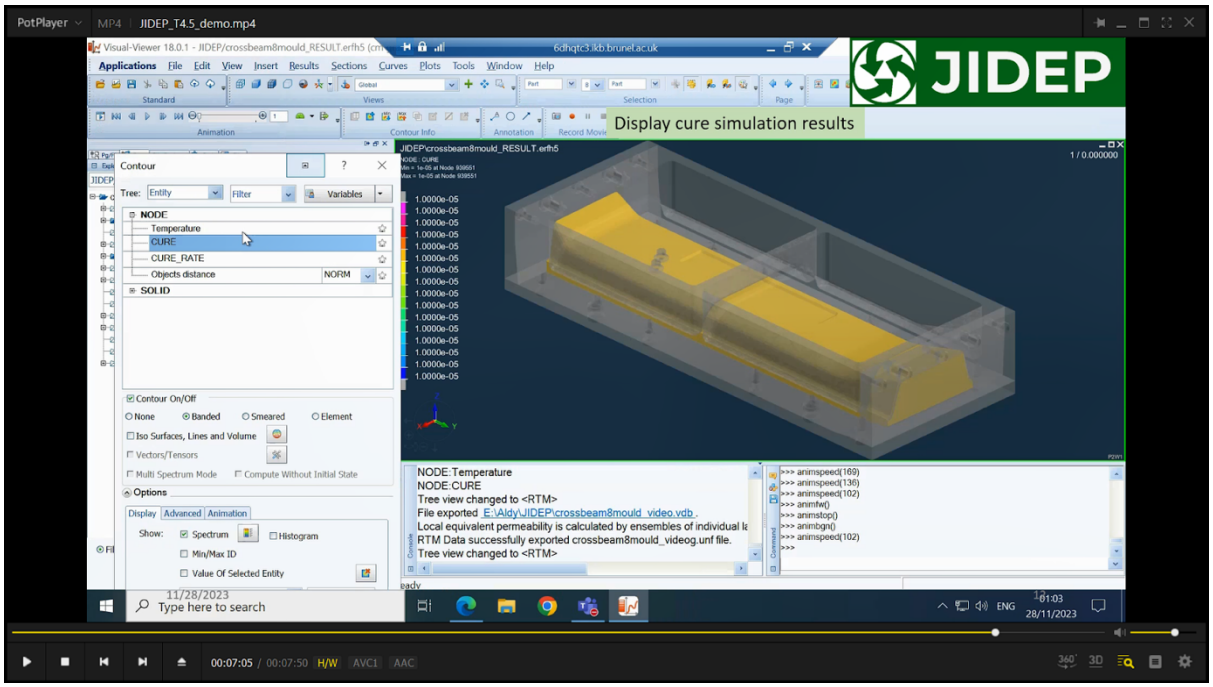


Figure 99: Selecting contour results to visualize

4. To view how the cure condition changes with time, go to the animation tab on the toolbar, where you can select play, pause or move 1 frame at a time (see Figure 87). The contour will display a range from 0-1 with 0 being completely wet/uncured and 1 being completely cured.

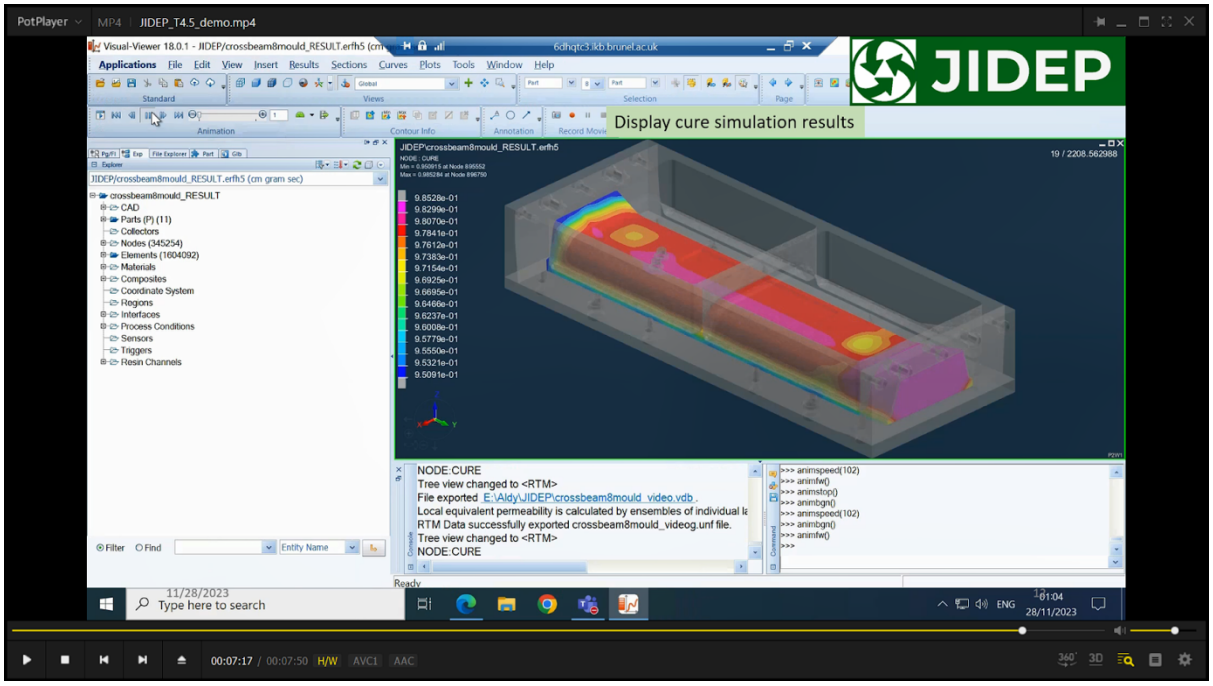


Figure 100: Cure simulation results at 2208s

7. PCB Analytic Tool

7.1 Description

The PCB analytic tool uses camera vision to recognize PCBs or PCB component types, such as processors, capacitors, resistors, etc., and the component locations on the PCB.

The tool has two approaches depending on the PCB. If the PCB is registered in the database, the analytic tool classifies the PCB and generates a Bill of Materials (BOM) with a unique identifier. On the other hand, if the PCB is not registered in the database, the analytic tool proceeds with a detection approach, which identifies each PCB component and generates a BOM with a unique identifier.

7.2 Key Features

Table 6 Key Features of PCB Analytic Tool

Feature number	Feature name	Tool Approach
F001	PCB Classification	Classification
F002	PCB Component Detection	Detection
F003	Unique Identifier Generation	Classification / Detection
F004	BOM Generation - PCB	Classification
F005	BOM Generation - Component	Detection

7.3 Operation Manual

After opening the PCB analytics tool, the user is prompted to use either an image of a PCB (energy-saving mode) or a direct video feed to analyse the PCB. After the user

presses the 'Detect' button, the analytics tool starts searching the database. If the PCB is 'known', the analytics tool uses the F001 Classification approach to predict the PCB. If the prediction confidence is high enough, the user is prompted to click 'Generate Material Passport'. Then, the analytics tool uses feature F003 to generate a unique serial number for the processed PCB and feature F004 to generate a BOM based on the classification approach.

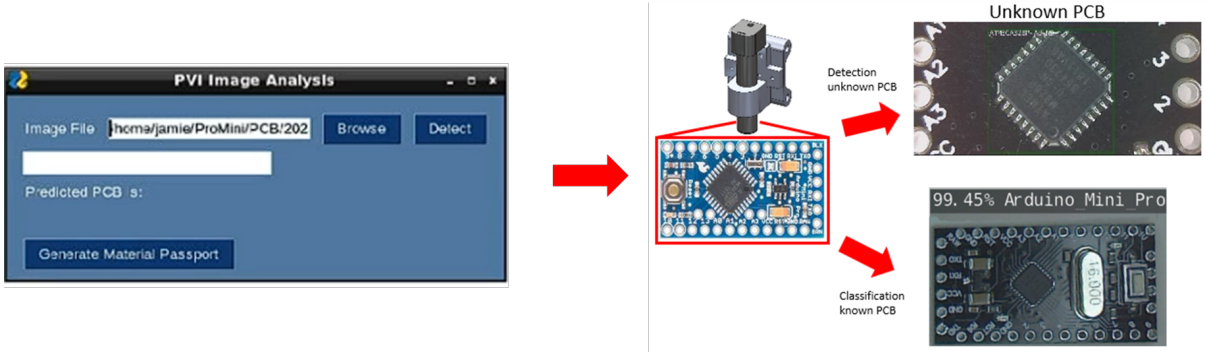


Figure 101 - PCB analytic tool analysis approach based on features F001 and F002.

If the PCB is 'unknown' or not in the database, the analytics tool uses the F002 Detection approach. First, the analytics tool uses feature F003 to generate a unique serial number for the new PCB. Next, the tool begins to take macro images of the PCB and stitches them to create an HD image of the PCB while locating and creating coordinates for each PCB component. Once the process is done, and the PCB components are identified, the user is prompted to click 'Generate Material Passport'. Then, the analytics tool uses feature F005 to generate a BOM of the unknown PCB based on the detection approach.

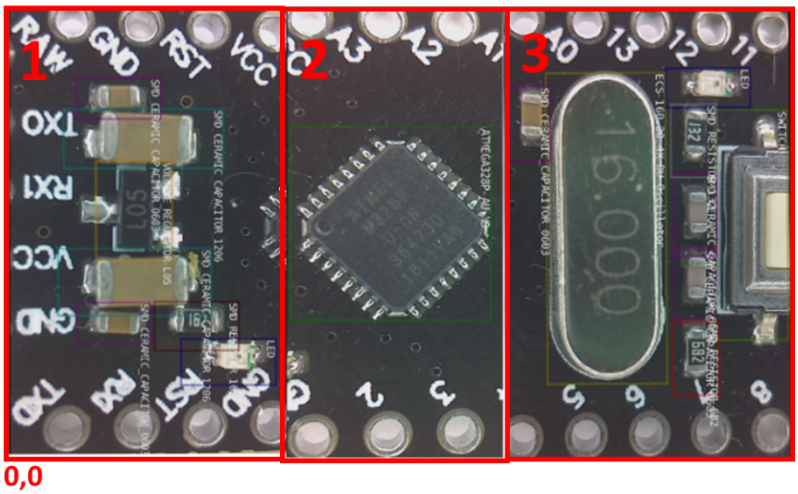


Figure 102: PCB analytic tool feature F002 detection approach.

8. Environmental Analytic Tool

Envionmental Analytic Tool is still in development, we will provide the operation manual in next version of this deliverable.

9. Troubleshooting

9.1 Common Issues and Solutions

9.1.1 Data Validation Errors:

Symptom: The system rejects input data, indicating validation errors.

Solution: Review each field for proper data format. Ensure numerical values are accurate, percentages are within the valid range, and text inputs meet character limits. Error messages often guide you to the specific issue.

9.1.2 Calculation Discrepancies:

Symptom: Circular indicator values seem inconsistent or unexpected.

Solution: Verify that all input parameters align with the intended material assessment. Double-check the weight units, percentage values, and other numerical inputs. If discrepancies persist, consider recalculating with a fresh set of inputs.

9.1.3 Unresponsive Interface:

Symptom: The tool responds slowly or freezes during use.

Solution: Check your internet connection for stability. If the problem persists, try accessing the tool during non-peak hours. Clear your browser cache or switch to a different browser to rule out local issues. Contact support if the problem persists.

9.1.4 Missing Data:

Symptom: Inability to locate specific data.

Solution: Confirm that the data is added correctly to the system. Check for typos or variations in the fields. If the issue persists, contact support for further assistance.

9.1.5 Compatibility Issues:

Symptom: Display issues or functionality problems specific to certain browsers.

Solution: Ensure you are using a supported browser. Update your browser to the latest version or try an alternative browser to see if the issue persists. Check for the tool's recommendations on browser compatibility.

9.1.6 Persistent Issues:

Symptom: Problems persist despite attempted solutions.

Solution: Contact concerning tools development team for support with detailed information about the issue, steps leading to the problem, and any error messages received. The support team is here to provide personalized assistance.

10. Conclusions

With the final version of deliverable D4.1, the JIDEP project achieves a significant milestone in advancing sustainable and innovative industry solutions. The Environmental Analytic Tool, Material Passport, Circularity Calculator, and advanced analytical tools for composite material structures and PCBs collectively reflect our dedication to promoting sustainability, transparency, and technological excellence. The Collaborative Space, Material Passport, Circularity Calculator, and Environmental Analytic Tools are accessible through the JIDEP platform at https://jidep.co. However, the Analytical Tool for Composite Material Structures and PCB Analytic Tool, developed solely as independent tools, is currently exclusive to consortium members, highlighting the unique benefits of being part of our project. By promoting collaboration, embracing innovation, and prioritizing environmental responsibility, we are paving the way for a brighter, more responsible future for industries worldwide.