PROJECT DELIVERABLE REPORT

Grant Agreement Number: 101058732

Joint Industrial Data Exchange Pipeline

Type: DEM- Demonstrator, Pilot, Prototype

D5.4 Use Case 3 Incremental Demonstration Report

Issuing partner	PVI
Participating partners	PVI, UPCE, ADS
Document name and revision	D5.3 v.01
Author	Oliver Buchan (PVI)
Deliverable due date	September 30, 2024
Actual submission date	October 31, 2024

Project coordinator	Vorarlberg University of Applied Sciences
Tel	+43 (0) 5572 792 7128
E-mail	florian.maurer@fhv.at
Project website address	www.jidep.eu

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	

Contents

Executive summary 3

1 Use-Case-3 demonstration plan 4

2 Use-Case-3 demonstration results 5

2.1 JIDEP testing – UPCE 5

2.2 JIDEP demonstration – UPCE 6

2.3 Input data acquisition for material passport creation for MCU ATMEGA4809 in JIDEP platform 7

2.4 JIDEP validation - UPCE 9

3 Conclusions and Next Actions 14

Executive Summary

This report confirms the demonstration-type deliverable results, by providing end-user validation activities (screenshots) of a live and working JIDEP system.

The report has extra associated materials (video summary), as well as partner presentations from the year-2 plenary session.

It should be noted that the report captures the state of the demonstrations for the M28, however the deadline for the completion of demonstrations is M32. Accordingly, certain demonstration activities are still ongoing.

1 Use-Case-3 Demonstration Plan

The overall UC3 demonstration plan anticipates industrial cooperation between LEs, SMEs and Academia by placing JIDEP at the core of this collaboration.

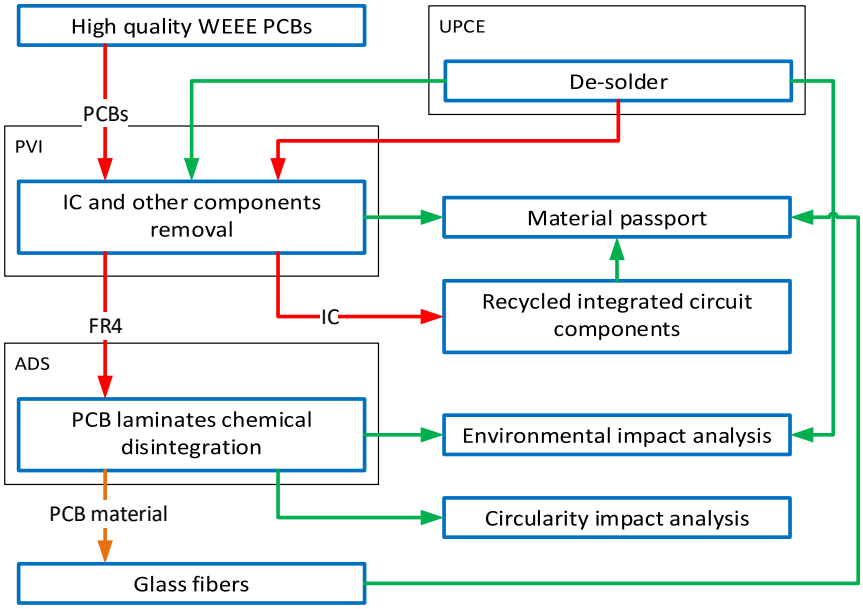

Figure 1: UC3 demonstration plan

As depicted in the above figure, the plan distinguishes 6 activities, 3 of which have already been completed, and the remaining 3 are ongoing.

Step	Demonstration activity	Activity end date	Actual start date	Status
1	Removing SoA ICs and other components from the high-quality WEEE PCBs (the PCB) (PVI)	2024 05	2022 12	Completed
2	Providing the PCB laminates to ADS for chemical disintegration (PVI)	2024 06	2022 11	Completed
3	Green chemical decomposition of the PCB (ADS)	2024 07	2022 11	Completed
4	Providing de-solder to PVI (UPCE)	2024 08	2023 12	Completed
5	Circularity impact analysis (ADS)	2024 09	2024 10	Ongoing
6	Environmental impact analysis (ADS, UPCE)	2024 10	2024 10	Ongoing

2 Use-Case-3 Demonstration Results

2.1 JIDEP Testing – UPCE

UPCE was a very proactive acceptance tester of the JIDEP platform. Numerous issues were raised during the testing and validation phase.

UAT Team & Hardware			
Company Name	**Tester Name**	**Operating System**	**Browser**
<Provide your company name>	<Provide your Name>	<Provide your OS name and version>	<Provide your Browser name and version>
University of Pardubice	Tomáš Syrový	Windows 11 Ent EDU	Chrome 127.0.6533.120

UAT Scope (In Scope – Out of Scope)	
UAT - In Scope	**UAT - Out of Scope**

UAT Test Results					
ID	**Test Cases**	**PASSED / FAILED**	**Tested By**	**Date Tested**	**Issues / Comments**
UAT1	*User registration*	Passed	Tomáš Syrový	25.7.2024	
UAT2	*User authentication*	Passed	Tomáš Syrový	25.7.2024	
UAT3	Material passport creating for PCB in standard configuration	Passed	Tomáš Syrový	21.8.2024	
UAT4	Material passport creating for CFRP car beam in "green" configuration starting from data of UAT3 (copy paste + changes)	Passed	Tomáš Syrový	26.8.2024	
UAT5	Search and view of "external" (from other users) Material passports in the platform	Passed	Tomáš Syrový	26.8.2024	
UAT6	Publication of Material passports in Market place	Passed	Tomáš Syrový	26.8.2024	
UAT7	Remove of Material passports from Market place	Passed	Tomáš Syrový	26.8.2024	
UAT8	Modification of existing Material passport (CFRP car beam in "green" configuration)	Passed	Tomáš Syrový	26.8.2024	
UAT9	QR code scan to view existing material passport	Passed	Tomáš Syrový	26.8.2024	
UAT10	View of existing material passport data	Passed	Tomáš Syrový	26.8.2024	

2.2 JIDEP Demonstration – UPCE

In UC3, PVI presented automated PCB and component identification in a machine vision environment, and UPCE presented the development of a desoldering paste for the selective disassembly process of electronic components from printed circuit boards.

PVI's machine vision software is capable of rapidly identifying whole PCBs, or individual components, rapidly and with high levels of confidence. The associated databases (for both PCBs and components) are capable of on-the-fly training and manual updates as new items are identified as of interest to the process.

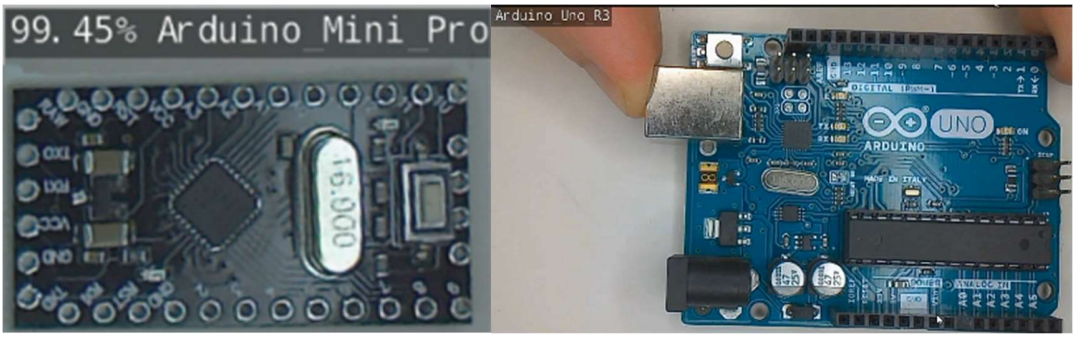

Figure 2: Machine vision identification of whole PCBs

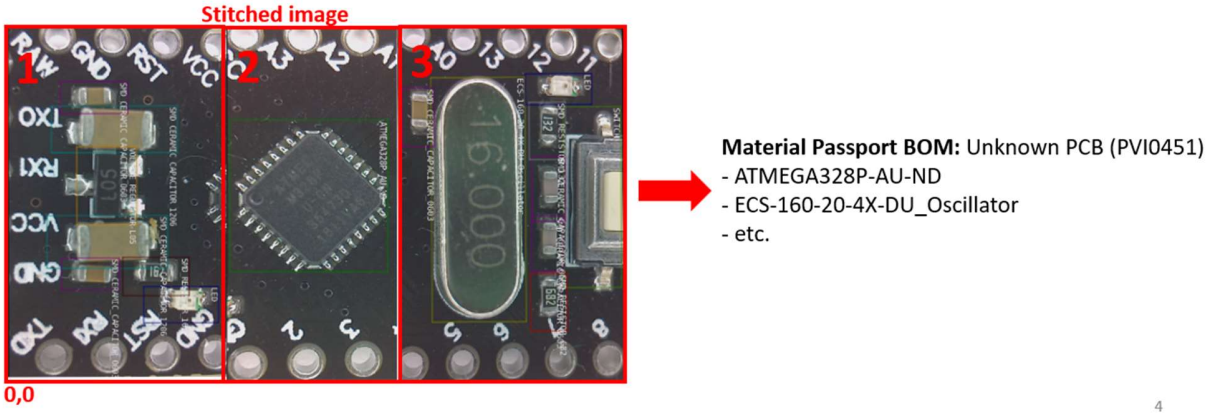

Figure 3: Machine vision identification of components on PCBs

UPCE's desoldering/etching paste is printed on the component parts by microdispensing technology using a collaborative robot. The essence of the technology is that the desoldering paste is applied to the printed circuit board in a targeted manner in specific areas of the solder joints of selected electronic components, thereby releasing the selected electronic component from the PCB. After the application of the desoldering paste and its reaction, the majority of the solder, which was used to attach the electronic component to the printed circuit board, will be locally etched away, and subsequently, the undamaged electronic component will be released from the PCB. The method of component disassembly can be applied in recycling processes when undamaged electronic components are obtained from the PCB, which are sorted after inspection and can be offered on the secondary market.

2.3 Input data acquisition for material passport creation for MCU ATMEGA4809 in JIDEP platform

In the procedure presented, an efficient desoldering paste of batch 'JIDEP 89' was used. The ATMEGA4809 MCU was disassembled from Arduino Nano Every.

The DOBOT collaborative robot and the microdispensing printhead were used for printing. The PCB was inserted into the foam bed. The etching paste was introduced into the cartridge, and the printing pressure was 200 kPa. The movement of the print nozzle around the MCU contacts (Fig. 1) was programmed in the programming interface.

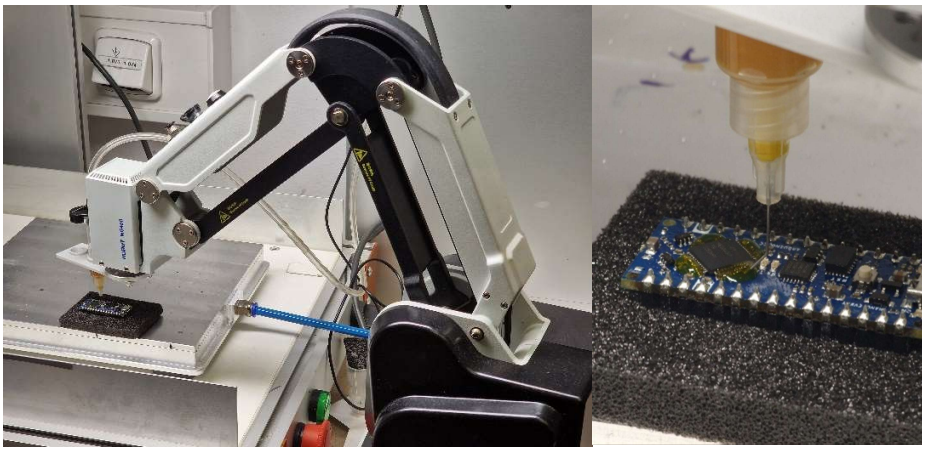

Figure 4: Collaborative robot with mocrodispensing printing head, printing of desoldering paste on pads of MCU at Arduino Nano PCB.

Subsequently, the desolder paste was printed on the MCU contacts (Fig. 1). The entire PCB was placed in a Petri dish of water and the dish was sealed. This was placed in a Memmert UF75 hot air dryer with a temperature of 60 ° C. After 30 minutes, the pan was removed and the MCU was removed from the PCB using tweezers. When the chip was lifted, there was no resistance, so it can be concluded that the etching was effective. Around the pins of the MCU were residues of the reaction mixture/reaction product which had the consistency of a very thick gel (Fig. 2b, 3a). This material was transferred to a vial containing the liquid after the MCU was washed with distilled water. The contents of the vial could further be selectively precipitated, for the isolation of metals such as Fe, Sn, etc. The cleaned and dry MCU ATMEGA4809 (Fig. 4) was weighted (138,9 mg) and the material passport on the JIDEP platform was created.

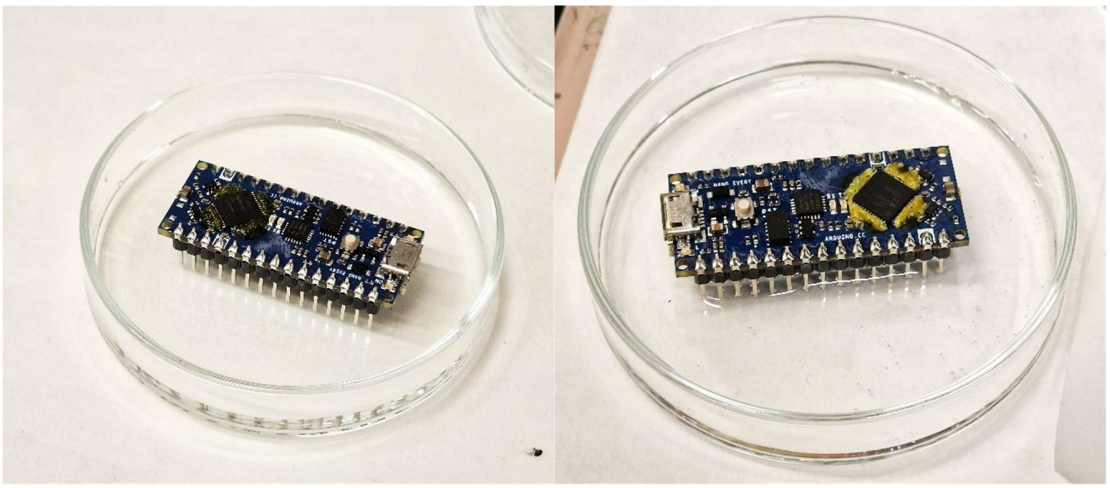

Figure 5: Left: PCB with printed desoldering paste immediately after printing, right: PCB with printed desoldering paste after 30 'embedded in 'heat wet' at a temperature of 60 ° C.

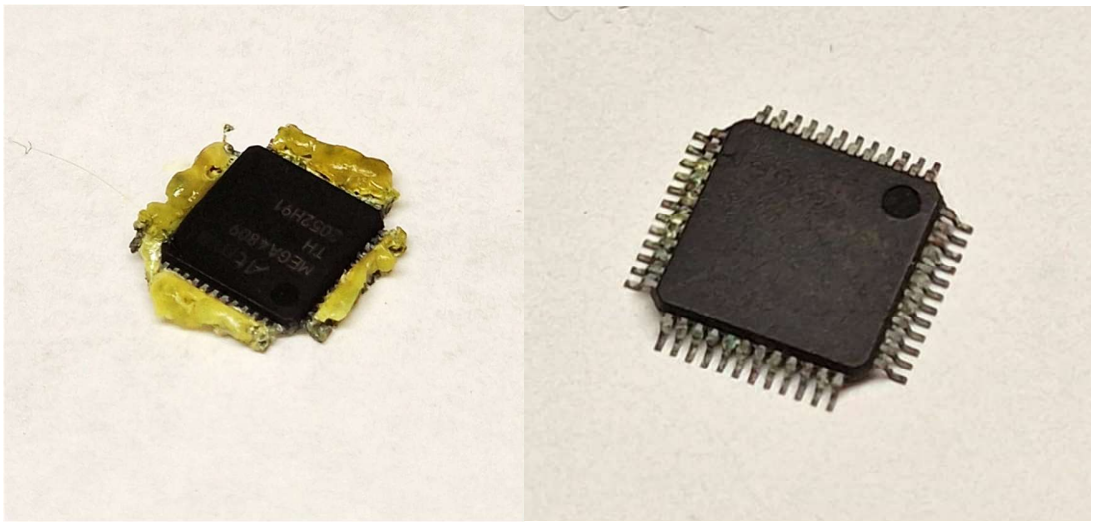

Figure 6: Left: PCB with printed desoldering paste immediately after printing, right: PCB with printed desoldering paste after 30 'embedded in 'heat wet' at a temperature of 60 ° C.

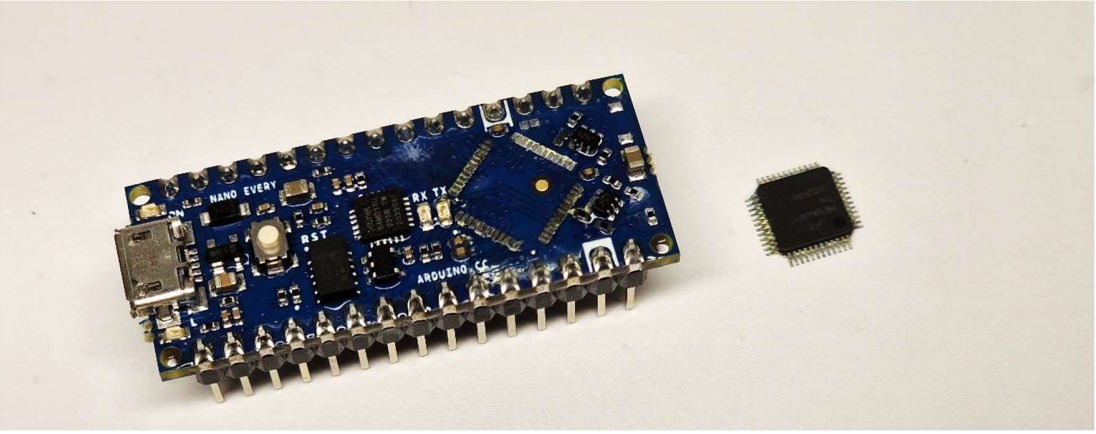

Figure 7: MCU ATMEGA4809 and PCB Arduino Nano Every after cleaning process

2.4 JIDEP Validation - UPCE

UPCE and PVI can confirm that JIDEP product passport works without major issues.

UPCE has created a material passport for the desolder past that has been created during the project's R&D phase.

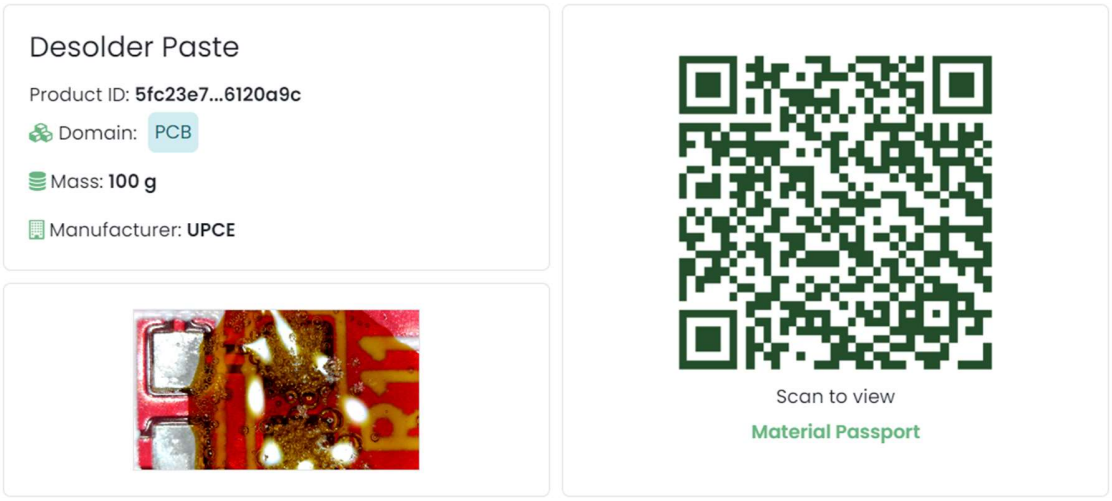

Figure 8: MCU ATMEGA4809 and PCB Arduino Nano Every after the cleaning process

The sub-assembly future has proved very effective at segregating products into distinct materials.

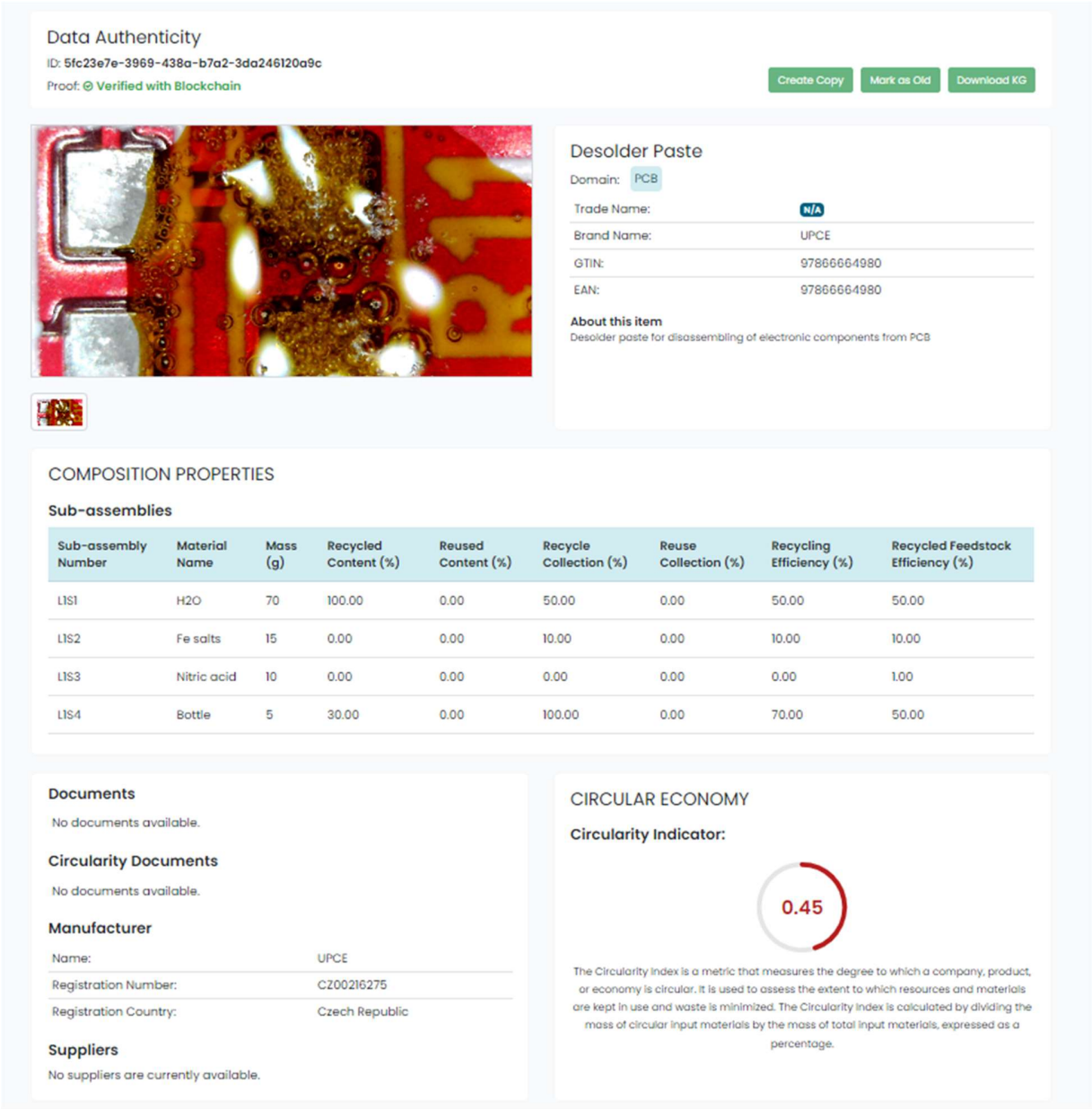

Figure 8: Material-product passport composition properties of desoldering paste (UPCE)

By being able to recover the integrated circuit elements from the waste electrical equipment, UPCE has also enlisted those components within the JIDEP platform, as new products.

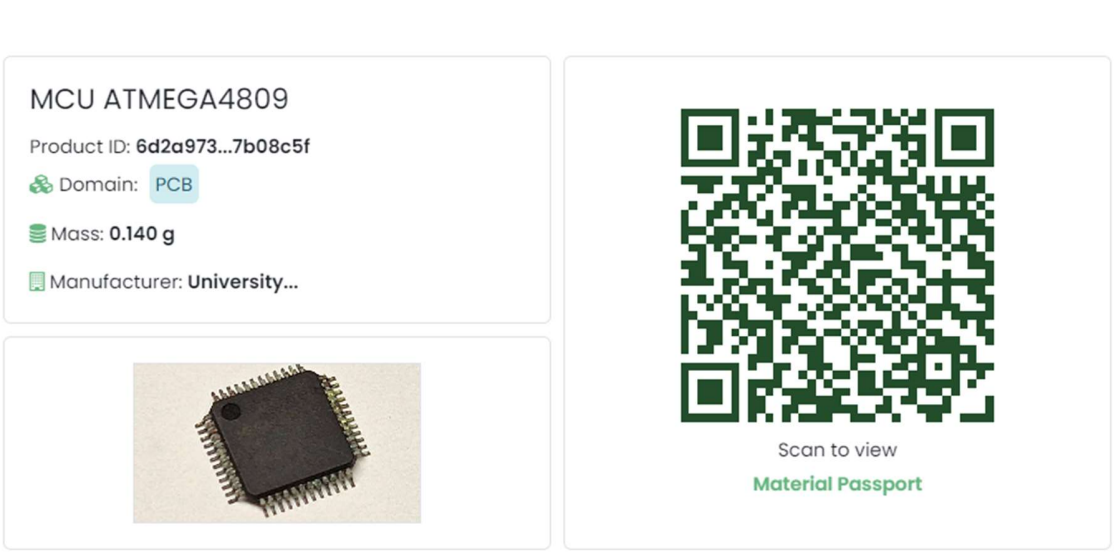

Figure 9: Material-product passport of recovered/upcycled integrated circuit (UPCE)

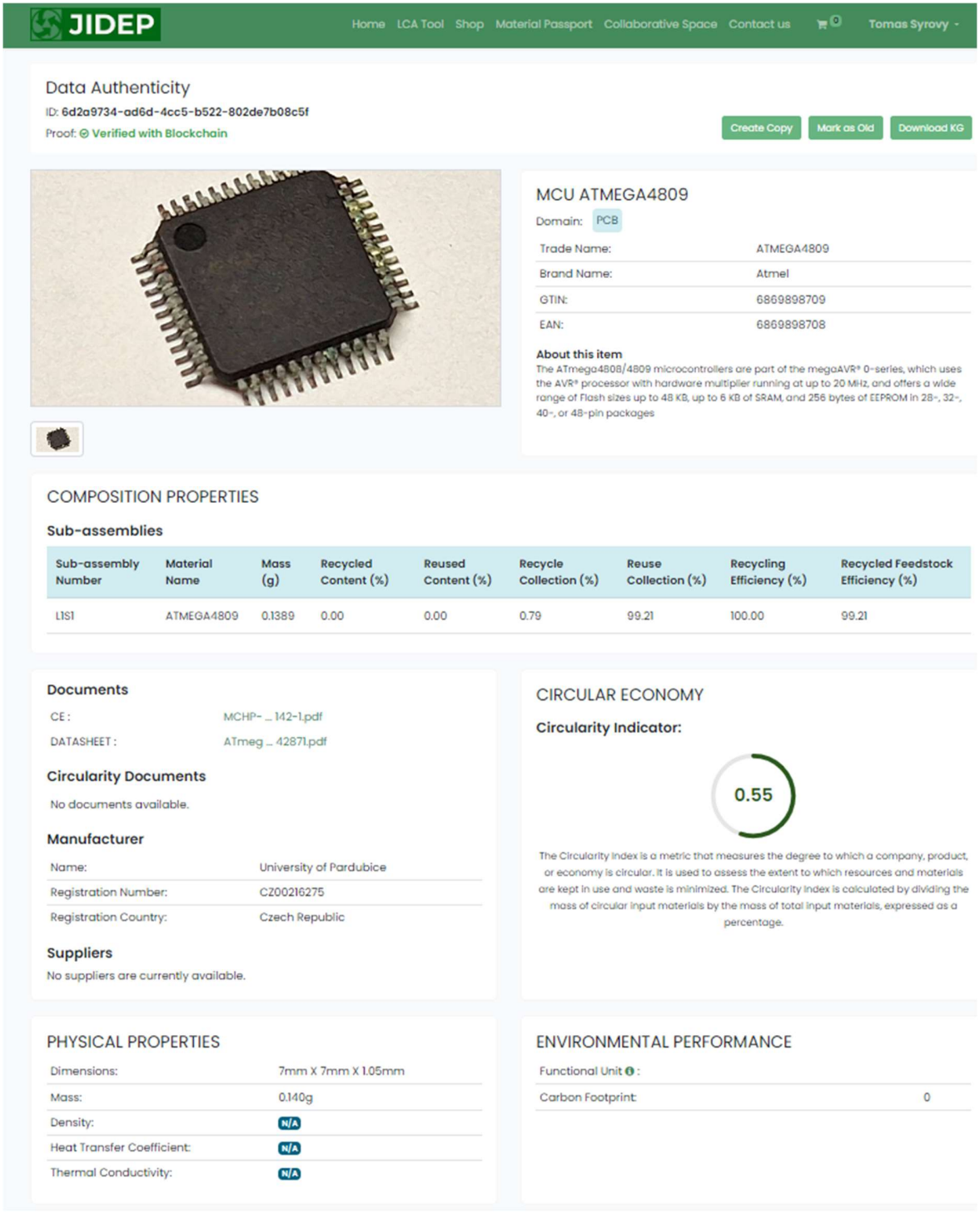

Figure 10: Material-product passport of recovered/upcycled integrated circuit (UPCE)

It was thus possible for UPCE to also perform the LCA calculation, which worked fine.

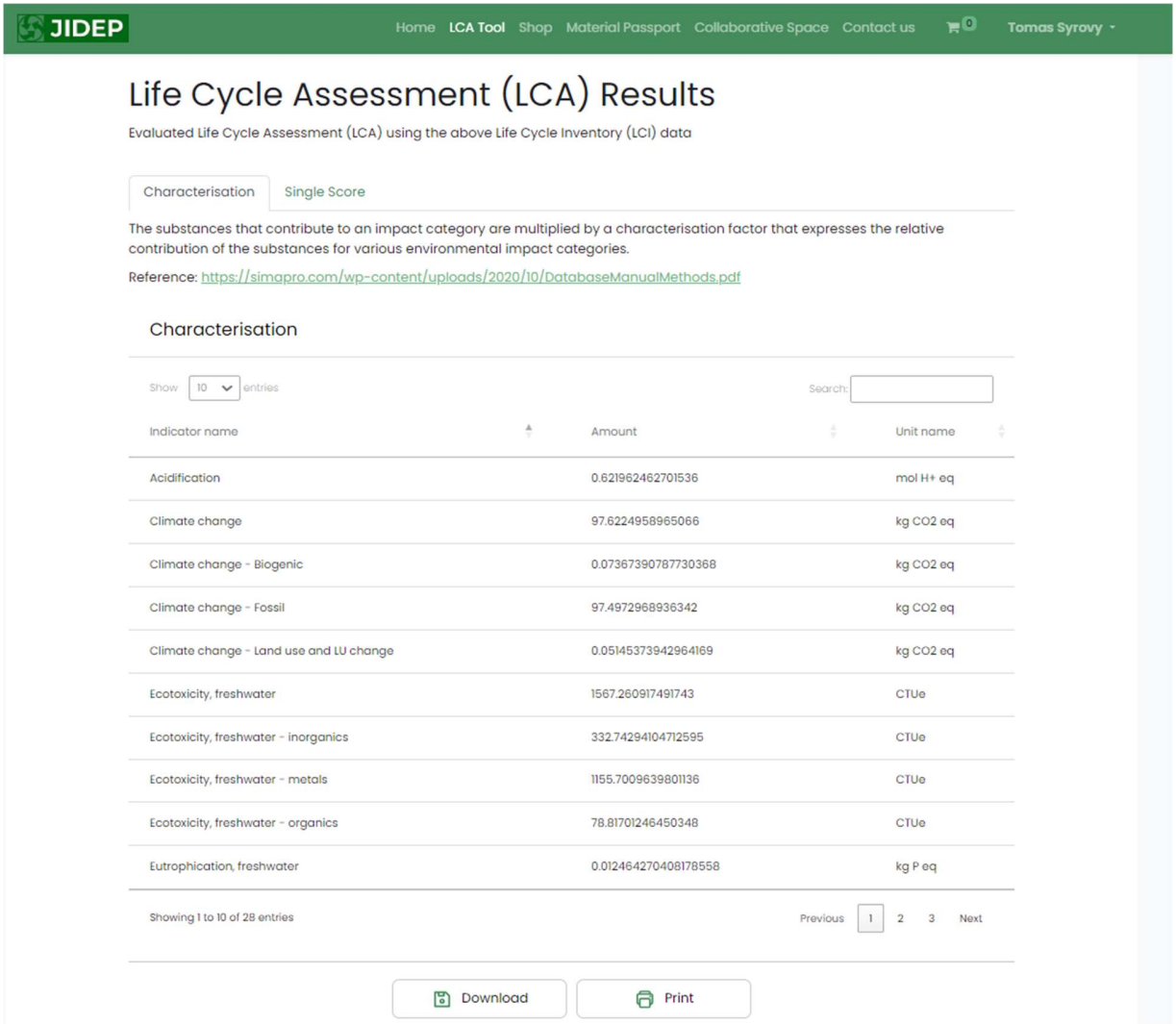

Figure 11: Material-product passport of recovered/upcycled integrated circuit (UPCE)

3 Conclusions and Next Actions

UPCE, together with PVI, confirms that the JIDEP platform, including its constituent tools, is fit for production use.

However, certain areas for future development are recommended:

1) Introduction of product passport template system
    a. In particular, ADS asks for the capability to provide metrics for non-homogeneous materials (varying length, thickness, mass density)
    b. the capability to describe materials or devices by custom physical characteristics (conductivity, resistance, spectral characteristics, opacity, etc.)
2) Introduction of custom LCA methods for organizations to define their own, not yet certified, environmental accountability metrics
3) Capability to provide other types/classes of materials, as recommended by ADL (§2.2)
4) Bulk data-upload capabilities whereby a user may generate their own spreadsheet of input values for the JIDEP platform (likely using much duplicated information) and have the JIDEP platform automatically create an entry for each line item.
5) Bulk data-export for every user-owned entry in JIDEP, for the purposes of checking and validating large quantities of entries, and potential subsequent bulk-updates.

Notice that ADS, the WP5 lead and a joint partner in all 3 use cases has confirmed, that the chemical recycling of non-flammable glass-epoxy boards, which are compound elements of electrical printed circuit boards (PCBs), is not possible due to the high resistance of FR4-type materials to chemical etching. For this reason, ADS could not enlist the recovered glass fibers from the PCBs in the context of Use-Case-3. Nevertheless, ADS spent significant effort in Use-Case-1 and Use-Case-2 testing and validation activities. For this reason, the demonstration efforts of ADS will not be duplicated in this deliverable report.