

European Connected Factory Platform for Agile Manufacturing



European Factory
Platform

WP9: Implementation of Embedded Pilots and Validations

D9.1: Implementation and Validation through Pilot-1 Vs: 1.0

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Short Abstract

The deliverable describes the implementation and validation of different technology solutions in the Aerospace Pilot of the EFPP project.

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This deliverable is subject to final acceptance by the European Commission.

Further Information

www.efpf.org

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Project Partners:



Executive Summary

The purpose of this document is to structure and document the actions carried out by the EFPF partners concerning the aerospace pilot, with a particular focus on pilot specific requirements validation, user value proposition and EFPF solutions' usability aspects.

The deliverable covers the planned pilot activities as described in D2.3 as well as the additional ones resulting from the feedback of the EU reviewers (official review on 02.09.2020), which reads as follows:

"Good overview and progress of the pilot applications are provided; however, these applications should be clearly linked with pilot requirements. The validation of requirements is not clearly visible. Also, it was not entirely clear how these applications will be used by the target users, e.g., on Cloud or in the premise."

"The workplace environment solutions (with Visual Analytics) received reviewers praise. A suggestion was to check whether compliance with any regulations can be achieved through this solution."

Therefore, this document will link the software applications tools and services developed in the EFPF project (in the following, generally referred to as solutions) to the existing requirements in aerospace. Additionally, for both existing and new user requirements, the validation strategies are defined, and practical validation activities are documented. Moreover, this deliverable describes how the EFPF solutions, which have been developed based on the pilot partners' requirements, can deliver a value proposition to the target users in the aerospace sector. Afterwards, each developed solution is evaluated with the help of a focused set of questions to assess the perceived usability and the essential features and benefits.

This document describes the existing and additional aerospace user stories/requirements developed during the past months. The additional ones were not part of the requirements document (D2.3) submitted initially to the EU in the early stage of the project. The updates in the requirements were necessary because after the leave of the partner Airbus from the project, some use cases related to the Airbus interests were no longer desirable and implementable in the pilot. The new use-cases are more representative of the aerospace SME needs for digitalisation, lot-size-one and connected factories scenarios. The new requirements use the predefined structure with relevant epics, user stories and activity diagrams; and are maintained in the JIRA repository.

The COVID19 crisis influenced the implementation phase of this pilot. Some companies were not accessible during the second and third wave in Germany and other European countries. That's why a delay of four months in the WP9 for all the pilot solutions was announced to the EU commission, and an adequate amendment was generated.

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0 Introduction

0.1 EFPF Project Overview

EFPF – European Connected Factory Platform for Agile Manufacturing – is a project funded by the H2020 Framework Programme of the European Commission under Grant Agreement 825075 and conducted from January 2019 until December 2022. It engages 30 partners (Users, Technology Providers, Consultants and Research Institutes) from 11 countries with a total budget of circa 16M€. Further information can be found at www.efpf.org.

To foster the growth of a pan-European platform ecosystem that enables the transition from "analogue-first" mass production to "digital twins" and lot-size-one manufacturing, the EFPF project will design, build, and operate a federated digital manufacturing platform. The platform will be bootstrapped by interlinking four base platforms from FoF-11-2016 cluster funded by the European Commission early on. This will inform the design of the EFPF Data Spine and the associated toolsets to fully connect the existing user communities of the four base platforms. The federated EFPF platform will also be offered to new users through a unified Portal with value-added features such as single sign-on (SSO), user access management functionalities to hide the complexity of dealing with different platform and solution providers.

0.2 Deliverable Purpose and Scope

The purpose of this deliverable, "D9.1 Implementation and Validation through Pilot-1", is to document the activities in the project with a particular focus on the aerospace pilot.

0.3 Target Audience

The deliverable is declared public, and therefore its content can be used to raise the awareness of the project among broader audiences.

0.4 Deliverable Context

This document is one of the cornerstones for achieving the project aims. Its relationship to other documents is as follows:

- **Description of Action (DOA):** Provides the foundation for the actual research and technological content of EFPF. Notably, the Description of Action includes a description of the overall project work plan.
- **Project Handbook (D1.1):** Provides the foundation for the practical work in the project throughout its duration and helps to ensure that the project partners follow the same well-defined procedures and practices in terms of information sharing.
- **Deliverable D2.3 (Requirements of Embedded Pilot Scenarios):** Contains the original user stories for the aerospace pilot with some defined requirements.
- **Deliverable D4.13 (Smart Factory Solutions in the EFPF Ecosystem):** Provides detailed descriptions of all developed solutions, which contain components, e.g., Data Spine and tools.

0.5 Document Structure

This deliverable is broken down into the following sections:

- **Section 0: Introduction:** An introduction to this deliverable, including a general overview of the project, an outline of the purpose, scope, context, status, and target audience of the deliverable at hand
- **Section 1: Aerospace Pilot:** Gives a short overview of the Aerospace Pilot and the user roles
- **Section 2: Pilot Implementations:** Describes the structure of user Stories, their parameters, and the link to the EFPP solutions
- **Section 3: Epics and User Stories:** Describes all User Stories in the Aerospace Pilot with the relevant parameters
- **Section 4: Concluding Remarks**
- **Annexes:**
 - **Annexe A:** Documentation of Questionnaires for End-User Validation
 - **Annexe B:** Document History

0.6 Document Status

This document is listed in the Description of Action as "public".

0.7 Document Dependencies

This document has no preceding documents or further iterations.

0.8 Glossary and Abbreviations

A definition of standard terms related to EFPP, as well as a list of abbreviations, is available at <https://www.efpf.org/glossary>.

0.9 External Annexes and Supporting Documents

- None external annexes or documents are available

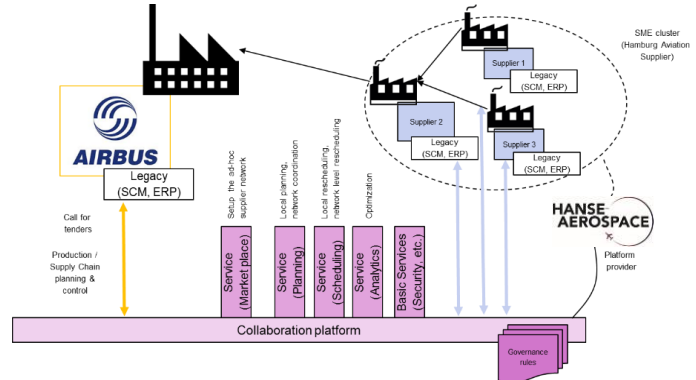
0.10 Reading Notes

- None

1 Aerospace Pilot

1.1 Short Description

In the aerospace manufacturing sector, highly customised commercial aircraft products often require precise solutions developed and provided by small but innovative high-tech companies. The customer demands, e.g., for novel cabin features, must be developed and produced quickly with OEMs and high-tech SMEs' close collaboration. This typically requires an ad-hoc production/supply network, and



currently, this is best served via a local cluster around the OEM. As soon as the parties are geographically separated, the OEM and the innovative SMEs (organised in industrial clusters) need ICT solutions (technical platform, novel governance approaches, coordination tools and services) to simplify the ad-hoc setup and management of collaborative production in the agile network and to manage the IPR, etc.

The Aerospace Pilot in the EFPF project addresses the ad-hoc setup of a production network involving local SME suppliers represented by the Hanse-Aerospace (HAW) association. This pilot focuses on realising two high-level scenarios:

- OEMs like Airbus is interested in rapidly integrating SME innovations into existing aircraft programs and building agile supply chains. Existing Airbus tools and platforms need complementary solutions for integrating SMEs directly into the supply chain. These solutions, such as tender decomposition, match-making, team building and smart contracting, can be provided by the EFPF platform
- SME clusters like Hanse-Aerospace and its member companies expect mature digital manufacturing solutions for supporting agile collaborations between SMEs, shop floor connectivity and data analysis. EFPF can provide a unified interface to distributed solutions to address the diverse digitalisation needs of SMEs in the aerospace sector

An overview of Aerospace Pilot stakeholders and expected outcomes is provided in the following table:

Classification Type	Pilot: "Ad-hoc Supplier Network in the Aviation Domain"
Problem description	<ul style="list-style-type: none"> • Setup and management of complex supply chains in the aviation domain, involving local SMEs organised in industrial clusters for lot-size-one products, e.g., aircraft • Ad-hoc collaborations within a local SME network using a technology platform that facilitates the visibility of distributed activities through the adoption of smart factory solutions
End-users	WOM, IAI, AAM, 3DI, HAW
End-user type	OEM, SMEs, Associations
Product type	Highly customised aircraft modules and services

1.2 User Roles

The user roles defined in the Aerospace Pilot include:

- **Purchasing Manager/ Procurement Manager/ (Strategic) Buyer /Ordering Officer:** These roles belong to the purchasing department in a manufacturing company and are involved in purchasing processes
- **Sales Engineer/ Sales Manager/ Director Sales:** These roles belong to the sales department of a manufacturing company and are responsible for product sales related decision making
- **Engineer (Design/ Product/ Qualification etc.):** This role belongs to the Engineering Department and is involved in the product design and development phases
- **Project Manager/ Project Leader:** This role belongs to the Project Management Department and is responsible for the management of running (e.g., production) projects
- **HR Manager/ Personnel Officer:** This role belongs to the HR Department and is involved in the recruitment and human resource management activities
- **Marketing Manager:** This role belongs to the Marketing Department and is responsible for company and product marketing activities
- **Customer Service Manager/ Customer Support Manager:** This role belongs to the Customer Service Department and is responsible for the customer support, service, and relationship management
- **Quality Manager:** This role is essential for companies as the quality managers secures the correct execution of processes and observances of all company relevant regulations and standards. Furthermore, the quality manager oversees improving processes where necessary and possible.

These User Roles are used to describe user stories, if applicable, to show the developers which users will use which processes and functions in the developed solutions.

2 Methodology Pilot Implementation

During the requirements elicitation process, the pilot requirements were documented as epics, user stories and activity diagrams. In the context of the EFPF project, these terminologies mean the following:

- **Epic:** An epic is a big chunk of work with one common objective, e.g., a business function or business requirement. One epic can be broken down into several user stories
- **User Story:** A user story is an informal, natural language description of one or more features needed of the EFPF platform and federated ecosystem.
- **Activity Diagram:** An activity diagram is a way to describe a process by representing the flow from one step to another, where a step can relate to an operation either by a human, organisation, or software. We use activity diagrams to represent user stories in more detail.

The documentation of requirements in the form of epics, user stories and activity diagrams allowed technical teams to quickly understand the required features (e.g., new technology or enhancement in existing technology) from target users' perspective. The pilot requirements in this deliverable will provide the basis for the definition of platform requirements (in D2.4), which will describe what is needed to deliver the federated EFPF platform in several iterations.

2.1 User Stories

A user story is an informal, natural language description of a software system's features. User stories are written from the perspective of an end-user. The user stories' scope is carefully defined to facilitate ease-of-understanding for the development teams and serve as a basis for communication. In the EFPF project, a user story is composed of three parts:

- User role
- Desired action
- Received benefit

As an example: *As a <user_role>, I want <desired_action> so that <receive_benefit>*

Acceptance criteria complete each user story to verify and accept the implemented features. The acceptance criteria, which can also be referred to as "requirements", reinforce the user story's scope and provide a clear indicator for completing the required functionality. Each user story must have one or more acceptance criteria, allowing the technical teams to test when the user story's desired actions are implemented.

As an example:

Acceptance criteria: Capability to search for logistics services and retrieve results according to indicated parameters (i.e., origin, destination, delivery time, etc.)

2.2 Parameters of the User Stories (US)

Each User Story (US) includes the following parameters:

- **Short description:** Describes the User Story (US) in a comprehensive way
- **Requirements and acceptance criteria:** Show the criteria and their fulfilment in a comprehensive form
- **Fulfilment of US through EFPF:** Technical overview of the components involved in the implementation of the user story
- **Testing and evaluation:** Show examples from the testing and evaluation process
- **User value proposition:** Describes how the specific applications gain value proposition to the end-users
- **Compliance with Standards and regulations:** If relevant compliances are secured to specific standards and regulations, they will be indicated here
- **Lessons learned and Outlook:** End-users describe their experience during implementation and list all issues/problems faced for each US and the consequent effects or response by the relevant project. The technical partners' questionnaires were also used to collect the feedback in a structured manner.

2.3 Link to EFPF Tools and Services

The table below gives a comprehensive overview of the EFPF solutions to reference the reader quickly. For each solution is shown which EFPF components and tools are used. The solutions used in the aerospace pilot are marked bold.

It should be noted that the validation of Solution 10 (S10) is not reported in this deliverable since there is no requirement in the Aerospace Pilot User Stories related to it. All the experimentation and validation is part of the Hanse-Aerospace Cluster of innovative companies reported in D5.11 EFPF MatchMaking and Intelligent Gathering (M18). The following validation will be reported in D5.14 EFPF MatchMaking and Intelligent Gathering – Final report (M48).

No	Solution	Relates to Pilot	EFPF Components Covered	Tools and Services Covered
S 1a	Solution 1a: Production Optimisation (Predictive Maintenance)	Furniture	EFPF Portal, Data Spine – Message Bus, Data Spine – Integration Flow Engine, EFPF Security Portal (EFS), Service Registry	Industreweb Collect Factory Connector, FCGMT, Anomaly Data Solution (ADS), Predictive Maintenance Tool, Deep Learning Toolkit (DLT), ROAM Risk Tool, Secure Data storage
S 1b	Solution 1b: Production Optimisation (Operator Error)	Furniture	Data Spine – Message Bus, EFPF Security Portal (EFS), Service Registry	Industreweb Collect Factory Connector, FCGMT, Industreweb Display
S 2	Solution 2: Bin Fill Level Monitoring	Furniture CE	EFPF Portal, Data Spine – Message Bus, Data Spine – Integration Flow Engine, EFPF Security Portal (EFS), Service Registry	Visual and Data Analytics Tool, Symphony HAL, Symphony Event Reactor
S 3	Solution 3: Workflow and Service Automation Platform	Furniture Aero- space	EFPF Portal, Data Spine – EFPF Security Portal (EFS), Service Registry	WASP
S 4	Solution 4: Matchmaking Service	Aero- space CE	EFPF Portal, Data Spine – EFPF Security Portal (EFS), Service Registry	Federated Search, Base platform Marketplaces, Product Catalogue Service, Business Opportunities
S 5a	Solution 5a: Efficient Resources Management Solutions (Visual Detection)	Aero- space	Data Spine – Message Bus, Service Registry	Industreweb Collect, Factory Connector, AI Vision Service (FC component) Secure Data storage
S 5b	Solution 5b: Efficient Resources Management Solutions (Stores Monitoring)	Aero- space	EFPF Portal, Data Spine – Message Bus, Service Registry	Industreweb Collect Factory Connector, ROAM Risk Tool

No	Solution	Relates to Pilot	EFPP Components Covered	Tools and Services Covered
S 6	Solution 6: Workplace Environment Monitoring	Aero-space	EFPP Portal, Data Spine - Message Bus, Data Spine – Integration Flow Engine, EFPP Security Portal (EFS)	TSMATCH Gateway Factory Connector, Symphony Platform
S 7	Solution 7: Tendering & Bid Management	All domains	EFPP Portal, Data Spine - EFPP Security Portal (EFS), Service Registry	Business Opportunities Service, Federated Search
S 8	Solution 8: Almende Risk Analysis & Management Tool	All domains	EFPP Portal, Data Spine – Message Bus, Data Spine – Integration Flow Engine, EFPP Security Portal (EFS), Service Registry	ROAM Risk Tool
S 9	Solution 9: Catalogue Service	All domains	EFPP Portal, Data Spine – EFPP Security Portal (EFS), Service Registry	Product Catalogue Service
S 10	Solution 10: Business Network Intelligence	All domains	EFPP Portal, Data Spine - Message Bus, EFPP Security Portal (EFS)	iQluster SDK Business Intelligence App
S 11	Solution 11: Data Analytics	CE	EFPP Portal, Data Spine – Message Bus, Integration Flow Engine, EFPP Security Portal (EFS), Service Registry	Visual and Data Analytics Tool, Deep Learning Toolkit
S 12	Solution 12: Blockchain Application	CE Aero-space	EFPP Portal, Data Spine – EFPP Security Portal (EFS)	DAML, Blockchain DApp (web and mobile application)
S 13	Solution 13: Online Bidding Process	CE	EFPP Portal, Data Spine – Integration Flow Engine, EFPP Security Portal (EFS), Service Registry	Matchmaker, Agents, Marketplace
S 14	Solution 14: System Security Modelling	CE	EFPP Portal, Data Spine – EFPP Security Portal (EFS), Service Registry	SSM

Table 1: Overview of EFPP solutions used in the pilot and related components and tools

3 Epics and User Stories (US)

The focus of the user stories in this pilot has shifted somewhat after Airbus left the project consortium. Originally, functionalities for exchanging data and information between SME and Airbus (OEM) should be developed and implemented. This was abandoned in favour of automated information exchange and digitalisation solutions at the shop floor level in the participating SMEs. The planned processes initially for the use of product catalogues and for the bundling of purchasing quantities in terms of tenders and purchasing consortia were modified to the effect that they now take place between the participating SMEs and no longer with Airbus, as access to the Airbus IT systems was no longer possible with the departure of this partner. As a result, user stories have been developed that meet the SMEs' needs much better than if the substantial restrictions imposed by the OEM had to be considered.

User stories (US) in the aerospace pilot are implemented in four different companies, and they are combined in four epics. The diverse nature of the solutions developed through the EFPF platform shows the platform's suitability and applicability in wider industrial scenarios. The range of solutions developed against user stories is shown in the following table.

US ID	US Title	3DI	AAM	IAI	WOM
Epic 1: Joint Purchase and Offer Products					
US1.1	Place products and services in the catalogue and offer them	X	X	X	X
US1.2	Finding suppliers for specific products and services on an ad-hoc basis	X	X	X	X
US1.3	Find partners for joint purchase of consumables	X	X	X	X
US1.4	Finding partners for joint purchase of (raw) materials and products with high MOQ	X		X	X
Epic 2: Tender and Bid Management					
US2.1	Tender of material that has reached the expiry date	X			
US2.2	Tender for Maintenance Services		X		
Epic 3: Parameter Monitoring in Production and Maintenance					
US3.1	Automated environmental monitoring of process-relevant parameters			X	X
US3.2	Tracking of Trolleys		X		
US3.3	Visual Detection of PPE			X	
US3.4	Stock Level Monitoring	X			
Epic 4: Supply Chain Management					
US4.1	Increase Supply Chain Transparency			X	
US4.2	Secured Logistics Chain			X	
US4.3	Material Track and Trace during lifecycle			X	

Table 2: Epics and User Stories (US) and Implementation Partners

All implemented US in the aerospace pilot are documented in the following sections.

3.1 Epic 1: Joint Purchase and Offer Products

3.1.1 US1.1: Place products and services in the catalogue and offer them to users

3.1.1.1 Short Description

Many small and medium-sized companies have only limited financial resources available for marketing measures. In addition, the highest priority is assigned to day-to-day business, which leads to the fact that few or only small personnel resources are used for the topic of visibility and marketing. Following that, SMEs can often be found online only very sparsely or not on the relevant portals, and their business depends on word-of-mouth.

A solution is needed to help small and medium-sized companies increase their visibility with minor financial and labour effort. The aim is to draw the attention of potential customers to the company's product portfolio and provide a possibility to offer its products and services via a product catalogue so that the companies' visibility is generally increased.

Partners involved in this user story were from the aerospace pilot, namely: HAW, 3DI, WOM, AAM and IAI. From the technical side, SRDC leads the technical development of this solution.

3.1.1.2 Requirements / Acceptance Criteria

Besides having described the user needs through relevant user stories, 25 requirements were defined. These requirements and their fulfilment are shown in Table 3.

Requirement ID	Short Description	Fully covered	Partially covered	Not covered	Number of validated fulfilment	Number of companies for validation
R-US1.1-1	Place products and services	X			4	4
R-US1.1-2	Search for different products and services	X			4	4
R-US1.1-3	Include or exclude certain customers/suppliers (white list/black list)	X			4	4
R-US1.1-4	Take into account lead-times and price ranges when searching	X			4	4
R-US1.1-5	Receive (supplier) / provide (customer) more information of the project	X			4	4
R-US1.1-6	Get contact details or the possibility to get into contact with potential partners	X			4	4
R-US1.1-7	Provide legal framework as contractual basis	X			4	4
R-US1.1-8	Provide information for customer directly out of factory connector	X			4	4

R-US1.1-9	Create B2B catalogue for dedicated customers and contract terms	X			4	4
R-US1.1-10	The platform shall provide means for presenting products and services.	X			4	4
R-US1.1-11	Used language for the catalogue solution shall be English.	X			4	4
R-US1.1-12	The platform users can assign themselves to an industry when registering.	X			4	4
R-US1.1-13	An aerospace specific breakdown structure and information must be available for presenting products.	X			4	4
R-US1.1-14	A yes/no indicator must be available for each product/service, indicating for the customer whether a presented product/service can be customised (trim and finish or similar).	X			4	4
R-US1.1-15	An aerospace specific breakdown structure and information must be available for presenting services.	X			4	4
R-US1.1-16	It shall be possible to declare certain individual information about a product/service as "non-public" to only disclose non-critical product/service level details.	X			4	4
R-US1.1-17	Each registered supplier must be able to place products and services themselves.	X			4	4
R-US1.1-18	Placing products and services into the catalogue must be guided by EFPF platform software in a step-by-step manner.	X			4	4
R-US1.1-19	Besides being led from EFPF software to place products and services, a smart import function must be available.	X			4	4
R-US1.1-20	The smart import function must allow automatic import of different data formats (PDF, XLSX, CSV etc.).		X		2	4
R-US1.1-21	After using the smart import function, it must be possible to validate the imported product and service information and change/complete them as required.	X			4	4
R-US1.1-22	A summarising overview must be available before finally placing a product or service into the catalogue.	X			4	4
R-US1.1-23	It shall be possible to place products and services into the catalogue without directly publish them (status "prepared" or similar).	X			4	4
R-US1.1-24	Each supplier must review his offered products and services himself using a "Cockpit" menu.	X			4	4
R-US1.1-25	The cockpit menu shall provide functions to manage his offered products and services so that the corresponding information can be updated/changed as required.	X			4	4

Table 3: Requirements of US1.1

It turns out that the developed solution can fully meet almost all requirements. All four aerospace companies participated in the validation. From 25 requirements, 24 are fully covered (equals 96%), and only one is partially covered (4%).

The latter one is about a smart import function for products and services to be uploaded. For more details on this, please refer to 3.1.1.7.

3.1.1.3 Fulfilment of the US1.1 through EFPF

The technical solution for the US1.1 relevant requirements builds upon the base platform "Nimble Catalogue Service" (in the following referred to as "Product Catalogue Service") that is connected to the EFPF Platform and Portal via the Data Spine.

Product Catalogue Service is a solution for product/service publishing, developed within the NIMBLE base platform and enhanced in the EFPF project. It is the main enabler of a company's discovery in the EFPF platform. It allows companies to introduce themselves to the EFPF ecosystem with the products they supply and the services they provide. That is, once a catalogue of products and services is published, it immediately becomes available and discoverable by other users in the federated EFPF Marketplace. To enable users to find what they are looking for quickly, Product Catalogue Service also offers publishing products with semantically relevant annotations. It uses generic and sector-specific taxonomies as knowledge bases from which relevant annotations can be obtained automatically given a product category. Please refer to Figure 1 for a high-level architecture:

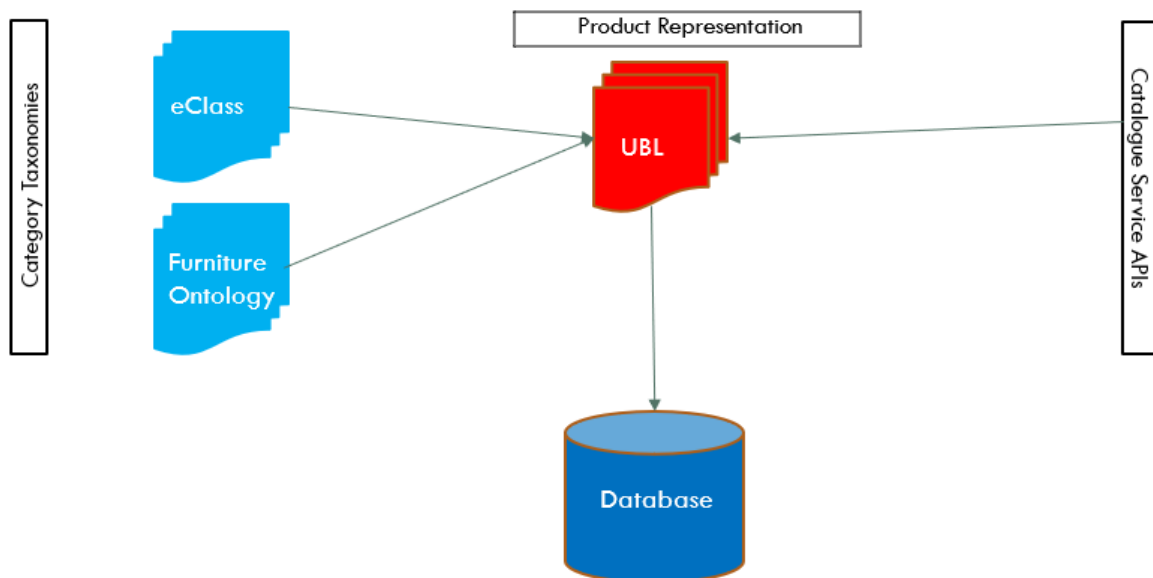


Figure 1: High-level architecture of the Product Product Catalogue Service

Products and services, as well as catalogues, are persisted on a UBL-compliant relational database. The data structure might differ from sector to sector or company to company; therefore, raw data, which could have varying formats, are kept in disparate repositories while metadata are kept in a global registry. Maintaining all the metadata in a single repository enables querying on products having heterogeneous structures initially. Once a product is identified, its complete structured definition can be fetched from the respective repository through public APIs. Moreover, Product Catalogue Service provides various REST endpoints to manage catalogues as well products and services. These endpoints are responsible for CRUD (Create, Read, Update and Delete) on both catalogues and products/services, and corresponding results are returned in JSON format, which conforms to UBL 2.1 specification.

Product Catalogue Service is one of the core components of the NIMBLE base platform, which is now accessible through the EFPF Portal. Once the user searches and then clicks on a specific product on EFPF Marketplace (accessible on the EFPF Portal), he/she is then navigated to a respective product page on the connected NIMBLE base platform. The user can investigate the product details and complete a purchase.

Within the scope of the EFPF project, the Product Catalogue Service has been enhanced to be a part of the EFPF Integrated Marketplace Framework. Most important was implementing the aerospace taxonomy to classify products and services, which was done based on the ATA¹ chapter descriptions. Several other new functionalities were considered to fulfil the aerospace specific requirements.

- Ability to whitelisting/blacklisting catalogues to change their visibility for certain user groups
- Offering catalogues for predefined user groups such as A/C OEM, Airlines, MRO, 1st-tier suppliers
- Catalogue-specific contract generation for parties
- Catalogue exchanging between buyer and sellers
- Ability to hide prices for certain catalogues

The Product Catalogue Service is accessible via the EFPF portal on the left-hand side under the menu "General" (refer to Figure 2).

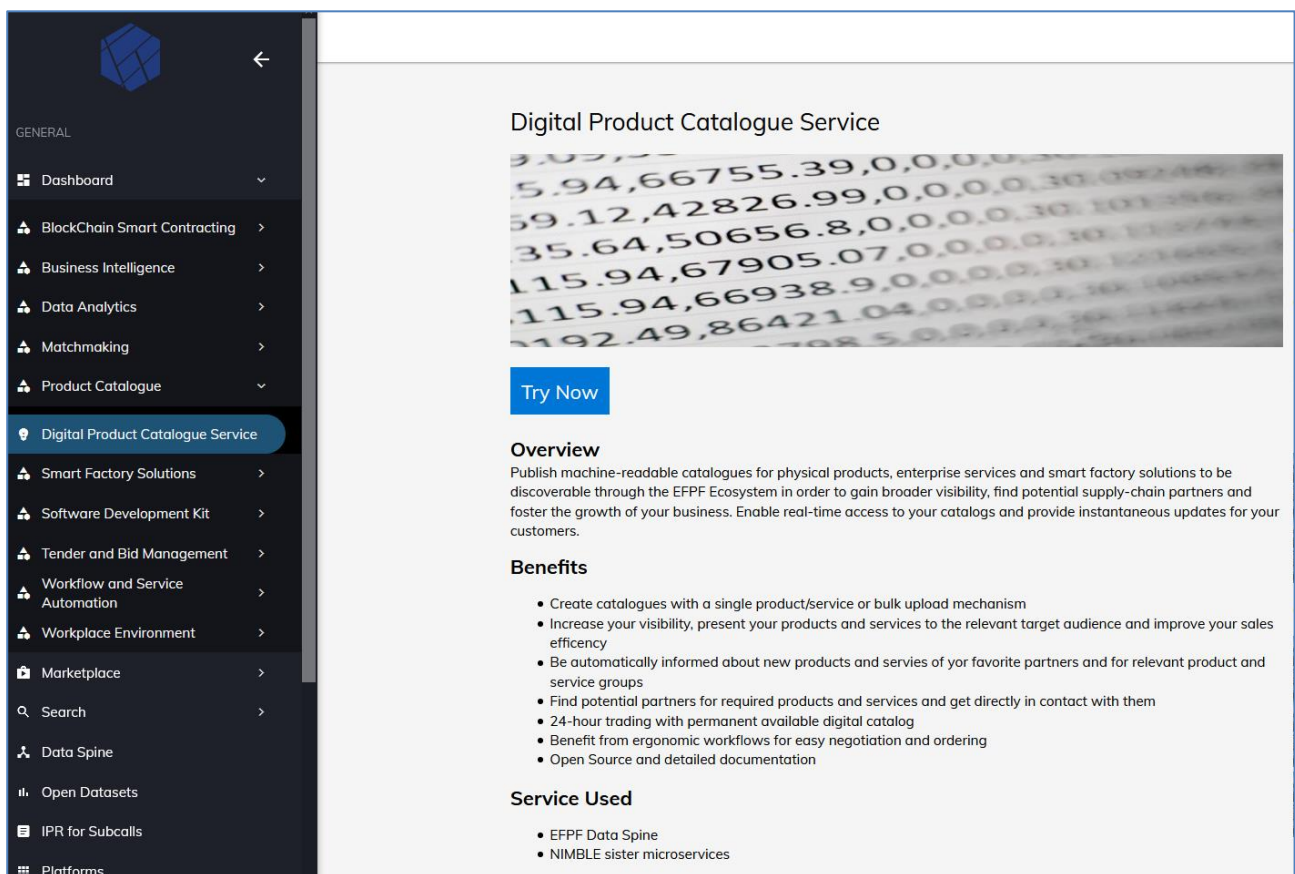


Figure 2: Access to the Product Catalogue Service via the EFPF portal

After clicking on the "Try Now"-button, the user is diverted to the Product Catalogue Service Dashboard. The dashboard provides multiple functions, so an overview about purchases and sales activities, catalogue items and performance statistics.

¹ ATA = Air Transport Association

Please refer to Figure 7 for an illustration of the dashboard from company IAI, whereas the tab "Sales" (German: "Verkäufe") is selected.

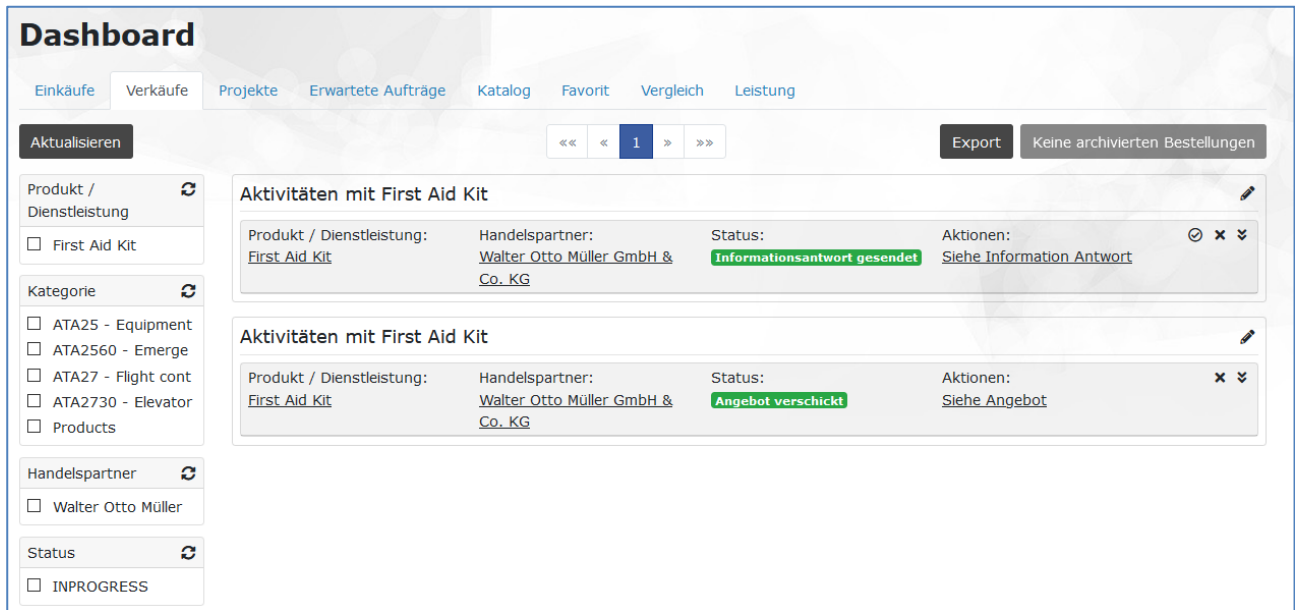


Figure 3: Dashboard with the interaction between possible trading partners from company IAI

For publishing products and services relevant button is available on the top left corner, whereas two possibilities for uploading products and services are available: for single items upload and multiple items.

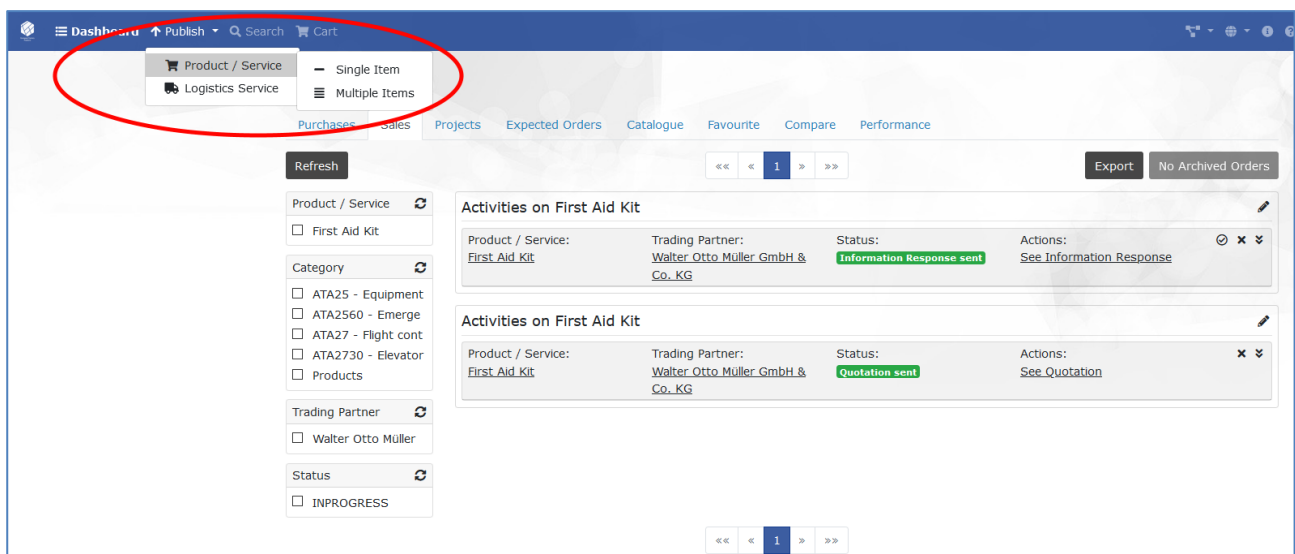


Figure 4: Dashboard with the interaction between possible trading partners from company IAI

For the single item upload, the user is guided in a step-by-step-manner (shown in the following), and for the multiple item upload function, an Excel sheet can be downloaded, filled in, and uploaded.

In the first step, the relevant category is shown and selected. At the top of Figure 5, the different steps are visible, and the current process status is indicated.

Figure 5: Selection of category for single item upload

During the following steps, information about the product or service is filled, e.g., the part number, dimensions, images, fulfilled specifications, delivered certificates, price, delivery terms, etc. To not overload this document, these steps are not illustrated. All entered information can be reviewed in the last step before publishing them into the catalogue (refer to Figure 6).

Figure 6: Review of product or service before publishing

All offered products and services are presented in the dashboard under the tab "Catalogue" ("Katalog"). Please refer to Figure 7.

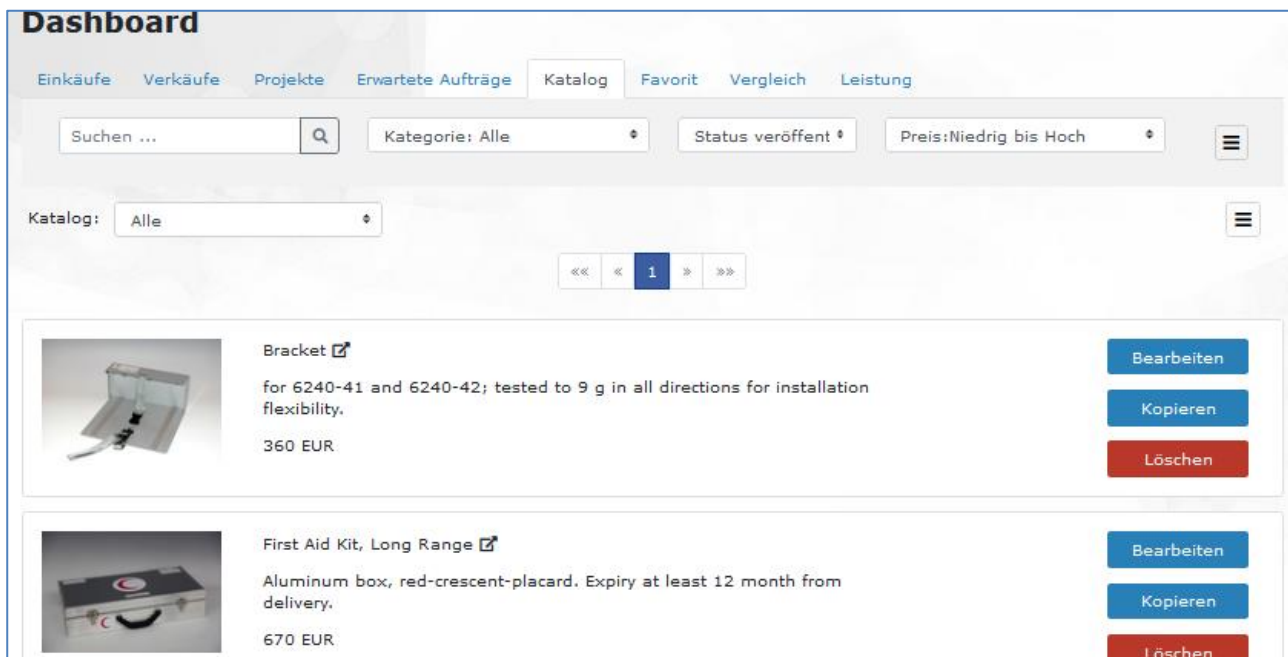


Figure 7: Dashboard with uploaded products from company IAI

3.1.1.4 Testing and Evaluation

Validation of the products catalogue was done from all four Aerospace partner companies under consideration of the above-defined requirements and further usability aspects. In different iteration steps, the companies 3DI and IAI uploaded some of their offered products into the catalogue, whereas complex and straightforward products were considered. Regarding offered services, the validation was done from AAM and WOM, whereas both have uploaded specific services offered by these companies. Each finding was reported in a complete form using screenshots with markings and comments to the developers. Whenever necessary, short video calls were made additionally to discuss the findings and possible corrections. Afterwards, the corrections were implemented so that they meet the formerly defined requirements correctly. As an example, some screenshots show the validation work as follows (refer to Figure 8 and Figure 9).

■ Requirement

- Place products and services into the catalogue

■ Comment

- see below (marked red)

Literature Pocket, large

Product / Service by: CanCompany

Catalogue: default

Categories: ATA25 - Equipment / furnishings, ATA2520 - Passenger compartment

Products

The pockets have a cover of pure nappa leather mounted on a honeycomb panel for fixing with two screws. The color range is unlimited, covering Airbus AIC, Boeing BAC-color code and any color from a mastersample. The materials are in compliance with EASA-CS/FAR 25.853 (a).

ID: 562e1229-4d18-4ab6-95b2-13b7d15dfa2d

Is it necessary to have this ID here? Has this value for the user?

Details Price Delivery & Trading Company Details

Details

Length: 356 mm Width: 16.5 mm

Height: 305 mm Weight: 0.37 g

Colour: AIC, BAC, any mastersample Condition: New

Datasheet: IAI_Literature Pockets_Rev.1.2.pdf International Commodity Code: 42029180

Material: Honeycomb and Nappa Leather Part Number: 1140-61series

Specification: EASA-CS/FAR 25.853 (a)

Negotiate

Delivery Period: 20 calendar day(s)

Warranty: 36 month(s)

Incoterms: EXW (Ex Works)

Payment Terms: PIA - Payment in advance

Payment Means: Credit Card

Price: On demand

Quantity: 1 Item(s)

Total Price: on demand

Negotiate

Request Information

Figure 8: Illustration of the way of working in regards to user feedback: screenshots with direct notes and markings

■ Requirement

- An aerospace specific breakdown structure and information must be available for presenting products.

■ Comment

- Fulfilled but it is difficult to map a raw material in a ATA-Chapter because some materials are used in different ATA-Chapter.
- New categories (located above the ATA-chapters) must be implemented: **Materials and consumables**

Produkt / Dienstleistung veröffentlichen

All published products / services must belong to at least one category, which will describe the product / service and help customers find your offering.

Aerospace Kategorien: Suchkategorie...

Kategorien

Products

- ATA21 - Air conditioning
- ATA22 - Auto flight
- ATA23 - Communications
- ATA24 - Electrical power
- ATA25 - Equipment / furnishings
- ATA26 - Fire protection
- ATA27 - Flight controls
- ATA28 - Fuel
- ATA29 - Hydraulic power
- ATA30 - Ice and rain protection
- ATA31 - Indicating / recording systems
- ATA32 - Landing gear

Details zum Products

Code: Products

TaxonomyId: Aerospace

Eigenschaften:

Datasheet	FILE
Condition	TEXT
International Commodity Code	TEXT
Part Number	TEXT
Colour	TEXT
Specification	TEXT
Material	TEXT

Ausgewählte Kategorien: Keine. Bitte fügen Sie eine Kategorie oben hinzu, um fortzufahren.

Continue With Selected Categories

Figure 9: Illustration of the way of working in regards to user feedback: screenshots with additional description of specific finding and proposal for improvement

Please note that only some exemplary screenshots are shown here. More documentation of the Product Catalogue Service is available on the EFPF Documentation Portal: <https://docs.efpf.linksmart.eu/projects/product-catalog-service/>.

3.1.1.5 User value proposition

The Product Catalogue Service promises to increase sales efficiency because of better visibility for their complete product portfolio in the federated EFPF ecosystem. In addition to that, companies can extend their reach, leading to more orders and improved operational performance.

The purchasing effectivity will be increased on the customer side. Money can be saved as fewer suppliers must be qualified and monitored, resulting in better visibility of a supplier's overall portfolio. This will also lead to better customer satisfaction.

3.1.1.6 Compliance with Standards and Regulations

According to ATA chapters in the aerospace sector, the same ontology was used in the Product Catalogue Service. No other specific standards were necessary.

A middle ground had to be found. On the one hand, the applicable terms and conditions of EFPF were considered. On the other hand, it was made clear that the process order management itself runs under separate agreements between suppliers and customers. Therefore, there is the possibility to negotiate contracts as extensive possibilities have already been implemented to negotiate legal terms and conditions. However, this only goes up to the point where a customer has placed an order. From that point on, the contracts negotiated separately between the parties apply.

In the B2B sector - especially in aviation - online shops are not widespread. Primarily SMEs, which serve the specialised areas of the supply chain in the aviation sector, rarely used such possibilities. Via the EFPF platform, an easy entry into this marketing segment would now also be possible for these companies without major technical or financial hurdles.

On the technical side, the primary taxonomy used in Product Catalogue Service is eClass, an ISO/IEC compliant industry standard for cross-industry product and service classification. Further, available taxonomies can be extended with domain-specific taxonomies such as Aerospace Ontology or Furniture Ontology.

Another standard that Product Catalogue Service makes use of is Universal Business Language (UBL), a worldwide standard providing a royalty-free library of standard electronic XML business documents that are commonly used in supply chain operations. It is adopted as a standard data model since it contains appropriate data elements for catalogue/product management such as catalogues, products, product properties, etc.

3.1.1.7 Lessons Learned and Outlook

This solution was evaluated by target users in their industrial/real-world scenarios. Based on the actual user-based evaluations of the developed solution's functional and non-functional aspects, the project partners learn the following lessons. For detailed results or specific user evaluation comments/scores, please refer to Section 5.2.3.

Generally, the feedback from the questionnaires was good. The product catalogue and the service catalogue are very well developed from the user's perspective, and their needs are met. The required functions are fully available, and the usability is judged as sufficient

respectively easy, and users can work confidently with the solution. Especially the single upload functionality with the step-by-step proceeding is well appreciated. Also, the well-structured and visible functions and the user guide is highlighted. Products and services can be easily offered on the platform.

However, there was also some feedback for the bulk upload functionality (smart import function). Further improvements can be made here if tools are developed to read in and upload such data automatically. The current solution with the Excel template is judged as a bit complicated. One possibility here would be to examine the extent to which the so-called HyCoDER tool currently being developed by the Fraunhofer IPT could be used. This tool (Hybrid Configurable Data Extraction and Restructuring System) is designed to process various input files consisting of lists (e.g., article lists) from different sources that differ in format, content, and organisation and ease the bulk uploading of products and services.

It would be interesting to work with the integration of a payment system (e.g. Stripe). Certain functions such as contract management and the rating system can only be meaningfully validated and further developed once a certain number of transactions have been entirely carried out on the platform. The user-friendliness must be measured against current standards offered by the major consumer platforms. The users from the business sector are also private consumers and used to these standards. Continuous improvements are necessary here and are implemented on an ongoing basis in cooperation with developers.

One goal should be to open the platform to locally used ERP/CRM systems used by users. To this end, it would be necessary to investigate which standard ERP/CRM systems are used to develop flexible interfaces. This would further increase the incentive to use the platform.

At the same time as the connection to ERP/CRM systems mentioned above, another goal could be to consider the ATA Spec 2000 data communication standard for communication between parties involved. Here, a connection to the so-called ARINC/SITA network would have to be examined, via which many Process Order Management processes (Purchase Order Placement/Order Acknowledgement/Invoicing, etc.) between aviation companies are already handled today. The digitalisation of the European aviation supply chain could thus be extensively advanced.

If process order management is handled entirely via the platform, it makes sense to implement functions for the direct tracing and tracking of shipments. Here, one could imagine connecting to existing logistics networks to avoid using different platforms for tracking and tracing and offering this service for all standard forwarders (FedEx/DHL/UPS/K&N, etc.) from one user interface.

Considering developed solutions for EFPE, a connection of the "Secured Supply Chain" solution could establish further networking between the developed solutions. More relevant functions could be implemented and offered from one source (refer to chapter 3.4.2 for the developed solution for the secured logistic chain).

3.1.2 US1.2: Finding suppliers for specific products and services on an ad-hoc basis

3.1.2.1 Short Description

One of the SMEs' strength (amongst others) over significantly larger competitors is flexibility and speed in responding to customer requests. The faster customer inquiries can be answered, and the quicker components can be manufactured after order receipt, the more successful the supplier is. This is where agile supply chains are needed to help requested suppliers respond quickly to customer requests.

Thus, the supplier's success needs to find partners and suppliers for various products and services. There is a complete overall view of available suppliers on the market without substantial research efforts. This ensures that the supplier can work with the best products (price/lead-time/quality) and suppliers (reliability/communication/quality).

Partners involved in this user story were from the user side HAW, 3DI, WOM, AAM and IAI. As technical partners, SRDC and C2K were responsible for the technical development.

3.1.2.2 Requirements / Acceptance Criteria

Several requirements have been defined as a base for developing a solution that fulfils the needs accordingly. Please refer to Table 4 for an overview of the requirements and their fulfilment.

Req. ID	Short Description	Fully covered	Partially covered	Not covered	Number of validated fulfilment	Number of companies for validation
R-US1.2-1	Search for suitable products and services.	X			4	4
R-US1.2-2	Get contact details or the possibility to send invitations to potential suppliers.	X			4	4
R-US1.2-3	The search function must allow searching at the product level and company level.	X			4	4
R-US1.2-4	A smart filter function shall enable a detailed search for the supplier.	X			4	4
R-US1.2-5	It should be possible to use non-public information for searching and filtering (abstract search), but the non-public information should not be displayed in the search result.	X			4	4
R-US1.2-6	After selecting a product, it must be possible to contact the supplier via the EFPF portal to get more detailed information, clarify queries, or start ordering.	X			4	4
R-US1.2-7	EFPF shall provide practical means to allow customers to get into contact with potential suppliers.	X			4	4
R-US1.2-8	Customers shall choose in their profile from which supplier or product group they want to be actively informed when a new item (product/service) has been added.			X	0	4

Table 4: Requirements of US1.2

It turns out that the developed solution can fully meet almost all requirements. All four aerospace companies participated in the validation. From 8 requirements, seven are fully covered (equals 88%), and one of the requirements is not covered as it was considered a specific need and therefore given a low priority.

3.1.2.3 Fulfilment of the US1.2 through EFPF

The technical solution for the above requirements and user needs builds upon the "Nimble Catalogue Service" and enhances the integrated search functions. Please refer to the chapter before for a detailed description of the tool and reach it via the EFPF portal. Furthermore, the newly developed Business Opportunity Tool from C2K was used (please also refer to 3.2), hosted within the SME Cluster platform but is made available directly from the EFPF Portal with support for the SSO security integration in development.

The SMECluster is a collaboration platform that helps SMEs grow and succeed by offering valuable tools and services to increase productivity within small businesses, communities, and individuals. The platform acts as a tool to promote specific services required for business improvement.

In the Product Catalogue Service, supplier for products and services can be searched using various parameters. These parameters are amongst others: category, price, lead time, certificates, companies, rating/trust, and several more, which are located on the left side of the search page. Refer to Figure 10 for the search result field:

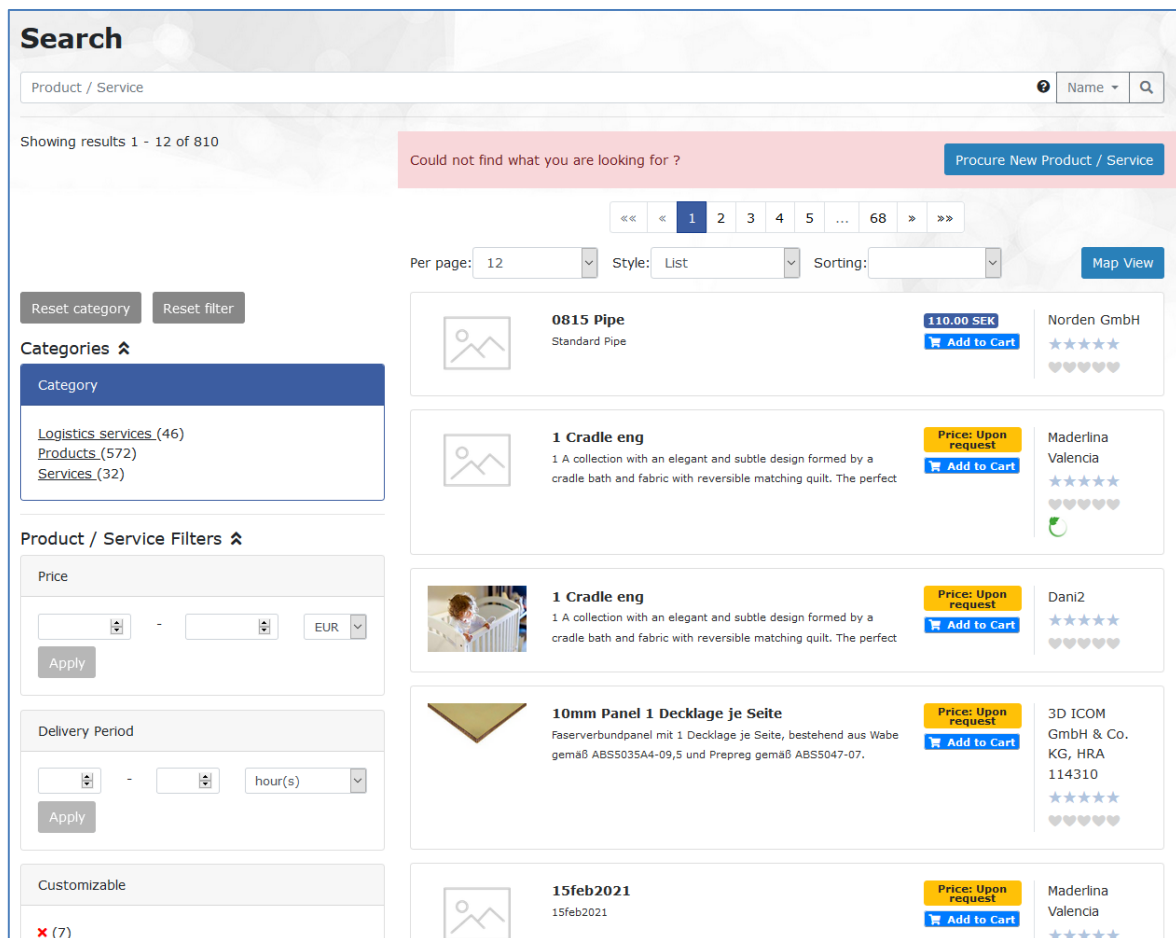


Figure 10: Product Catalogue Service filter and search result page with described "No success"-indication (red area) and the link (blue field) to the Business Opportunity Tool.

If matching products or services are found during the search, they can be clicked for further review. The next page opens with multiple functions in regards to the specific product or service. Product images can be viewed on this page, properties including the price (if not "on request" selected by the supplier) can be viewed, and the supplier can be contacted for further processing. Refer to Figure 11 for more detailed information:

First Aid Kit, Long Range

Product / Service by: [INNOVINT Aircraft Interior GmbH](#)

Catalogue: Main Catalogue

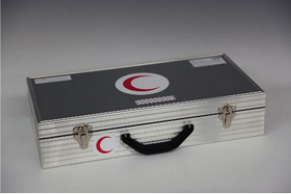
Categories: [ATA25 - Equipment / furnishings](#) [ATA2520 - Passenger compartment](#)

Products

Aluminum box, red-crescent-placard. Expiry at least 12 month from delivery.

Part Number: 6240-42

[Add to Cart](#)



Details Price Delivery & Trading Certificates Company Details

Properties

Width:	250 mm
Length:	480 mm
Height:	80 mm
Weight:	3 kg
Colour:	White
Condition:	NEW
International Commodity Code:	30065000
Material:	Aluminum
Part Number:	6240-42
Specification:	Exceeding AIR-OPS annex IV PART-CAT, FAR- 121.309, subpart X, appendix A, ICAO annex 6, part I.

Negotiate & Order

Delivery Period
3 weeks

Warranty
36 month

Incoterms
EXW

Payment Terms
PIA - Payment in advance

Payment Means
Credit Card

Price
670.00 EUR per ea

Quantity: ea

Total Price:
670.00 EUR

[Organize Bulk Purchase](#)

[Negotiate & Order](#)

[Request Information](#)

Figure 11: Exemplary shown: product from IAI with part number, description with applicable product properties incl. price, as well as the possibility to contact the offering company.

If further information is required, the offering company can be contacted via a "Request Information"-button. A relevant page opens accordingly, and needed information can be described (please refer to Figure 12):

Order for:

First Aid Kit, Long Range ^ Show Details v

Request for Information Negotiation Order Preview Order Processed Order Dispatched

Requested filled technical data sheet(s): ... Browse

Notes and Additional Files

Notes:

Add Note

Additional Files: ... Browse

Back Skip Send Request

Figure 12: "Request Information"-field to contact potential suppliers

If no further information needs to be queried, the ordering process can be initiated via clicking the "Negotiate & Order"-button. The following window opens to fill in the required information, such as the delivery address and the required delivery date and additional notes and files. If there are not already contract details in place between both parties, there is the possibility to propose general terms valid for this transaction. This process clicks on the button "Send Request", whereas the supplier received applicable notification accordingly. Please refer to Figure 13 for a review of the described page:

Order for:

First Aid Kit, Long Range Show Details ✓

Request for Information **Negotiation** Order Preview Order Processed Order Dispatched

Manufacturer's Terms **Counter Offer**

Offer Counter Terms

Warranty: 36 month Quantity: 1 ea
 Incoterms: EXW
 Payment Terms: PIA - Payment in advance
 Payment Means: Credit Card
 Price: 670.00 EUR per ea

Delivery Details

Delivery Address Delivery Date

Delivery Date: 30.01.2022 Quantity: 5 ea Delete

Add Delivery Date

Terms and Conditions

Frame Contract

Notes and Additional Files

Purchase Order

Ordered Product	Description	Part Number	Quantity	Net Price
First Aid Kit, Long Range	Aluminum box, red-crescent-placard. Expiry at least 12 month from delivery.	6240-42	1 ea	670 EUR
Total				670.00 EUR

Net Price: 670.00 EUR Back Send Request

Figure 13: Applicable Product Catalogue Service page for placing a purchase order

In case no suitable suppliers can be found by the search function, a link to the (newly developed) Business Opportunity Tool allows extended functions to place search for relevant suppliers, which is indicated on the "Results"-page with the question "Could not find what you are looking for?". Refer also to Figure 10 on page 29 for a screenshot of the mentioned functionalities.

If the link "Procure New Product / Service" is clicked, the user is directed to the (newly developed) Business Opportunity Tool. On the landing page of the Business Opportunity Tool, the relevant need for a supplier of certain products and services can be entered under the "Create a Business Opportunity" option. Various information needs to be filled in to

describe the need as exactly as possible. Please refer to Figure 14 for a screenshot of the landing page with all needed input shown:

Create a Business Opportunity

Create a Business Opportunity to share with other companies.

Business Opportunities can be things your business wishes to procure (formal Tenders, simple call for supply of parts or materials), or things you wish to offer and receive applications for (notification of available capacity).

Over three steps you will add basic information, details about accreditations and other requirements, along with supporting documents. At the end you can choose to "publish" to make it visible on the main Business Opportunity Search, or to invite companies directly to apply.

[Home](#) / [My Opportunities](#) / Create Opportunity

1 Description
2
3

This allows you to hide sensitive information to share at a later date

All fields marked with * are mandatory

Opportunity Name * Show?
This will be the primary Title for the listing to summarise what it relates to.

Opening Date * **Closing Date ***

Value * **Currency ***
Enter a maximum value for the unit price of item you wish to Procure or Offer. If not relevant enter 0 and describe pricing structure in more detail in the "Bid Outline" field below
 ☒

Category *
Please select the nature of the listing
 ☒

Quantity *
Enter the minimum qty of product or component required. If it is not relevant enter a quantity of 0 and enter any custom details in the "Bid Outline" field below
 ☒

Duration / Delivery Date *
Enter duration the product or service should be provided for
 ☒

Lead Date *
When should the Product / Service be delivered by?
 ☒

Production / Material Details *
Enter specific details to provide requirements for any products or materials.
 ☒

Location *
Enter the location to which the Product or Service should be carried out or delivered.
 ☒

Outline of your bid (max 500 words) - you can add you supporting documents on the last step *

Figure 14: Landing page of the Business Opportunity Tool to place a search for the right supplier

After clicking on the "Next"-button on the bottom of the page, a next window opens. Additional information can be entered, e.g., required accreditations of the needed partners,

specification details etc. If all information is entered on the last three pages, the search for a suitable supplier can be published via a "Publish Opportunity" button. Refer to Figure 15:

Figure 15: Last page for placing a search in the Business Opportunity Tool

Afterwards small popup window gives direct user feedback and states that the opportunity has been published (refer to Figure 16):

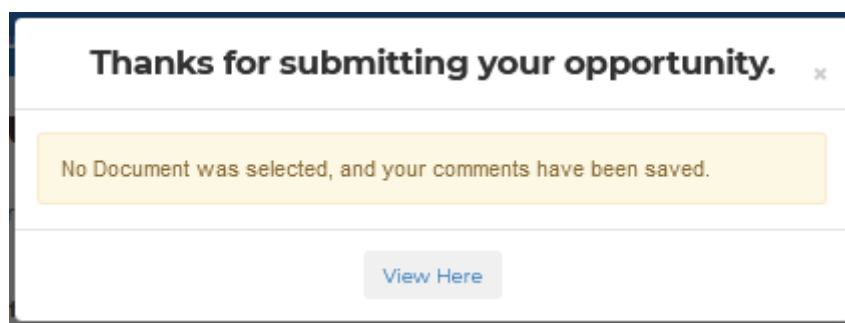


Figure 16: User feedback for a published opportunity

Also, the business opportunity tool can be searched for already existing opportunities. Using this function, it could be checked whether someone is searching for a partner for the same product already before placing an opportunity.

To do so, the user clicks on "Search Opportunities" in the tool and can then enter keywords, locations and categories (refer to Figure 17):

[Search Opportunities](#)
[My Opportunities](#)
[My Teams](#)
[Register Company](#)
[Logout](#)

Search Business Opportunities

Below are the Business Opportunities available to members of the platform.

Business Opportunities can be things your business wishes to procure (formal Tenders, simple call for supply of parts or materials), or things you wish to offer and receive applications for (notification of available capacity).

You can use the Keyword Search and filtering to find Opportunities that would be appropriate to your business.

[Home](#) / [Opportunities](#)

Keywords

Locations

Category

Accreditations
☐ ISO 9001
☐ CHAS
☐ BS OHSAS 18001

Search: Isovolta decor foil Airdec AIC 2.16 fog PSA

Location: Europe

Opening Date: 12/04/2021
Closing Date: 30/04/2021

We are looking for a partner to purchase the above mentioned decor foil. We would buy 3ea sheets, 7ea more are needed to avoid setup cost to reduce the whole package price.

Phenol resin PR-FR-5361

Value: € - **Location:** Europe

Opening Date: 12/04/2021
Closing Date: 19/04/2021

At least 1 ton (1.000kg) is needed if we have a chance to win the job (as only then we can purchase to a good price). We need urgent feedback. Who wants to join this bulk purchase?

Looking for Phenolic Resin

Value: € - **Location:** Europe

Opening Date: 19/04/2021
Closing Date: 30/04/2021

We are looking for a supplier for 1 ton of phenolic resin. Main point here is that we need this large quantity delivered within 6 weeks starting from today! All european suppliers are welcome.

Figure 17: Search for products in the Business Opportunity Tool

Suppose a suitable opportunity can be found via the search. In that case, the user can either contact the partner for more information ("Send procurer a message") or apply directly as a partner ("Apply now"), which is shown in Figure 18:

[Search Opportunities](#)
[My Opportunities](#)
[My Teams](#)
[Register Company](#)
[Logout](#)

Opportunity

[Home](#) / [Opportunities](#) / [Opportunity](#)

Opening Date
12/04/2021

Closing Date
30/04/2021

Search: Isovolta decor foil Airdec AIC 2.16 fog PSA
Innovint Aircraft Interior GmbH **Location:** Europe

We are looking for a partner to purchase the above mentioned decor foil. We would buy 3ea sheets, 7ea more are needed to avoid setup cost to reduce the whole package price.

Procurement Comments

Duration / Delivery Date
30/04/2021

Lead Date
21/05/2021

[Accreditations](#) [Documents](#) [Specification](#)

Accreditations

Need more information?

Figure 18: Contact possibilities once suitable opportunities are found

In both cases, after having clicked on either button, relevant pages open to specify the messages to the procurer. Figure 19 shows exemplarily the "Application"-window:

Figure 19: Provide an application for an opportunity

After having clicked on "Submit Application", a notification is being sent to the procurer. At the same time, the partner who provides the application receives a confirmation via email (refer to Figure 20):

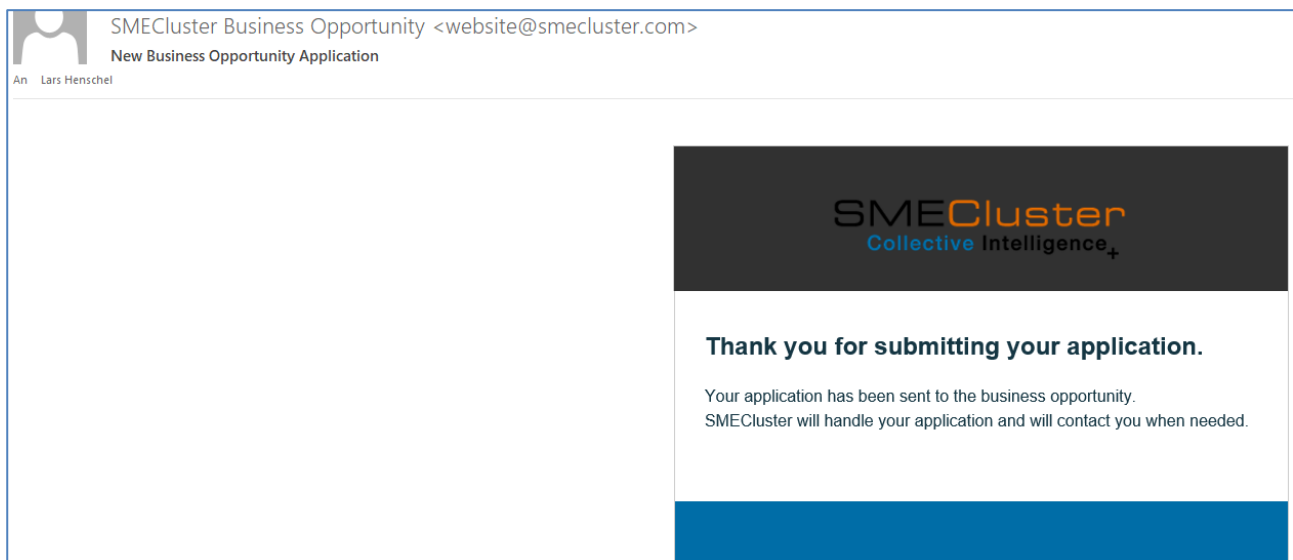


Figure 20: Confirmation via email: Application provided

In the "My Opportunities" menu, for the procurer, all recent applications are shown (refer to Figure 21):

My Opportunities

Below are the Business Opportunities for you Company.

You can view the current applications via the link to the right of each Opportunity.

[Home](#) / [My Opportunities](#)

Create Opportunity

Opportunity Name	Contract Value	Submission Date	
  Search: Isovolta decor foil Airdec AIC 2.16 fog PSA	Not public	12/4/2021 - 30/4/2021	View Applications (3)
  Phenol resin PR-FR-5361	€ -	12/4/2021 - 19/4/2021	View Applications (1)
  Looking for Phenolic Resin	€ -	19/4/2021 - 30/4/2021	
  Looking for a partner for PED Containment Bags PNR 7261-50	€ -	20/4/2021 - 30/4/2021	

Figure 21: My Opportunities menu with all actual opportunities

Details can be reviewed by clicking on "View Application". Furthermore, the procurer could be contacted via a "Send Message"-button to initiate all further steps (refer to Figure 22):

Review Opportunity Application

Below are the details of the Business Opportunity Application.

You can choose to send a Message to the company or add them to a Team in order to discuss and negotiate and business arrangements.

[Home](#) / [My Opportunities](#) / [Review](#)

Application Details:

Reference: SMEC-BUSSOP-77-122

Company Name	Walter Otto Müller GmbH & Co. KG
Applicants Contact Information	Alexander Streblow streblow@seo-foto.de 49482189610
Description	I want to join.
Accreditations	
Category	Group Purchase
Applicants Address	Zusestrasse 8 none Itzehoe Germany 25524
Applicants Categories	Tooling Other

Figure 22: Details of an application and possibility to contact the procurer via the "Send Message"-button

3.1.2.4 Testing and Evaluation

Validations of the Product Catalogue Service and the Business Opportunity Tool were done from IAI, AAM, 3DI and WOM under consideration of the above-defined requirements and further usability acceptance criteria by publishing different opportunities. Different products and services have been searched for. Also, different opportunities have been established in the Business Opportunity Tool. Each finding was reported in a complete form using screenshots with markings and comments to the developers. Whenever necessary, short video calls were made additionally to discuss the findings and possible corrections. Afterwards, the corrections were implemented so that they meet the formerly defined requirements correctly. As an example, some screenshots show the validation work (please refer to Figure 23, Figure 24 and Figure 25).

■ Requirement

- *A smart filter function shall enable a detailed search for the supplier.)*

■ Comment

- *Maybe the text appearance can be harmonized in terms of wording etc.:*

Figure 23: Feedback for the Product Catalogue Service using screenshots specific comments.

■ Requirement

- *Place search for consumable*

■ Comments

- *Duration / Delivery Date → meaning not clear*
- *Lead Date → meaning not clear*

Figure 24: Feedback for the Business Opportunity Tool using screenshots with markings and additional comments.

■ Requirement

- Search for consumable/raw material (group purchase)

■ Comments

- After having clicked on an opportunity (e.g. the below marked one) the following source code windows opens

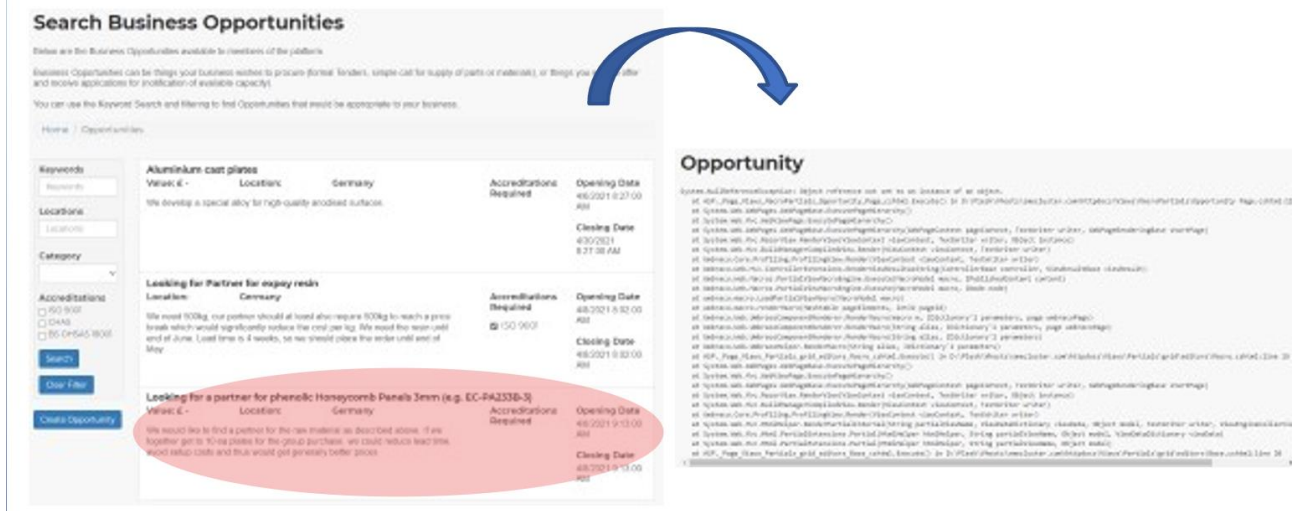


Figure 25: Feedback for the Business Opportunity Tool using screenshots with markings and additional comments.

3.1.2.5 User value proposition

More robust networking of small and medium-sized enterprises in Europe to exchange products and services will provide clear competitive advantages for the companies involved. A cooperative approach is not widespread in this group of companies. One reason is the fear of losing one's market advantages because one always must open the company slightly to other stakeholders. More significant, however, is that it takes a lot of effort for small and medium-sized enterprises to identify suitable partners, products, or services. A digital platform that offers easy access to such data can significantly lower the threshold for cooperation.

Using the described solution companies is supported to increase their sales efficiency as it is possible to quote shorter lead-times as relevant suppliers can be found quickly. In the end, this leads to better customer satisfaction as the lead-time improvement can be passed on to own customers.

Because more partners can be found thus more quotes for products and services can be inquired, which leads to better prices on the one hand, and to more possibilities to quote for own customers on the other hand.

All mentioned advantages lead to improved operational performance.

3.1.2.6 Compliance with Standards and Regulations

According to ATA chapters in the aerospace sector, the same ontology was used in the Product Catalogue Service. No other specific standards were necessary.

In regards to valid terms and conditions, a middle ground had to be found. On the one hand, the applicable terms and conditions of EFPF were considered. On the other hand, it was made clear that the process order management itself runs under separate agreements between suppliers and customers. Therefore, there is the possibility to negotiate contracts as extensive possibilities have already been implemented to negotiate legal terms and conditions. However, this only goes up to the point where a customer has placed an order. From that point on, the contracts negotiated separately between the parties apply.

In the B2B field – particularly in aviation – online stores are not standard. Mainly SMEs serving the very specialised areas of the supply chain in the aviation industry rarely use such opportunities. Through the EFPF platform, it would now also be possible for these companies to quickly enter this marketing segment without significant technical or financial hurdles.

For used standards on the technical side, please refer to chapter 3.1.1.6.

3.1.2.7 Lessons Learned and Outlook

This solution was evaluated by target users in their industrial/real-world scenarios regarding the functional and non-functional aspects of the developed solution. Following that, the following lessons are learned by the project partners. For detailed results or specific user evaluation comments/scores, please refer to Section 5.2.1.

Once again, in the development process, during several iterations steps, it turned out that the better the cooperation between technical and user partners is, the better the result of the developed solution. The reason for this is that the technical partners need a solid understanding of the real world. In turn, the user partners need a solid understanding of what is technically possible.

Generally, the users judge the solution as good to use as it fulfils their needs with good user guidance (e.g. descriptions of fields to be filled) and well-structured menus with self-explaining elements. For the further development of the platform, users expect some improvement and expansion of the functions. As user-friendliness is crucial for user acceptance, the user's feedback includes placements of buttons ("Create Opportunity", button inside the "My Opportunities"-menu to invite suppliers) and better user guidance stating at which step the users currently is (step 1, step 2 etc.).

Regarding missing functionalities, the main point is that during switching from the Product Catalogue Service to the Business Opportunity Tool, the search criteria could be directly taken over so that the effort to create an opportunity is reduced and some fields are pre-filled.

Users will continue to provide feedback on the developments on the platform.

3.1.3 US1.3: Find partners for joint purchase of consumables

3.1.3.1 Short Description

Many companies only need a limited quantity/number of products, and due to the small order, it is usually not possible to achieve favourable purchase prices. By bundling quantities/units of products, correspondingly, much better purchasing conditions can be achieved, which can partly be passed on to the partners.

Partners involved in this user story were from the user side HAW, 3DI, WOM, AAM and IAI. As technical partners, SRDC and C2K were responsible for the technical development.

3.1.3.2 Requirements / Acceptance Criteria

In summary, nine requirements have been defined as a base for developing a solution that fulfils the needs accordingly. Please refer to Table 5 for an overview of the requirements and their fulfilment.

Req. ID	Short Description	Fully covered	Partially covered	Not covered	Number of validated fulfilment	Number of companies for validation
R-US1.3-1	Search for different consumables providers	X			4	4
R-US1.3-2	Search for consumables	X			4	4
R-US1.3-3	Search also time-related	X			4	4
R-US1.3-4	Get contact details or the possibility to get into contact with potential partner companies (send invitation)	X			4	4
R-US1.3-5	Place search inquiries for consumables	X			4	4
R-US1.3-6	Add more information to the search inquiry (like dates/specific descriptions etc.)	X			4	4
R-US1.3-7	Have a dashboard with summarising information about search inquiries	X			4	4
R-US1.3-8	Search for different consumables providers	X			4	4
R-US1.3-9	Search for consumables	X			4	4

Table 5: Requirements of US1.3

The developed solution fully covered all defined requirements.

3.1.3.3 Fulfilment of the US1.3 through EFPF

An electronic catalogue is needed with various items/products like

- Personal Protection Equipment
- Office supplies

- Cleaning supplies
- Auxiliary and operating materials

SMEs already carry out this type of purchases on the subject as mentioned above, but not by electronic means. Sometimes the company collects the orders for the individual items from defined partners at a specific time. This company is then the consortium leader and generates a collective order. This order is sent to a service provider with whom purchasing conditions have been negotiated in advance. It would be desirable if, with the help of a platform, this order could be handled like an invitation to tender and sent to various service providers, who would then prepare corresponding offers – as shown in the following Figure 26:

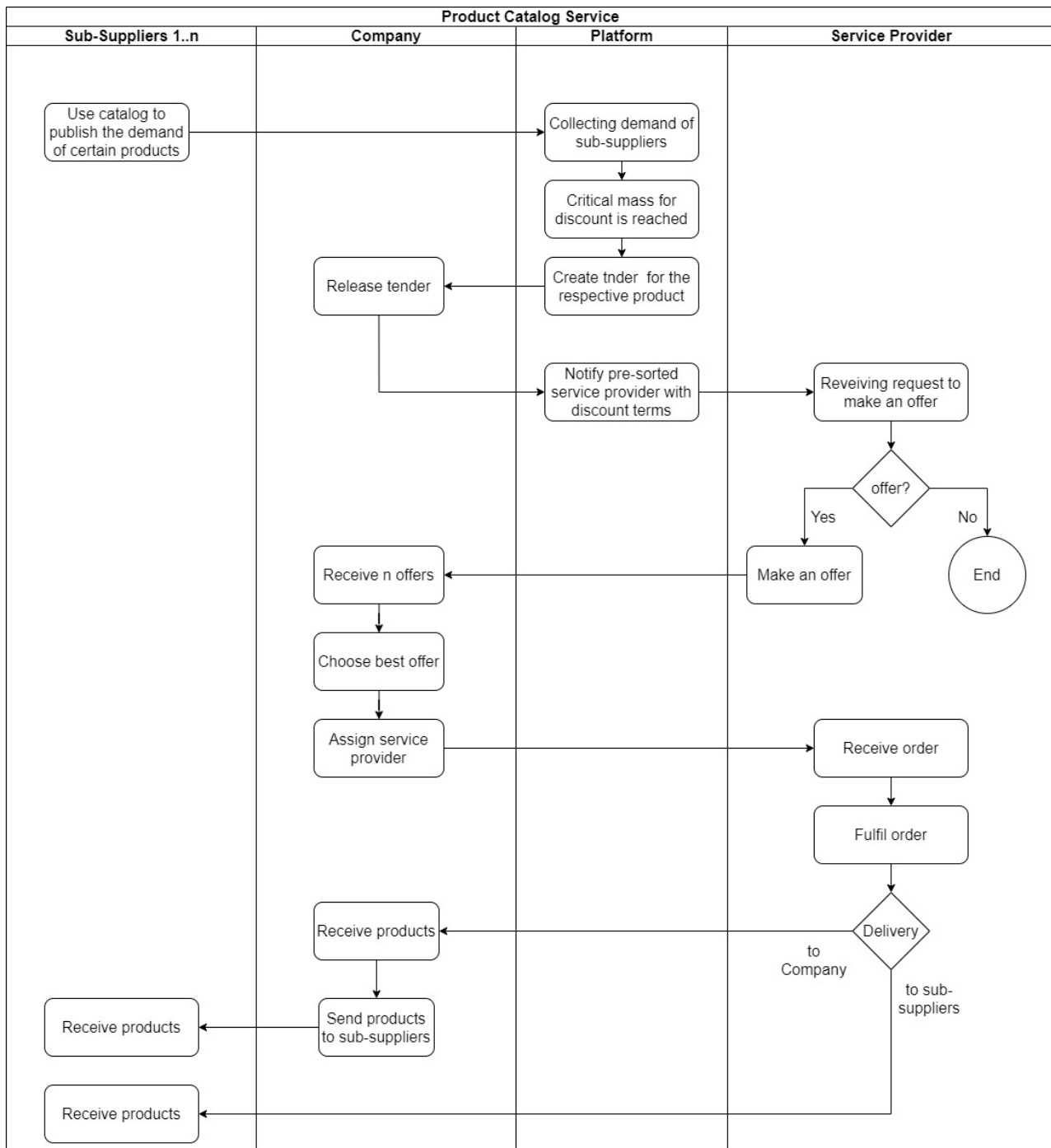


Figure 26: Workflow for US1.3

The leading company selects a suitable supplier and generates a collective purchase order for all partners. If necessary, the delivery of the so-called individual orders is sent to the appropriate addresses, collectively to one address.

As the fulfilment of this user story is similar to US1.4, please refer to chapter 3.1.4.3.47

3.1.3.4 Testing and Evaluation

Validation of this Business Opportunity Solution was done from IAI, AAM, 3DI and WOM under consideration of the above-defined requirements and further usability acceptance criteria by publishing different opportunities. The validation was carried out against the previously defined criteria, and the screenshots below show examples from the validation process (refer to Figure 27 to Figure 29).

Requirement

- Find partners for joint purchase of consumables
- Search for different consumables providers
- Search for consumables

Comment

- Partners and consumables are easy to find via a keyword search.

Search Business Opportunities

Below are the Business Opportunities available to members of the platform.

Business Opportunities can be things your business wishes to procure (formal Tenders, simple call for supply of parts or materials), or things you wish to offer and receive applications for (notification of available capacity).

You can use the Keyword Search and filtering to find Opportunities that would be appropriate to your business.

Home / Opportunities

Keywords

Locations

Category

Ethanol 99%,1l MEK

Value: € - Location: Germany Opening Date: 18/04/2021

Due to the shortage of consumables in the pandemic, we are looking for partners for the procurement of a larger quantity (at least 5000l = 5 IBCs)

Closing Date: 31/05/2021

Search Opportunities My Opportunities My Teams Login Register

Opportunity

Home / Opportunities / Opportunity

Opening Date

18/04/2021

Closing Date

31/05/2021

Ethanol 99%,1l MEK

Value: € - → **Walter Otto Müller GmbH & Co. KG** Location: Germany

Due to the shortage of consumables in the pandemic, we are looking for partners for the procurement of a larger quantity (at least 5000l = 5 IBCs)

Figure 27: Validation of the Business Opportunity Solution regarding keyword search

- **Requirement**
 - Find partners for joint purchase of consumables
 - Search also time-related
- **Comment**
 - Various date fields for search and narrowing are implemented (e.g. delivery date, lead date).

The screenshot shows a form for creating a business opportunity. Several date fields are highlighted with red arrows:

- Opening Date ***: 19.04.2021
- Closing Date ***: 19.04.2021
- Duration / Delivery Date ***: 19.04.2021
- Lead Date ***: 19.04.2021

Other fields include Value, Currency (GBP), Category (Procure Products), and Quantity.

Figure 28: Validation of the Business Opportunity Tool regarding date search

- **Requirement**
 - Find partners for joint purchase of consumables
 - Get contact details or the possibility to get into contact with potential partner companies (send invitation)
- **Comment**
 - A system for sending messages and invitations is implemented.

The screenshot shows two parts of the Business Opportunity Solution interface:

Opportunity Detail: Displays information for 'Phenol resin PR-FR-5361'. It includes the opening and closing dates, the procurer's name (Innovint Aircraft Interior GmbH), location (Europe), and a description of the need. A red arrow points to the 'Need more information?' section, which contains buttons for 'Send procurer a message' and 'Apply now'.

Create Opportunity: Shows the steps to create a new opportunity. It includes a section for 'Additional Information' where users can upload documents and add comments. A red arrow points to the 'Invite Companies' button at the bottom.

Figure 29: Validation of the Business Opportunity Solution regarding message system

3.1.3.5 User value proposition

Undoubtedly, it will significantly benefit SMEs in Europe if ad-hoc cooperation related to specific purposes, such as joint purchasing, can be arranged quickly and simply via a digital platform. Networking among each other is not very well developed, especially in the SME sector. In addition, digitisation is often not yet very far advanced in companies. The first digitisation measures mainly address internal company processes - B2B processes are presumably the exception. There is great potential here to strengthen the own position in the global competitive environment significantly.

The system benefits from the broadest possible user base. With growing acceptance and dissemination, the benefit also increases automatically because the reach for products and services and tenders and bids increase. By integrating the tools, application scenarios are conceivable in the future that currently cannot be mapped in the real economy, at least not via an open and standard platform, such as combining a product search with a tender to get better price options.

3.1.3.6 Compliance with Standards and Regulations

Not applicable.

3.1.3.7 Lessons Learned and Outlook

This solution was evaluated by target users in their industrial/real-world scenarios regarding the functional and non-functional aspects of the developed solution. Following that, the following lessons are learned by the project partners. For detailed results or specific user evaluation comments/scores, please refer to Figure 111 in chapter 5.2.1. Please refer to 3.1.4.7 for a detailed analysis of the answers to the questionnaire.

3.1.4 US1.4: Finding partners for joint purchase of (raw) materials and products with high MOQ

3.1.4.1 Short Description

Small and medium-sized companies have often found their niche in the production of small series or lot-size-one manufacturing. In particular, in the aviation industry, such small series are usually stretched out over months or years, so that effectively, one no longer even must speak of a small series, but a lot size one manufacturing. This becomes a problem, especially when products requested by customers can only be manufactured with materials that have a certain MOQ. It is possible to purchase only the required quantity in some cases, but certain setup costs become valid due to the order below MOQ. Although this all does not prevent the requested product from being offered, the price is often no longer in line with the market due to the minimum quantity to be considered, which far exceeds the requirement, so that the order is not won in the end.

Based on this, the interest of the offering company is to find partners for the joint purchase of (raw) material and products with high minimum order quantity (MOQ). In this way, high setup costs or high purchase quantities can be avoided to offer competitive prices. This increases the probability of winning an order.

Partners involved in this user story were from the user side HAW, WOM, 3DI and IAI. As technical partners, SRDC and C2K were responsible for the technical development.

3.1.4.2 Requirements / Acceptance Criteria

The following Table 6 shows the defined requirements and their fulfilment for developing a solution that fulfils the users' needs.

Req. ID	Short Description	Fully covered	Partially covered	Not covered	Number of validated fulfilment	Number of companies for validation
R-US1.4-1	Search for different (raw) material and products providers	X			4	4
R-US1.4-2	Search for (raw) material and products	X			4	4
R-US1.4-3	Search also time-related	X			4	4
R-US1.4-4	Get contact details or the possibility to get into contact with potential partner companies (send invitation)	X			4	4
R-US1.4-5	Place search inquiries for raw materials and products	X			4	4
R-US1.4-6	Add more information to the search inquiry (like dates/specific descriptions etc.)	X			4	4
R-US1.4-7	Have a dashboard with summarising information about search inquiries	X			4	4

Table 6: Requirements of US1.4

All requirements are fulfilled.

3.1.4.3 Fulfilment of the US1.4 through EFPF

The technical solution builds upon the base NIMBLE platform's "Product Catalogue Service" solution and its integration with the newly developed Business Opportunity solution.

To raise the understanding of the needs on the user side, additionally, relevant workflows were designed, as below:

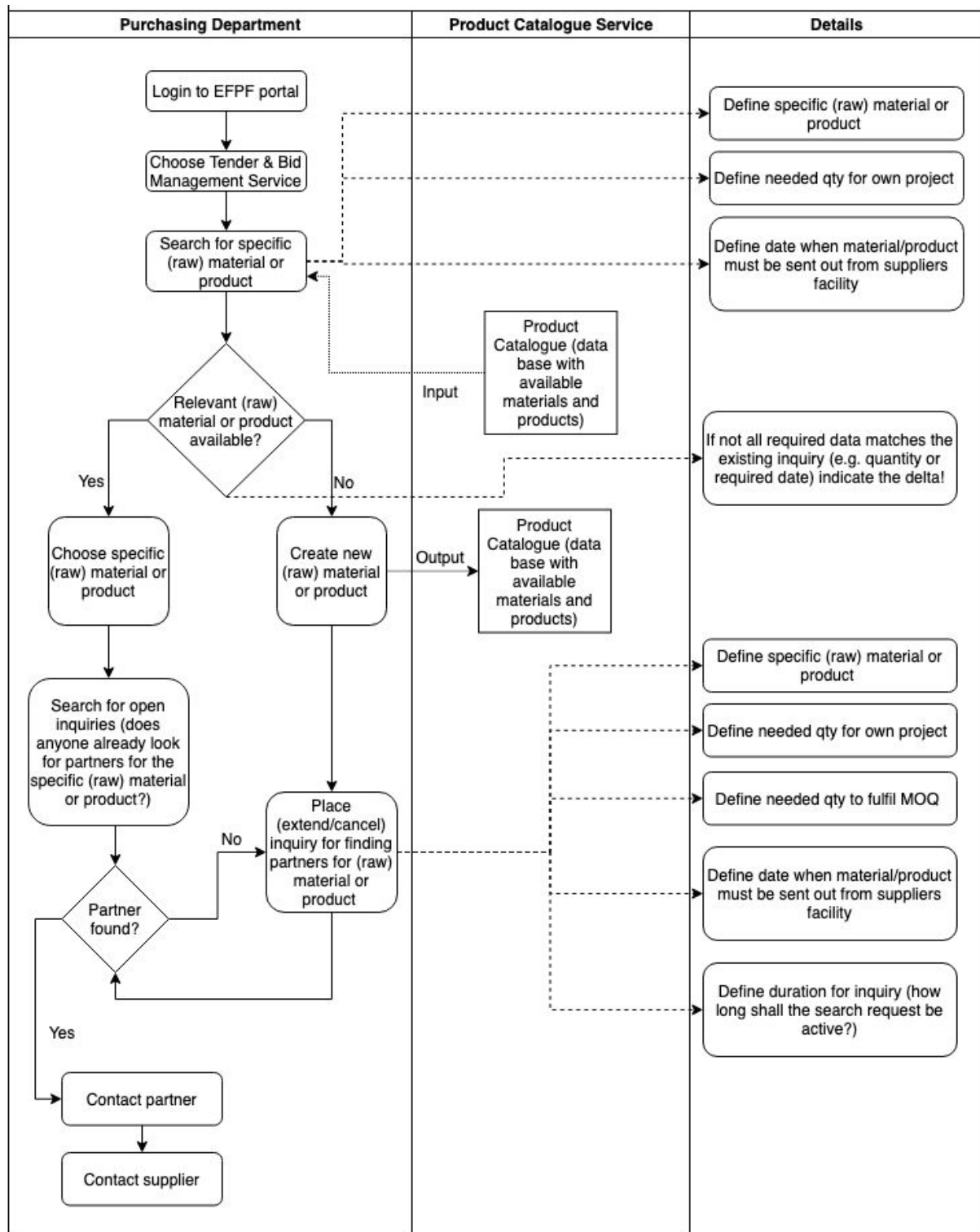


Figure 30: Workflow for US1.4

PED Containment Bag

Product / Service by:
INNOVINT Aircraft Interior GmbH


Catalogue:
Main Catalogue

Categories:
ATA25 - Equipment / furnishings
ATA2520 - Passenger compartment
Products

Fireresistant up to 1.200 degree Celsius. For PED up to 15,4" Compartment dimensions: 380x260x30mm

Part Number: 7261-50

[Add to Cart](#)



Details Price Delivery & Trading Certificates Company Details

Price
Price: 890.00 EUR per ea
Minimum Order Quantity: 10 ea

Negotiate & Order

Delivery Period
4 weeks

Warranty
36 month

Incoterms
EXW

Payment Terms
PIA - Payment in advance

Payment Means
Credit Card

Price
890.00 EUR per ea

Quantity: ea

Total Price:
890.00 EUR

[Organize Bulk Purchase](#)

[Negotiate & Order](#)

[Request Information](#)

Figure 31: Product with high minimum order quantity

To find a partner for the joint purchase of the product to fulfil the minimum order quantity, the user can click on the "Organise Bulk Purchase"-button on the lower right side of the Product Catalogue Service interface.

After clicking on the link, the Business Opportunity Tool opens in a new window. Relevant business opportunities can be created to find suitable partners searching for the same product or material.

Directly on the landing page, which is called "Create a Business Opportunity", relevant need to find a partner for the joint purchase can be entered. Various information needs to be filled in to describe the need as exactly as possible. Amongst other information, also the required delivery date can be entered. Please refer to Figure 31 for a screenshot of the landing page with all needed input shown:

Home / My Opportunities / Create Opportunity

1 Description **2** **3** This allows you to hide sensitive information to share at a later date

All fields marked with * are mandatory

Opportunity Name * Show?
This will be the primary Title for the listing to summarise what it relates to.
 Looking for a partner for PED Containment Bags PNR 7261-50

Opening Date * **Closing Date ***
 20.04.2021 30.04.2021

Value * **Currency ***
Enter a maximum value for the unit price of item you wish to Procure or Offer. If not relevant enter 0 and describe pricing structure in more detail in the "Bid Outline" field below
 0 EUR ☒

Category *
Please select the nature of the listing
 Group Purchase ☒

Quantity *
Enter the minimum qty of product or component required. If it is not relevant enter a quantity of 0 and enter any custom details in the "Bid Outline" field below
 10 ☒

Duration / Delivery Date *
Enter duration the product or service should be provided for
 25.06.2021 ☒

Lead Date *
When should the Product / Service be delivered by?
 25.06.2021 ☒

Production / Material Details *
Enter specific details to provide requirements for any products or materials.
 PED Containment Bags from company Innovint. PNR 7261-50 ☒

Location *
Enter the location to which the Product or Service should be carried out or delivered.
 Hamburg, Germany ☒

Outline of your bid (max 500 words) - you can add you supporting documents on the last step *
 We are looking for a partner to purchase each 5ea PED Containment Bags, so that 10ea MOQ are met. We are convinced from the quality of the bags, this is why we do not want to purchase alternative products.

[Next →](#)

Figure 32: Process of creating a business opportunity for the joint purchase of products

After clicking on the "Next"-button on the bottom of the page, a next window opens. Additional information can be entered, e.g., required accreditations of the needed partners, specification details etc. If all information is entered on the last three pages, the search for a suitable supplier can be published via a "Publish Opportunity"-button.

Create Opportunity

[Home](#) / [My Opportunities](#) / Create Opportunity Info

1 2 3 Additional Information

This allows you to hide sensitive information to share at a later date

Upload relevant documents.

Document types accepted: docx & pdf

 Upload Documents

Show?



Add comments

Comment 1



Comment 2



Comment 3



Add an additional comment: +



Invite Companies

Publish Opportunity

Figure 33: Last page for placing a search in the Business Opportunity Tool

A small popup window gives direct user feedback and states that the opportunity has been published (refer to Figure 34):

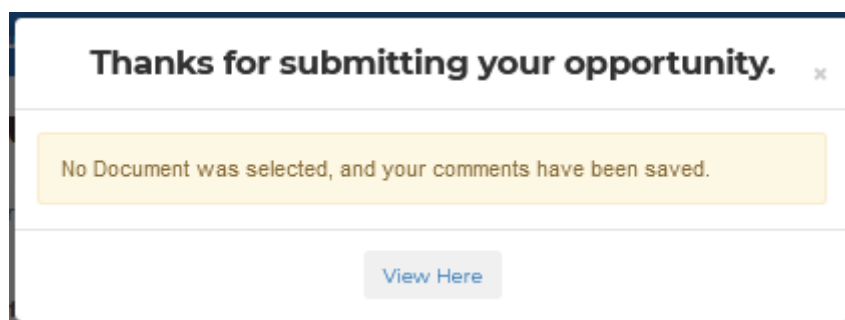


Figure 34: User feedback for a published opportunity

Also, the business opportunity tool can be searched for already existing opportunities. Using this function, it could be checked whether someone is searching for a partner for the same product already before placing an opportunity. Please refer to chapter 3.1.2.3 as the further proceeding is like the description therein.

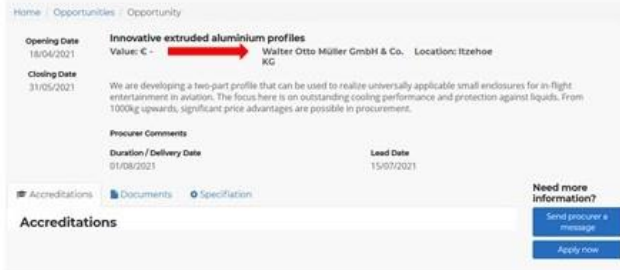
3.1.4.4 Testing and Evaluation

Validations of the Product Catalogue Service and the Business Opportunity Tool were done from IAI and 3DI under consideration of the above-defined requirements and further usability acceptance criteria by publishing different opportunities.

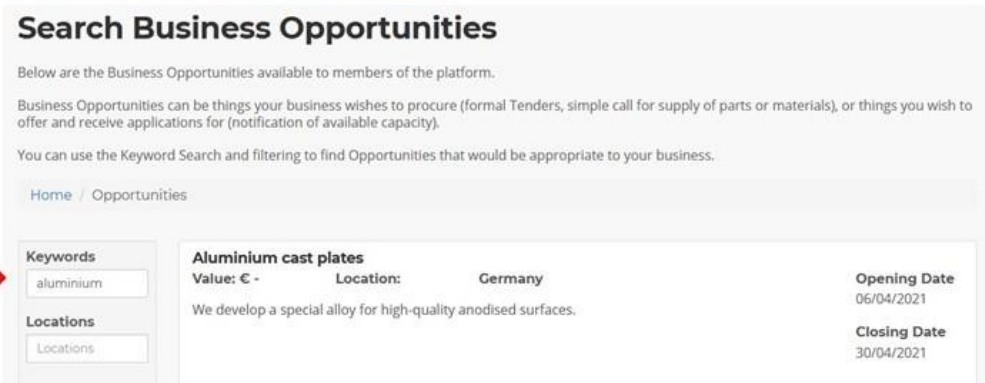
Different products and services have been searched for. Also, different opportunities have been established in the Business Opportunity Tool. Each finding was reported in a complete form using screenshots with markings and comments to the developers. Whenever necessary short video calls were made additionally to discuss the findings and possible corrections. Afterwards, the corrections were implemented so that they meet the formerly

defined requirements correctly. For exemplary screenshots for this proceeding, please refer Figure 35 and Figure 36 .

- **Requirement**
 - *Finding partners for joint purchase of (raw) materials and products with high MOQ*
 - *Search for different (raw) material and products providers*
 - *Search for (raw) material and products*
- **Comment**
 - *Partners and raw material and products are easy to find via a keyword search.*



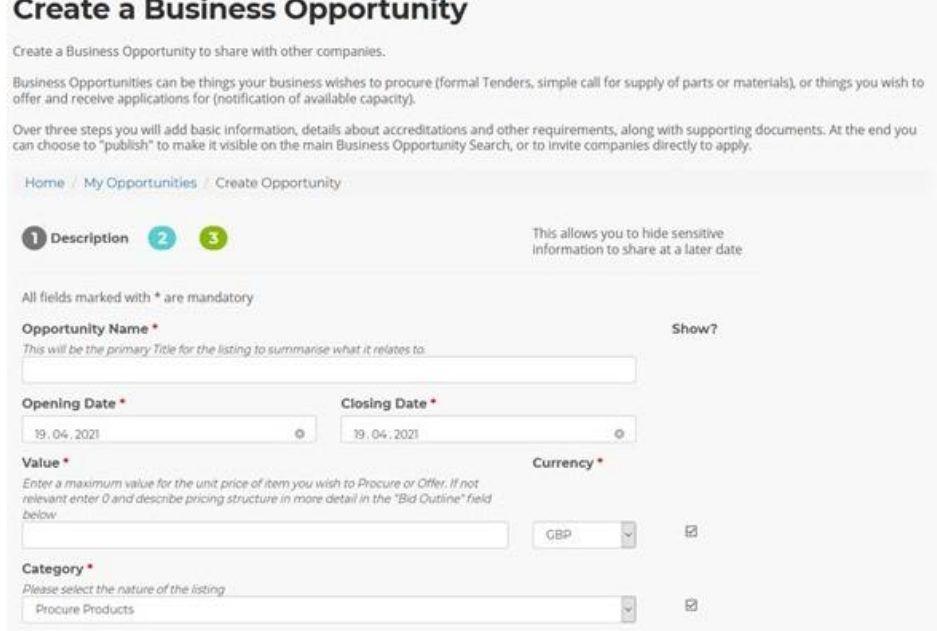
The screenshot shows a detailed view of a business opportunity. It includes fields for Opening Date (18/04/2021), Closing Date (31/05/2021), and Lead Date (15/07/2021). The title is 'Innovative extruded aluminium profiles' with a value of €- and location in Germany. A red arrow points to the company name 'Walter Otto Müller GmbH & Co. KG'. The description mentions developing a two-part profile for small enclosures. There are tabs for Accreditations, Documents, and Specification. A 'Need more information?' button is also visible.



The screenshot shows the search interface. It includes a 'Keywords' section with 'aluminium' entered, and a 'Locations' section. The main search results show 'Aluminium cast plates' with a value of €-, location in Germany, and opening/closing dates. A red arrow points to the 'Keywords' input field.

Figure 35: Validation of the Business Opportunity Solution regarding material search

- **Requirement**
 - *Finding partners for joint purchase of (raw) materials and products with high MOQ*
 - *Place search inquiries for raw materials and products*
- **Comment**
 - *Search queries for raw materials and products can be freely formulated and placed.*



The screenshot shows the 'Create a Business Opportunity' form. It includes sections for 'Description', 'Opening Date', 'Closing Date', 'Value', 'Currency', and 'Category'. The 'Description' section has a 'Show?' button. The 'Opening Date' and 'Closing Date' fields are set to 19.04.2021. The 'Value' field is empty, and the 'Currency' is set to GBP. The 'Category' is set to 'Procure Products'. A red arrow points to the 'Description' section.

Figure 36: Validation of the Business Opportunity Solution regarding raw material search

3.1.4.5 User value proposition

In particular, purchasing products or raw materials with a minimum order quantity demands enormous resources from SMEs. On the one hand, larger batch sizes require more storage space and capital commitment. On the other hand, materials with expiry dates, for example, can no longer be used after this date and are disposed of unused. Here, the Business Opportunity Tool offers an excellent approach to save costs and avoid waste.

- Increased sales efficiency (better prices can be quoted for leading to more orders/getting the job).
- Increased sales efficiency (better prices can be quoted, possibly leading to more orders/getting the job)
- Better customer satisfaction (due to better-offered prices)
- Improved operational performance (more orders)

3.1.4.6 Compliance with Standards and Regulations

Not applicable.

3.1.4.7 Lessons Learned and Outlook

This solution was evaluated by target users in their industrial/real-world scenarios regarding the functional and non-functional aspects of the developed solution. Following that, the following lessons are learned by the project partners. For detailed results or specific user evaluation comments/scores, please refer to 5.2.1.

In general, users rate the solution as easy to use, as it meets their requirements with clear user guidance and well-structured menus. The functions are also primarily self-explanatory. For the further development of the platform, the users expect some improvements and extensions of the functions. In terms of user-friendliness, an optimised placement of buttons ("Create Opportunity" button within the "My Opportunities" menu to invite suppliers) was suggested. In addition, it would be helpful if the user guide indicates which step the user is currently in (step 1, step 2, etc.).

Regarding missing functionalities, the main point is that during switching from the Product Catalogue Service to the Business Opportunity Tool, the search criteria could be directly taken over so that the effort to create an opportunity is reduced and some fields are pre-filled.

3.2 Tender and Bid Management

3.2.1 US2.1: Tender of material that has reached the expiry date

3.2.1.1 Short Description

This user story is related to the operations of a typical purchasing manager in the manufacturing company, who wants to create a tender for a specific material that will reach the expiry date in the following weeks and days because after this date, it is not usable for high-quality products in the aviation industry. Companies are often confronted with short-time changes in respective materials to be used for their products. Reasons are changing requirements made by the customers or new regulations regarding the usage of dangerous materials made by the European Chemicals Agency (ECHA), which updates the REACH guidelines² twice a year. In some cases, this leads to material excess, long-time storage of materials or worst-case materials in stock that reach the expiry date and therefore become scrap. To prevent the material from being thrown away, tenders should be made in the opportunities tool so that other companies who need this material can buy this material.

3.2.1.2 Requirements / Acceptance Criteria

The following Table 7 shows the defined requirements and their fulfilment. All requirements are fulfilled.

Req. ID	Short Description	Fully covered	Partially covered	Not covered	Number of validated fulfillments	Number of companies for validation
R-US2.1-1	Document/track raw material batches in terms of quantity and expiration dates by connecting with the ERP-System of the user company or manual input.	X			1	1
R-US2.1-2	Inform about material getting close to expiration.	X			1	1
R-US2.1-3	Possibility to specify a date from which the material will be visible as an offer in a tender and bid tool.	X			1	1
R-US2.1-4	Create Tenders defining materials, quantities and closing/delivery dates	X			1	1
R-US2.1-5	Connection to product catalogue service	X			1	1
R-US2.1-6	Invite / send messages to procurement	X			1	1
R-US2.1-7	Search for materials with a short time until reaching the expiry date	X			1	1

Table 7: Requirements of US2.1

² REACH = Registration, Evaluation, Authorization and Restriction of Chemicals; REACH is a regulation of the European Union, adopted to improve the protection of human health and the environment from the risks that can be posed by chemicals, while enhancing the competitiveness of the EU chemicals industry. It also promotes alternative methods for the hazard assessment of substances in order to reduce the number of tests on animals.

3.2.1.3 Fulfilment of the US2.1 through EFPF

The workflow to describe the different activities in this use case is shown in Figure 37. The Business Opportunities solution development was led from C2K and tested by the aerospace SME 3DI for this specific use case.

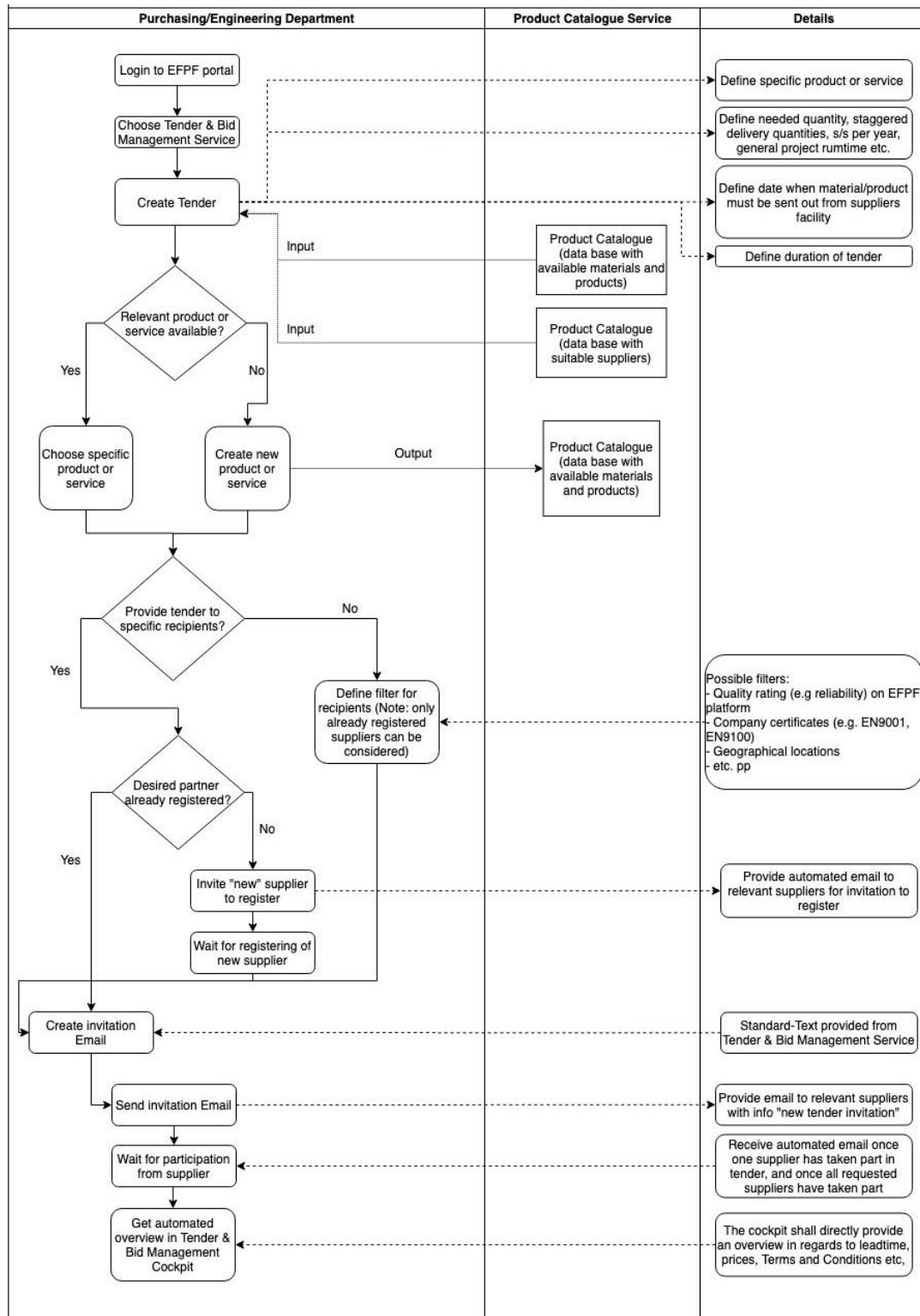


Figure 37: Workflow for US2.1

3.2.1.4 Testing and Evaluation

3DI did the validation. All defined requirements were tested. The results are shown in Table 7. Some examples for screenshots are shown in the following figures.

Search Business Opportunities

Below are the Business Opportunities available to members of the platform.

Business Opportunities can be things your business wishes to procure (formal Tenders, simple call for supply of parts or materials), or things you wish to offer and receive applications for (notification of available capacity).

You can use the Keyword Search and filtering to find Opportunities that would be appropriate to your business.

[Home](#) / [Opportunities](#)

Keywords

Locations

Category

Accreditations
☐ ISO 9001
☐ CHAS
☐ BS OHSAS 18001

DashHound
Value: £ - **Location:** Cwmbran

DashHound is a social commerce platform that empowers beauty consumers to make efficient, infallible purchase decisions. Through the use of cutting-edge machine learning techniques, the platform connects beauty enthusiasts, globally, with the products used by their online influencers.

Accreditations Required
☒ CHAS
☒ Custom Accreditation

Opening Date
 18/02/2021
Closing Date
 28/02/2021

General Communications
Value: £ - **Location:** Cardiff

Experts in providing bespoke telecommunication services for business for 3 decades. At General Communications, we offer your company the most cost-effective communication solutions based specifically on your business needs. We have assisted thousands of companies throughout the UK, finding the best solutions for their requirements and providing the best price. Saving your business money We at Gen Comms work directly to show you exactly how to save your company money on your annual spend of business phones and mobiles, to find you the best tariffs. We work closely with the 4 largest UK networks to proved you deals that you can't get anywhere else.

Accreditations Required
☒ ISO 9001
☒ BS OHSAS 18001
☒ Cyber Plus Security

Opening Date
 18/02/2021
Closing Date
 20/02/2021

Blue Sky Digital
Value: £ - **Location:** Cardiff

Accreditations Required
 (None listed)

Opening Date
 19/02/2021

Figure 38: Search for Opportunities

[Search Opportunities](#)
[My Opportunities](#)
[My Teams](#)
[Register Company](#)
[Logout](#)

Opportunity

[Home](#) / [Opportunities](#) / [Opportunity](#)

Opening Date
 19/02/2021
Closing Date
 25/02/2021

Blue Sky Digital
Value: £ - **Control 2K Ltd** **Location:** Cardiff

Blue Sky Digital is South Wales' only approved dealer for Canon, Sharp and HP digital office systems and brings together over 25 Years experience in the office equipment industry. As a dealership Blue Sky Digital benefits from the added expertise and support which working with Canon, Sharp and HP brings. We supply multi-functional devices, office printers, print production machines and audiovisual equipment. This includes the latest technology, software and accessories to help grow business capacity, improve efficiency and increase savings including phone and voice systems. We also partner with skilled niche IT suppliers to offer specific services and software including data capture. Contact us today to experience professional, approachable and efficient service.

Procurer Comments
 (None listed)

Duration / Delivery Date
 Not Public
Lead Date
 Not Public

☒ Accreditations
☒ Documents
☒ Specification

Accreditations
☒ Sharp Gold Partner
☒ ISO 9001

Need more information?

Figure 39: Getting in contact with other companies via Opportunity tool

3.2.1.5 User value proposition

From a purchaser point of view, it is possible to search for tenders or companies who offer material at a low price, which is reasonable respective the shortened expiry date.

If the expiry dates fit the companies needs, it can buy the materials at a much better price than they must pay when ordering new material.

From the companies' point of view, expiration of material, which means financial loss, can be prevented.

3.2.1.6 Compliance with Standards and Regulations

Not applicable.

3.2.1.7 Lessons Learned and Outlook

Same as the previous user stories, the Tendering solution is available in the EFPP federation and accessible through the Portal. The critical point is to reduce the number of questions for registering a company because it could deter people.

3.2.2 US2.2: Tender for Maintenance Services

3.2.2.1 Short Description

This user story relates to a typical sales manager who wants to sell services to customers with the participation of sub-suppliers because my company can deliver not all service.

For some years now, there has been a reduction in the number of suppliers in maintenance at large OEMs. AAM is one of the selected suppliers in this segment, which the customer can directly contract. Nevertheless, the operators/users have the wish or the operational requirements to continue to have activities carried out by the original supplier. AAM acts as an intermediary between the customer and the downstream suppliers and assumes the coordination and purchasing functions in these cases.

3.2.2.2 Requirements / Acceptance Criteria

The following Table 8 shows the defined requirements and their fulfilment. All requirements are fulfilled.

Req. ID	Short Description	Fully covered	Partially covered	Not covered	Number of validated fulfilment	Number of companies for validation
R-US2.2-1	Search for suppliers with specific products and services.	X			1	1
R-US2.2-2	Place a tender with all relevant information	X			1	1
R-US2.2-3	Be contacted for queries from the suppliers	X			1	1
R-US2.2-4	Receive quotations for the needed product and services	X			1	1
R-US2.2-5	Receive automated reminders about changes in tender conditions.	X			1	1

Table 8: Requirements of US2.2

3.2.2.3 Fulfilment of the US2.2 through EFPF

The partner involved in this user story was from the user side, AAM. As a technical partner, C2K was responsible for leading the technical development of the Business Opportunities solution.

Due to many sub-suppliers, a tool is needed here. The individual suppliers can register on the EFPF platform to obtain the relevant information in a targeted and, above all, verifiably documented manner. This is possible with the developed Business Opportunities Tool.

On the other hand, AAM receives various customer requests (50 - 100 per day) to act as intermediaries. Most inquiries are about production-accompanying processes (materials; services), which must be ordered promptly. For this purpose, the EFPF platform can create the corresponding inquiry and provide it with a timestamp and a deadline for preparing the offer. The corresponding participants in these "calls for tenders" can be registered (checked)

in advance to keep the ordering process short. The selection of the suppliers is carried out, for example, via the rough selection according to

- Material delivery
- Technical service
- Material supply and technical services like Electro, Mechanics, Hydraulics, Compressed air technology, Extraction technology, Plant construction., etc.

An essential user need was that the solution must enable selecting one or more groups of suppliers to be automatically addressed (tender). This is possible with the developed solution.

Other fundamental user needs include a short response time necessary in individual cases (2-3 hours). Moreover, all incoming offers should be pre-selected in a shortlist, e.g., concerning price and delivery time, to simplify the selection process. After the selection of a suitable supplier, an order should be generated directly from the platform. Here, the generation of an "AAM" delivery note is necessary since the customer's goods receipt only recognises corresponding attached documents exclusively from AAM. This could be tested not yet. The general workflow describing the activities taking place in this use case is shown in Figure 40.

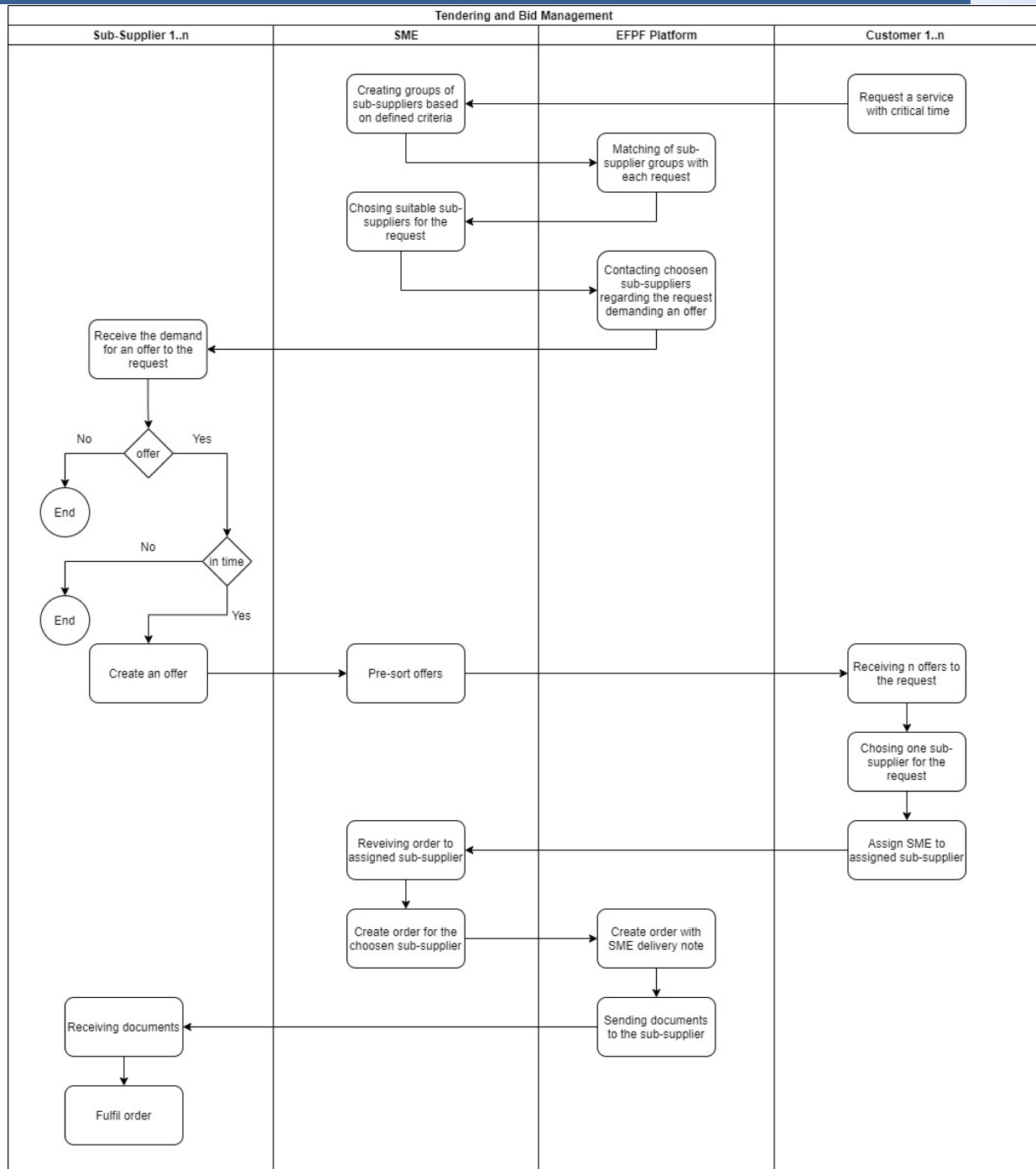


Figure 40: Workflow for US2.2

3.2.2.4 Testing and Evaluation

AAM examined the specifications for the maintenance requests under the defined requirements and other usability aspects. AAM loaded some of the required services into the tool in different iteration steps, whereby only precisely defined services were considered here. There are many similar maintenance services, but due to many pieces of equipment, it is only possible to request a specific service to a limited extent. The prerequisite here is that the provider knows the requested equipment, e.g., drilling machine: here, there are simple hand-guided devices or large drilling machines subject to entirely different test regulations. Regarding the services offered, validation was carried out by AAM, whereby

specific, simple services were uploaded. In various meetings, the needs were concretely discussed with the developers. If necessary, additional meetings (telephone or video calls) were held to discuss the problems found and possible corrections. The corrections were then implemented in such a way that they fulfilled the previously defined requirements.

3.2.2.5 User value proposition

The use of the Business Opportunities tool within the framework of the EFPF platform (Tender for Maintenance Services) is an additional tool for the users to involve other SME companies in large tenders from their customers for services that they cannot provide themselves. With this tool, the users can better inform future partners and quickly obtain corresponding offers from external partners. AAM can use this tool as a possible unique selling point in marketing and the preparation of offers. Furthermore, users also can compete with their services and thus obtain a better market overview.

This tool has a corresponding service character, as the users can/want to communicate more specifically with their potential suppliers. The advantage here is that through the targeted use of the tool, users receive offers from potential suppliers much more quickly and respond more quickly to the services requested by our customers. In this context, the use-case partners estimate that the administrative costs for obtaining corresponding offers can probably be reduced by up to approx. 30 %, as necessary and time-consuming searches for possible suppliers are no longer necessary. Therefore, the use-case partners can offer our customers more attractive prices and win a corresponding number of tenders.

This faster tender preparation enables AAM to provide a better service to the customer and increases customer loyalty.

3.2.2.6 Compliance with Standards and Regulations

Not applicable.

3.2.2.7 Lessons Learned and Outlook

This solution was evaluated by target user AAM in his industrial/real-world scenarios regarding the functional and non-functional aspects of the developed solution. Following that, the following lessons are learned by the project partners. For detailed results or specific user evaluation comments/scores, please refer to chapter 5.2.1. Please refer to 3.1.4.7 for a detailed analysis of the answers to the questionnaire.

3.3 Parameter Monitoring in Production and Maintenance

3.3.1 US3.1: Automated Environmental Monitoring of Parameters

3.3.1.1 Short Description

Many SMEs lack fundamental digitisation. To not forget them in the global digitisation race, solutions are also needed that connect existing machines and devices to digital networks without significant investments and thus make their parameters readable and evaluable to increase the efficiency of production processes. Such solutions, which tie in with low-digitized infrastructures, are needed not to leave SMEs behind.

In this specific use case, capturing relevant shop floor information from the real world is demonstrated. The data are linked together and available in the EFPF platform through digital information and communication technologies.

The overall goal is to ensure that specific parameters in specific production machines and production environment are kept. The EFPF aerospace partner WOM requires control of temperature and humidity in their manufacturing area to ensure consistent quality and environmental conditions required for component tolerances. In aviation, large OEMs such as Airbus and Boeing set detailed product specifications for suppliers. In some cases, certain production steps are only permitted under very specific and monitored environmental conditions. For example, aerospace paints may only be processed within a specific temperature range.

The EFPF aerospace partner IAI needs to survey raw material stored in a freezer to avoid scrapping in case of too high temperature. In the second IAI relevant use-case, the vacuum forming machine's vacuum needs to be controlled to take immediate actions once the pressure is too high.

In all three cases, the goal is to secure the stability and quality of manufacturing processes by monitoring the relevant parameters and provide alarms in case defined thresholds are underrun or exceeded. Overall goals are to make sure that:

- Products are manufactured in acc. with relevant process specifications,
- Rejects and waste are reduced,
- Failures can be detected early, and intervention actions can be taken if necessary.
- Record history data as proof for the correct functioning of the system even when unattended.

Partners involved in this user story were from the user side, WOM and IAI. As technical partners, FOR and NXT led the technical development.

3.3.1.2 Requirements / Acceptance Criteria

The following Table 9 shows the defined requirements and their fulfilment.

Req. ID	Short Description	Fully covered	Partially covered	Not covered	Number of validated fulfilment	Number of companies for validation
R-US3.1-1	Monitor process parameters like temperature, pressure/underpressure etc.	X			2	2
R-US3.1-2	Provide alarm in different appearances (e.g. lights/SMS/Email) if parameters are out of defined tolerances.	X			2	2
R-US3.1-3	Record the defined parameters over time and enable easy data access.	X			2	2
R-US3.1-4	The monitoring system shall consist of control computers with corresponding intelligent software and interface modules, relevant relays and actuators, and different status indication devices.	X			2	2
R-US3.1-5	The monitoring system shall record relevant data and provide them to the EFPF data spine.	X			2	2
R-US3.1-6	LED lamps (green/red) and a sounder as general indication devices shall be installed directly at the specific implementation locations (freezer/vacuum machine) to give direct feedback about the monitoring status to staff in the workshop.	X			2	2
R-US3.1-7	For the temperature use case: the green LED lamp shall always be powered on, indicating the correct status of the temperature.	X			2	2
R-US3.1-8	For the vacuum use case: the green LED lamp shall be powered only when the machine starts running and the monitored parameters are correct.	X			2	2
R-US3.1-9	Email and SMS as alarm indication devices shall be put in place to give direct feedback about the monitoring status to staff in the back office.	X			2	2
R-US3.1-10	Email and SMS as alarm indication devices shall be put in place to give direct feedback about the monitoring status to staff at home when the company is not occupied (e.g. at night).	X			2	2
R-US3.1-11	The monitoring system shall control the LED lamps and sounder and the Email and SMS automatically without needed manual input.	X			2	2
R-US3.1-12	The required technical equipment shall be state-of-the-art.	X			2	2
R-US3.1-13	The required technical equipment shall be readily available and consider standard parts where possible.	X			2	2
R-US3.1-14	The technical equipment shall be installed in a cabinet to protect electronic components from the industrial environment.	X			2	2

R-US3.1-15	The monitored data must be accessible via the EFPF portal without an additional login.	X			2	2
R-US3.1-16	The monitored data shall be presented in a GUI with maximized usability and ergonomic handling.	X			2	2
R-US3.1-17	The monitored data shall be presented in a graph with the option to zoom in/zoom out and look into specific areas in more detail.	X			2	2
R-US3.1-18	It shall be possible to set the thresholds (values for triggering the alarms) via the EFPF portal (GUI).	X			2	2
R-US3.1-19	After having set a new threshold, a separate request for confirmation shall pop up.	X			2	2
R-US3.1-20	After having confirmed a new threshold, the changes shall apply to the monitoring system without delay.	X			2	2
R-US3.1-21	The implemented solutions shall be customizable for similar applications with different environmental parameters to be monitored (e.g. vibrations/humidity, etc.)	X			2	2
R-US3.1-22	All monitored systems shall have the full functionalities if there is an error (e.g. software problem/hardware failure) in the installed monitoring system.	X			2	2
R-US3.1-23	The obstruction of the typical workshop operator workflows shall be minimized.	X			2	2
R-US3.1-24	The installation of the technical equipment must be guided with proper documents.	X			2	2
R-US3.1-25	The required technical infrastructure at installation location/facilities shall only be 220V and internet via WLAN or Ethernet cable.	X			2	2

Table 9: Requirements of US3.1

It turns out that the developed solution can fully meet all requirements.

3.3.1.3 Fulfilment of the US3.1 through EFPF

To solve the above use cases, it was first necessary to capture these requirements formally. For this purpose, the requirements were defined, and needed workflows were recorded by WOM and IAI and made available to the technical partners (Figure 41).

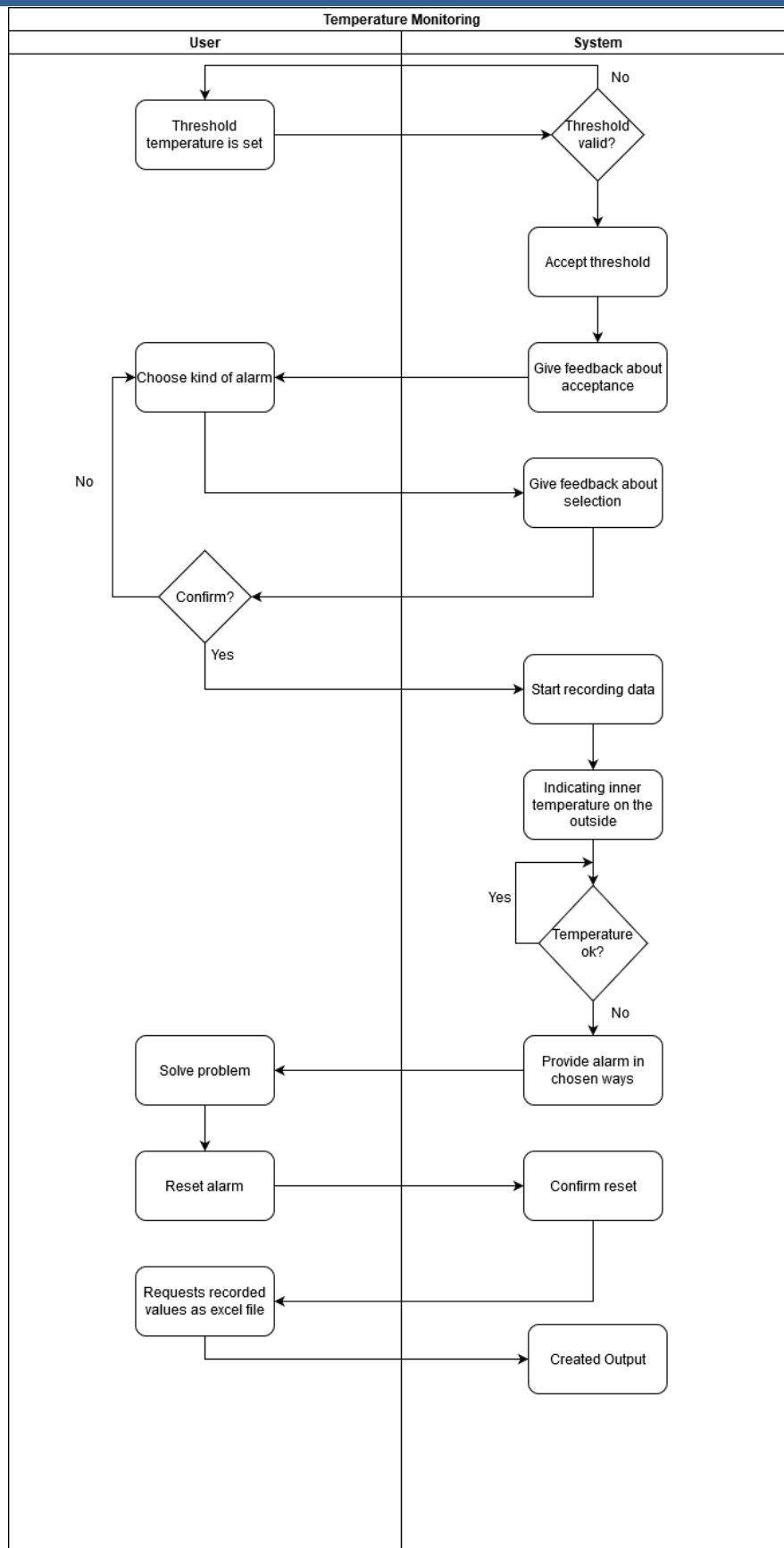


Figure 41: Exemplary workflow description for temperature monitoring

Likewise, the existing infrastructure was also described in a comprehensive document (refer to Figure 42) so that the starting points for the technical developments were defined.



Working Environment Monitoring Scenario	
Use Case Definition	
<div> <div>  NEXTWORKS <small>ENGINEERING FORWARD</small> </div> <div>  </div> </div> <p>An explanation how to describe use cases can be found here. Additional parameters are described in the table below.</p>	
Use Case Name	<i>Monitoring vacuum of the vacuum forming machine</i>
Description	<i>For manufacturing of products made from sandwich materials with rounded edges or general round shapes a vacuum form machine is used. This one consists of a large table, which is totally covered from a very elastic and air tight material, which itself is mounted to a stiff frame. After having placed a wooden form and the raw materials with adhesives etc. on the table (below the elastic material) the table is closed and the vacuum pump is turned-on. Depending on the curing time of the used adhesive the vacuum machine remains closed for 12-24h. It is essential that the vacuum is stable and has no fluctuations over this period. Saying that the vacuum pump must ensure constant underpressure. Today no alarm mechanism is in place in case the vacuum pump fails, respectively the vacuum cannot be held. Used vacuum machine is from company Papenbrock, VMP 366</i>
Company details	<i>Innovint Aircraft Interior GmbH, Holzmühlenstraße 84-86, 22041 Hamburg, Germany www.innovint.de</i>
Contact person	<i>Lars Henschel / Project Manager</i>
Actors	<i>Shop floor mechanics</i>
Organizational Benefits	<i>Save money as no material has to be scrapped if the vacuum is not kept over the required time. Thus, less environmental impact.</i>
Frequency of Use	<i>Depending on order situation. Once it is used cycles of 12-24h are necessary.</i>
Triggers	<i>Turn-on of vacuum pump.</i>
Preconditions	<i>The vacuum pump has no failure and allows constant underpressure.</i>
Postconditions	<i>N/A</i>
Environment description	<i>No Wi-Fi available. 220 Volt available. Dimensions of vacuum machine is 313x144x83cm. See picture below for more info.</i>
Measurement Parameter 1 + unit	<i>Underpressure. Exact values hPa/mbar tbd.</i>
Accuracy of Parameter 1	<i>±10mbar</i>
Final results	<i>Once the constant under pressure flow decreases the system shall provide an aural and visual (aural might not be sufficient due to loud surrounding) warning, and send an email or SMS after business hours. A data recording of the measured underpressure flow as history is required. Frequency: every 5 seconds. No restrictions in terms of authorization or proprietary data.</i>
Foreseen challenges (optional)	<i>No internet is available. No hardware for aural/visual/email or SMS alarms available.</i>
Main Course (optional)	<i>Describe the common steps of interaction between the user and the system</i> <i>-Step1: The user turns on the vacuum pump.</i> <i>-Step2: The system let the user know that the defined threshold values have been registered and accepted.</i> <i>-Step 3: The user chooses which kind of alarms shall be used at which times (aural/visual/email/SMS).</i> <i>- Step 4: The system confirms the selected alarm variants.</i>

Figure 42: Use Case Definition Document for Environment Monitoring

The main challenge was to determine which corresponding sensors should be used to record the measured values and how these could be digitised to visualize them via a GUI in the EFPF Portal. To evaluate the validated data and, if necessary, trigger alarms

(email/lights/sounder), the control software had to be programmed, and the corresponding hardware had to be defined.

To enable the automatic and dynamic matching between Things (machine or process data) and IoT services, a so-called Thing to Service Matching, or TSMatch, gateway as a software module was developed from FOR. This TSMatch solution can be used in Industrial IoT scenarios in smart facilities, including but not limited to the shop floor, commercial buildings, and building offices.

To connect to the EFPF Data Spine, the Symphony Factory Connector from NXT was used. It primarily abstracts the low-level details of various heterogeneous fieldbus technologies and provides a standard interface to its users. Symphony provides access to any available resources (sensors and actuators) as data points, supports access via REST and gRPC, and enables publish/subscribe features via MQTT. Additionally, with this software, alarm triggering is possible.

Figure 43 shows the general system architecture for the fulfilment of the required functionalities.

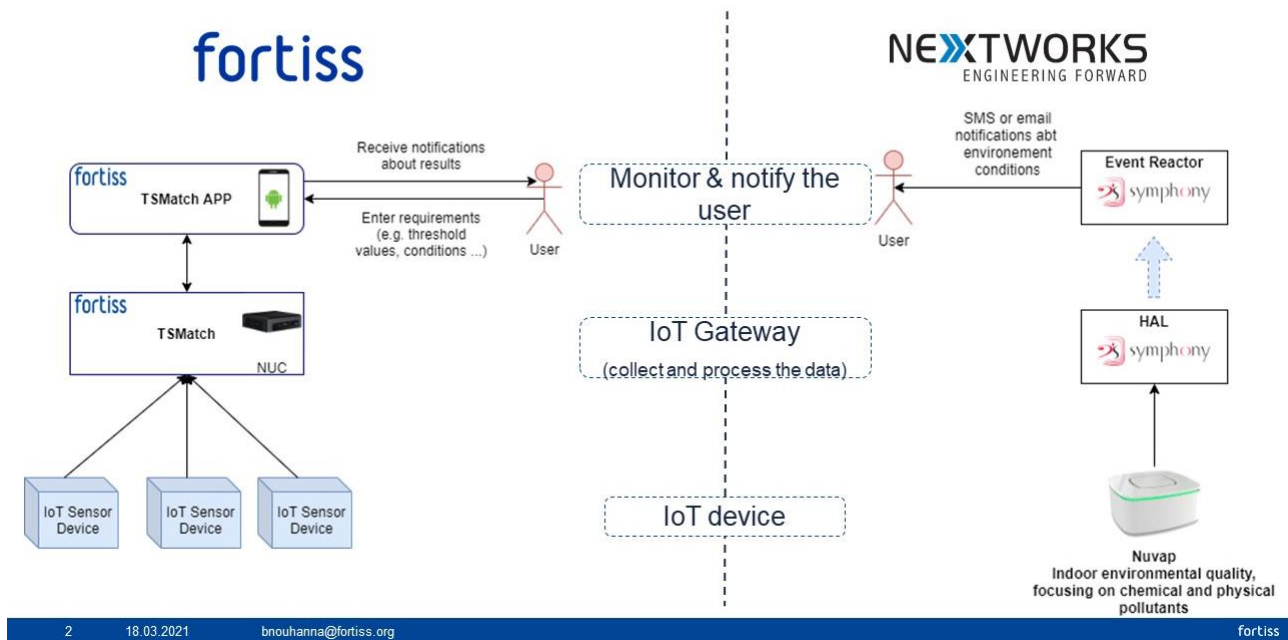


Figure 43: Illustration of the defined system architecture

The solution utilizes small industrial computers and Ethernet-IP input-output modules linked to the relevant process sensors and actuators on the hardware side. All needed hardware was agreed upon between the partners. These are installed in electrical cabinets with supporting electrical equipment to solve a high-standard industrial level. The installation of all hardware and equipment into the cabinets has been done by the user companies WOM and IAI. Please refer to following Figure 44, Figure 45 and Figure 46 to review some of the installed hardware:

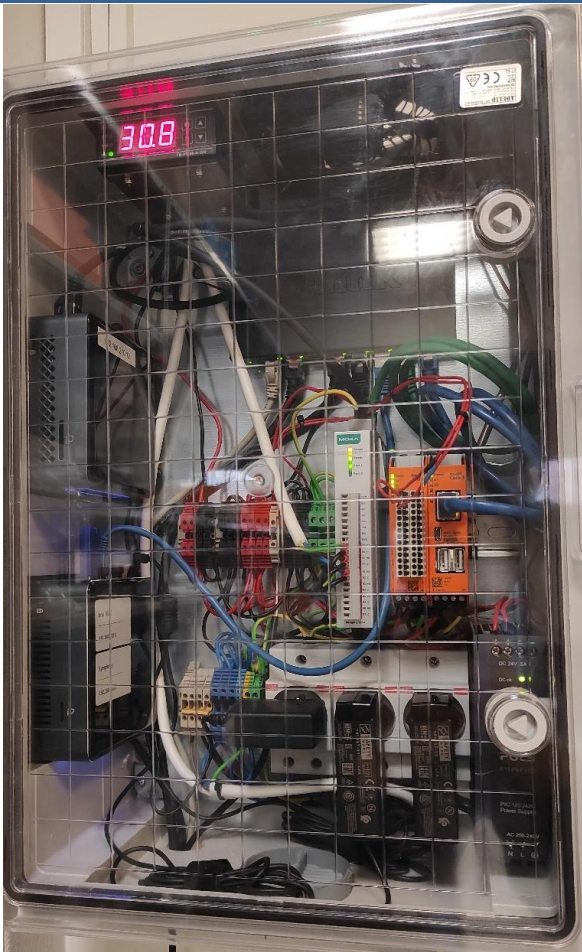


Figure 44: Electrical cabinet for temperature and vacuum use case implementation at IAI



Figure 45: Installed vacuum sensor at vacuum machine at IAI



Figure 46: Installed temperature sensor at IAI

The electrical and network infrastructure in the companies had to be adapted accordingly, so that remote access and connection to the EFPF Data Spine could be established to analyse relevant usage data to provide valuable business intelligence in the future via the EFPF Portal. Aural and visual warnings and alarms via email and SMS were required to assure that instant actions can be undertaken. Please refer to Figure 47 for a picture of the installed alarm lamps and the sounder.



Figure 47: Installation of the workshop alarm system at IAI vacuum machine

To gain access to the data and set the thresholds (e.g., temperature value, above which the alarm system shall be triggered), the user has to login into the EFPF Portal and select the “Symphony Platform”-button on the left-hand side below the “TOOLS”-menu. The relevant landing page for the implemented solutions is shown afterwards (in this case, the IAI Temperature and Vacuum Use Cases). Please refer to Figure 48.

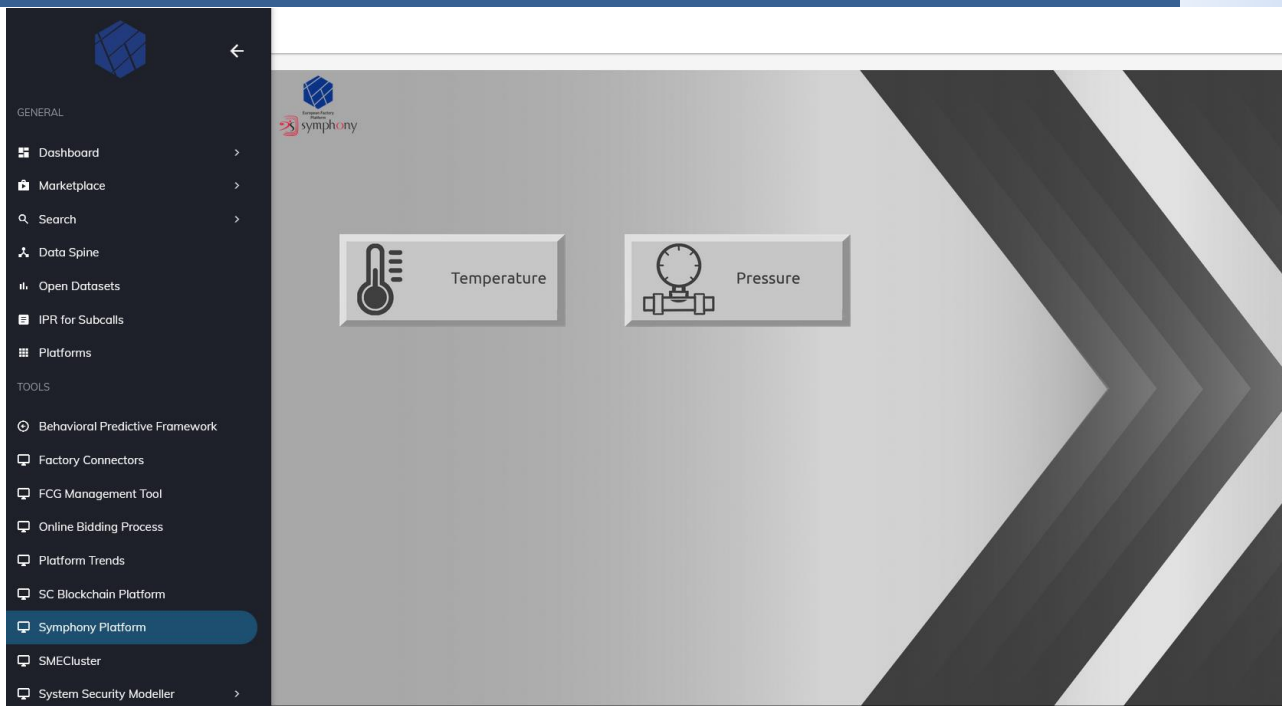


Figure 48: Landing page of the Symphony Platform in EFPF portal (logged in with IAI account)

After having clicked on the relevant use case (in this case, “Pressure”), the following GUI opens (refer to Figure 49):



Figure 49: GUI in EFPF Portal for IAI use cases

Here the thresholds can be defined, the current sensor value is visible, and the type of alarm notifications can be set. Furthermore, the sensor data history is in a graphical form available.

Once the defined thresholds are exceeded, the shown lamps switch from green to red, and a sounder comes on. Furthermore, an email is being sent out to notify, e.g. the head of the production, about a possible malfunction in the monitored system. Refer to following Figure 50:



Figure 50: Alarm notification for temperature monitoring at IAI

3.3.1.4 Testing and Evaluation

The solutions were validated from IAI and WOM under consideration of the above-defined requirements and further usability aspects. Both companies set the relevant threshold in the Symphony GUI to a value where the alarms are triggered. The correct function of the alarm system has then been tested. It turned out that all required functions worked as expected.

Both partners tested the monitoring on the shop floor. Measured values for temperature, humidity and underpressure were recorded under actual production conditions. As the validation was carried out under real conditions on the shop floor, a quick and permanent exchange with the developers via Skype was necessary. The validation was carried out against the previously defined criteria, and the figures/screenshots below show examples from the validation process.

- **Requirement**
 - *Monitor process parameters like temperature, pressure/underpressure etc.*
- **Comment**
 - *Different sensors were used in the validation process (pressure, temperature, humidity). The screenshot shows the example of a temperature sensor.*

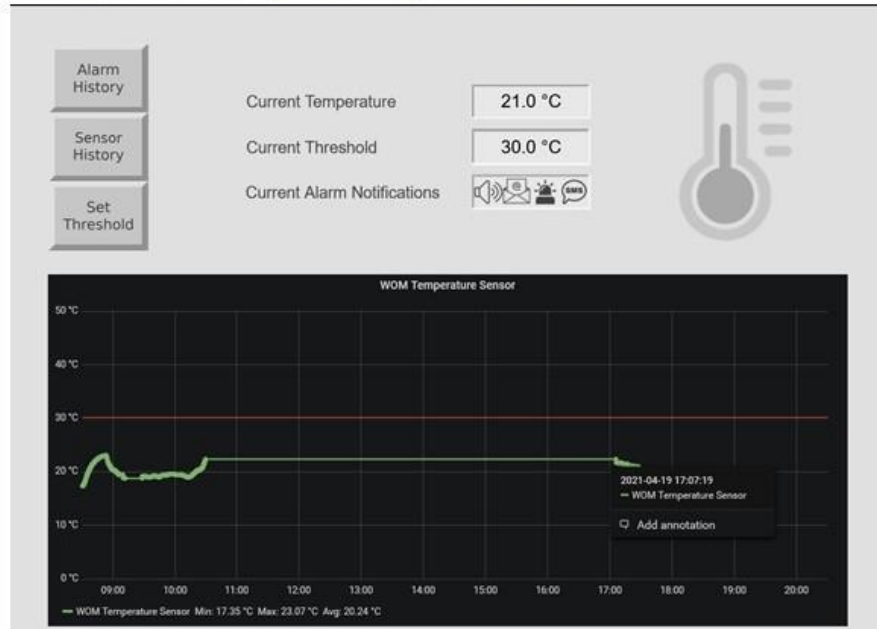


Figure 51: Validation of the Environmental Monitoring Solution regarding process parameters

- **Requirement**
 - *Provide alarm in different appearances (e.g. lights/SMS/Email) if parameters are out of defined tolerances.*
 - *Email and SMS as alarm indication devices shall be put in place to give direct feedback about the monitoring status to staff in the backoffice.*
 - *Email and SMS as alarm indication devices shall be put in place to give direct feedback about the monitoring status to staff at home, when the company is not occupied (e.g. at night).*
- **Comment**
 - *Acoustic and visual alarms are implemented - as well as e-mail notification.*



Figure 52: Validation of the Environmental Monitoring Solution alarms



Figure 53: Validation of the Environmental Monitoring Solution regarding process parameter monitoring

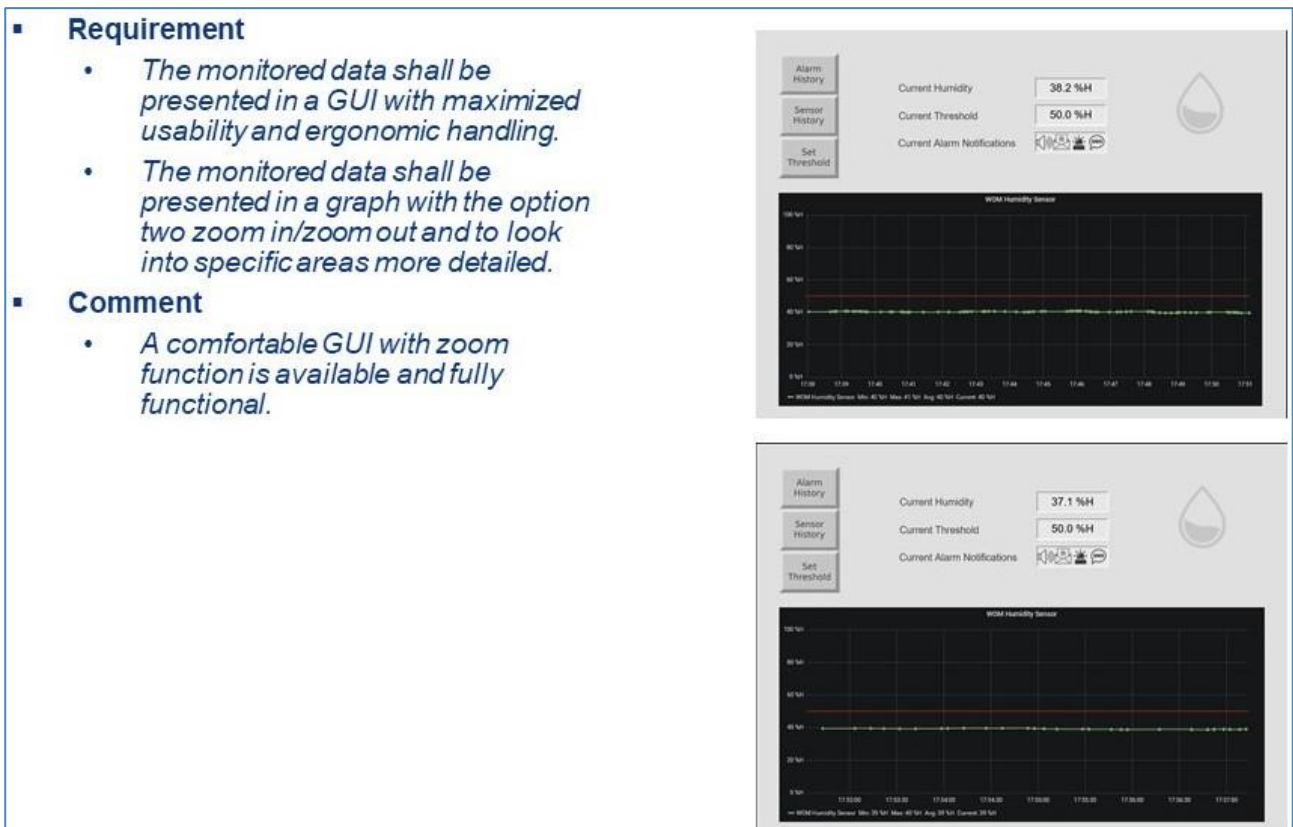


Figure 54: Validation of the Environmental Monitoring Solution regarding the dashboard

3.3.1.5 User value proposition

With the described monitoring systems at WOM and IAI facilities, the general reliability and quality of the linked manufacturing processes are increased.

As all sensor data are recorded, a certain level of traceability is reached so that the values can be reproduced and any abnormalities can be identified in retrospect.

Furthermore, the staff can intervene if relevant process parameters are out of tolerance, which secures the manufacturing process reliability, avoids delivery delays and minimizes rejects/waste occurrence. With this, manufacturing efficiency increases by saving money (e.g., less effort for rework activities, fewer materials must be scrapped). With latter also environmental pollutions are reduced. Further advantages are:

- Implement a certain level of traceability as all data will be recorded so that the values can be reproduced and any abnormalities can be identified in retrospect
- Ensuring compliance with manufacturer specifications (if applicable)
- Ease compliance demonstration for relevant audits with applicable authorities
- Increase manufacturing efficiency by saving money as few materials must be scrapped (less waste)
- Reducing waste leads to few environmental pollutions
- Furthermore, no freezer (IAI) opening shall be necessary, which leads to reduced power consumption.

The implementations will help companies reduce the part failure rate, financial losses and secure and increase customer satisfaction.

3.3.1.6 Compliance with Standards and Regulations

The user-story implementation considered that the hardware used must comply with legal safety regulations (e.g., DGUV, 2006/42/EC). The users were responsible for the professional selection of the hardware and implementation on site.

The software development also considered the requirements for data security and data protection. As far as integrating the local network on-site and the internet connection is concerned, the user is responsible.

3.3.1.7 Lessons Learned and Outlook

This solution was evaluated by target users WOM and IAI in their industrial/real-world scenarios regarding the functional and non-functional aspects of the developed solution. Following that, the following lessons are learned by the project partners. For detailed results or specific user evaluation comments/scores, please refer to chapter 5.2.2.

Following the analysis of the questionnaire answers and taking all other feedback into account, the following statements can be made:

Setting up and integrating the hardware requires technical experience at the user level. As the electrical cabinets were wired and installed at the users' premises, specific skills of the staff and the willingness of the managing directors were needed (especially in terms of insurance), which both might complicate the installation for future companies. However, this is not a general disadvantage, as both partners gained valuable experience so that the

trouble-shooting on the hardware side is eased. The whole electrical cabinets could be delivered as pre-configured hardware kits from the technical partners to avoid these activities at potential customers for future implementations. These hardware kits must comply with industry standards (IP protection class, electric security, IT security, rack or rail mounting, fail-safety). They had then only to install the cabinets to the existing shop floor infrastructure. Suppose this is guided with an applicable technical installation document, which explains which hardware will be delivered, installed and connected, which infrastructure should be available etc. In that case, potential customers will get a clear picture of the overall solution. This would increase the general attractiveness of the solution itself.

In terms of software troubleshooting, this is not possible now without help from the developers. Consequently, this requires ongoing ad-hoc support from the technical partners, if required.

The system consists of numerous hardware components, which makes it quite complex. Three small industrial computers are required to record a measured value such as temperature. Maybe the number of computers can be reduced, which would decrease the cost for the needed hardware, and it would also affect the effort to install the solution.

One function in the GUI that was missing was the export of the data, which should be implemented in future enhancements. Regarding the data storage, it must be ensured that measured values are stored securely over a defined period. If data acquisition fails, the user must be alerted or notified. Otherwise, critical processes will remain unobserved.

The great advantage of the developed solution is its high flexibility. Even if the implementations are limited to pressure/temperature and humidity sensors, many other applications are possible with minimal adjustments to the existing solution. Thus, in addition to other environmental values such as air pollution and light, more technical parameters such as gases, vibrations, liquid leaks, accelerations, current flows and so on can be monitored. There are almost no limits here. In this respect, not two specific solutions were developed here for the two partners WOM and IAI, but rather the foundation was laid for countless other use cases that can be offered via the EFPF portal.

The particular circumstances relating to the global pandemic situation made work difficult for the partners during the development and implementation phases. For example, the technical partners couldn't visit the user partners on-site. However, this hurdle was overcome by regular and ad-hoc phone calls via messenger services such as Skype and taking and sending pictures and videos. This ensured that all partners were clear about the necessary technical, environmental conditions.

Nevertheless, not all difficulties could be solved without delay. For example, the devices to be configured were sent to the technical partners, which were set up in their laboratory environments, often only in the home office due to various restrictions in the countries. This complicated the configuration so that the correct programming could not always be done immediately, resulting in unplanned iterations. Nevertheless, thanks to the partners' commitment to each other and the technical implementations, solutions were developed that were in no way inferior to those that would have been developed under more uncomplicated conditions.

3.3.2 US3.2: Trolley Tracking

3.3.2.1 Short Description

AAM takes care of various transport trailers (trolleys) with which various jigs (devices) are transported for its customers. These transports are carried out between the Airbus locations Hamburg (Germany), Toulouse, St. Nazaire (France) and Mobile/Alabama (USA). The trolleys are only used for internal transport and are transported by ship to the respective location.

AAM has been commissioned to carry out a monthly visual inspection of these trolleys about damage and, if necessary, to carry out repair work immediately. For this purpose, corresponding protocols are drawn up, which must be quickly and easily accessible.

Every three months, the chassis of the trolleys are inspected following German accident prevention regulations (DGUV). Once a year, a technical inspection (TÜV) with an inspection sticker is carried out. Subsequently, the trolleys are released for further use.

This inspection is essential because although the trolleys are used on private property in Germany, France and the USA. They are transported/pulled on public roads from the port to the customer's premises and must be technically safe.

3.3.2.2 Requirements / Acceptance Criteria

The following Table 10 shows the defined requirements and their fulfilment.

Req. ID	Short Description	Fully covered	Partially covered	Not covered	Number of validated fulfilment	Number of companies for validation
R-US3.2-1	Every employee of the customer should see all his open processes	X			1	1
R-US3.2-2	Every employee of the customer should see all his closed processes	X			1	1
R-US3.2-3	History overview, e.g. for 1 Trolley / which problems were there	X			1	1

Table 10: Requirements of US3.2

All requirements are fulfilled.

3.3.2.3 Fulfilment of the US3.2 through EFPF

The required solution based on the requirements was realised based on the available WASP (Workflow and Service Automation Platform) for fast automation processes. The solution is being used to create standard BPMN-based processes, and it allows assigning activities to different users. To allow implementation of needed functionalities, adjustments of the software had to be developed from ICE.

A trolley is only recognisable or trackable if it is loaded with a component since only the transported components are equipped with trackers. When the component is unloaded, the trolley is no longer "visible" for tracking, or nobody can determine where it is. As a test, three trolleys were equipped with trackers (beacons) to identify the current position of the trolleys. Geo-zones" has been set up at the corresponding locations. A signal is automatically sent via an appropriate website as soon as a trolley moves within these zones. If the trolley is not moved for a while, the trackers switch off to save the battery. This makes it possible to know when the trolley will be in Hamburg to plan the corresponding tests. Damage can only be done when the trolley is inspected on site. The disadvantage is that they are only a short time on site before they must be used again. The procurement of spare parts may also take longer, and the trolley is already on the road again without repair. Occasionally AAM receives information about damage from a coordinator in advance. However, this is not the rule. A communication platform in which the relevant information can be recorded quickly and easily and history can be displayed would be desirable. It is also desirable that when a trolley enters its "home" geo-zone, information is generated in which it is possible to see which checks must be carried out, whether damage has occurred and if so, on which part of the trolley, so that the procurement of spare parts can be started early. The complete workflow is shown in Figure 55.

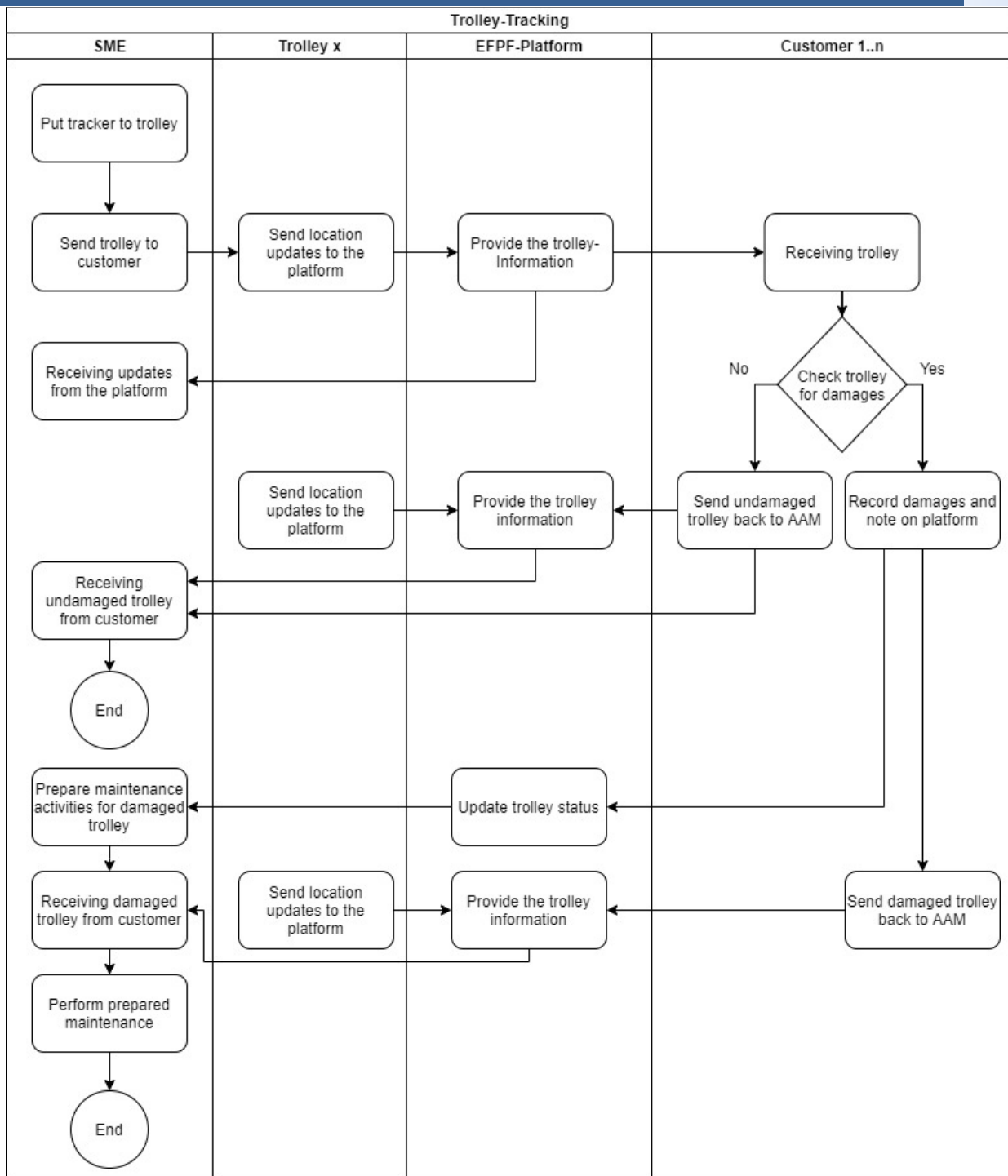


Figure 55: Workflow for US 3.2

3.3.2.4 Testing and Evaluation

The validation of the solution for this use case was carried out by AAM taking into account the defined requirements. We paid particular attention to the ease of use and quick learnability of the tool for the user.

One can go through the individual steps based on the process created to generate the corresponding information. This tool was combined with existing trackers on the various

trolleys to know earlier when a trolley is in our geo-zone (Hamburg) to make the appropriate preparations. The planned functions are given.

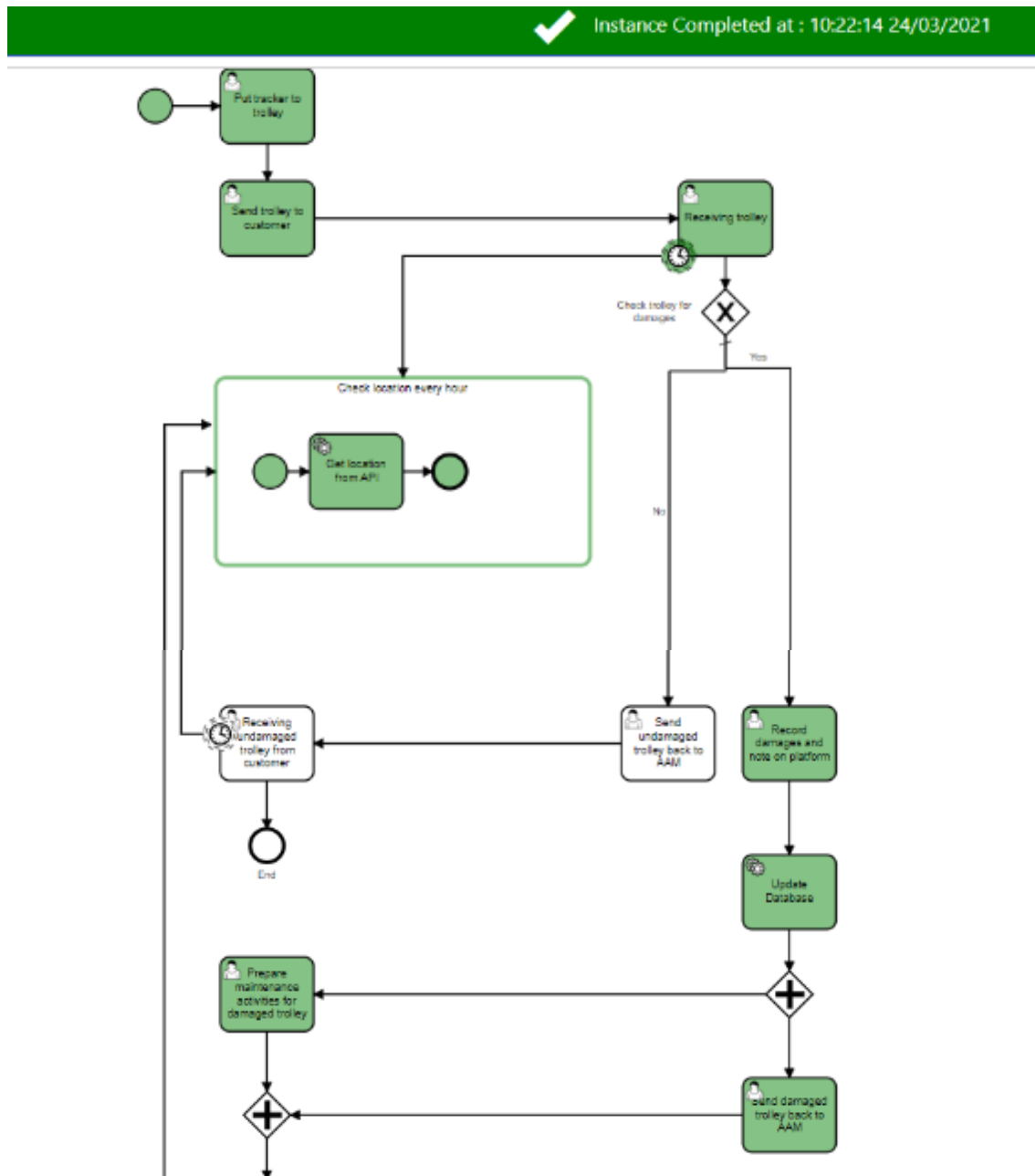


Figure 56: Screenshot Trolley Tracking Workflow for US 3.2 (part 1 of 2)

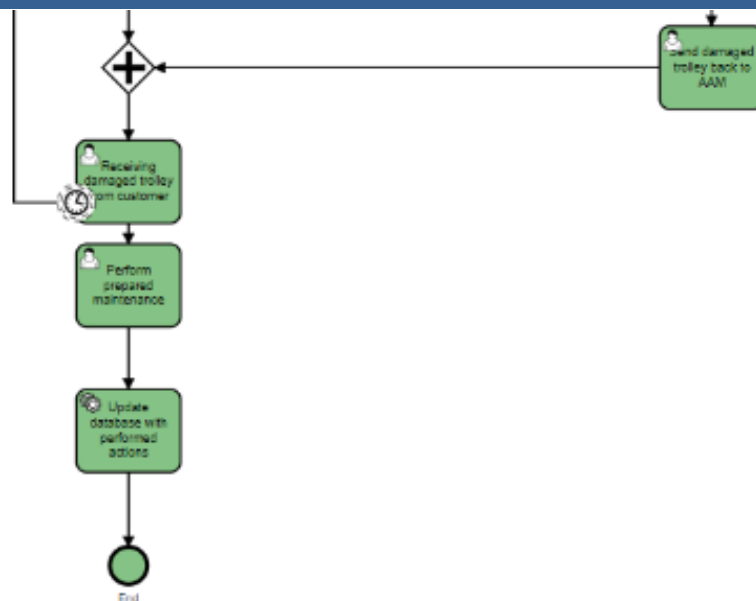


Figure 57: Screenshot Trolley Tracking Workflow for US 3.2 (part 2 of 2)

Task Description	
Trolley_Tracker	
Please complete the following form	
No Input Variables associated with this Task	
Task Outputs	
Output Name	Output Value
Tracker_Serial	<input type="text"/>
trolley_no	<input type="text"/>
Finish	

Figure 58: Screenshot Trolley Tracking for US 3.2

3.3.2.5 User value proposition

The WASP solution within the EFPF Platform is primarily seen as a suitable (as Trolley Tracker) solution for this use case. The Trolley Tracking scenario can undoubtedly be used as a unique selling point in marketing the WASP solution.

For the EFPF aerospace pilot users, WASP has a corresponding service character, as they can/want to communicate with our customers in a more targeted manner. The advantage here is that the WASP users receive information about the condition of the trolleys much earlier when they use the tool in a targeted manner and can thus plan the reported repairs better in advance. The procurement of spare parts can also be planned much better. In this context, procurement costs can be reduced by about 20%, as possible express surcharges for transport or shipping are eliminated. In addition, warehousing costs can be reduced accordingly by approx. 15%.

The employees can be better planned so that ad-hoc assignments are reduced and, above all, the employees in the other projects can continue to work usually. With the WASP solution, the customer also can see the status of the trolleys immediately. This high transparency, in general, allows a better service for the customer and raises customer loyalty.

3.3.2.6 Compliance with Standards and Regulations

Not applicable.

3.3.2.7 Lessons Learned and Outlook

This solution was evaluated by target user AAM in his industrial/real-world scenario regarding the functional and non-functional aspects of the developed solution. Following that, the following lessons are learned by the project partners. For detailed results or specific user evaluation comments/scores, please refer to chapter 5.2.2.

After having analysed the answers to the questionnaires in detail, the following lessons learned can be reported:

One main point was that during the process execution, it would be precious to watch the tasks one is working in and see the status of the rest of the tasks in the process. This would increase awareness about the dependencies between tasks, and the user would get a more comprehensive overview.

A poor rating with only a “2” was given because the user could see all other service tasks from other users.

Furthermore, specific proposals for usability improvements were made, e.g. “Task boxes cannot be resized, and this does not allow writing long texts inside them.” and “The inactivity session timeout could be extended to 60 min.”

Additional improvements regarding the functionalities are proposed, e.g. “There is no option to export the BPMN process in a picture format (JPG or PNG).”.

During the implementation of this use case, the users had to specify requirements for programming to be described even more clearly, as there were different perceptions of processes based on very fine-grained details. The overall solution is well suited to the target scenario, and the user partners will continue to push this solution to reduce the weaknesses that currently exist and, above all, to obtain an acceptable user value.

3.3.3 US3.3: Visual Detection of Personal Protection Equipment (PPE)

3.3.3.1 Short Description

This particular use case deals with the integration of machine learning into the daily operations of manufacturing companies. The project partners C2K and IAI want to demonstrate what is possible with software intelligence and the capabilities/functionalities available in the EFPF platform. The goal is to increase manufacturing process reliability and efficiency and implement automated health and safety compliance.

With its large variety of manufacturing processes and products, IAI has its spray booth facility (shown in Figure 59 and Figure 60).



Figure 59: Spray booth at IAI. The curtain on the left- and the right-hand side is closed before the paint job starts



Figure 60: Spray booth at IAI: shown is the extraction system, wherein parts are painted.

In this use case, a tool for automatic detection of the wearing of face masks should be implemented that orchestrates the various systems used in the spray booth.

In operation, the solution detects in real-time whether operators of the spray booth are wearing PPE breathing apparatus mandated by occupational safety standards and regulations. If the User is wearing a correct spray breathing mask, the process is started, including pneumatic air supply and extraction, along with visual lamps to confirm the system's state. Once the operator has finished using the spray booth, they present themselves to the camera, removing the mask. This detection event stops the air supply and counts down the extraction system to stop after 20 minutes.

3.3.3.2 Requirements / Acceptance Criteria

In total, 35 requirements were defined to make sure that the right solution is developed.

Req. ID	Short Description	Fully covered	Partially covered	Not covered	Number of validated fulfilment	Number of companies for validation
R-US3.3-1	The status regarding wearing a face mask as part of PPE shall be automatically detected using a detection system.	X			1	1
R-US3.3-2	The detection system shall, amongst others, consist of a camera, a control computer with corresponding intelligent software and interface modules, relevant relays and actuators, and different status indication devices.	X			1	1
R-US3.3-3	The software must not store any personal data (e.g. biometric) of the operators of any other persons present in the camera's field of view.	X			1	1
R-US3.3-4	The software of the mask detection system shall only work on a video stream basis without recording any image data.	X			1	1
R-US3.3-5	The detection system shall record relevant data and provide them to the EFPP data spine.	X			1	1
R-US3.3-6	The detection system shall control the air pressure valve automatically.	X			1	1
R-US3.3-7	The detection system shall control the extraction automatically.	X			1	1
R-US3.3-8	LED lamps as indication devices shall be installed to give the operator direct feedback about the mask detection status.	X			1	1
R-US3.3-9	LED lamps as indication devices shall be installed outside the spray booth to signal the "Spray booth in use" / "Spray booth not in use" status of the booth.	X			1	1
R-US3.3-10	The detection system shall control the LED lamps for operator feedback automatically.	X			1	1
R-US3.3-11	The detection system shall control the LED lamps for the Spray booth in use status automatically.	X			1	1
R-US3.3-12	Explosion-proof requirements must be met for technical equipment being installed inside the spray booth.	X			1	1
R-US3.3-13	Non-explosion proof equipment must be installed outside the spray booth only.	X			1	1
R-US3.3-14	The required technical equipment shall be state-of-the-art.	X			1	1

R-US3.3-15	The required technical equipment shall be readily available and consider standard parts where possible.	X			1	1
R-US3.3-16	The technical equipment shall be installed in a cabinet to protect electronic components from the industrial environment.	X			1	1
R-US3.3-17	The camera shall be of high industrial standard for industrial environments.	X			1	1
R-US3.3-18	The camera shall have a minimum resolution of 800x600.	X			1	1
R-US3.3-19	The camera shall be either connected via Ethernet or USB port.	X			1	1
R-US3.3-20	The camera resp. the used lens shall be optimized for an operator distance of 1.200m to 1.500mm.	X			1	1
R-US3.3-21	The camera shall be customizable for other similar applications with different requirements regarding the field of view, working distance, etc.	X			1	1
R-US3.3-22	The detection system shall pre-configured also to include an air pressure sensor at a later stage.	X			1	1
R-US3.3-23	The air pressure valve shall be turned on once a “mask-on” detection is done from the system.	X			1	1
R-US3.3-24	The air pressure valve shall be turned off once a “mask-off” detection is done from the system.	X			1	1
R-US3.3-25	The extraction shall be turned on once a “mask-on” detection is done from the system.	X			1	1
R-US3.3-26	The extraction shall be turned off after 20 minutes once a “mask-off” detection is done from the system.	X			1	1
R-US3.3-27	The red LED lamp outside the spray booth shall be turned on once a “mask-on” detection is done from the system, and the green lamp shall be turned off.	X			1	1
R-US3.3-28	The red LED lamp outside the spray booth shall be turned off after 20 minutes once a “mask-off” detection is done from the system, and the green lamp shall be turned on.	X			1	1
R-US3.3-29	A manual override shall be installed to control the air pressure flow manually.	X			1	1
R-US3.3-30	A manual override shall be installed to control the extraction manually.	X			1	1
R-US3.3-31	Steps that require operator input for mask detection status shall be integrated into the typical workflow of the spray booth operators.	X			1	1
R-US3.3-32	The camera and corresponding LED lamps for operator feedback should be installed so that the mask detection is performed directly before closing the spray booth from the inside.	X			1	1
R-US3.3-33	The obstruction of the typical spray booth operator workflow shall be minimized.	X			1	1
R-US3.3-34	The installation of the technical equipment must be guided with relevant documents.	X			1	1
R-US3.3-35	The required technical infrastructure at installation location/facilities shall only be 220V and internet via WLAN or Ethernet cable.	X			1	1

Table 11: Requirements of US3.3

It turns out that the developed solution can fully meet all requirements. Partner IAI participated in the validation. From 35, all are fully covered (equals 100%). No requirement is partially or not covered.

3.3.3.3 Fulfilment of the US3.3 through EFPF

The Resource Management Visual Detection Solution uses an Industweb Collect Factory Connector (FC) running in the manufacturing facility to visually monitor the environment using a camera to recognise objects within its field of vision. It uses an Intel Visual Processing AI Unit to detect objects from a pre-trained AI model. The training stage takes 1 to 5 days depending on the complexity of objects to be trained, which is carried out using a Machine Learning PC as part of a commissioning step.

Like the Automated Environmental Monitoring of Parameters use cases, it was first necessary to formally define the users' requirements. For this purpose, the requirements were defined (see section before) from IAI. Also, the needed workflow was defined by both partners. The main goal was to implement all new functions into the existing process without a negative impact on the execution of the painting process. Please refer to Figure 61 for the description of the needed workflow.

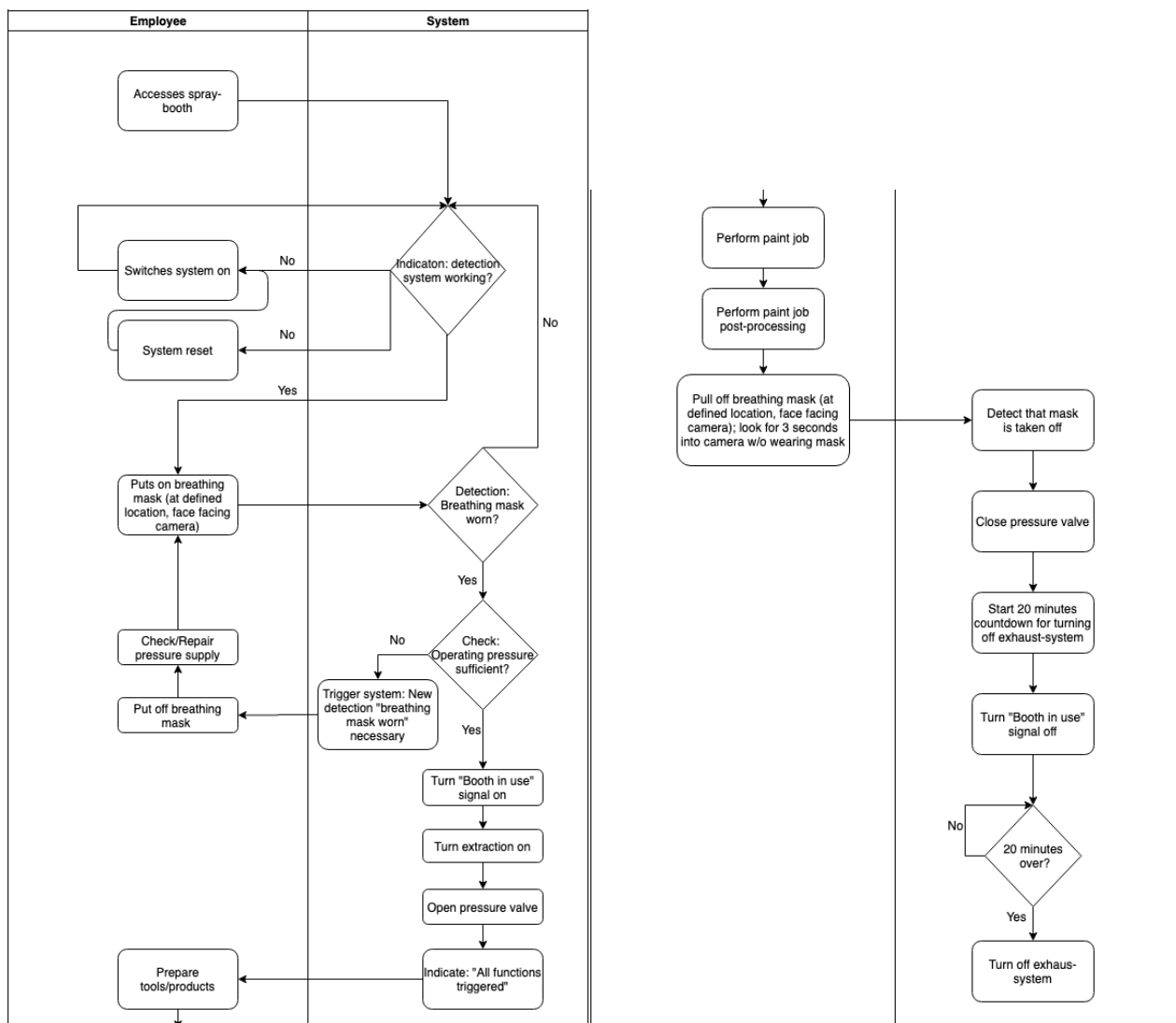


Figure 61: Required workflow for visual detection

Based on the requirements and the workflow, the software solution was developed. Also, the wiring diagram was established so that the needed hardware could be defined and purchased (refer to Figure 62 for the wiring diagram):



Figure 62: Wiring diagram for the visual detection use case

In parallel, videos of employees wearing the protective mask were taken under different lighting conditions and viewing angles. The software was adapted to cater to these (please refer to Figure 63).



Figure 63: IAI staff with PPE mask in the spray booth

The solution utilizes a small industrial computer, the Factory Connector, interfaced via Ethernet input-output modules to the process sensors and actuators. All the hardware was installed in an electrical cabinet or directly above the cabinet. Please refer to Figure 64.

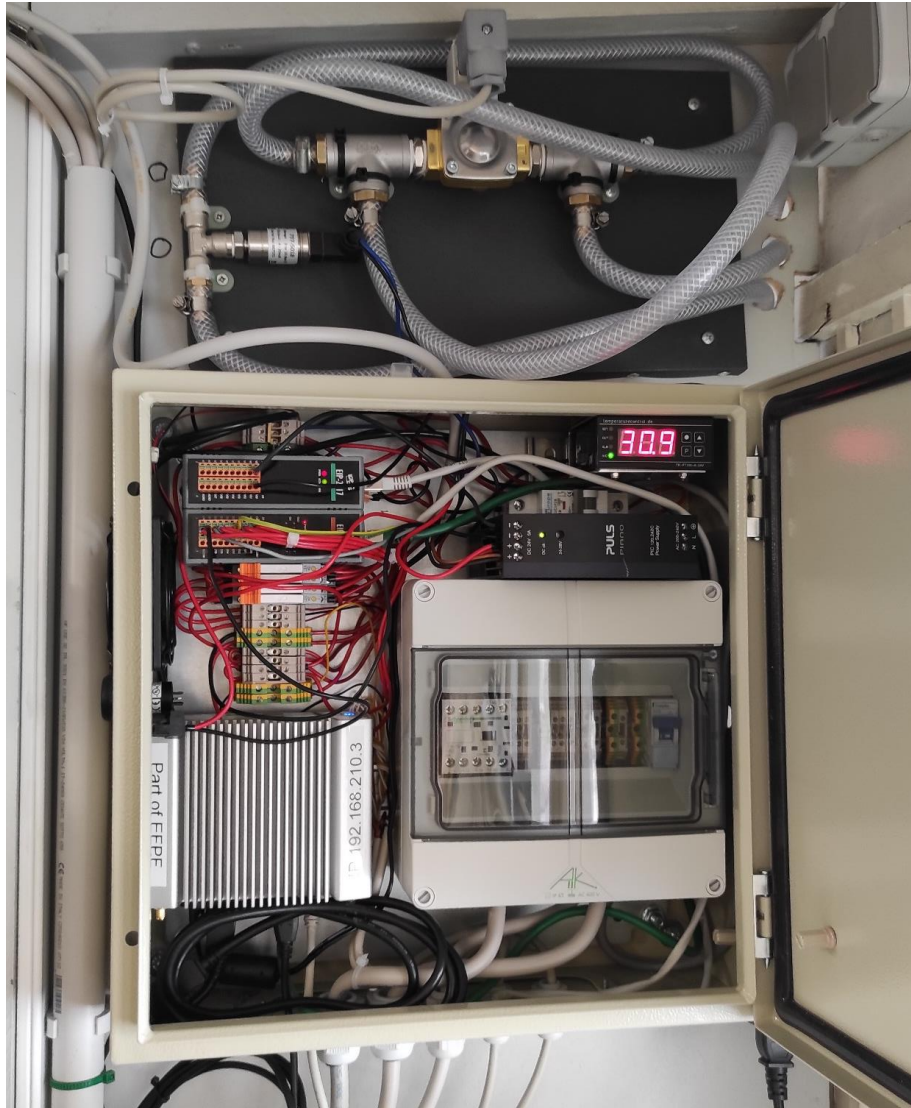


Figure 64: Electrical cabinet with hardware for mask detection use case

In addition, the existing electrical and network infrastructure at IAI had to be adapted accordingly. Remote access and connection to the EFPP Data Spine was established by the Industrieweb Collect Factory Connector (FC). This computer is installed at the bottom left side of the cabinet and visually monitors the environment using a camera to recognise objects within its field of vision. The AI Vision Service running on the FC then detects the trained objects with a probability match, raised as events in the FC runtime engine. The configuration rules of the FC runtime engine then trigger actions in real-time to control the production process.

The camera is installed at the ceiling in front of the spray booth so that the staff can look for 4 seconds into the camera before closing the curtain and start the painting process. Refer to Figure 65 and Figure 66.



Figure 65: Installed camera with LED indicator lights at the ceiling in front of the spray booth



Figure 66: Staff looking into the camera to activate the system

For future analytics and Business Intelligence applications and visualisation of events on a dashboard, the FC also pushes data to the EFPF Data using the EFPF SDK.

3.3.3.4 Testing and Evaluation

After the installation was completed, all aspects of the wiring and factory connector communications with EFPF Data Spine were checked, and the initial tests performed. The goal was to analyse the correct behaviour of the software under the given lighting conditions and the correct triggering of all required actions. The system testing demonstrated that all process functions operated successfully and provided valuable feedback for additional features.

The precise definition of the system and the new workflow and the early involvement of the relevant employees have meant that they are thrilled to use the new camera system. This also confirms that the well-implemented solution brings added value and leads to better employee motivation.

3.3.3.5 User value proposition

The implemented solution facilitates compliance with legal occupational health and safety measures. In addition to directly monitoring whether the relevant equipment is being worn, future applications could also determine times when employees were exposed to hazardous substances by evaluating the usage data of the paint booth. In this way, the health of employees can be protected even further proactively.

Additionally, the solution improves the workflow by reducing the necessary manual steps before and after performing the paint job, giving the paint job itself a greater focus. As the available air pressure is monitored before and during the paint job, automated quality monitoring is implemented. Both lead to increased quality and a more effective way of working.

Collecting and visualizing data from the system's sensor and metadata can be used for various purposes. These purposes could be workload/utilization of the spray booth, duration of real paint job and air pressure value monitoring.

3.3.3.6 Compliance with Standards and Regulations

Privacy data regulations are met as the video stream is analysed in real-time to record no video. Furthermore, the analysis of the wearing of a mask is done only via the geometry of the breathing mask or similar. It also is ensured that no real faces of the employees are stored in any database.

The system also supports the employer in complying with applicable occupational health and safety laws.

3.3.3.7 Lessons Learned and Outlook

This solution was evaluated by target users in their industrial/real-world scenarios. Based on these evaluations of the developed solution's functional and non-functional aspects, the project partners learned the following lessons. For detailed results or specific user evaluation comments/scores, please refer to chapter 5.2.8.

The general result of the target user evaluation is that the implemented solution meets all requirements, is well implemented into the existing workflow and the spray booth staff is keen to work with it.

On the one hand, the solution required intensive software development, and on the other hand, intensive installation of hardware and complex wiring of electrical equipment. Due to the current situation regarding the pandemic, only remote support could be provided from the technical partners C2K. The implementation could have been significantly facilitated if both partners could have worked physically together at the IAI installation site. However, due to the excellent responsiveness from both partners, whereas no message from either party stayed answered for more than 30 minutes (mainly Skype was used), this use case implementation was brought to instant success with the first test run. Also, IAI staff was willing to deal with complex electrical installations, which made the external support almost unnecessary. Together with the technical partner's good guidance, working in this way has resulted in valuable experience being gained by both partners to implement similar use cases with other customers in the future.

Although a particular use case was developed, there are multiple other similar applications possible. According to the user answers, the software can be trained to other PPE than IAI uses, which opens the solution to a broader market. Furthermore, the generic solution to detect things in different environments allows monitoring areas where staff with specific characteristics are present. This would lead to the necessity to anonymize data directly in the camera not to harm relevant privacy data regulations.

However, besides all positive there is also some room for improvement: For later industrial applications in EFF customer companies of similar use cases, there should be manuals available that helps the companies to understand what the solution generally provides, by use of which tools and required hardware/infrastructure it is done and how a route to implementation of such a solution generally looks like. Also, the customer should state which qualifications are available among its staff and how the willingness of internal support is generally. From experience IAI as user-made during the process, it is favourable to do much of the implementation work independently, as troubleshooting is much easier as relevant know-how is directly available.

3.3.4 US3.4 Stock Level Monitoring

3.3.4.1 Short Description

This use case relates to the typical operations of a production manager who wants to know when the stock runs out for specific parts. The continuous measurement of box content on a shelf is necessary, and a signal shall be generated if a minimum stock level is reached.

3.3.4.2 Requirements / Acceptance Criteria

The following Table 12 shows the defined requirements and their fulfilment.

Req. ID	Short Description	Fully covered	Partially covered	Not covered	Number of validated fulfilment	Number of companies for validation
R-US3.4-1	An e-mail notification shall be sent to a distribution list when threshold weight levels are undercut	X			1	1
R-US3.4-2	Different threshold levels shall be defined according to a possible change of the products to be weighted.	X			1	1
R-US3.4-3	Not every little weight change shall lead to an e-mail notification.	X			1	1
R-US3.4-4	Possibility to measure weights up to 50 kg shall be given	X			1	1
R-US3.4-5	Only weight changes with a duration longer than one hour shall lead to an e-mail	X			1	1
R-US3.4-6	Automated ordering via Product Catalogue Service			X	0	1

Table 12: Requirements of US3.4

Only one requirement could not be fulfilled. The connection between the developed solution and the Product Catalogue Service could not be established due to the time restrictions of the task. It is planned to update the solution with this feature in the future.

3.3.4.3 Fulfilment of the US3.4 through EFPF

The Stock Level Monitoring Solution uses an Industweb Collect Factory Connector (FC) interfaced to an I/O module to pick up weight data regarding products in the stores using a load cell sensor. The FC is configured to push this data based on a predefined interval to publish this data to a message bus in the data spine. These data are then subscribed to by the ROAM risk tool. The user defines recipes in the ROAM risk tool to act upon this data and define the business logic for placing orders to raise the stock level for the corresponding products or materials. At the moment, orders are placed by emailing to the procurement manager within the company. The end-user can configure this.

Summarizing all the above mentioned, the solution measures the weight of material stored on shelves and sends an e-mail to people in a defined e-mail distribution list. Logistic, work preparation or purchasing department can order new material before the stock runs out.

The stock level monitoring solution can be used as a stand-alone solution or parallel to a merchandise management system to monitor critical long-lead items.

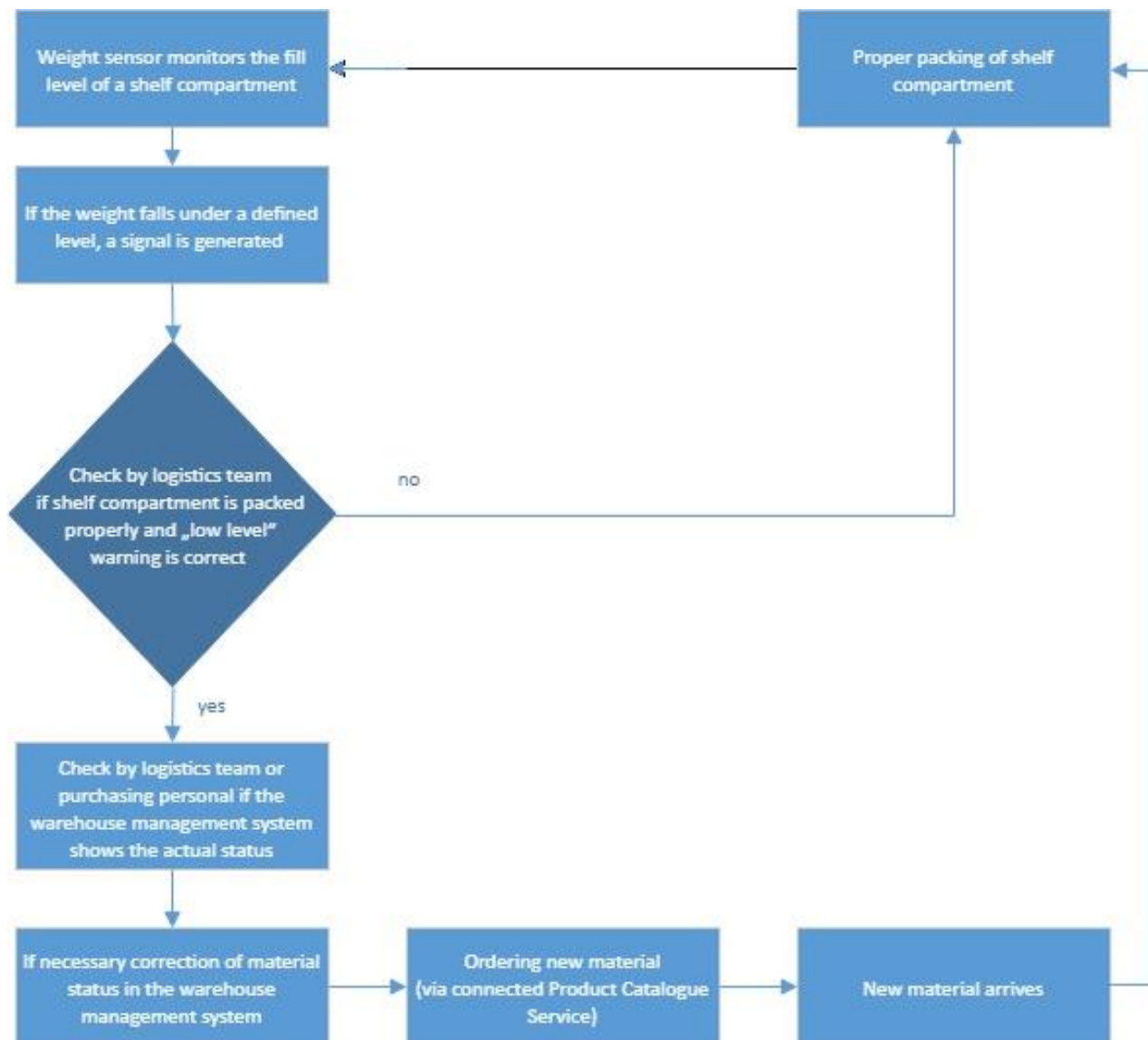


Figure 67: Workflow for US3.4

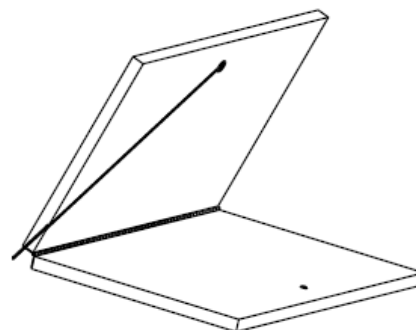


Figure 68: Foldable device with integrated weight sensor

The foldable device for integrating the weight sensor (Figure 68) was designed and built from 3DI. The electrical cabinet and the sensor (Figure 69) were bought from the market.

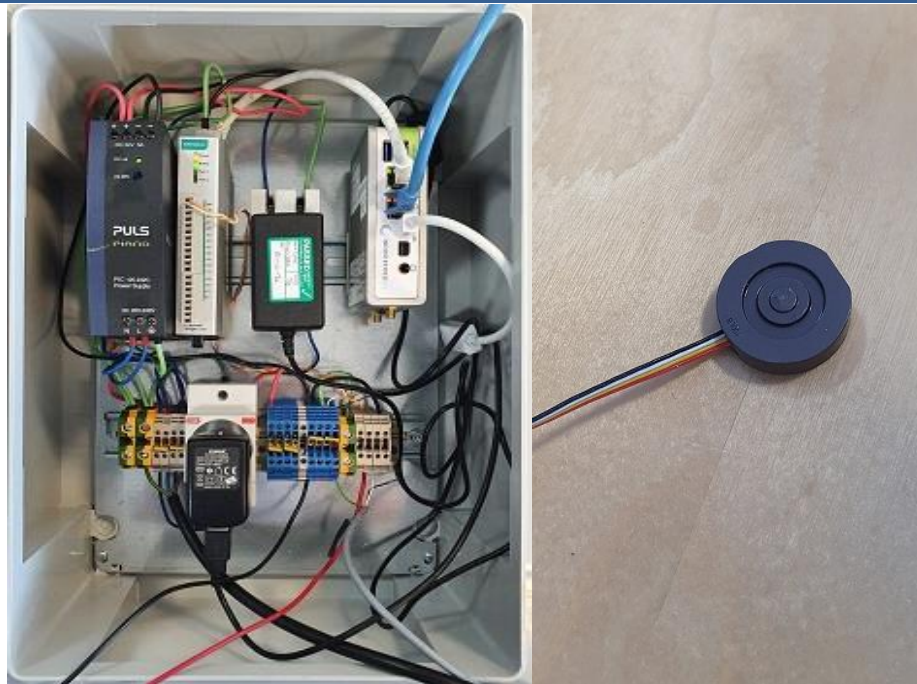


Figure 69: Electrical cabinet with hardware and sensor for weight measuring

3.3.4.4 Testing and Evaluation

The validation of the factory connector tool was done from partners 3DI and C2K and Almende under consideration of the defined requirements.

The connection of the factory connector via Data Spine to C2K worked without any problems. The electrical cabinet was combined with an analogue weight sensor which sends voltage signals whose strength depend on the applied weight. The weight signals are sent to the ROAM tool and were checked whether the values are fallen below the defined threshold values.

During installation, the first weight sensor was destroyed for an unknown reason. This was noticed by negative weight values and a sensor whose temperature rises to more than 50°C. To continue testing, an adjustable voltage device was installed to simulate the sensor.

After the values were fallen under the defined thresholds, e-mails arrived at defined addresses in the distribution list.

The users of the ROAM tool can program threshold levels and other criteria which lead to an email notification. New recipes for notifications can be created as described in the following figures.

Workflows

+

Name ↑

Id

Description: Placeholder

Subscription Details

Recipes

Recipe 1: Modified recipe of type FindSensorValuesSmallerThanOrEqualToLimit

name: FindSensorValuesSmallerThanOrEqualToLimit

sensor_limits

↑

{ "LOC_1_1": 10 }

Figure 70: Threshold recipe detail for an email notification when sensor signals fall below 10kg

orkflows








					Filter	Search 
+	Name ↑	Id	Tags	Creation Time		
  	HigherThresholdTestWorkflow	607d6c1a798263b305f6df96	Test, 3DI	2021/04/19, 11:40:10		
  	LowerThresholdTestWorkflow	607d6c08798263b305f6df94	Test, 3DI	2021/04/19, 11:39:52		

Figure 71: Adjustable recipes defining different threshold levels

3.3.4.5 User value proposition

The logistic, work preparation and purchasing department can receive e-mail warnings if a critical material, especially with long lead-times, decrease to a critical stock level. The logistic, work preparation and purchasing department can set different threshold levels when an e-mail warning of low stock quantity is sent. This makes the solution flexible for use for other materials. The company can improve their delivery performance, reducing manufacturing problems due to missing material. The company has a fall-back solution for monitoring critical stock levels, apart from the warehouse management system. The

technical components of the solution are flexible for use on other shelves. The fixed installation in only one place is not necessary.

3.3.4.6 Compliance with Standards and Regulations

Not applicable

3.3.4.7 Lessons Learned and Outlook

This solution was evaluated by target user 3DI in their industrial/real-world scenarios. Based on these evaluations of the developed solution's functional and non-functional aspects, the project partners learned the following lessons. For detailed results or specific user evaluation comments/scores, please refer to chapter 5.2.9.

According to the evaluation, generally, the technical solution fulfils the needs. All scores are either 4 or 5. The only short consultation with the developers to fully understand all functionalities of the ROAM tool is appreciated. Regarding the documentation and instruction, they were not entirely understandable, so the documentation should be improved. A circuit diagram for the complete solution should be enclosed when going to an industrialisation of the product.

Further development regarding a wireless solution would be reasonable and desirable. An automated ordering function and connectivity to the Product Catalogue Service would positively impact companies' positive impact.

3.4 Supply Chain Management

3.4.1 US4.1: Increase Supply Chain Transparency

3.4.1.1 Short Description

Due to low digitalisation in aerospace supply chains, there is generally low transparency at the same time. Often regular information about production status is only provided upon delivery. Suppose the supplier does not inform manually about delivery delays or other problems during the manufacturing process. In that case, the whole production planning at the customer production plant might get mixed up, leading to additional efforts and delivery delays towards own customers. Many SMEs do not have appropriate ERP systems, which makes monitoring of orders more difficult.

To support SME in tracking orders, reducing delays, and being informed about possible problems early, a helpful tool is developed, including automatic reminders when dates are slipped. The overall goal is to have a better view of the status of ordered products and services. Manufacturers can optimise manufacturing capacities to ensure efficient use of available resources and have actual data about the status of the product or service available.

Partners involved in this user story were HAW and IAI from the user side, and as a technical partner, ICE was responsible for leading the technical development.

3.4.1.2 Requirements / Acceptance Criteria

In total, 16 requirements have been defined to reflect the users' needs, which are shown in the following Table 13:

Req. ID	Short Description	Fully covered	Partially covered	Not covered	Number of validated fulfilment	Number of companies for validation
R-US4.1-1	Receive structured and automated feedback.	X			1	1
R-US4.1-2	Receive automated information e-mails.	X			1	1
R-US4.1-3	Include a pool of different, pre-defined standardized processes.	X			1	1
R-US4.1-4	Provide the ability to choose the necessary process from a pool of standard processes.	X			1	1
R-US4.1-5	Make a workflow view of the chosen process available for the key stakeholder.	X			1	1
R-US4.1-6	Enable the critical stakeholder assigning an order or other reference number to the chosen process.	X			1	1
R-US4.1-7	Include the function to create simple profiles for stakeholders.			X	0	1
R-US4.1-8	Enable the critical stakeholder to define whether a project is of character "large".	X			1	1

R-US4.1-9	Provide the ability to define which of the different process steps shall become relevant for the “project”.	X			1	1
R-US4.1-10	Enable the critical stakeholder to assign each process step to other responsible stakeholders.	X			1	1
R-US4.1-11	Enable the responsible stakeholders, to whom specific process steps are assigned, to update the status.	X			1	1
R-US4.1-12	Automatically inform/notify the stakeholders once a project status has changed.			X	0	1
R-US4.1-13	Check the current status of projects at any time.	X			1	1
R-US4.1-14	Enable the critical stakeholder to define time deadlines (dates) for each process step.	X			1	1
R-US4.1-15	Automatically inform/notify the critical stakeholder if a deadline of a process step is missed (via email).	X			1	1
R-US4.1-16	Provide an overview for the key stakeholder to summarise all currently ongoing orders and their functional status.	X			1	1

Table 13: Requirements of US4.1

As Table 13 shows, 16 requirements have been defined for the development of the solution. Two of them could not be fulfilled. They were classified as “nice-to-have” requirements and can be fulfilled in later tool versions. The basic functionality of the solution is not affected, and also, in the user's expectation, the sufficient fulfilment of their needs are confirmed with the available functions (refer to chapter 3.4.1.7).

Besides having defined requirements reflecting the needed functionalities, a supporting presentation with some back-end illustrations was created to facilitate understanding the requirements from ICE. See Figure 72 and Figure 73 for suitable extracts from this document:

- **Main Purpose**

 - **Tool, which can be used**
 - **to increase supply chain transparency between companies, where the supply chain is only low digitized.**
 - **to control and track sub-contracted jobs for critical projects**
 - *e.g. due to tough contractual obligations*
 - *e.g. due to extremely short timelines*
 - **to bring suppliers back on track in case the performance worsened**
 - *e.g. most of the last orders where delivered too late*

Figure 72: Extract from WASP requirements presentation

Detailed function: Define projects

➤ 6th step

Do you want to provide automated reminder e-mails to supplier once the below steps are due in few days?

Order acknowledged

☐

Manufacturing started

☐

Quality Inspection successful

☐

Products ready for pick-up

☐

XX1

☐

XX2

☐

Dear Supplier,

as a kind reminder, the production step „Manufacturing started“ for order XXXXX ([Part Description]) is due in X days.

If the confirmed ODD is jeopardized, please inform your customer:

Einkauf@customer.de

Thank you!

Possible automatically generated email

Note: Show here only the steps for which dates were assigned on previous page!

Figure 73: Extract from WASP requirements presentation

Please note that only some exemplary screenshots are shown here. If required, several documents can be provided for further demonstration of validation work.

3.4.1.3 Fulfilment of the US4.1 through EFPF

The required solution based on the requirements was realised based on the available WASP (Workflow and Service Automation Platform) for fast automation processes. The solution is being used to create standard BPMN-based processes, and it allows assigning activities to different users. To allow implementation of needed functionalities, adjustments of the software had to be developed from ICE.

To ensure that the right processes are reflected in the developments, a workflow was provided from IAI, shown in Figure 74.

The goal of the workflow was to show different steps of the order tracking in general and provide the different needed functions and the required notifications generated from the tool. Therefore, different functions were developed. The following description shows some main steps of the tool without going too much into detail not to overload this document.

Generally, the WASP solution is embedded in the EFPF portal main page. It can be opened via clicking on the “Workflow and Service Automation Platform”-button on the left-hand side of the “General” menu. Refer to Figure 75.

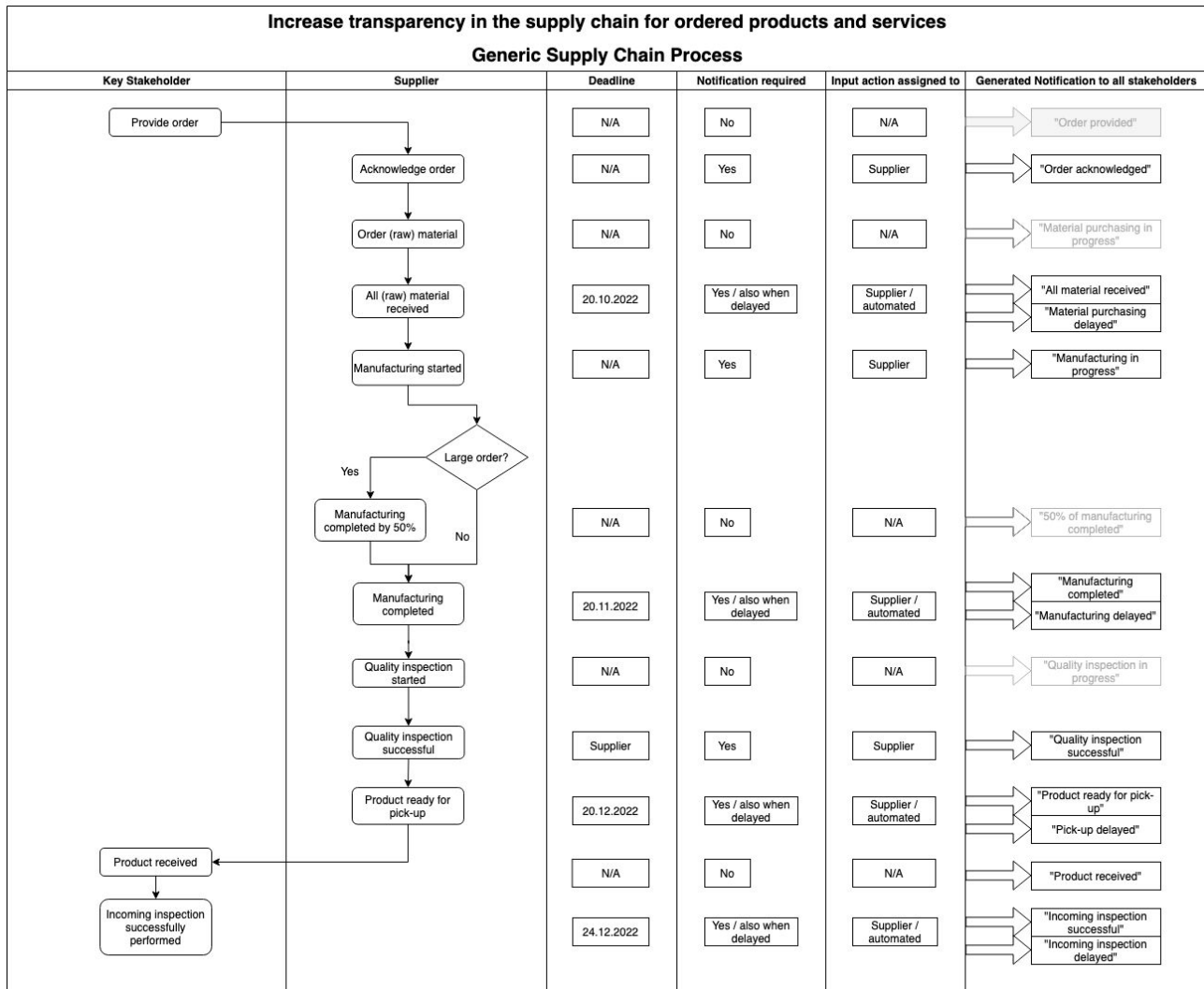


Figure 74: Workflow for US3.4

Workflow and Service Automation Platform

Control Panel - Process List [Refresh](#)

Process Name	Process Owner	Deployment Time	Instances Running	Process Status	Actions
Invoice Order	Mitch Hancock	11:17:48 27/11/2020	1	Active	Actions
Invoice Order	Mitch Hancock	11:05:02 27/11/2020	0	Active	Actions
N/A	Mitch Hancock	15:08:36 20/11/2020	0	Active	Actions
trolleytracking	Mitch Hancock	09:19:41 11/11/2020	0	Active	Actions

[Try Now](#)

Overview
WASP enables fast automation of processes, from receiving purchase orders to streamlining machine operations, from handling information from heterogeneous sources to orchestrating external software services and from execution of production activities to interconnectivity of supply chain operations. Furthermore, WASP supports achieving better transparency and surveillance in low-digitized supply chains. WASP can be used through its online portal. Alternatively, WASP can be sourced for private use and inhouse deployment. Either way, users have access to a range of distributed workflow/process management functionalities that make it easy to handle the interplay of distributed services and manual (human based) activities.

Benefits

- Design, execute and monitor multiple processes/workflows on the intuitive interface
- Store and reuse the designed processes/workflows
- Assign responsibilities (manual tasks) either to people in your (virtual) organisation or to external suppliers in WASP
- Introduce your own REST services in the WASP marketplace and use them in workflows
- Cloud-based service – design, execute, monitor distributed workflows
- Documentation – How to guide available

Service Used

- EFPF Service Registry
- EFPF Security Portal

Learn More

[Demo Video](#)
[Deployment Guide \(N/A\)](#)
[Reference Architecture](#)
[FAQ](#)

Guides

[User Guide](#)

Figure 75: Access to the WASP tool via the EFPF portal

Following that, the WASP Welcome Page opens, and different main menu points are visible at the top side of the page (refer to Figure 76):



Welcome to WASP

WASP is a platform for fast automation of processes regardless of the type of activity, whether it is an internal task like providing direct input from people or making a decision; an external task done by other software-based services; a manufacturing machine that can be controlled remotely; or a combination of these. WASP follows a SaaS operation model, thus users subscribe to one of our membership types in order to have access to a range of functionalities that will automate and overall help you improve your services and processes.



Growing marketplace of services. As a practitioner you can use and consume any public service from the marketplace to help you automate your processes; as a software service provider, you can register your service in our marketplace and it will be available to all our users to consume; or you can register your own services to be used ONLY in your own processes or at your own organisation.



Figure 76: Welcome page of the WASP tool

For the current use case, the menus “Designer”, “Control Panel”, and “My Tasks” are the most important.

In the “Designer”-menu, different processes can be created, or existing ones can be opened. Here the basis is laid down for how detailed the supplier tracking shall be. For evaluation purposes, a very detailed supplier tracking process was created. Here the following steps of an order are considered:

- Raw material ordered
- Raw material received
- Manufacturing started
- Manufacturing completed
- Quality Inspection successful

- Product Ready for pick-up
- Incoming Inspection Successfully Performed

Please refer to Figure 77 for an illustration of the Process Designer and the created workflow:

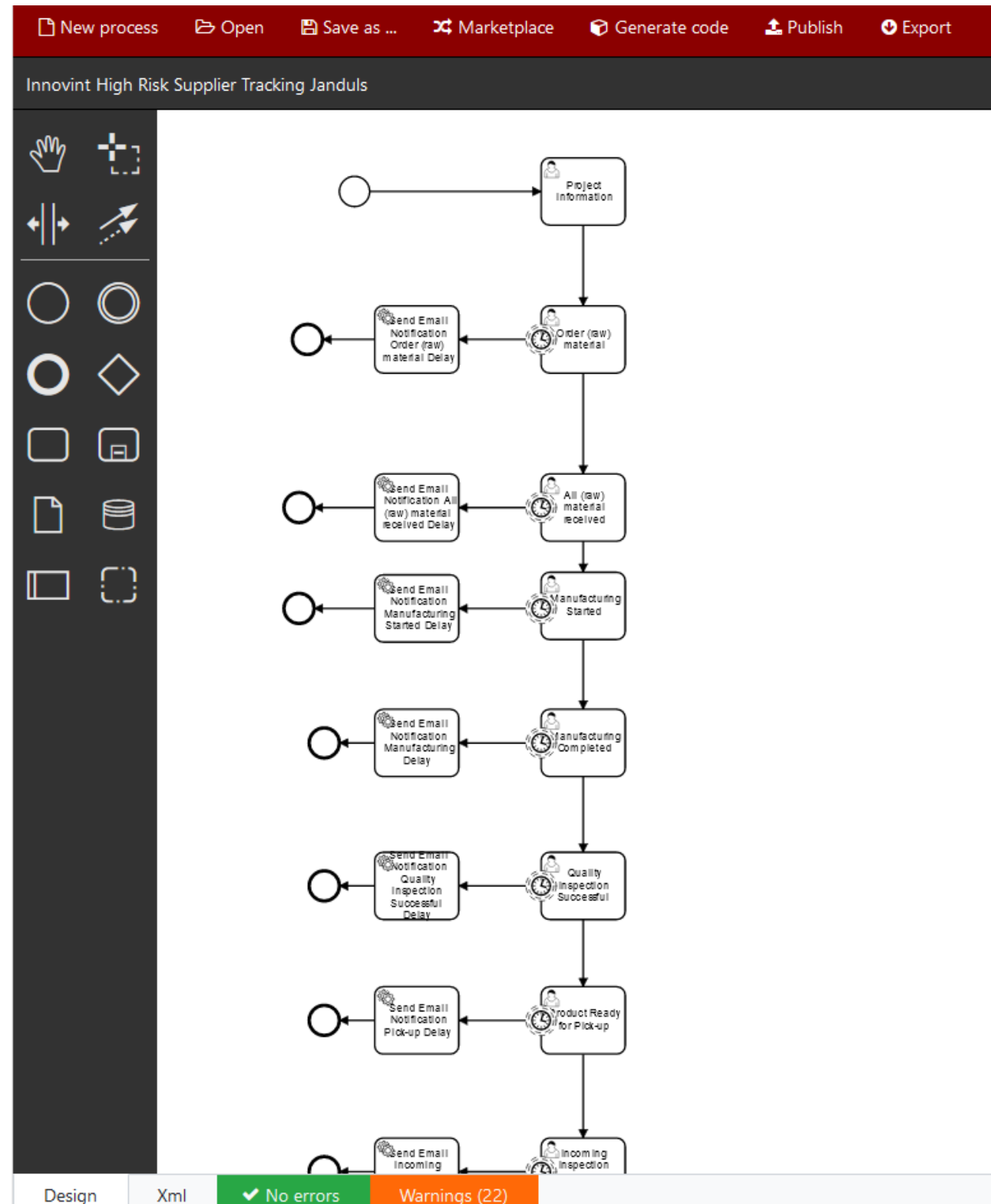


Figure 77: Process Designer with a created process

Each step can be selected, and different properties can be added. For example, the first step, “Project Information,” was in a way defined, that all relevant information for the tracking of a specific order can be entered: Order Number, specific due dates for all further steps acc. to the process, and the tasks can be assigned to different stakeholders (e.g. sales contacts/purchaser). For example, the task “Quality Inspection Successful” would be assigned to the sales contact person on the supplier side (in this case, from company IAI). The task “Incoming Inspection Successfully Performed” would be assigned to the purchaser on the customer side (in this case, from company IAI). Refer to Figure 78:

bpmn:UserTask properties

ID: Task_04q79b7

Name: Incoming Inspection Successfully Performed

Description: Click finish to verify incoming inspection has been performed

Due date:

Follow up date:

Assignee: ☒ External user
lars.henschel@innovint.de

☐ Notify User by Email

Task form: No form

Inputs:

Outputs:

Figure 78: Properties definition for the different steps

As soon as all process parameters are defined, the process is ready for a different purchase order for the mentioned supplier. After having clicked on the “Publish Button”, the process is transferred to the “Control Panel”, refer to Figure 79:

Process Name	Process Owner	Deployment Time	Instances Running	Instances Completed	Instances Deleted	Process Status
Innovint High Risk Supplier Tracking Janduls	Lars Henschel	07:28:43 21/04/2021	0	0	0	Active

Control Panel - Process List

Figure 79: Control Panel with published process

Each time order shall be tracked, and the user clicks on the “Start Process Instance Button”, which deploys a variant of the process to the “My Tasks” menu. Now the process is started via a click on the “Start Task”-button. Refer to Figure 80.

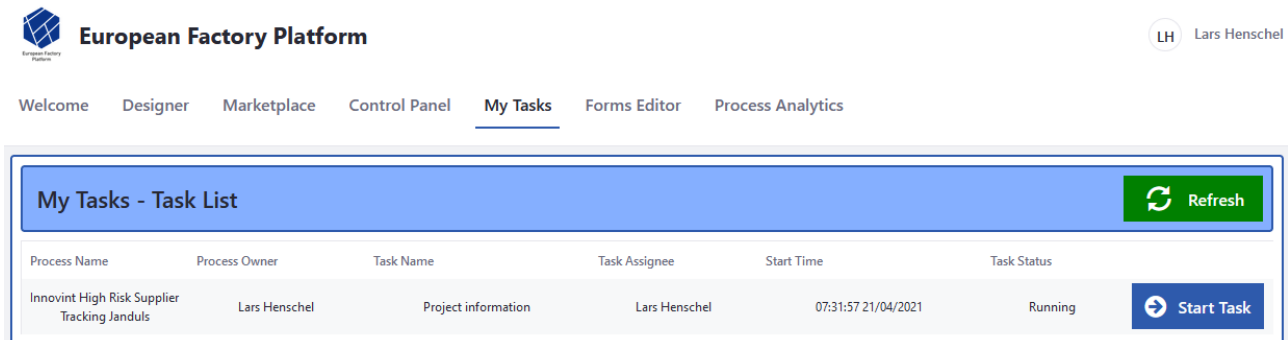


Figure 80: My Tasks menu with the relevant process and "Start Task"-button

As per the definition of the properties in the Process Designer, for each different step, action has to be fulfilled afterwards. For example, for the first step, all relevant information for the order to be tracked must be filled in. Refer to the following Figure 81.

Process Name

Innovint High Risk Supplier Tracking Janduls

Active

Process Instance

Started at : 07:31:57 21/04/2021

Active

Task

Started at : 07:31:57 21/04/2021

Running

Return to Task List

Refresh

Task Name	Task Assignee	Start Time	Task Status
Project information	Lars Henschel	07:31:57 21/04/2021	Running

View Process

Task Description

Enter the order number etc.

Please complete the following form

No Input Variables associated with this Task

Task Outputs

Output Name	Output Value
OrderNumber	140421-LAH-01
RawMaterialOrdered	2021-04-23
RawMaterialReceived	2021-04-25
ManufacturingStarted	2021-04-30
ManufacturingCompleted	2021-05-03
QualityInspectionDone	2021-05-05
ProductReadyForPickUp	2021-05-15
IncomingInspectionSuccessful	2021-05-21

Finish

Figure 81: Relevant information that must be fulfilled for the specific order to be tracked

As shown, for each step, a due date is filled in. As the relevant contact person on the supplier side is defined in the base process, he receives automated emails once there is a delay on his side noted from the software. Furthermore, the purchasing manager on the customer side receives a notification to take instant actions.

With the click on the “Finish”-button, the process instance is started and automatically monitored from the software. For each user to which a task from a specific process instance, the status for the specific process instance is visible via the control panel. Refer to Figure 82

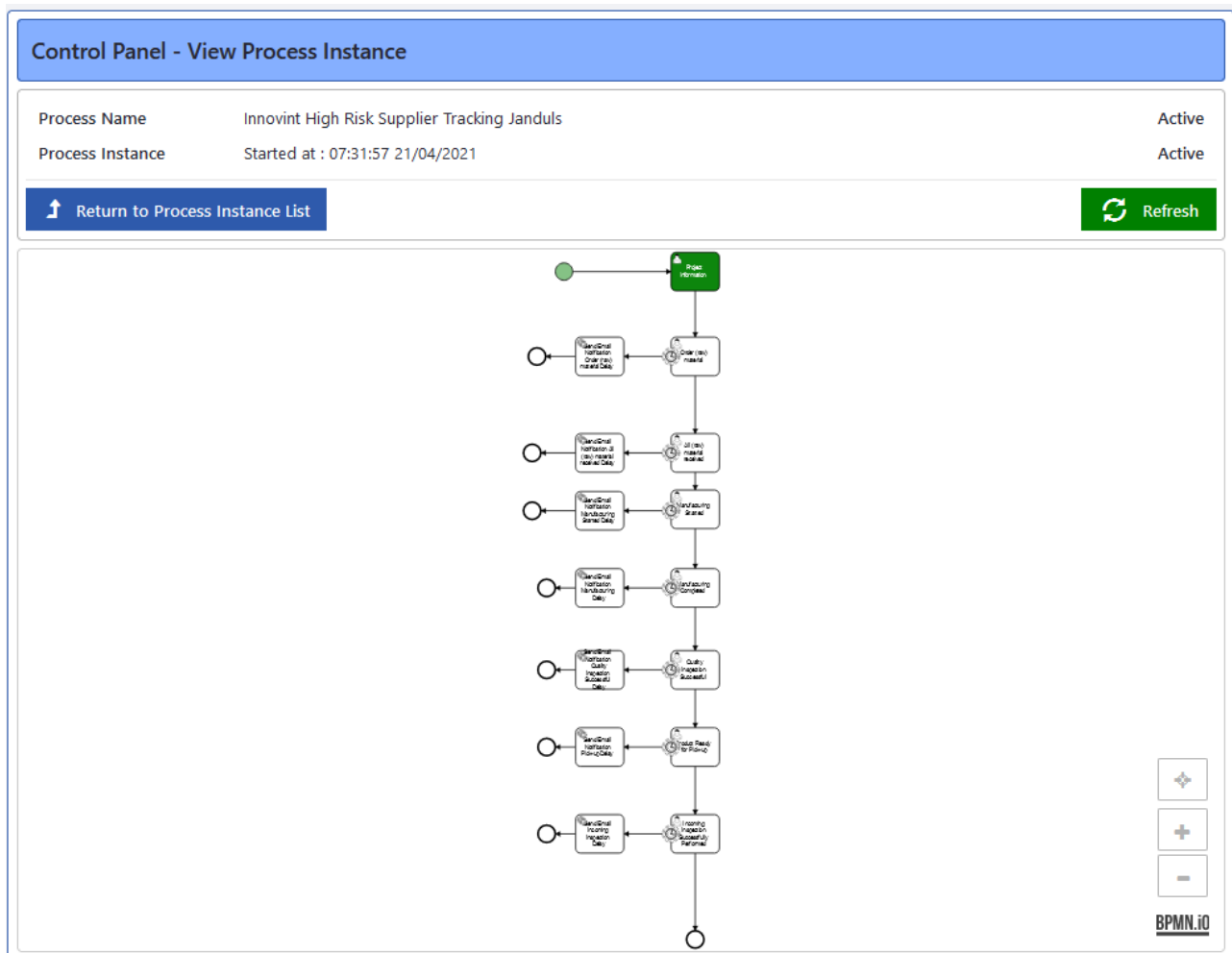


Figure 82: Active process instance with current status indication.

As shown, all steps that are already fulfilled are marked green.

3.4.1.4 Testing and Evaluation

Validation of the WASP tool was done from IAI under consideration of the above-defined requirements and further usability aspects by exemplary setting up an order process starting with entering purchase order numbers, relevant dates and assigned different process steps to virtual supplier accounts (also managed from IAI). Therefore, IAI accessed the tool, took different roles (e.g. customer purchasing manager, supplier sales manager) and went through the process until delivery of the ordered products.

With feedback in the form of presentations with screenshots and video calls regarding back-end functionalities and front-end usability, the solution was improved step by step. As an

example, some screenshots show the validation work as follows (please refer to Figure 83 and Figure 84 and Figure 85).

■ Current steps to create a process instance (project)

- Depending on which process (1/2/3) you will use the different steps of the applicable processes can be selected and various parameters can be defined:
 - Name/Description/Duedate/Followup date/Assigned/Notify User by Email

■ Comment

- Generally the structure/sequence by which relevant parameters will be defined is not clear (Process Designer vs. My Tasks)
- At this stage only the basic parameters should be selectable, but not the parameter content itself. E.g.: For step “Acknowledge Order” it should be possible to define that an assignee can be allocated to a step, but the assignment itself should not be done already at this point where only the basic processes are defined. The further definitions of the available tasks parameters should be done only in the My Task section when defining a process instance (project).

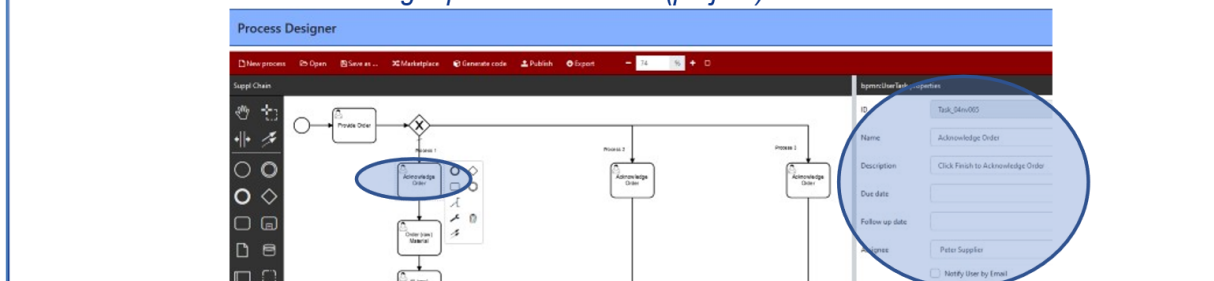


Figure 83 Feedback for the WASP Tool using screenshots with markings and additional comments.

■ Current steps to create a process instance (project)

- Once the processes are defined the user clicks on „Publish“ and the process will show up in the Control Panel – Process List

■ Comment

- This is fine, but should not be necessary every time a new process instance (project) is created.
- With the current programming state it is necessary because process instance (project) specific parameters are defined already in the Designer (e.g. Assignee, refer to page 3)

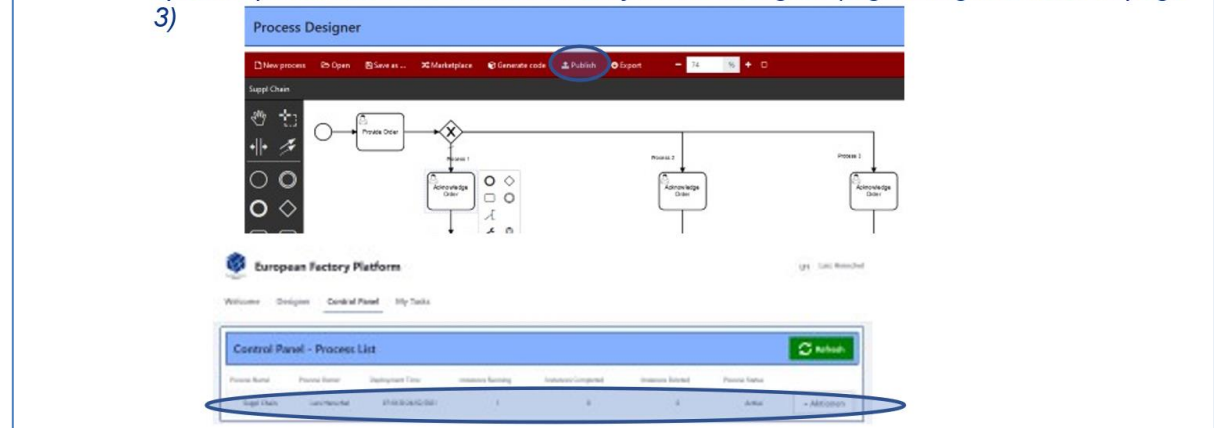


Figure 84: Feedback for the WASP Tool using screenshots with markings and additional comments.

■ **Proposals for a more structured definition of relevant parameters**

- *It should not be necessary to publish a process every time you plan to create a process instance (project), moreover it should be considered as a pool of processes you can choose on from when a process instance (project) is created.*
- *In the control panel you should be able to „Create a process instance (project)“.*
- *Within this step the following general process instance (project) related parameters should be requested:*
 - *Order Number*
 - *Supplier*
 - *Process (1/2/3)*
- *Once these information are entered the process instance (project) is considered as „created“.*
- *Afterwards the best way would be that the tool requests information for every step that is available according to the chosen process (1/2/3), e.g.*
 - *Step „(Raw) material received“*
 - *Define Assignee*
 - *Enter the Due Date*
 - *Select the kind of email notification etc.*

Figure 85: Feedback for the WASP Tool using screenshots with markings and additional comments.

3.4.1.5 User value proposition

The WASP solution helps address the user needs in connected factories scenarios. It increases supply-chain transparency for purchasing processes and subcontracted tasks, leading to improved internal production planning and manufacturing capacity.

A better identification of potential risks in an early stage allowing practical mitigation activities. The increase in customer satisfaction is possible due to:

- Securing on-time and on-quality deliveries leading to lower customer complaints
- Quicker and more precise feedback regarding the order status, especially in case of delays
- Automatic analysis of on-time data for the respective suppliers, leading to better visibility of the performance of the own supply chain
- Identify and mitigate risks at an early stage and inform the sales administration department to provide precise feedback about possible lead-time improvements or delays to the customers

3.4.1.6 Compliance with Standards and Regulations

General supplier monitoring is essential in the supply chain management domain, and this could require various standards or certifications (e.g. EN9100, EASA Part 21.G). These standards and their implications on the WASP-based supply chain management solution were considered. The WASP solution uses the BPMN standard for process definition and execution, and therefore the use of WASP promotes this well-established standard among manufacturing SMEs.

3.4.1.7 Lessons Learned

Target user IAI evaluated this solution. Based on the functional and non-functional aspects of the developed solution, the following lessons are learned by the project partners. For detailed results or specific user evaluation comments/scores, please refer to chapter 5.2.7 Figure 117.

The user requirements are well implemented, and the tool is suitable for the intended purpose. Although there is a certain complexity of the solution, it also offers many functionalities, and almost all parameters can be edited, making it very flexible.

The menus are structured, but it still requires a specific training period. Some usability improvements can still be implemented here:

- Some adoptions in regards to the wording, away from technical language more to supply chain-related wording
- Improve the intuition of the user interface: not all functions (and where they are available = their visibility) are directly clear.

To help users in the future to handle the solution quicker and right from the beginning for all-day related supply chain activities, it would make sense to describe in a "manual" the different steps from creating a process until starting process instances fill information in. It would also be helpful to add screenshots with explanations.

Corresponding feedback has already been communicated to ICE with the validation.

Regarding the available functions, some more features will be implemented in future enhancements of the WASP solution:

- For individual steps, it will be possible to specify that automated reminder emails can be sent in advance (rather than after a date has passed) for significant milestones. At the same time, a function will be implemented that allows the supplier to give direct feedback on the reason for delays or the general order status.
- In addition, it will be possible to request the status ad-hoc via a button in the process status overview.

3.4.2 US4.2 Secured Logistic Chain

3.4.2.1 Short Description

Companies that have access to and are responsible for handling and preparing air cargo can apply for the Known Consignor status described in Regulation (EU) 185/2010.

With this certification, the consignor invests in the security of its supply chain by taking specific measures to increase security. This way, it is relieved of the need to have its goods controlled and avoids potential delays and additional screening costs before being stored in the aircraft.

There is no comprehensive solution available for logistic chains that ensure that freight/packages have not been manipulated on the way to the air carrier. Instead, various steps and tools are currently used in these logistics chains, with only the partners directly involved ever having control over the measures to be followed.

To support the tamper-proof storage of information in this logistics chain latest blockchain technologies shall be used to develop a solution that ensures compliance and proper monitoring of the relevant requirements. The goal is to ensure that wherever a transfer of freight/packages between persons/ companies occurs, the freight/packages are the same and have not been manipulated. Relevant persons are identified/authorized, and their data are recorded.

3.4.2.2 Requirements / Acceptance Criteria

Besides having described the user needs using relevant user stories also 13 specific requirements were defined. These requirements and their fulfilment are shown in the following Table 14.

Req. ID	Short Description	Fully covered	Partially covered	Not covered	Number of validated fulfilment	Number of companies for validation
R-US4.2-1	The software shall reduce risks in regards to the reliability of the logistic supply chain for airfreight.	X			1	1
R-US4.2-2	The software shall help to identify manipulated packages and prevent them from going onto aircraft.	X			1	1
R-US4.2-3	The software shall be accessible either via personal computer or via App on tablets and (industrial) smartphones.	X			1	1
R-US4.2-4	It shall be possible to register with your company with relevant details and define the company status (known consignor/regulated agent/airline company).	X			1	1
R-US4.2-5	It shall be possible to put shipping information (e.g. order number) into the software and thus create a "project".	X			1	1
R-US4.2-6	It shall be possible to notify the forwarder and include shipping information in this notification.			X	0	1
R-US4.2-7	It shall be possible to select approved forwarders out of a list.			X	0	1

R-US4.2-8	It shall be possible that the forwarder uploads their EU approvals.	X			1	1
R-US4.2-9	It shall be possible to create digital "handover protocols" (identification of driver/transport vehicle etc.) for projects.	X			1	1
R-US4.2-10	It shall be possible in a certain way that the people who hand over the freight are guided through questions and answers (e.g. The car used by the forwarder is lockable - Please confirm).	X			1	1
R-US4.2-11	It shall be possible to upload additional information for a project regarding the packages, e.g. weight/photos.	X			1	1
R-US4.2-12	It shall be possible to review the additional information for a project regarding the packages, e.g. weight/photos, to check whether a package has been manipulated (relevant for the handovers between forwarders).	X			1	1
R-US4.2-13	It shall be possible for the forwarders to track the package via the software and handing it over to the next forwarder in the logistic chain (requirements before apply).			X	0	1

Table 14: Requirements of US4.2

As shown, one company (IAI) was intended to perform the validation. Ten are fulfilled from the 13 requirements, and three are not, which equals a percentage of 77%. As the next round of implementation of required improvements is ongoing, the percentage will be raised soon. The Requirement ref. R-US4.2-6 is too far-reaching, so this function will not be considered for the time being.

Apart from the defined requirements reflecting the needed functionalities, a supporting presentation with some more comprehensive illustrations and explanation was created to facilitate the understanding of the requirements from technical partner CNET, who led the technical development of the solution. See Figure 86 and Figure 87 for suitable extracts from this document:

➤ **Two possibilities:**

- The consignor submits its goods for controls before they are loaded onto the airplane.
 - Causes delays and increases the costs per kilogram of cargo shipped.
- The consignor invests in the security of its supply chain by taking certain measures to increase security.
 - No need to have its goods controlled, and
 - Avoid potential delays and additional screening costs.



Figure 86: Extract from Secured Logistic Chain requirements presentation

➤ 4. During the shipping process, the freight handover protocol is filled out by the respective shipping employee.

Frachtübergabe Protokoll

Fracht übergeben an: _____

Person hat sich ausgewiesen durch:

☐ Pass
☐ Personalausweis
☐ Sonstiges

Uhrzeit: _____ Datum: _____ Erl.: _____

Der Frachtführer bestätigt hiermit die Fracht i.S.d. EU 300/2008 als sicher übernommen zu haben und weiterhin zu behandeln.



```

graph TD
    KC[Known Consignor  
Checked, approved and monitored  
by German Federal Aviation  
Authority] --> CA[Carrier  
Submits transit declaration to  
known Consignor/regulated  
Agent]
    CA --> RA[Regulated Agent  
Checked and approved by  
German Federal Aviation  
Authority]
    RA --> AC[Airline Company  
Checked, approved by German  
Federal Aviation Authority]
        
```

Figure 87: Extract from Secured Logistic Chain requirements presentation

Please note that only some exemplary screenshots are shown here. If required, several documents can be provided for further demonstration of validation work.

3.4.2.3 Fulfilment of the US4.2 through EFPF

The Secured Logistic Chain solution uses the EFPF Smart Contracting platform based on DAML (Data Asset Modelling Language).

Both the Secure Logistics Chain and Material Track & Trace solutions (please refer to next chapter 3.4.3) use the EFPF Smart Contracting platform based on DAML (Data Asset Modelling Language, an open-source (Apache 2.0), high-level domain-specific language that provides an abstraction layer on top of both traditional databases such as PostgreSQL, and blockchain implementations, recently including Hyperledger Sawtooth and Hyperledger Fabric. It is rapidly gaining support on multiple platforms. DAML decouples the distributed trust models, data schemas and business logic - the smart contracts - from the implementation details of communication, cryptography, distributed data stores and synchronization. DAML is based on Haskell's functional programming language and designed to build distributed applications by describing data schemas, smart contracts, and identity management. DAML promises a business-oriented, declarative way to build distributed applications using blockchains. The Material Traceability and Secure Supply Chain are being developed as separate DAML Models.

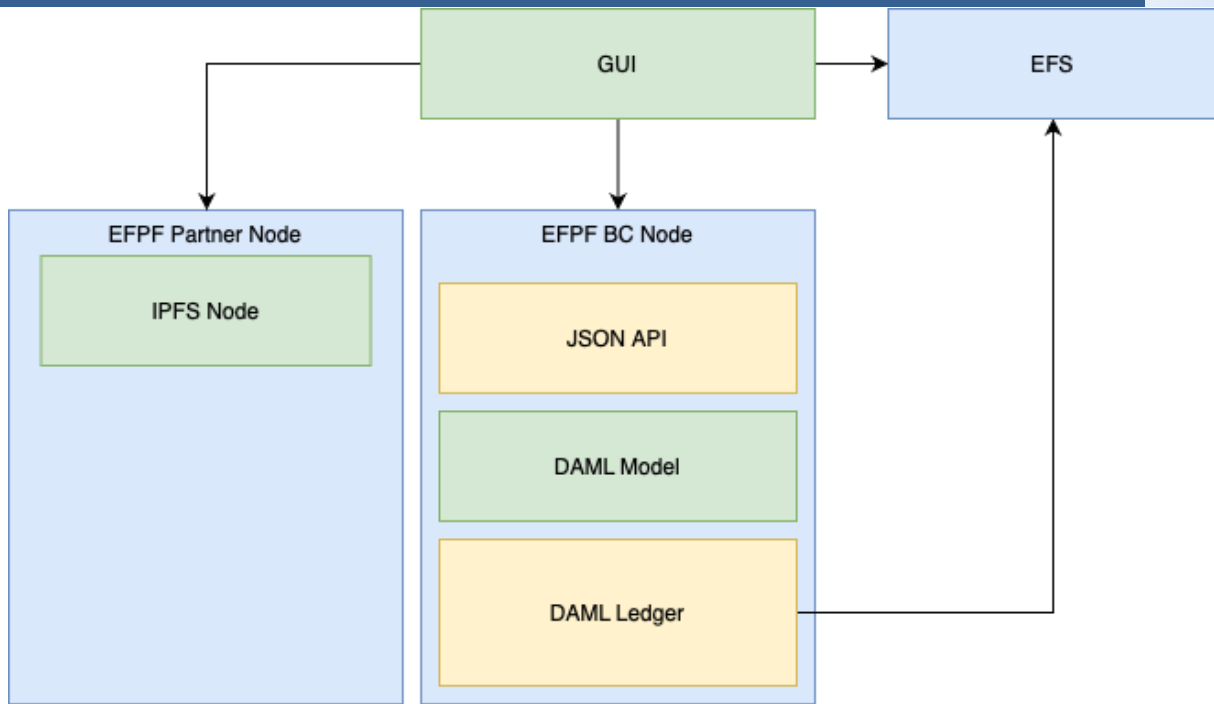


Figure 88: Technical Components for US4.3

A web-based smart contract management tool in the DAML SDK, the Navigator, can test and validate the smart contracts during development and as an administrative tool in production. An app-based UI will be developed to run on smart tablets and phones and use photography and scanning facilities. To store larger files, e.g., scans of identification, transport documents or material certificates, IPFS servers for peer-to-peer hypermedia storage will be used. The distributed nature and hash-based, location-independent file resource identifiers of IPFS are suitable design matches for blockchain-based solutions. Files may still be private and under the control of the company that owns them. Further technical information can be found here: www.daml.org, <https://ipfs.io>.

The frontend of the solution was not fully developed at the time of submitting the deliverable owing to several reasons, e.g. the focus of CNET on other pilot solutions and the complexity of the technical solution that made it more complicated (or time-consuming) to get necessary agreements from users in COVID restrictions. That is why at this point, the focus for validation was laid on the key technical aspects. Below some selected steps are described.

In the first step, the user logs into the EFPF Portal and accesses the solution via the menu on the left-hand side. During the registration process in the solution, the user filled in different information. Amongst others, he also selected which kind of stakeholder in the logistic chain he represents. According to the “Known Consignor” definition, certifications possibilities are Known Consignor, Carrier, Regulated Agent and Airline Company.

Please note that the following description is somewhat abbreviated. This is to create the proper understanding of the solution but not to go into every detail. Figure 89 shows an extract from the programming of the solution:

```

happy_path =
scenario do
  -- Create the parties
  alice <- getParty "AliceTheSupplier"
  bob <- getParty "BobTheForwarder"
  charlie <- getParty "CharlieThePacker"
  carla <- getParty "CarlaTheCarrier"
  dan <- getParty "DanTheHandoverMan"
  erica <- getParty "EricaTheTransporter"

  -- Creates an instance of the Freight contract, authorized by supplier "Alice"
  let my_freight_identifier = "Alice package 00001"
  alice_package <- submit alice do
    create Freight
    with supplier_identifier = my_freight_identifier; supplier = alice; currentHandler=alice; handlers = []

  submitMustFail charlie do
    exercise alice_package SelectCurrentHandler
    with selected_handler = charlie

  alice_package <- submit alice do
    exercise alice_package SelectCurrentHandler
    with selected_handler = charlie

  -- 1. Trained employees pack the freight tamper evident.
  let
    my_tamper_proof_documentation = SecurityControlDocumentation with
      documentation = "Package sealed, see attached image."

  packing_ready <- submit charlie do
    exercise alice_package ConfirmTamperEvidentPacking
    with supplied_proof = [my_tamper_proof_documentation]

  -- 2. Choose which forwarder shall be used and check his regulated agent status in the EU-database.
  assignment <- submitMustFail bob do
    exercise packing_ready SelectFirstForwarder
    with forwarder = bob

  assigned_forwarder <- submit alice do
    exercise packing_ready SelectFirstForwarder
    with forwarder = bob

  submit alice do
    exercise assigned_forwarder ConfirmForwarderNotified
    with notification_text = "Please be informed that you have a package to pick up with id " <> my_freight_identifier

  alice_package <- submit charlie do
    exercise alice_package TransferCurrentHandler
    with selected_handler = dan

  -- The shipment is now handled by Dan

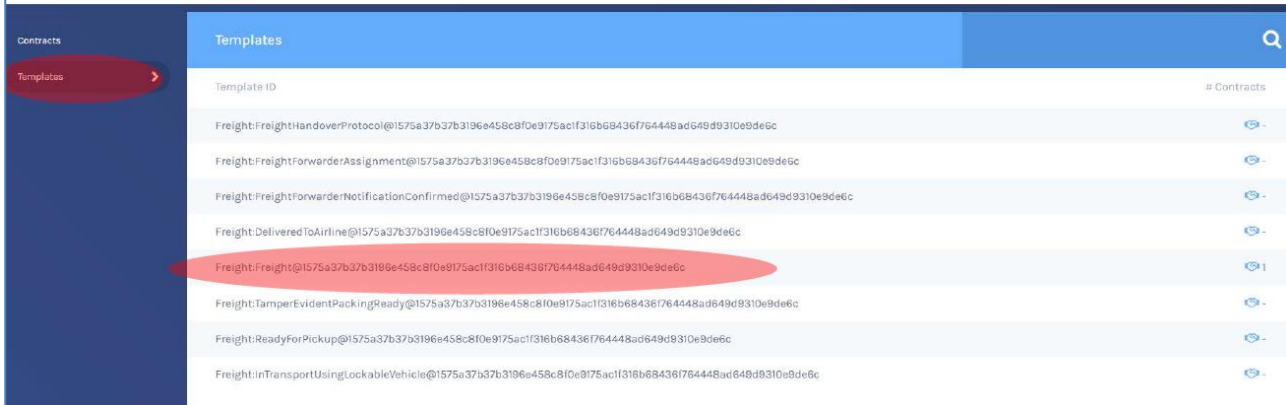
```

Figure 89: Extract from programming for Secured Logistic Chain solution (early stage)

The background situation for the validation is that a company with the “Known Consignor” status would like to ship a package. Therefore Alice (dummy user), working for the administration management, wants to create the applicable project in the tool. After having accessed the tool, a project is created from her. In the current version, it is done via selecting the applicable template. Please refer to Figure 90.

■ Description: 2nd step (demo)

- Click on templates and then on the specific template „Freight:Freight“ to define the new project



- **Result (real life story):** *alice is guided from the solution in a step-by-step manner. First of all she must define the project. In this demo this step is done manually by choosing the correct template from a pool of available templates.*

Figure 90: Description: Creating a project with the DAML tool

In the next step, the relevant information is filled in from Alice: a reference number (e.g., purchase order number), the supplier, and the one currently handling the project. Refer to nextFigure 91.

■ Description: 3rd step (demo)

- Fill in relevant information and click on „Submit“ to create the project.

The screenshot shows the input form for the 'Freight:FreightForwarderAssignment' template. The form has fields for 'supplier', 'identifier', 'currentHandler', and 'handlers'. The 'supplier' field is filled with 'alice', the 'identifier' field is filled with 'PO', and the 'handlers' field is filled with 'alice'. There are buttons for 'Add new element' and 'Delete last element'. At the bottom, there is a 'Submit' button.

- **Result (real life story):** *alice is guided from the solution to fill in a reference number (e.g. PO number) to identify the project, to enter the supplier company and the current handler. In this demo this step is done manually by clicking into the fields and fill them in accordingly.*

Figure 91: Description: Input of information for a project with the DAML tool

After the project is created, it can be opened in the tool from a colleague (Charlie) from Alice in the outgoing goods department. Now Charlie logs in as he wants to confirm that he has packed the applicable package tamper-evident, and he wants to confirm this in the tool.

Charlie enters relevant information (while being guided by the tool step-by-step) to confirm the tamper-evident packing. He also adds a photo of the package, which he made with his industrial smartphone. Afterwards, he confirms this step by pressing the “Submit”-button. Refer to Figure 92.

■ Description: 9th step (demo)

- *Add appropriate documentation via „Add new element“ and click „Submit“*

- **Result (real life story):** *charlie is guided from the solution in a step by step manner to add appropriate information to confirm the tamper evident packing. He also adds a photo of the package, which he made with his industrial smartphone. He then presses a button which confirms the correct packing. In this demo this step is reflected by the described step above.*

Figure 92: Confirmation of tamper-evident packing

Now the package shall be handed over to a carrier named Carla (regulated agent). Appropriate information must be added to the project during handover. This information is needed to fulfil requirements securing the proper identification of the carrier. Also, other requirements have to be fulfilled, e.g., that the transporter doors are lockable and locked after the package is put in. This also could be proofed with a photo, which can also be uploaded into the solution. Refer to Figure 93

■ Description: 12th step (demo)

- Click on „Handover“, fill in the required information and click on „Submit“.

The screenshot shows a web application interface for a DAML tool. At the top, there's a navigation bar with buttons: 'Handover' (highlighted in red), 'ConfirmAmperEvidentPacking', 'Archive', 'SelectCurrentHandler', and 'TransferCurrentHandler'. Below this is a header area with a 'Contract' section containing a long alphanumeric string and a 'Template' section with a URL. On the left, a sidebar lists 'Signatories' (alice), 'Observers' (charlie, dan), and 'Contract key' (_1, _2, PO). The main area is titled 'Contract details' and contains a form for the 'Handover' step. The form has several fields: 'Choice: Handover', 'h_handed_over_to' (with a dropdown showing 'CarlaTheCarrier'), 'h_handed_over_to_carrier' (with a dropdown showing 'carla'), 'h_proof_of_identity_type' (with a dropdown showing 'ID card'), and 'h_proof_of_identity' (with a dropdown showing 'photo_ID_carlathecarrier.jpg'). A large blue 'Submit' button is at the bottom right.

- **Result (real life story):** dan is guided from the solution in a step by step manner to add appropriate information during handover. These information are needed to fulfil requirements securing the proper identification of the carrier. Also other requirements have to be fulfilled, e.g. that the transporter doors are lockable and locked after the package is put in. This also could be proofed with a photo made from dan, which is also uploaded into the solution. In this demo this step is reflected by the described step above.

Figure 93: Handover over packages from Known Consignor to Regulated Agent

Carla is not the only carrier that will carry the package. She must hand over the package to another carrier (in this case to Erica-the-transporter), which will be done similar to the step before. Carla is guided from the solution in a step-by-step manner to add appropriate information during handover.

The last step, which is not shown here, is the handover from the Regulated Agent to the Airline Company, which will be done again as described before.

3.4.2.4 Testing and Evaluation

Validation of the DAML tool was done from IAI under consideration of the above-defined requirements and further usability aspects by exemplary setting up a package delivery starting from a “Known Consignor”, going over two stations of “regulated agents” until the package finally arrives at an airline company. Based on the knowledge due to the existing known consignor certification, IAI accessed the tool, took different roles (e.g., known consignor as the party initiating a logistic chain for a specific package, regulated agent as a party in the mid of the chain receiving that package and provide it to the airline company) and exemplary entered information for the different steps.

With feedback in the form of presentations with screenshots and video calls regarding back-end functionalities and frontend usability, the solution was improved step by step. As an example, some screenshots show the validation work as follows.

■ Description: 1st step (demo)

- *Choose your role (first one is „alice“ = „alicethesupplier“)*

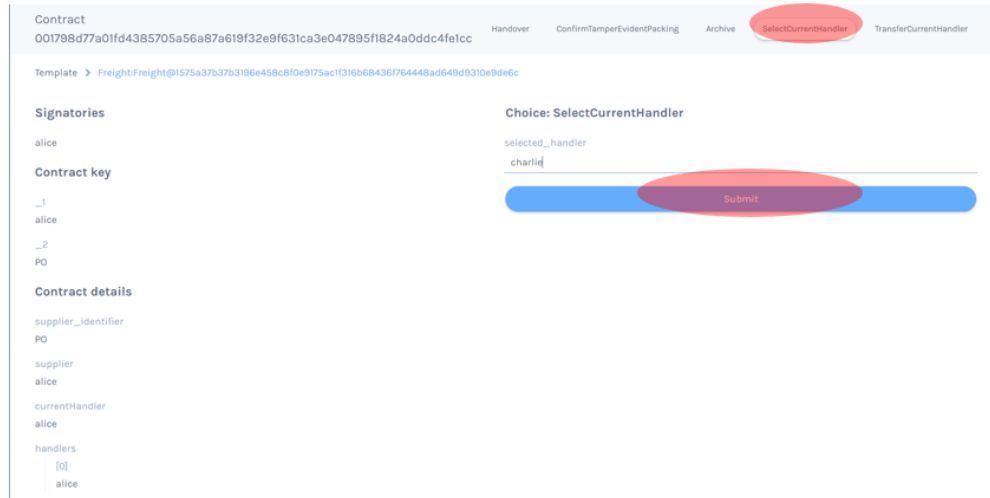


- **Result (real life story):** *alice (administration management staff) logs in into the solution to create a project because she wants to ship a package*

Figure 94: Feedback for the DAML solution using screenshots with markings and additional comments.

■ Description: 5th step (demo)

- *Select „SelectCurrentHandler“, add the handler (in this case „charlie“) and click on „Submit“.*



- **Result (real life story):** *alice wants to publish the project so that it is ready for the next step. Therefore she is guided from the solution which asks her whether she wants to publish it, which she can confirm with „yes“. In this demo this step is reflected by the step described above (refer to next page).*

Figure 95: Feedback for the DAML solution using screenshots with markings and additional comments.

3.4.2.5 User value proposition

Generally, this Secured Logistic Chain solution provides added value to global aerospace logistic chains. It helps to directly reduce risks affecting the reliability and security of supply chains and identify manipulated air freight (terrorist reasons).

The use of the solution brings various advantages for users as well as for monitoring agencies. Logistic chain stakeholders (known consignors, regulated agents, airline companies) are supported with one tool for secured logistic chains covering all relevant functions. With only a few clicks, the history of air freight on their way from a known consignor to regulated agents and airline companies can be tracked, and the compliance to relevant requirements can be monitored. Thus, using different tools and other analogue means is avoided, reducing labour efforts to fulfil relevant agency requirements.

By facilitating the blockchain technology's acceptance of all stakeholders, especially for legal bodies (e.g., Luftfahrtbundesamt in Germany), the acceptance of this tool is high as data cannot be manipulated.

3.4.2.6 Compliance with Standards and Regulations

The solutions support the compliance with relevant civil aviation security rules, especially the following:

- Regulation (EU) 185/2010
- Regulation (EU) 300/2008

3.4.2.7 Lessons Learned and Outlook

Based on the evaluation of the solution by target user IAI regarding the functional aspects of the developed solution, the project partners learn the following lessons. For detailed results or specific user evaluation comments/scores, please refer to chapter 5.2.4.

In regards to the available functions, almost all required ones are available. It becomes clear that the solution itself has enormous potential when incorporating other different functions. Besides planned improvements of the frontend, it is planned to incorporate more functions on the backend side. There is still a need for improvement regarding usability, especially in better user guidance and front-end functionalities. As this feedback is already provided to the technical partner, it will be taken care of for the next version of the solution. As the technical partner has already planned the possible front-end illustrations (similar to the one shown in 3.4.3.3), it is expected to have an exemplary user interface that makes the user feel confident and comfortable using the tool.

In regards to implementations of additional functionalities, some ideas were already discussed between the partners:

- Scan barcodes directly to identify packages (e.g., by order numbers as reference)
- Take photos and add them as proofs in the applicable project (thus, manipulation could be detected easier)
- Connect it directly with the EU Union database on supply chain security to make an automated check of the regulated agent status possible.

3.4.3 US4.3 Material Track & Trace during Lifecycle

3.4.3.1 Short Description

This user story relates to the typical operations of a quality management employee, whose goal is to identify other affected products when a manufacturer of a material used in them reports material defects so that reliable track and tracing is possible. Follow-up actions can be initiated accordingly (e.g. inform other customers).

Moreover, as a quality management employee, a key goal is to identify other affected products when a customer reports a defect in a supplied product so that reliable track and tracing are possible and follow-up actions can be initiated accordingly (e.g., inform other customers).

The two required functionalities mentioned are typical examples of the unique requirements in the aviation industry. The challenge faced by the aerospace industry is keeping track of tens of thousands of different parts that need to be tracked across supply chains from origin to delivery and on into service. Improved parts management could speed up safety checks after the accident and help avoid further incidences based on the same reason. As blockchains are open and decentralized, the same information can be shared with different parties.

3.4.3.2 Requirements / Acceptance Criteria

Besides having described the user needs using relevant user stories also 18 specific requirements were defined. These requirements and their fulfilment are shown in the following Table 15.

Req. ID	Short Description	Fully covered	Partially covered	Not covered	Number of validated fulfilment	Number of companies for validation
R-US4.3-1	The software shall provide functions to track and trace raw material batches for specific products throughout all lifecycles.	X			1	1
R-US4.3-2	The software shall generally link material batches/certificates (raw materials or sub-assemblies) to specific purchase order numbers/part numbers with corresponding serial numbers (end-product).	X			1	1
R-US4.3-3	The software shall be accessible either via personal computer or via App on tablets and (industrial) smartphones.	X			1	1
R-US4.3-4	The software shall provide the possibility to link internal batch numbers (raw material and sub-assemblies) to supplier batch numbers.	X			1	1

R-US4.3-5	It shall be possible to change or update existing projects (consisting of the purchase order number, a part number (end product) and corresponding serial numbers.		X		1	1
R-US4.3-6	It shall be possible to register with your company with relevant details.	X			1	1
R-US4.3-7	It shall be possible to create projects consisting of the purchase order number, a part number (end product) and corresponding serial numbers in an app on an industrial smartphone or workstation.	X			1	1
R-US4.3-8	It shall be possible to assign serial numbers to Part Numbers (end-product).		X		1	1
R-US4.3-9	It shall be possible to select existing projects using an app on an industrial smartphone or workstation.	X			1	1
R-US4.3-10	It shall be possible to identify other affected end products when a manufacturer of a therein used (raw) material reports material defects.	X			1	1
R-US4.3-11	It shall be possible to identify other affected end products when a customer reports a defect in a supplied end product.	X			1	1
R-US4.3-12	It shall be possible to search for all Purchase Order Numbers (end product) under which a specific (raw) material or sub-assembly with the corresponding batch number was processed.	X			1	1
R-US4.3-13	It shall be possible to search for all part numbers (end product) with corresponding serial numbers under which a specific (raw) material or sub-assembly with a corresponding batch number was processed.	X			1	1
R-US4.3-14	It shall be possible to search for (raw) materials or sub-assemblies with corresponding batch numbers based on part numbers (end product) and their corresponding serial numbers.		X		1	1
R-US4.3-15	It shall be possible to search for internal batch numbers and get the corresponding (raw) material or sub-assembly part number with corresponding manufacturer batches and material certificates.	X			1	1
R-US4.3-16	It shall be possible to search for (raw) material or sub-assembly part numbers with corresponding manufacturer batches and get the corresponding internal batch numbers.	X			1	1
R-US4.3-17	It shall be possible to enter (raw) materials or sub-assembly batch numbers into existing projects using an app on an industrial smartphone or at a workstation.	X			1	1
R-US4.3-18	It shall be possible to store delivery notes and corresponding material certificates of incoming (raw) materials or sub-assemblies, linked with the corresponding manufacturer batch numbers, in the software.	X			1	1

Table 15: Requirements of US4.3

Out of 18 requirements, 15 are entirely fulfilled. Three are partially fulfilled, mainly because the serial number tracking was only partially implemented during validation. This will be present in the next version of the solution.

Besides having defined requirements reflecting the needed functionalities, supporting the workflow of the As-Is process was visualized to facilitate the understanding of the requirements from technical partner CNET, who led the technical development of the solution. Figure 96 and Figure 97 show the process with relevant details:

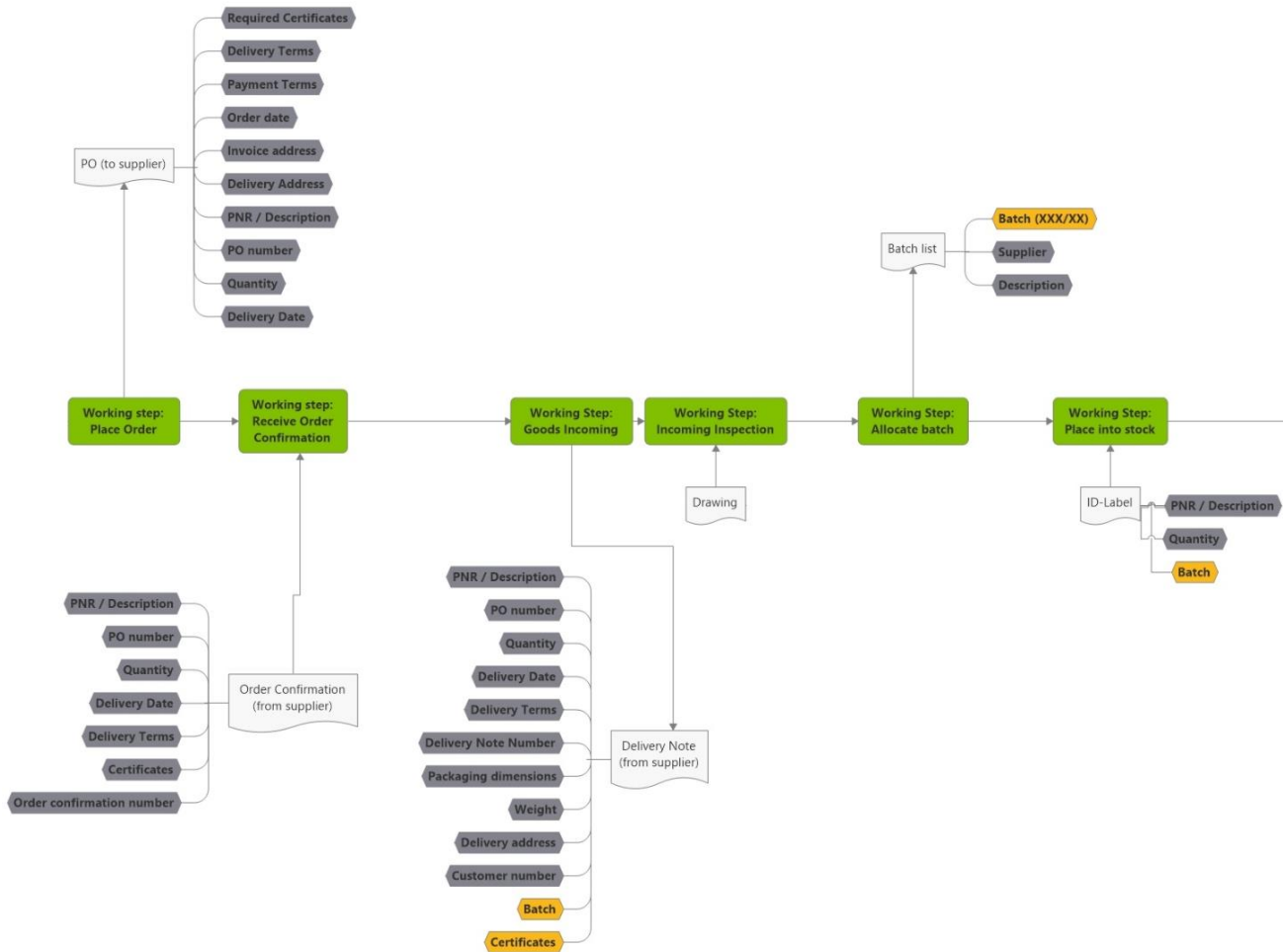


Figure 96: As-Is process, part I

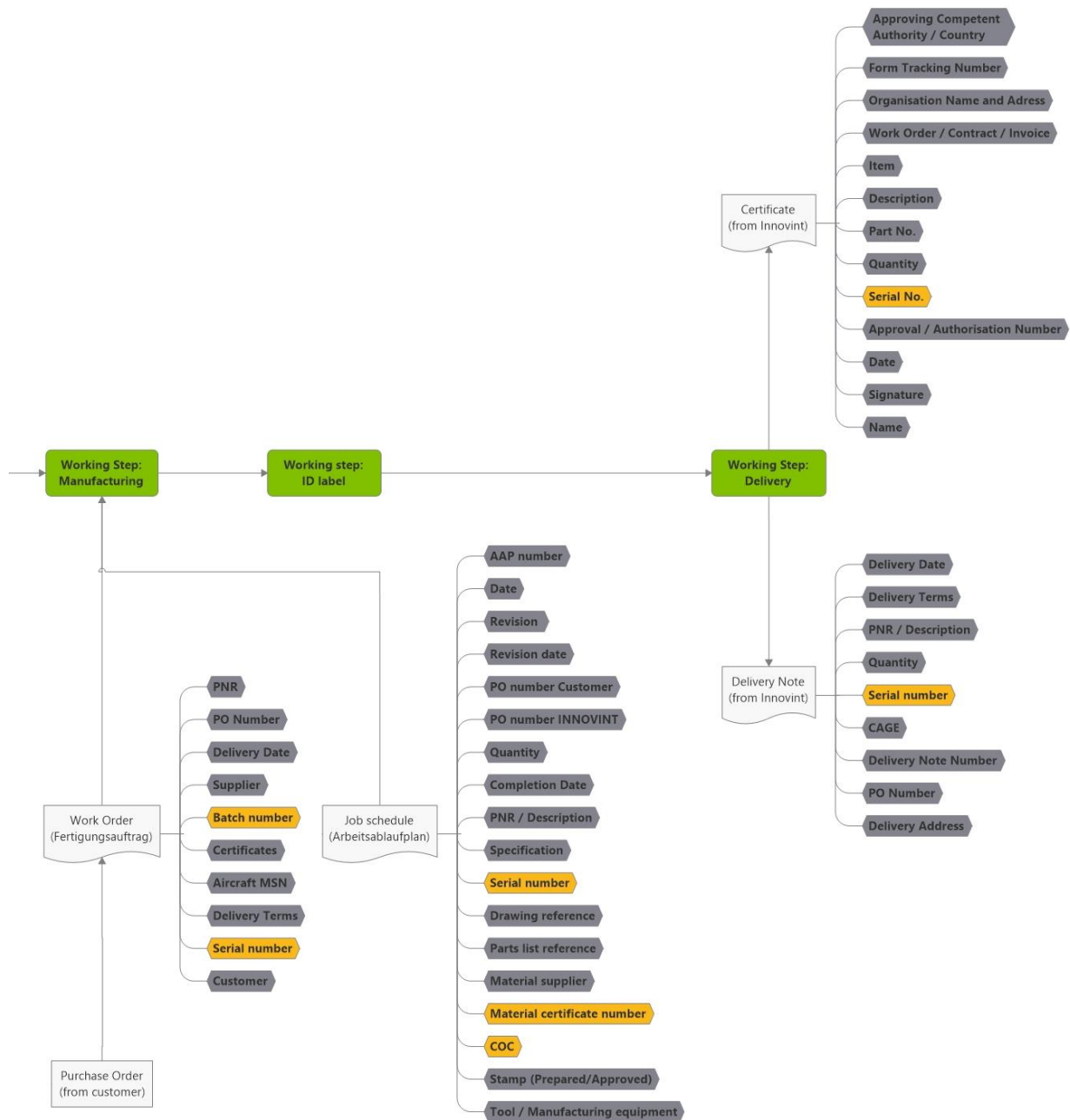


Figure 97: As-Is process, part II

3.4.3.3 Fulfilment of the US4.3 through EFPF

Generally, the same DAML based solution for the Secured Logistic Chain is used, already described in chapter 3.4.2. While the frontend of the Secured Blockchain Solution has not yet been developed because it was focused on vital technical functions, a frontend prototype has already been designed for the Material Track & Trace Solution.

To explain the needed functionalities, they were visualized in a target process workflow described in Figure 98.

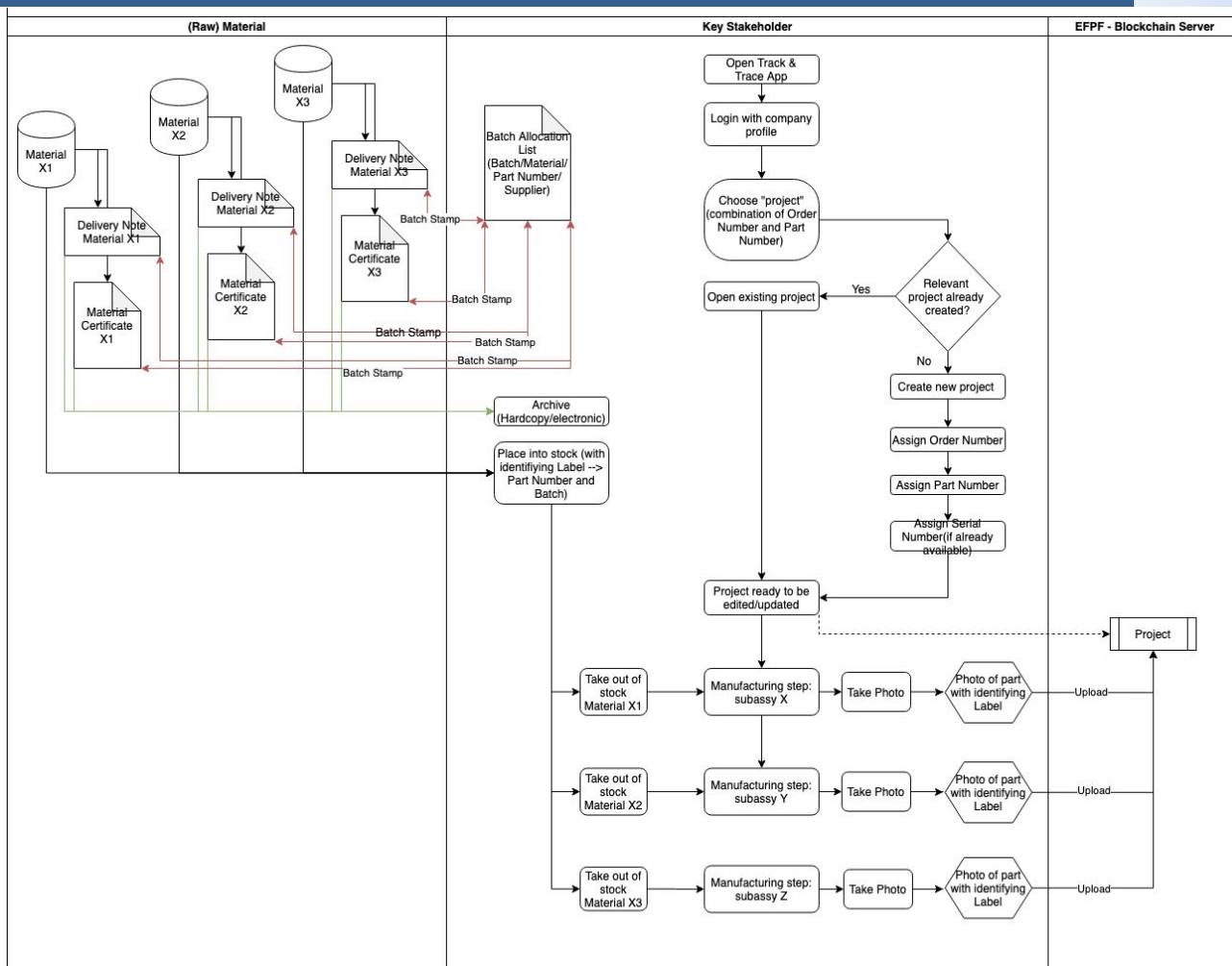


Figure 98: Workflow for US4.3

The background situation for the validation is that a company wants to manufacture a product identified by a part number under an order number. For the production, different materials are necessary, whose batch numbers are to be tracked. In addition, a serial number is to be assigned to the product so that the complete traceability of the materials used is given by the last assignment of part number to the serial number.

Please note that the following description is somewhat abbreviated. This is to create the proper understanding of the solution but not to go into every detail.

In the first step, the ordered materials must be entered in the goods receipt and the solution. For this purpose, the solution is opened. Refer to Figure 99, which shows the landing page of the solution:



Figure 99: Landing page of the Material Track & Trace solution with four different menu options

After clicking on “Incoming Materials”, the next page opens where the material data (batch number of supplier, certificate numbers, and the internal company batch numbers and a description of the material) can be filled in. After having clicked on “Place into Stock,” the material is entered into the database. Refer to Figure 100:

← Incoming Materials (Material X1)

Supplier Notes

Batch Number: 123-456	Dimensions: 10x10x10
Certificates: 123-456	Description: Lorem Ipsum
Weight: 10 KG	Quantity: 10

Your Notes

Batch Number	<input type="text" value="2021-016"/>
Description	<input type="text" value="Blue fabric"/>

+ADD DOCUMENTSPLACE INTO STOCK

Figure 100: Entering a new material into the solution

Via the button “+ADD DOCUMENTS”, different kind of documents (certificates, delivery notes) can be added so that they are directly available in the solution. This can be done with different materials, which can be used later when creating a project and assigning different materials.

In the next step, a corresponding “Project” must be selected to assign an order number, a part number and a description during the manufacturing process. Therefore it is clicked on the “Projects”-button (refer to Figure 99), whereas the already available projects are shown (refer to Figure 101):

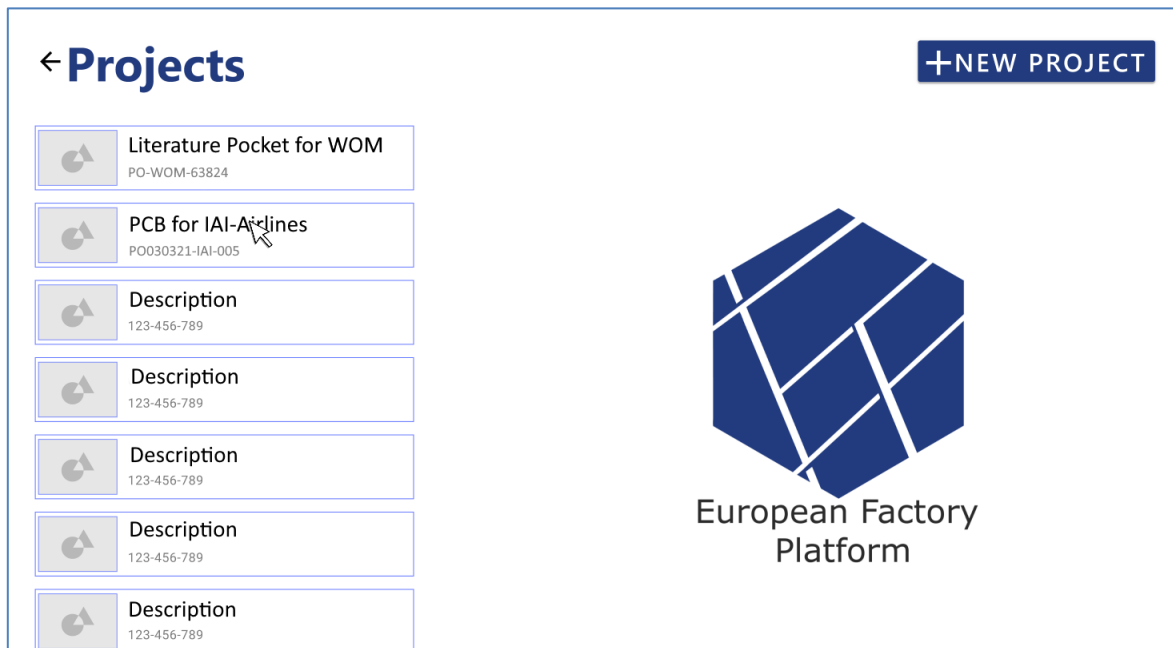


Figure 101: Menu page for selecting existing projects

If the applicable project is not yet available, it can be created via the “+NEW PROJECT”-button. After having clicked on the button, a corresponding page opens, and different inputs can be done to create a new project (Figure 102):

Figure 102: Creation of a new project with fields already filled

The solutions also provide the possibility to add different steps for each project. After having selected a project (Figure 101), steps can be added via the “+ADD STEP” button (refer to following Figure 103):

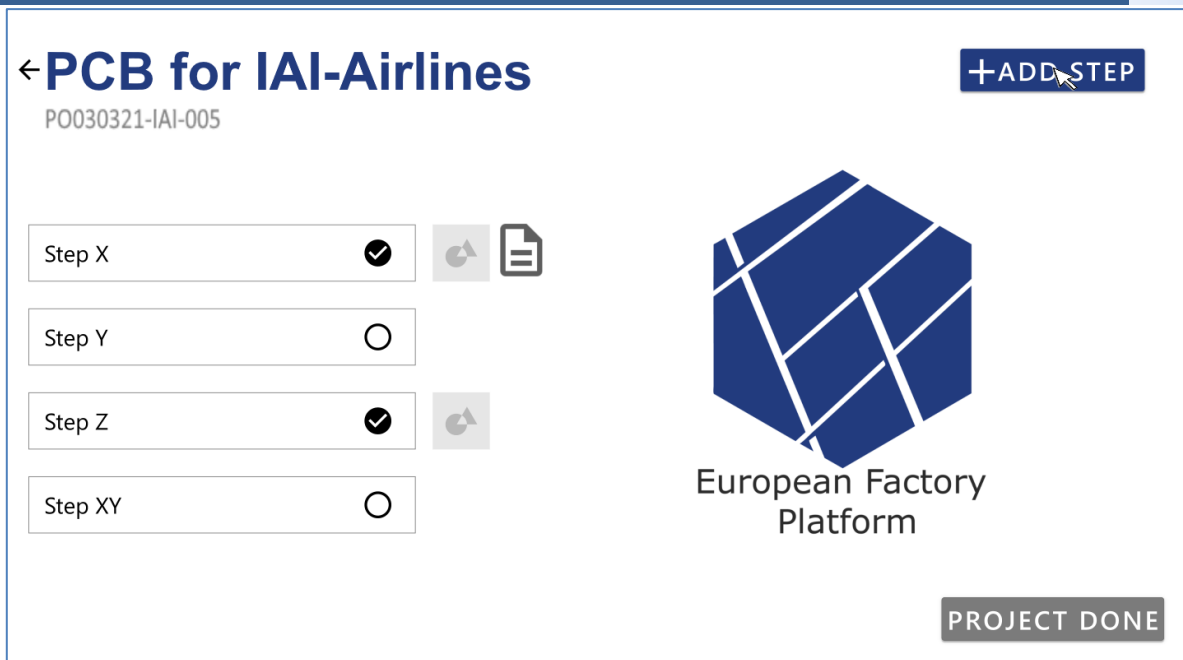


Figure 103: Adding steps to projects

Now, during different manufacturing steps, different materials can be added, which is not shown here. After having clicked on one of the available steps, a next page opens where material can be selected out of the available stock materials (refer to Figure 104):




Figure 104: Select a material for a particular step

Adding materials will probably be done after the product is finished, but it is also possible to do it step by step after each manufacturing step.

Now, if a material, a material batch number, a purchase order number, a part number with the corresponding serial number or material only shall be tracked, via the “Track Material” button on the landing page (Figure 99), different possibilities are shown (refer to following Figure 105):

← Material Tracking

Batch Number	<input type="text"/>
Purchase Order	PO030321-IAI-005
Part & Serial Number	<input type="text"/>
Materials	<input type="text"/>



European Factory Platform

SEARCH

Figure 105: Possibilities for Material Tracking

After having entered in one of the fields the data that shall be searched for (in this case in the Purchase Order field), a click on the “SEARCH”-button leads to the following page (refer to Figure 106):

← Material Tracking - Purchase Order

PO030321-IAI-005

Used Materials	Blue Fabric
Used Batch Numbers	2021-016
Part Number	7261-50
Serial Number	0685



European Factory Platform

Only one matching material found!

Figure 106: Result for a purchase order search

As shown, all matching information was provided from the solution. As only one matching material is found, an additional hint is given from the software.

3.4.3.4 Testing and Evaluation

Validation of the DAML tool was done from IAI under consideration of the defined requirements and further usability aspects by exemplary creating a project and entering materials of an end-product, whose deliveries were also considered by filling in material

numbers and batches into the solution on receipt at IAI. Also, the backend related development from the technical partner has been validated. See exemplary Figure 107 and Figure 108:

■ Description: 8th step (demo)

- *Add additional information to a project, like Order Number/Serial Number/Product Number etc and click on „Submit“.*

DAML Manufacturing_Department

Template SupplyChain.TrackTrace:ManufacturingDepartmentSubmitOrder@fac920d26046c2aed81bd05564ce995d682

manufacturingDepartment
Manufacturing_Department

productNumber
ProductNumber1

serialNumber
SerialNumber1

orderNumber
OrderNumber1

qualityManagementDepartment
Quality_Management_Department

Submit

- ### ■ Result (real life story):
- After having selected a project (by means of its purchase order number) I want to add a raw material with corresponding information (batch number etc.) to it. In this demo this step is reflected by the described step above.*

Figure 107: Feedback for the DAML solution using screenshots with markings and additional comments.

■ Description: 9th step (demo)

- *Allocate a batch number to the selected project by clicking on „AllocateBatchNumber“ and enter the appropriate information.*

Contract 00de5cb27d53e16ca87c7385f2c2d48f1b57fc7bfa9ca066b2e3adcc3c0928d0f5 Archive AllocateBatchNumber

Template > SupplyChain.TrackTrace:ManufacturingDepartmentSubmitOrder@fac920d26046c2aed81bd05564ce995d682b813a6a585a1d307c5dc986fafa

Signatories
Manufacturing_Department

Observers
Quality_Management_Department

Contract details
manufacturingDepartment
Manufacturing_Department
productNumber
ProductNumber1
serialNumber
SerialNumber1
orderNumber
OrderNumber1
qualityManagementDepartment
Quality_Management_Department

Choice: AllocateBatchNumber

materialConsumed
[0]
materialNumber
MaterialNumber1
batchNumber
BatchNumber1
quantity
2

Add new element Delete last element

version
integer

Submit

- **Result (real life story):** N/A

Figure 108: Feedback for the DAML solution using screenshots with markings and additional comments.

3.4.3.5 User value proposition

- Increase transparency for combinations of raw materials and end products to fulfil aerospace requirements for material track and trace
- Have all data stored in one application and access relevant data with few clicks
- Use blockchain technology to raise acceptance of stakeholders for the tool as data cannot be manipulated, and there is only one version of data, meaning it can be used to ensure traceability without massive paperwork
- Operational and cost benefits.
- Companies know which part from which batch was used to build which products and sold to which customers, all while maintaining full traceability for each part back to its origin. Possibility to produce any associated raw material certificates, test reports and other supporting documentation quickly.
- Tracking would not be limited to single companies, but different stakeholders could be given different visibility for parts of a project, easing the cooperation and raising the effectiveness.

3.4.3.6 Compliance with Standards and Regulations

To satisfy the quality requirements of EASA (European Union Aviation Safety Agency) regulations (e.g. Part 21.G, Part145), suppliers must be able to trace all components of a failing part back to its origin. To do this and ultimately hold suppliers accountable for providing reliable products, they must have the ancestry of those components on file.

Furthermore, standards for quality management systems (EN9100) also prescribe similar requirements:

“The organization shall plan, implement and control a process for configuration management as appropriate to the organization and its products and services to ensure the identification and control of physical and functional attributes throughout the product lifecycle.”

3.4.3.7 Lessons Learned and Outlook

Based on the evaluation of the solution by target user IAI regarding the functional aspects of the developed solution, the project partners learn the following lessons. For detailed results or specific user evaluation comments/scores, please refer to the filled questionnaire in chapter 5.2.5.

Having analysed the questionnaire and taking all other feedback into account, the solution is solid-state regarding functionality and usability. However, the primary missing point was that the serial number functionality was not implemented to the full extend. As it will be incorporated for the next version, this is judged as minor. In regards to further possibilities for this solution, there are mainly three points:

- Connection to warehouse management systems: there would not be an own warehouse system within the current solution, but both systems could benefit from each other.
- Connection with ERP systems would ease the solution's usability. Working steps for the different project / end-products would not have to be entered manually but could be taken from existing work orders.

- Contrary to the possible connection to the ERP system, another improvement could be made when deleting the specific requirement of the solution to add steps under a project. This would simplify the use of the solution so that, independently of a specific working step, materials and the corresponding batches could be added to a project.
- Functionality should be implemented to allow other stakeholders (e.g. customers) partly visibility of specific projects if required.

4 Concluding Remarks

The solutions developed in the EFPF project for SMEs from the aerospace sector were linked to the elaborated user stories, taking into account the existing requirements in the aerospace sector. In addition, validation strategies were defined for both existing and new user requirements and practical validation activities were documented. Extensive feedback could be given to the developers by answering specific tool questionnaires, which can be used for further development and troubleshooting.

It was possible to realize almost all of the new user stories defined after the departure of Airbus, and it has been shown that such a good result could only be achieved in close coordination between practical partners and developers. The COVID19 crisis had a significant impact on the project. Physical meetings between project partners did not occur during the parts of the development phase and not during the implementation phase. Some companies were limited in implementing the solutions without the developers on-site during the second and third waves. However, with the help of video conferencing and remote access applications, most software problems and deviations from the planned behaviour of the installed technology could be solved quickly. However, some things took longer for users to describe their requirements even more clearly, as there were different perceptions of processes. Also, the implementations on-site were slower than if a technical partner had been directly available. Also, on the side of the practice partners, some know-how had to be built up before configuration problems could be solved and unusual behaviour of the equipment could be interpreted correctly. This is perhaps one of the most critical findings from the implementation phase: the end-users need basic knowledge of system architectures and programming to interpret error messages independently and react adequately.

As a general summary, it can be stated that various applications addressed the central optimization potentials for SME. The topics covered range from flexibly scalable store floor connectivity solutions to increasing companies' visibility in the entire supply chain management to ensure internal company processes based on the latest technology. In addition, the unique features of the aviation process world were also addressed: here, in addition to a solution for ensuring the traceability of materials throughout the entire process chain, a solution for simplifying logistical processes to maintain aviation security was developed.

The further development of the implemented solutions and the use of the broad offer of the EFPF platform also for other use cases remains the exciting task of the participating SMEs in cooperation with the technical experts.

5 Annexe A: Questionnaires for Tool Evaluation

5.1 Methodology and Generic Questionnaire

Target users evaluated the functional and usability aspects of the (aerospace pilot specific) EFPF solutions. The evaluation process involved the users testing and working with the solution and then recording their experiences in a specific questionnaire. The questionnaire was composed of 2 parts for each solution, the first part focused on usability aspects, and the second focused on the functional aspects. The use of questionnaire allowed the users to record their experience and overall satisfaction with the developed solutions in their own time. The first part of the questionnaire (shown below) remained for all solutions, whereas the second part was customised to suit the functional aspects of different solutions. Refer to Table 16 for the specific questionnaires for all solutions.

Q#	Questions	Disagree 1	2	Agree 3	4	5
Q1	Overall, I am satisfied with how easy it was to use the tool	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Notes	*Any suggestions for enhancements?					
Q2	The functions and capabilities of the tool are properly visible and usable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Notes	*Any suggestions for enhancements?					
Q3	I am able to complete tasks & scenarios without needing developers help	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Notes	*Any suggestions for enhancements?					
Q4	The documentation and instruction were easy to understand and follow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Notes	*Any suggestions for enhancements?					
Q5	I felt confident and comfortable using this tool	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Notes	*Any suggestions for enhancements?					
Q6	The interfaces of the tool provided adequate information about the purpose and functions of the tool	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Notes	*Any suggestions for enhancements?					
Q7	I found the tool was easy to install/configure/execute	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Notes	*Any suggestions for enhancements?					
Q8	I will recommend this tool to the contacts in my business network	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Notes	*Any suggestions for enhancements?					

Table 16: Generic Questionnaire for all Tools

The primary purpose of these questionnaires is to identify further weaknesses in the implemented solutions and the associated potential for improvement via corresponding questionnaires and the associated user feedback. While the focus of the requirements validation was more on fulfilling the functional requirements, the questionnaires are more concerned with the overall impression of the implemented solutions. The main focus is on "perceived quality", i.e. how satisfied are the users with the implementation of the use cases and the operation of the tools. Furthermore, the goal is to name optimisation potential

(missing functions). The answers to the questionnaires were systematically reviewed in this regard. Particular attention was paid to the ratings of 3 or worse. Any optimisation potential identified was extracted and incorporated into the individual user stories' respective "Lessons learned" chapters.

5.2 Specific Questionnaires for the Implemented Solutions

To complete the questionnaires, users were guided step-by-step through the individual questions. For each technical solution, there was a questionnaire for each user partner involved in the development. Figure 109 and Figure 110 show examples of the questionnaires.

EFPF Solution - Tendering and Team Formation (Business Opportunities)

The first part of this questionnaire has been designed to assess the perceived usability of EFPF tools with a generic set of questions. In addition to their scores, participants can also provide details of their experience in the Notes section (under each question)

Part 1: Generic Questions

Figure 109: Starting point for the questionnaire for the Business Opportunity Tool

I am able to use the search feature to search by keyword as well as use additional filters

1 2 3 4 5

What is the reason for this rating? (optional)

This is from current perspective the only point where some improvement could be done: taking over the search criteria with applicable content from the PCS once no results are available and the users switches to the BOT. In this sense also maybe some more search criteria, that are already used in the PCS, could be implemented in the BOT as well.

Figure 110: One question for the Business Opportunity Tool with the corresponding answer

The filled questionnaires shown below are examples of their structure and responses. In order not to overload this document, only one questionnaire is shown per solution/tool.

5.2.1 Matchmaking Service and Tendering & Bid Management – Business Opportunity Tool

The questionnaire for the Business Opportunity solution regarding user feedback is documented below. For the overall rating, the average of the individual user ratings was calculated. The detailed responses were summarised and generalised in the lessons learned sections of the respective user story that uses this solution (refer to chapters 3.1.3.7, 3.1.4.7, 3.2.1.7 and 3.2.2.7).

Responses	Questions	Question Type	User Score (Average)	Total Score
Some improvements regarding user guidance would be fine. The button "Create Opportunity" should be in the upper part of the site.	The team formation area was easy to navigate and allowed me to share messages and documents to only members of a specific team	new-question-five	4	5
Most of the important details are included. In future it should be possible to add details if necessary.	The company profile includes all the details I need to choose an appropriate company	new-question-five	4	5
If the right keywords are used, the right opportunities can be found.	I found it easy to apply to opportunities	new-question-five	4	5
This is from current perspective the only point where some improvement could be done: taking over the search criteria with applicable content from the PCS once no results are available and the users switches to the BOT. In this sense also maybe some more search criteria, that are already used in the PCS, could be implemented in the BOT as well.	I am able to use the search feature to search by keyword as well as use additional filters	new-question-five	4	5
If the own requirements in regards to what is searched for a business opportunity is created in less than 2 minutes, which shows to things: 1. limited to relevant functions without overload by unnecessary ones/ 2. intuitive to use; The button "Create Opportunity" should be in the upper part of the site.	I found it easy to create opportunities	new-question-five	4	5
Structured menu guidance and well explained fields. It would be necessary to have a button inside "My opportunities", on every opportunitie, to invite providers. Now you have to do it when you create the opportunitie, but if you forgot this step, you can't do it later. Also, imagine you want to add another provider to the tender, now you can't.	I found the platform as a whole easy to manage	new-question-five	4	5
Yes! The tool bringt added value, and the more companies this tool use the more added value is created for them.	I will recommend this tool to the contacts in my business network	new-question-five	4	5
As the BOT is available via single-sign on functionality through the EFPF portal finding and accessing the tool is easy. No improvements necessary.	I found the tool was easy to install/configure/execute	new-question-five	5	5
Where fields need to be filled in, their titels speak in most cases for its own. Additionally, some text for further explanations is provided. In regards to the interfaces to the Product Catalogue Service this is well defined and the applicable buttons are at the right process steps available. Only note for some improvement regarding the interfaces to the PCS at this point is that search parameters could be transferred once the switch from PCS to the Business Opportunity Tool is done. This would avoid double work in some fields.	The interfaces of the tool provided adequate information about the purpose and functions of the tool	new-question-five	5	5
Quit good to use	I felt confident and comfortable using this tool	new-question-five	5	5
well documented	The documentation and instruction were easy to understand and follow	new-question-five	5	5
contains self-explaining elements	I am able to complete tasks / scenarios without needing developers help	new-question-five	5	5
sometimes a user guidance (e.g. Step 1, Step 2 etc.) could be helpful	The functions and capabilities of the tool are properly visible and usable	new-question-five	4	5
Using the tool is easy, but there are too many lines that must filled in bevor using it (company profile). Theses lines should be optional: Address name, 2nd Line of Address, County. It would be good to have some services also in the list of products .	Overall, I am satisfied with how easy it was to use the tool	new-question-five	4	5

Figure 111: Filled questionnaire for the Business Opportunity Tool

5.2.2 Workplace Environment Monitoring – FCGMT, Analytics Tools, Event Reactor

The questionnaire for the Workplace Environment Solution regarding user feedback is documented below. For the overall rating, the average of the individual user ratings was calculated. The detailed responses were summarised and generalised in the lessons learned sections of the respective user story that uses this solution (refer to chapter 3.3.1.7).

Responses	Questions	Question Type	User Score (Average)	Total Score
The zoom-in and mouse-over functions are useful and well implemented. For the zoom-out, a button (reset) would be nicer than a refresh. It is not that clear without having feedback from the technical partners how to "zoom in" and how to "zoom out".	I find the graph visualization for sensor values and threshold useful	new-question-five	5	5
At first, the selection options are confusing. The unit should be preset for the specific sensor (for example, °C for a temperature sensor) or it should be possible to set defaults. A feedback that the new limit value has been set successfully would be helpful. If that is the only way setting thresholds it is fine. If it is possible to make this slightly more "user friendly" (name the button "Set new threshold" or similar) it would be great.	I find the feature of sending requests to set the alarm threshold helpful	new-question-five	4	5
The operation is intuitive. The interface reacts quickly and without errors.	I can intuitively find my way around in the GUI	new-question-five	5	5
No overload of buttons, pleasant colors for the buttons and background. Generally the GUI can be handled quite ergonomically. Only it was not clear how to set new thresholds (via "New request") and what the purpose of location "per-device"/"per-room" etc. is for.	The Design of the GUI is user friendly and easy to work with	new-question-five	5	5
I appreciate the large icons and the clear structure.	The Alarm mechanism met my requirements	new-question-five	5	5
Yes, clearly and well structured. Access via the EPFP portal easily possible in two steps: 1. Login to the portal 2. Go to tools and click on symphony.	In case of Alarm, the Siren and Lights worked properly and are synced with email notifications	new-question-five	5	5
The alarm options meet the practical requirements. In a later development stage, it would certainly be helpful if the user could configure his alarm settings himself, i.e. define the type of alarm and recipient himself. The alarm should also be clearly visualised in the GUI. It should be possible to deactivate the visual and acoustic alarm in the GUI.	In case of Alarm, I received notification via email	new-question-five	5	5
The visual and audible alarms worked properly. There should be the possibility in the GUI to deactivate/acknowledge a triggered alarm or to mute the siren first. The function of the synchronously sent email could not yet be tested, but both the optical and acoustic alarm as well as the email notification functioned independently of each other, so it can be assumed that the function will be given after troubleshooting.	The History page is useful and I can make use of available Gadgets easily	new-question-five	4	5
The defined hardware (lamps/sounder) are sufficient for the purpose. The sounder is not too loud and noisy, but you can hear it well through different rooms/workshop areas. Emails are sent out instantly together with the alarms (red lamp/sounder).	I can submit new request easily and see the response.	new-question-five	5	5
An email has been sent. A severity is specified in the email. It seems that there are plans to set several thresholds and to enable graduated alerts depending on the severity. This would be a useful feature in any case.	I can easily browse the GUI and move between pages.	new-question-five	5	5
Emails are sent out instantly without time delay.	I will recommend this tool to the contacts in my business network	new-question-five	5	5
I have two different history pages: alarm history and sensor history. It should be ensured that the sensor and alarm history is securely stored and retrievable for a defined period of time, independent of the hardware on site. Ideally, this period should be definable by the user, e.g. 90 days. The platform could specify a maximum value in its service offering (e.g. one year). In the sensor history, there should be search filters (date, time) similar to the alarm history.	I found the tool was easy to install/configure/execute	new-question-five	4	5
Only an export function for the history data is missing.	The documentation and instruction were easy to understand and follow	new-question-five	4	5
The numerous options are confusing at first. It would be helpful if you could set defaults depending on the sensor (°C for temperature, for example). Feedback on the successful acceptance of the value would be helpful. There sometimes seems to be a slight delay in the takeover. Is that correct?	I am able to complete tasks & scenarios without needing developers help	new-question-five	4	5
The given commands are followed by relevant user feedback and the execution (e.g. set a new threshold) is done very quickly.	The functions and capabilities of the tool are properly visible and usable	new-question-five	5	5
The operation of the GUI is intuitive, the navigation is simple and fast.	Overall, I am satisfied with how easy it was to use the tool	new-question-five	4	5
Well and clearly structured, inputs and handling was clear after reading the manual. It was not clear without reading the manual that via "New Request" other thresholds will be defined, but as the manual was available it was no problem. Other functions like creator-ID and Location "per-device"/"per-room" are not needed for the current use case, but we also do not need for what they are for.				
Yes, monitoring environmental factors with sensors is useful or even necessary in many contexts. If these solutions are not already on the market and are coupled for example to a machine, flexible solutions can only be realised with their individual effort and high investments. SMEs do not always have these resources. This tool offers a very simple and flexible way of implementation.				
If the offered solutions are coming with the "whole package" I described in the pages before I will recommend this tool. Furthermore, we should define more possible use cases to show the capabilities of this solution and to raise it to a more general level.				
I am an experienced IT user, so the installation was not problematic. An inexperienced user would certainly have problems. To appeal to as many users as possible, the solution should be more out-of-the-box.				
Generally for people with some technical understanding the installation of the hardware is possible. In regards to the configuration of the RevPi we were not able to configure it due to lack of IT-programming skills. For later similar applications / installations in other companies with similar hardware the configuration of the devices should be done from the technical partners. The only thing for potential users to be done should be setting up the cabinet with needed hardware (like power outlet/switches/lamps etc.). However, this should be guided by applicable documents: at minimum applicable wiring diagrams should be provided. This should come with other general supporting documents that describe the installation of the whole solution with needed infrastructure etc. Furthermore, we should be very careful with the offering of these solution through the platform. It should be clarified what kind of hardware is needed, which hardware will come with the solution in what state, which infrastructure should be available etc. Reason for this is that potential customers must have a clear view before ordering the solutions.				
Perhaps it would be possible to implement some kind of device status in the gui. Users would then have a quick overview of whether the monitoring is working properly. The gui would also have to react with an alarm (email notification) if the sensors do not provide any data for some reason. Otherwise, a critical exceeding could go unnoticed.				
The support of the developers is excellent, questions and problems could be solved quickly.				
With further documentation and hints (via manuals/calls etc.) the confidence grew. However, confidence and comfort will only arise at later customers for similar application the better and the more guided the provided manuals etc are, AND the better the transparency right from the beginning is (e.g. if I as a customer order a solution for temperature monitoring, what is expected to be available in regards to my infrastructure? What hardware will come with the solution, which hardware do I have to purchase? How does the technical documentation look like? What about liability for pre-configured devices etc. that I will install in my company?)				
At the current stage of development, a certain amount of technical knowledge is required on the user side. SMEs do not always have such resources. External services may be associated with further costs. The documentation should therefore appeal more to inexperienced users. In the portal, an online help for the functions of the tool would be useful.				
Documentation was good, also the short answer times from the technical partners via phone/Skype were appreciated. Due to lack of programming skills the provided manual was not sufficient for configuring the RevPi. However, strong support from Fortiss helped and this is valuable experience as we should focus on delivering pre-configured devices to later customers for similar applications.				
If a hardware kit is developed, the function should be given out-of-the-box - perhaps at most with a simple web interface as with a router configuration. Troubleshooting without the developers is not possible at this stage. However, the pure use of the tool is possible without outside help.				
Once everything was implemented not much help from the technical partners was needed.				
I fully agree with this.				
Relevant data are presented in a well structured way in the Symphony GUI (accessible via EPFP Portals - Tools). May be an export function for the value history would make sense, so that the data can be saved locally and e.g. for quality records.				
Consideration should be given to reducing the number of hardware components required and simplifying the installation process. The hardware components should be suitable for industrial use (IP-coded, rail or rack mounting, fail-safe, usable in various environmental conditions). The GUI is clear and intuitive.				
Generally the tool itself can be controlled via a well structured GUI (Symphony). Furthermore we received a well done UI user manual, which makes it easy to deal with the GUI.				

Figure 112: Filled questionnaire for the Working Environment Monitoring Solution

5.2.3 Catalogue Service – Product Catalogue Service

The questionnaire for the Product Catalogue Service regarding user feedback is documented below. For the overall rating, the average of the individual user ratings was calculated. The detailed responses were summarised and generalised in the lessons learned sections of the respective user story that uses this solution (refer to chapters 3.1.1.7 and 3.1.2.7).

Responses	Questions	Question Type	User Score (Average)	Total Score
Very easy to use	Accessibility of the Product Catalog Service is easy through EFPF platform.	new-question-five	5	5
User guidance is sufficient but could be raised, e.g. with some coloured hints if an action has started.	I can offer my catalogs and products to other users or user groups.	new-question-five	4	5
It is good to have this possibility. However, most of the companies that will find to each other via the tool will have their own general terms and conditions already defined.	I can generate contracts for my catalogs to improve my B2B collaborations.	new-question-five	5	5
Easy to use	I can add users or groups to my white list/blacklist to manage the discoverability of my catalogs across the EFPF platform.	new-question-five	5	5
Management is simply possible	Management of the catalogs (publishing, customizing, deleting or exporting) is easy and intuitive.	new-question-five	5	5
All relevant properties are possible	I can describe my product/service with relevant properties in product publishing page.	new-question-five	5	5
Single Upload is well designed and easy to use, bulk upload functionality could be improved. Please refer to answer before.	Single Upload page and Bulk Upload template are easy to understand and use.	new-question-five	5	5
Although the bulk upload functionality makes it much easier to use the catalog, further improvements can be made here, as dealing with the template is complicated. One possibility here would be to examine the extent to which the so-called HyCoDER tool currently being developed by the Fraunhofer IPT could be used. This tool (Hybrid Configurable Data Extraction and Restructuring System) is designed to process various input files consisting of lists (e.g. article lists) from different sources that differ in format, content and organization, and would ease the bulk uploading of products and services.	I can easily publish multiple products/services through Bulk Upload functionality.	new-question-five	4	5
The user is well guided in a step-by-step manner.	I can easily publish a single product/service through Single Upload functionality.	new-question-five	5	5
All relevant categories are available	I can find suitable categories for my products and services.	new-question-five	5	5
The product catalogue and the service catalogue are very well developed. Products and services can be easily offered on the platform. In the B2B sector - especially in aviation - online shops are not widespread. Especially SMEs, which serve the very specialised areas of the supply chain in the aviation sector, have so far rarely used such possibilities. Via the EFPF platform, an easy entry into this marketing segment would now also be possible for these companies without major technical or financial hurdles.	I will recommend this tool to the contacts in my business network	new-question-five	5	5
No installing is necessary as the tool is accessible online via the EFPF portal.	I found the tool was easy to install/configure/execute	new-question-five	5	5
The user interfaces, especially where to give input, are clear in all tested steps during validation. The access via the EFPF portal is easy and only few steps are needed. As only remark here: the use of the Excel template for bulk upload of products and services is a bit complicated. Some improvements here, especially in regards to user guidance, would be helpful.	The interfaces of the tool provided adequate information about the purpose and functions of the tool	new-question-five	5	5
The confidence grew with ongoing iterations steps between the technical partner and us as user. Having the final solution in mind, also people having not this background can easily work with the tool.	I felt confident and comfortable using this tool	new-question-five	5	5
Nowadays, people are used to working with similar portals. Therefore, separate instructions are not necessary.	The documentation and instruction were easy to understand and follow	new-question-five	5	5
	I am able to complete tasks & scenarios without needing developers help	new-question-five	5	5
Due to its well structured appearance all functions are properly visible.	The functions and capabilities of the tool are properly visible and usable	new-question-five	5	5
Although a lot of functions are implemented, the tool is well structured and usable. At the right points the user is guided.	Overall, I am satisfied with how easy it was to use the tool	new-question-five	5	5

Figure 113: Filled questionnaire for the Product Catalogue Service

5.2.4 Blockchain Application (Secured Logistics Chain) – DAML

The questionnaire for the DAML solution regarding user feedback is documented below. The detailed responses were summarised and generalised in the lessons learned sections of the respective user story that uses this solution (refer to chapter 3.4.2.7).

Response	Question	Question Type	User Score	Total Score
All relevant inputs are available, e.g. also that the transporter doors are lockable and the transporter is locked after the package is put in.	I can easily register the freight handover protocol and related documentation at handover.	new-question-five	4	5
This functionality was up to now not available in the backend, but will be incorporated in the next version.	I can easily select a regulated agent to handle the transport from a list of approved agents.	new-question-five	3	5
Also additional information can be added. It is planned to also be able to upload photos as proof.	I can easily confirm that a package has been packed tamper-proof and provide e.g. photographic evidence for this.	new-question-five	4	5
Relevant input fields are available: reference number (e.g. PO number), the supplier who issues the new freight item, and the one who is currently handling the new project.	I can easily create a new freight item for airfreight.	new-question-five	4	5
Once the solution is readily available it brings various advantages for users as well as for monitoring agencies. Logistic chain stakeholders (known consignors, regulated agents, airline companies) are supported with one tool for secured logistic chains that covers all relevant functions. With only few clicks the history of air freight on their way from a known consignor to regulated agents and airline companies can be tracked, and the compliance to relevant requirements can be monitored.	I will recommend this tool to the contacts in my business network	new-question-five	5	5
The user guidance has to be improved.	I found the tool was easy to install/configure/execute	new-question-five	3	5
Difficult to answer at this stage. However, as possible frontend illustrations are already known, adequate interfaces with a high level of usability are expected to be implemented.	The interfaces of the tool provided adequate information about the purpose and functions of the tool	new-question-five	4	5
Confidence grew the more we used the available backend interface. As we have already seen possible frontend illustrations we expect to have a proper user interface in the future that makes the user feel confident and comfortable using the tool	I felt confident and comfortable using this tool	new-question-five	Empty	5
The provided documents from CNET helped to understand the available functions and allowed us to rate this solution for validation.	The documentation and instruction were easy to understand and follow	new-question-five	4	5
Not at the moment, because frontend is missing. However, in close collaboration with the technical partner CNET also the available backend functionalities allowed us to complete tasks and scenarios.	I am able to complete tasks & scenarios without needing developers help	new-question-five	4	5
Almost all required ones are available. As the frontend was not developed during validation, this question cannot be answered.	The functions and capabilities of the tool are properly visible and usable	new-question-five	3	5
Main emphasis was laid on key technical aspects, so this question can hardly be scored.	Overall, I am satisfied with how easy it was to use the tool	new-question-five	3	5

Figure 114: Filled Questionnaire for the DAML Secure Logistics Chain Solution

5.2.5 Blockchain Application (Material Track & Trace) – DAML

The questionnaire for the DAML solution regarding user feedback is documented below. The detailed responses were summarised and generalised in the lessons learned sections of the respective user story that uses this solution (refer to chapter 3.4.3.7).

Response	Question	Question Type	User Score	Total Score
Due to the search functions that allows to search for several parameters this solution is extremely flexible and provides the possibility to track back to raw materials and certificates based on different inputs.	I can get a comprehensive overview of a work order and how it traces back to raw materials and certificates.	new-question-five	4	5
This is also a good feature, that photos can be added to the different manufacturing steps.	I can conveniently provide image verification of project steps, part assembly and certificates.	new-question-five	4	5
Yes! Also delivery notes/certificates can be uploaded.	I can easily add a new asset (part, raw material) for tracking.	new-question-	4	5
Proper landing page, and without only few clicks you have the overview.	I can easily get an overview of projects (work orders) and select the correct one.	new-question-five	4	5
For companies that have to know which parts from which batch were used to build which products and sold to which customers, all while maintaining full traceability for each part back to its origin, this solution brings huge added value.	I will recommend this tool to the contacts in my business network	new-question-five	4	5
	I found the tool was easy to install/configure/execute	new-question-	4	5
The interface needs partly be further developed (huge effort). The upload functionalities (documents and photos) are good, but especially a connection to ERP systems (to avoid filling steps manually in) and also to warehouse management software would ease the use of the solution.	The interfaces of the tool provided adequate information about the purpose and functions of the tool	new-question-five	4	5
Confidence grew with further using of the tool.	I felt confident and comfortable using this tool	new-question-	4	5
As the documentation for the target processes was very clear (workflows), and they were supported with comprehensive user stories, there was not much documentation or instructions needed from the developers.	The documentation and instruction were easy to understand and follow	new-question-five	4	5
During validation of the backend functionalities there was more input needed from the developers, but the frontend was quite self-explaining.	I am able to complete tasks & scenarios without needing developers help	new-question-five	4	5
All field to be filled were self explaining and the intended functions were clear.	The functions and capabilities of the tool are properly visible and usable	new-question-	4	5
The frontend is clearly structured. There are improvements necessary on the arrangements of buttons.	Overall, I am satisfied with how easy it was to use the tool	new-question-five	4	5

Figure 115: Filled Questionnaire for the DAML Track and Trace Solution

5.2.6 Trolley Tracking - Workflow and Business Process Design and Execution

The questionnaire for the WASP solution regarding user feedback is documented below. The detailed responses were summarised and generalised in the lessons learned sections of the respective user story that uses this solution (refer to chapter 3.3.2.7).

Based on the way data is stored in the RateMe system, please read this document bottom up			
Responses	Questions	Question Type	User Score
	Please add your details	new-question-form	Empty
	Accessibility of the tool is easy through single sign on functionality	new-question-five	4
From the end user validation, just the user assignment has been experimented	I am able to integrate a variety of tools, systems and users through WASP	new-question-five	5
	The control panel is easy to view and understand	new-question-five	4
During the process execution it would be very valuable to watch not only the tasks under execution at that moment highlighted, but the status of the rest of tasks in the process, in order to gain awareness about the dependencies between tasks and get a more clear picture about the live process.			
	I can get a holistic overview of distributed activities within the control panel	new-question-five	3
	I can intuitively find my way around in the WASP user interface	new-question-five	4
I can see all service task of all other users. I don't know whether this is only because it is in test mode.	WASP offers adequate security and privacy to users and their activities	new-question-five	2
When an empty category selected in the marketplace section (i.e.: Iagrama), the dropdowns become not selectable and the user is therefore blocked. The Return button should be pressed but this is not clear enough for the user.			
	Adding new services to the WASP Market Place is easy	new-question-five	4
	WASP offers useful functionality for managing distributed activities in my domain	new-question-five	3
	WASP offers new functionality that is not available in any tool that I know	new-question-five	2
Users assigned to some task are able to inspect the task in the MyTask list. However, they cannot view the whole business processes where it is involved. Users could be able to visualize the whole process (read-only if the user is not the process owner).	I am able to keep a record of distributed activities that take place within the processes	new-question-five	3
The process instance view could be accessed through some shortcut to make its access more agile.	I am able to monitor running processes and keep track of distributed activities that take place within the supply chain	new-question-five	4
It can be assumed that both edition and execution modes are different, but it would be very useful to inspect the properties of each process not only when the process workflow is being edited but also when this is being executed (i.e.: in a tooltip when passing mouse over the task).			
An alternative visualization of all the tasks involved in the process will be valuable, in a similar way that the "My Tasks" visualization: name of task, assignee, etc. available for the process owner.	I can execute and manage the processes to gain improved visibility of distributed activities	new-question-five	4
As commented earlier, could be interesting not to need to exit the tool to create a new service.			
So each process needs to be assigned to a user or to an automatic procedure (i.e.: REST call), when a process is properly assigned or not, this should be indicated in the process box. Often it is not clear which processes have been already assigned to resources at a glance.	I can easily design processes and associate (automated and manual) services with different tasks	new-question-five	3
	EFPP Tool - WASP	new-question-splash	Empty
	I will recommend this tool to the contacts in my business network	new-question-five	5
The different alternative paths from a Gateway component are not clearly identified in properties. Together with labels, different colours for each path could be used.	The interfaces of the tool provided adequate information about the purpose and functions of the tool	new-question-five	4
	I felt confident and comfortable using this tool	new-question-five	5
	The documentation and instruction were easy to understand and follow	new-question-five	4
	The use of this tool allows to efficiently monitor the distributed activities taking place in our processes	new-question-five	4
	My feel confident that my partners will find it easy to work with this tool	new-question-five	5
The different alternative paths from a Gateway component are not clearly identified in properties. Together with labels, different colours for each path could be used.	The interfaces of the tool provided adequate information about the purpose and functions of the tool	new-question-five	4
Maybe it would be interesting, create a war, to make easier integration of API services. Now you have to exit from the tool to create a service task.	I am able to complete most of the requirements & scenarios without needing developers help	new-question-five	4
Task boxes cannot be resized, and this does not allow writing long texts inside them. When any element is selected (left click), the item is selected and the properties panel appears in the right side. During process definition time, this is not friendly (more evident when using 4x3 ratio monitors) so this hampers the continuation of the edition. The properties panel could be prompted only by right-clicking (directly or through some contextual menu if considered).			
There is no option to add comments (just text area for notes) in the diagram.			
There is no option to export the BPMN process in a picture format (JPG or PNG).			
When performing some changes (i.e.: assignment of user to task), the zoom level is set to minimum in order to visualize the entire process workflow. This is quite annoying for the user when trying to do very changes to the tasks or other components.			
After assigning a first task to a user and then saved, if other second task is selected and this is not assigned yet, the dropdown of the user assignment remains with the last selection. This is confusing, so suggests to the user that the second task is already assigned while probably it is not. If a second task is selected and this has not been assigned yet, the dropdown should be set to a blank value to avoid this confusion.			
The inactivity session timeout could be extended to 60 min.			
It is necessary to have an IT profile.	The functions and capabilities of the tool are properly visible and usable	new-question-five	4
When editing a process diagram, if other tab is selected from the menu and the editor is selected again, the process being edited disappears from the canvas.			
	Overall, I am satisfied with how easy it was to use the tool	new-question-five	4
	EFPP Tools - WASP	new-question-splash	Empty
	EFPP - Tools Evaluation Questionnaire	new-question-splash	Empty
	introduction		Empty

Figure 116: Exemplary filled Questionnaire for the WASP solution for Trolley Tracking

5.2.7 Supply Chain Transparency - Workflow and Business Process Design and Execution

The questionnaire for the WASP solution regarding user feedback is documented below. The detailed responses were summarised and generalised in the lessons learned sections of the respective user story that uses this solution (refer to chapter 3.4.1.7).

Responses	Questions	Question Type	User Score	Total Score
As all solutions within EFPF this WASP tool is also accessible via the EFPF main page with only little steps.	Accessibility of the tool is easy through single sign on functionality	new-question-five	5	5
Not sure what this really refers to. Need advise. Please do not count this rating.	I am able to integrate a variety of tools, systems and users through WASP	new-question-five	3	5
Please refer to answer before (wording adjustments). May be also a stringent use of a language without mixing different ones up would help increase the usability. We can support for the english - german translations.	The control panel is easy to view and understand	new-question-five	4	5
Generally true, but some adoptions in regards to the wording (to get a little bit away from the very technical wording to a more supply chain related wording) would increase the usability at this point.	I can get a holistic overview of distributed activities within the control panel	new-question-five	4	5
The judgement in regards to this questions clearly depends on the expectations on user side. As we can imagine that a high level of intuitively is generally expected, this rating is "3". We can also imagine, that there are users that are experienced with these kind of tools and especially BPMN, and they would most probably rate "4". As we judge this user group as minor, the overall rating is "3".	I can intuitively find my way around in the WASP user interface	new-question-five	3	5
	WASP offers adequate security and privacy to users and their activities	new-question-five	4	5
	Adding new services to the WASP Market Place is easy	new-question-five	4	5
	WASP offers useful functionality for managing distributed activities in my domain	new-question-five	4	5
Without knowing the exact opportunities with state of the art ERP systems I would agree to this statement. Supplier tracking mostly is done with own platforms (e.g. large Aircraft OEMs or other first tier suppliers). However, their platforms are restricted to them as customers and their suppliers. The WASP tool is more open in this sense. Also we want to highlight that although there is a certain complexity of the tool, it also offers a large numbers of functionalities. This flexibility could be a unique feature.	WASP offers new functionality that is not available in any tool that I know	new-question-five	4	5
	I am able to keep a record of distributed activities that take place within the processes	new-question-five	4	5
	I am able to monitor running processes and keep track of distributed activities that take place within the supply chain	new-question-five	4	5
	I can execute and manage the processes to gain improved visibility of distributed activities	new-question-five	4	5
Setting up basic processes was due to the variety of functions and editable parameters not easy. Here the help of the developers was necessary. To avoid this in the future, it would make sense to describe in a "manual" the different steps from creating a process until starting process instances and fill information in. It would be helpful to add screenshots with explanations.	I can easily design processes and associate (automated and manual) services with different tasks	new-question-five	3	5
Once the agreed changes are implemented, we will recommend the tool.	I will recommend this tool to the contacts in my business network	new-question-five	4	5
	The interfaces of the tool provided adequate information about the purpose and functions of the tool	new-question-five	4	5
The more discussions and communication between the partners evolved, the more confidence was present on user side. Although this is very positive, it also showed that user guidance is necessary due to the complexity of the tool. As mentioned before, proper guidance material must be created to allow working with the tool without the need to contact technical partners.	I felt confident and comfortable using this tool	new-question-five	4	5
Throughout the development process both partners documented their work in comprehensive documents, so that at each point everybody involved knew the current development status. The documentation and instructions to use the tool were explained in several video meetings. Valuable feedback was generated. This should be transferred in a comprehensive manual to support users to directly work with the tool with proper guidance.	The documentation and instruction were easy to understand and follow	new-question-five	4	5
	The use of this tool allows to efficiently monitor the distributed activities taking place in our processes	new-question-five	4	5
As already stated before, there is some initial training needed at the beginning/the first time working with the tool. As not all functions (and where they are available - their visibility) are directly clear, the rating is here "3". As the user interface will be improved at some points, which is already agreed, the rating is here "4" considering these changes already.	My feel confident that my partners will find it easy to work with this tool	new-question-five	4	5
Main interface here is the use of BPMN, which gives the possibility to import and export data from other sources using the same notation. This gives the advantage for users, that are experienced already with this standard, to work with the tool right away.	The interfaces of the tool provided adequate information about the purpose and functions of the tool	new-question-five	4	5
Setting up basic processes was due to the variety of functions and editable parameters not easy. Here the help of the developers was necessary. To avoid this in the future, it would make sense to describe in a "manual" the different steps from creating a process until starting process instances and fill information in. It would be helpful to add screenshots with explanations. Also right from the beginning without the help of the developers it was not clear right away at which menu point ("Designer", "Control Panel", "My Tasks") which functions were available.	I am able to complete most of the requirements & scenarios without needing developers help	new-question-five	3	5
Functions are properly usable. The visibility of them, especially their specific intended purposes, could be increased. We could imagine that a change in the wording (e.g. change "Process Instance" to "Project" and similar). One function could be implemented: For the users only the task, to which they are assigned, are visible. Maybe for new process instances the user could define general viewing access for the parties that are part of the specific process instances (e.g. suppliers/customer contact persons). Generally the emailing function will extended, so that direct user input (e.g. from suppliers) is possible in the tool. This is an important function which is currently not available. However, as it is planned to be implemented, and all promised changes have been incorporated in the past, this is considered as "already implemented" for this rating.	The functions and capabilities of the tool are properly visible and usable	new-question-five	4	5
In general, the menu structure of the tool is very structured. Nevertheless, it requires a bit of training and habituation to understand the tool. However, this is also due to the high flexibility of the tool, which is offered to the user: Almost all existing parameters can be edited, which on the one hand leads to a large number of setting options, but on the other hand makes the operation a bit more difficult. In the current version, the rating would be a "3". However, since optimizations are still being made that have already been coordinated between the partners, and all other changes have been reliably incorporated in the past, a "4" is awarded here in this sense.	Overall, I am satisfied with how easy it was to use the tool	new-question-five	4	5

Figure 117: Exemplary filled Questionnaire for the WASP solution for supply chain transparency

5.2.8 Efficient Resources – Industreweb Collect, Factory Connector, AI Vision Service

The questionnaire for the Resource Management solution regarding user feedback is documented below. The detailed responses were summarised and generalised in the lessons learned sections of the respective user story that uses this solution (refer to chapter 3.3.3.7).

Response	Question	Question Type	User Score	Total Score
Yes.	I feel this technology could be applied to other business processes	new-question-five	4	5
Yes, due to clear LED indication to give user feedback.	The solution guides the operator clearly on using the process in a safe manner	new-question-five	5	5
Answered in the sense of "identification of other potential applications that bring added value"	Adapting the solution to visually detect my business resource / asset was achieved quickly	new-question-five	4	5
Not sure what this question means. If it is in the sense of "added value in other but similar applications": yes, this solution could be adapted to for example the detection of staff per room/working times at specific machines/access authorization etc. However, private data regulations are standing against these potential other application.	The solution could be adapted to detect my specific business resource / asset?	new-question-five	3	5
Currently in development, but it is planned to have at least the following process events: Workload/utilization of the spray booth; Duration of real paint job; Air pressure value over time	The solution allows me to capture and store process events for later analysis	new-question-five	4	5
The tool improves our work flow, secures that our staff wears the PPE (protective equipment) and allows us to gain and visualize data that might be helpful to detect further needs for optimization.	The solution has provided a significant improvement to my production process	new-question-five	4	0
It is a good opportunity to advertise for the own capabilities	I will recommend this tool to the contacts in my business network	new-question-five	4	5
The confidence in regards to installation/configuration grew with the realization that the implementation is also possible for us as non-electric-experienced people due to the good support of parter C2K. However, there was a certain point where we had to decide that external support is needed (external electrician), which is due to high voltage wiring, which might have an impact on the insurance side. For later industrial applications in other companies of similar use cases there should be manuals available that helps the companies to understand what the tool provides, how it is done, where the GUI etc. are available and what can be monitored, which expectation are present in regards to the existing infrastructure and the staff that must install the tool etc.	I found the tool was easy to install/configure/execute	new-question-five	4	5
The purpose and function of the tool was defined together with us, so it was pretty clear to us right from the beginning.	The interfaces of the tool provided adequate information about the purpose and functions of the tool	new-question-five	5	5
For installation: the confidence grew with the realization that the implementation is also possible for us as non-electric-experienced people due to the good support of parter C2K. However, there was a certain point where we had to decide that external support is needed (external electrician), which is due to high voltage wiring, which might have an impact on the insurance side. For using the tool during all day work: our staff is keen to use the camera detection as we integrated the needed steps well in the existing work flows.	I felt confident and comfortable using this tool	new-question-five	5	5
The documentation was mainly a wiring diagram and email/phone instructions. For later similar industrial applications of this use case there should be a more overall "technical instructions/manual", which summarizes in one document what steps are needed, what should be checked in regards to the staff qualification (to decide whether external support is needed) and in regards to the existing infrastructure.	The documentation and instruction were easy to understand and follow	new-question-five	4	5
This is only possible for troubleshooting in regards to hardware/wiring, but not for the programmed software. Herefore developers help is needed, but as a remote connection is in place help is provided quickly.	I am able to complete tasks & scenarios without needing developers help	new-question-five	3	5
As the definition of the required functions/indications was defined closely between both partners the end result is fully in line with the requirements.	The functions and capabilities of the tool are properly visible and usable	new-question-five	5	5
Installation was well guided with close cooperation and great responsiveness on both sides. Hardware installation was also possible for non-electric-experienced staff (only for the high voltage wiring external electrician was used).	Overall, I am satisfied with how easy it was to use the tool	new-question-five	4	0

Figure 118: Exemplary filled questionnaire for the resource management solution

5.2.9 Stock Level Management Solution – Factory Connector and ROAM Tool

The questionnaire for the Store Management solution regarding user feedback is documented below. The detailed responses were summarised and generalised in the lessons learned sections of the respective user story that uses this solution (refer to chapter 3.3.4.7).

Responses	Questions	Question Type	User Score	Total Score
	I feel this technology could be applied to other business processes	new-question-five	5	5
I needed short consultation with the developer to fully understand all functionalities.	The ROAM tool interface is intuitive and its functionalities are easy to use	new-question-five	4	5
	The MQTT functionality of the ROAM tool provides me with the right output and notifications	new-question-five	5	5
	It is easy to configure recipes and workflows in the ROAM tool interface for my use case	new-question-five	5	5
	The solution allows me to monitor changes in my process and send the events to other tools for processing	new-question-five	5	5
	The solution was easily adapted to monitor my specific business resource / asset?	new-question-five	5	5
	I will recommend this tool to the contacts in my business network	new-question-five	5	5
I needed short consultation with the developer to understand how to configure the tool my needs.	I found the tool was easy to install/configure/execute	new-question-five	4	5
	The interfaces of the tool provided adequate information about the purpose and functions of the tool	new-question-five	4	5
	I felt confident and comfortable using this tool	new-question-five	5	5
It was not fully understandable to me. But it must be said, that I only had a very short time to deal with the documentation	The documentation and instruction were easy to understand and follow	new-question-five	4	5
At the first time I needed help by the developer	I am able to complete tasks & scenarios without needing developers help	new-question-five	4	5
If you want to change data of your recipes or workflows, the usability for people with low IT / programming knowledge could be a bit more detailed	The functions and capabilities of the tool are properly visible and usable	new-question-five	4	5
	Overall, I am satisfied with how easy it was to use the tool	new-question-five	5	5

Figure 119: Filled questionnaire for the Stock Monitoring Solution

6 Annexe B: History

Document History	
Versions	V0.1: <ul style="list-style-type: none">• Document setup and draft Table of Contents
	V0.2: <ul style="list-style-type: none">• First draft version
	V0.3: <ul style="list-style-type: none">• Final draft
	V0.4 <ul style="list-style-type: none">• First internal review
	V0.5 <ul style="list-style-type: none">• Second internal review
	V1.0 <ul style="list-style-type: none">• Final deliverable
Contributions	all WP9 partners