Deliverable 2.8. iPRODUCE Social Manufacturing Vision and Reference Model 3

CERTH

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Abstract	D2.8 presents the outcomes of Task 2.5 – Social Manufacturing Reference Model and Framework Evolution. Building upon previous deliverables D2.7 and D2.6, this document provides an updated and final version of the project's vision. It encompasses the progress made in understanding stakeholders' requirements, evaluating the collaborative manufacturing facilities, and enhancing the user flow within the OpIS platform. The deliverable showcases the building blocks and operational performance of the OpIS platform within the social manufacturing framework.

DELIVERABLE HISTORY			
Date	**Version**	**Author/ Contributor/ Reviewer**	**Summary of main changes**
20/04/2023	V0.1	T. Restas (CERTH), T. Kontodina (CERTH). C. Tsotakis (CERTH)	Initial version (ToC)
20/06/2023	V0.2	T. Restas (CERTH), T. Kontodina (CERTH). C. Tsotakis (CERTH)	Draft version
21/06/2023	V0.3	I. Fróes (CBS) B. Carvalho (CBS)	Peer/Internal Review
22/06/2023	V0.4	T. Restas (CERTH), T. Kontodina (CERTH). C. Tsotakis (CERTH)	Integrated version including modifications and adjustments based on peer review
22/06/2023	V0.5	I. Fróes (CBS) B. Carvalho (CBS)	Second peer/internal review
23/06/2023	V0.6	T. Restas (CERTH), T. Kontodina (CERTH). C. Tsotakis (CERTH)	Final version for submission

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PP	Restricted to other programme participants (including the EC services)	
RE	Restricted to a group specified by the consortium (including the EC services)	
CO	Confidential, only for the members of the consortium (including the EC)	

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iPRODUCE ● Grant Agreement: 870037 ● Innovation Action ● 2020 – 2023 | Duration: 42 months

Topic: DT-FOF-05-2019: Open Innovation for collaborative production engineering (IA)

Executive Summary

This document, D2.8 – IPRODUCE Social Manufacturing Vision and Reference Model 3, is a deliverable within the iPRODUCE project, which has received funding from the European Commission's Directorate-General for Research and Innovation under the Horizon 2020 Research and Innovation Programme (H2020). It provides a summary of the outcomes achieved throughout the project and reported in M42 in WP2, specifically focusing on Task 2.5 – Social Manufacturing Reference Model and Framework Evolution.

Drawing on the groundwork established in earlier deliverables, including D2.7 (M18) and D2.6 (M9), this document represents the final updated rendition of D2.7, with completion scheduled for M42. It encompasses the continuous progress and evolution of iPRODUCE's vision for social manufacturing in the consumer goods sectors at a European level. The preceding deliverables included a comprehensive review of the main EU survey, aiming to understand stakeholders' requirements and barriers when engaging with the platform. Additionally, an analysis was conducted in earlier versions to assess the federated structure of collaborative Manufacturing Demonstration Facilities (cMDFs) and their governance principles. The two preceding versions of the deliverables also presented a comprehensive overview of the user flow within the Open Innovation Space (OpIS) platform, addressing identified gaps and missing functionalities based on pilot use cases. This work laid the foundation for the current deliverable, D2.8, which displays the developed software building blocks of the OpIS platform, highlighting their operational performance within the social manufacturing framework.

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1. Introduction

1.1. Scope and objectives of the deliverable

iPRODUCE is a social manufacturing platform that enables user-driven open innovation and co-creation. It facilitates secure data sharing, collaboration, and matchmaking through an Open Innovation Space (OpIS) supported by various digital tools. The platform is deployed in collaborative Manufacturing Demonstration Facilities (cMDFs) to form a federation of cMDFs, allowing for information and resource sharing across different entities. It includes co-creation methodologies, training toolkits, and sharing information business models to adapt organizational structures and scale collaborative production activities.

The objective of this deliverable, D2.8 – IPRODUCE Social Manufacturing Vision and Reference Model 3, is to provide an update on the two previous versions of the deliverables, D2.7 (M18) and D2.6 (M9) related to the task T2.5 – Social Manufacturing Reference Model and Framework Evolution. Within the framework of this task, the outputs from T2.1 – T2.4 have been combined and integrated to enhance and reinforce iPRODUCE's vision of Social Manufacturing in the consumer goods sector.

During the development of D2.6 and D2.7, significant progress was accomplished in multiple key domains. D2.6 focused on consolidating the outputs from previous tasks of WP2 into an all-encompassing document. It provided a comprehensive overview and detailed insights into various aspects of the social manufacturing framework, identified stakeholders and their needs, addressed business, operational, and technical challenges, and described existing methods, functions, services, and tools used in co-creation activities. Furthermore, an in-depth analysis was conducted on the cMDF social manufacturing concept. This analysis carefully examined user roles and product specifications for each specific use case, offering a holistic understanding of the social manufacturing concept within individual cMDFs. Another crucial aspect was the description of the proposed structure of local cMDFs and ecosystems. This section extensively covered multiple horizontal considerations, related to the governance principles of local cMDFs, as well as regulations, intellectual property management, data management, ethics, and occupational health and safety considerations.

In D2.7, the focus shifted to enhancing the OpIS platform and addressing the requirements and barriers identified through stakeholder assessments. Building upon the insights gained from stakeholders, the document presented a comprehensive overview of the finalized OpIS User-Flow, meticulously mapping out the interconnections among various OpIS components. This detailed analysis not only showcased the user journey within the iPRODUCE platform, but also delved into the perspectives and intentions of stakeholders, highlighting their motivations, specific requirements, and potential barriers to active engagement in social manufacturing across Europe. Taking into account these valuable insights, the document aimed to optimize the usability and effectiveness of the OpIS platform to the maximum extend possible, ensuring it caters to the diverse needs of its users and fosters a thriving social manufacturing ecosystem.

Together, these developments presented in D2.6 and D2.7 laid the groundwork for the current work of the deliverable D2.8 and enhancements within the OpIS platform. Firstly, the primary objective of this deliverable is to highlight the successful alignment of iPRODUCE with existing manufacturing reference models, promoting interoperability with other compliant platforms. Extensive consideration has been given to various aspects, including the iPRODUCE architecture, open innovation approach, local cMDFs concept, and ecosystem structure. Secondly, D2.8 seeks to address the need for a better understanding

of why yet another platform is required by presenting a comprehensive analysis. This analysis provides a detailed explanation of the scope and contents of the OpIS platform, emphasizing its unique advantages and benefits. By highlighting the advancements and clarifying the platform's value proposition, the analysis supports a better understanding of the necessity and relevance of the OpIS platform in the context of social manufacturing. While continual efforts are being made to enhance the platform further, the document acknowledges the substantial progress achieved in aligning the OpIS platform with stakeholder requirements and facilitating a more seamless user experience. The ongoing commitment to refinement and improvement underscores the dedication to meeting the evolving demands of social manufacturing and driving its continuous advancement.

1.2. Relation to other tasks and deliverables

WP2 – Business Challenge Definition for Social Manufacturing in Consumer Goods Sectors is responsible for defining the business challenges for social manufacturing in consumer goods sectors by aligning the project vision, analysing stakeholder perceptions, mapping co-creation methods, and developing a comprehensive reference model. To that end, T2.5 – Social Manufacturing Reference Model and Framework Evolution is closely linked to the other four tasks of WP2. These tasks include the following: T2.1 – Users and Stakeholders Requirements, Perspectives and Motivation, T2.2 – Benchmarking Makers Approaches and Value Adding Potential in Consumers Goods Manufacturers, T2.3 – Mapping and Assessment of Co-creation and Open Innovation Methods, Tools and Practices, and T2.4 – Defining the Local Collaborative MDFs, Use-Cases, Innovation Challenges and KPIs.

1.3. Structure of the deliverable

This deliverable is structured into five sections, providing a comprehensive overview of the Social Manufacturing Framework and the OpIS platform. **Section 1** serves as an introduction, while **Section 2** offers a summary of the framework, highlighting the role of the collaborative Manufacturing Demonstration Facilities (cMDFs), and the use case scenarios developed within the iPRODUCE project. **Section 3** includes the key components and policies related to iPRODUCE's Social Manufacturing Framework, providing a summary of federation, governance principles, intellectual property management, data management policies and health and safety issues that have been addressed. **Section 4** titled "Holistic View of the OpIS User Flow" delves into the user experience and navigation within the OpIS platform. **Section 5** focuses on the scope and the contents of the OpIS platform, detailing its features and functionalities. Finally, **Section 6**concludes the deliverable, summarizing the key findings and insights.

2. Social Manufacturing Framework

The following subsections provide a comprehensive summary and in-depth analysis of the main aspects that were previously presented in D2.6 and D2.7, highlighting the key findings, developments, and insights gained from these deliverables. These subsections serve as a valuable reference, allowing for a deeper understanding of the progress made and the evolution of concepts, methodologies, and tools within the iPRODUCE project's social manufacturing framework.

2.1. Social Manufacturing Framework Overview

Within the iPRODUCE project's Social Manufacturing Framework, the OpIS platform serves as a vital component for facilitating co-creation and co-design activities. Through the evaluation of stakeholder's perceptions and needs, key insights were gained (performed in D2.6), directly influencing the functionality of the OpIS platform. A notable finding arising from this evaluation underscored the importance of intuitive and user-friendly digital cooperation tools. Recognizing their critical role in the success of the OpIS platform, significant efforts were invested in designing interfaces and incorporating features that enhance digital co-creation and co-production processes. Moreover, the platform's unified nature accommodates diverse partners with their individual tools, allowing for both independent use and seamless integration within the unified platform. The OpIS platform includes a range of tools, such as the Marketplace, Matchmaking Tool, IPR Authoring Tool, AR/VR Toolkit, Mobile App, Generative Design Platform, Agile Data Analytics & Visualization Suite, and Digital Fablab Kit, which have been developed to support these collaborative activities and promote seamless interaction among users, as presented in the figure below (Figure 1).

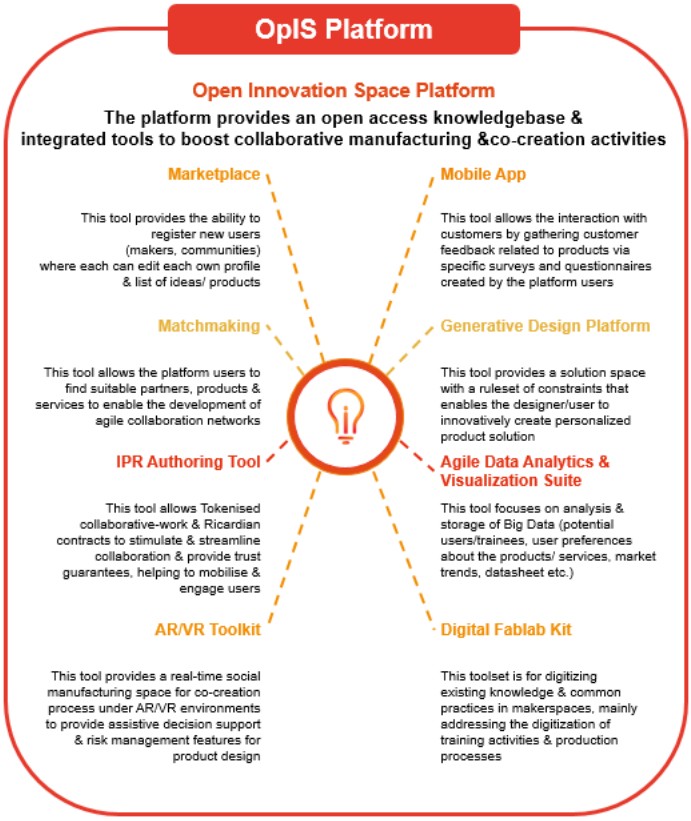

Figure 1 OpIS platform main tools

Furthermore, the evaluation placed a strong emphasis on the importance of inclusivity and diversity within the social manufacturing ecosystem, as highlighted by the surveys conducted during M9 and presented in detail in D2.6. Recognizing that certain groups were underrepresented, specific measures were identified and implemented to address this issue. For instance, one notable measure was the development of an inclusive digital space with an intuitive interface that considered various cultural and language contexts. This approach, justified by extensive testing (WP9) involving individuals from diverse backgrounds, ensured that users from various cultural, linguistic, and social contexts could effectively engage with the platform and actively participate in social manufacturing activities. Additionally, training and mentorship programs were identified as crucial elements for empowering users to enhance their knowledge and skills in social manufacturing.

The OpIS platform also seeks to foster participation, collaboration, and networking among makerspaces and individuals. Matchmaking services and the establishment of professional networks were highlighted as integral for connecting manufacturers, consumers, and other stakeholders. To facilitate this, the platform offers features to allow users to create profiles, join online communities, and facilitate team creation. Additionally, the inclusion of tools like the IPR Authoring Tool reinforces collaboration, while ensuring the protection of intellectual property.

Overall, the evaluation of stakeholders' perceptions and needs played a pivotal role in guiding the development of the OpIS platform. It prioritized the creation of intuitive tools, opportunities for participation, and features that promote team creation. By striving to establish an inclusive and collaborative environment for social manufacturing activities, the platform enables users to engage in co-creation, networking, and the exchange of knowledge.

2.2. Collaborative Manufacturing Demonstration Facilities (cMDFs)

Collective Manufacturing Demonstration Facilities (cMDFs) are an integral part of the iPRODUCE project's ecosystem. These facilities consist of a group of geographically proximate firms that engage in vertical and horizontal relationships, fostering collaboration and competition within a specific market. They also provide open access to manufacturing and production capabilities for the public. The cMDFs are characterized by a common set of work procedures, activity plans, and branding, and user information is available through the project's components, such as Marketplace Profiles. Local partnerships play a crucial role in supporting collaboration within and between cMDFs, enabling user engagement, co-creation, validation, and training.

The iPRODUCE initiative is built upon the concept of local "ecosystems" that include SME associations, specialists, Fablabs, and Makers' facilities. These ecosystems are interconnected and enriched through the collaboration of existing manufacturing facilities. Geographical proximity is essential, as physical interaction and engagement with the cMDFs are necessary to mobilize the creative efforts of prosumers and consumers. The identification of relevant partners who can contribute to the diversity and benefits of the ecosystem is also crucial. The iPRODUCE project utilizes the Industrial Internet Reference Architecture (IIRA) model (highlighted in the D2.6), considering both the business viewpoint, which focuses on stakeholders' commercial vision and objectives, and the usage viewpoint, which addresses expected system usage.

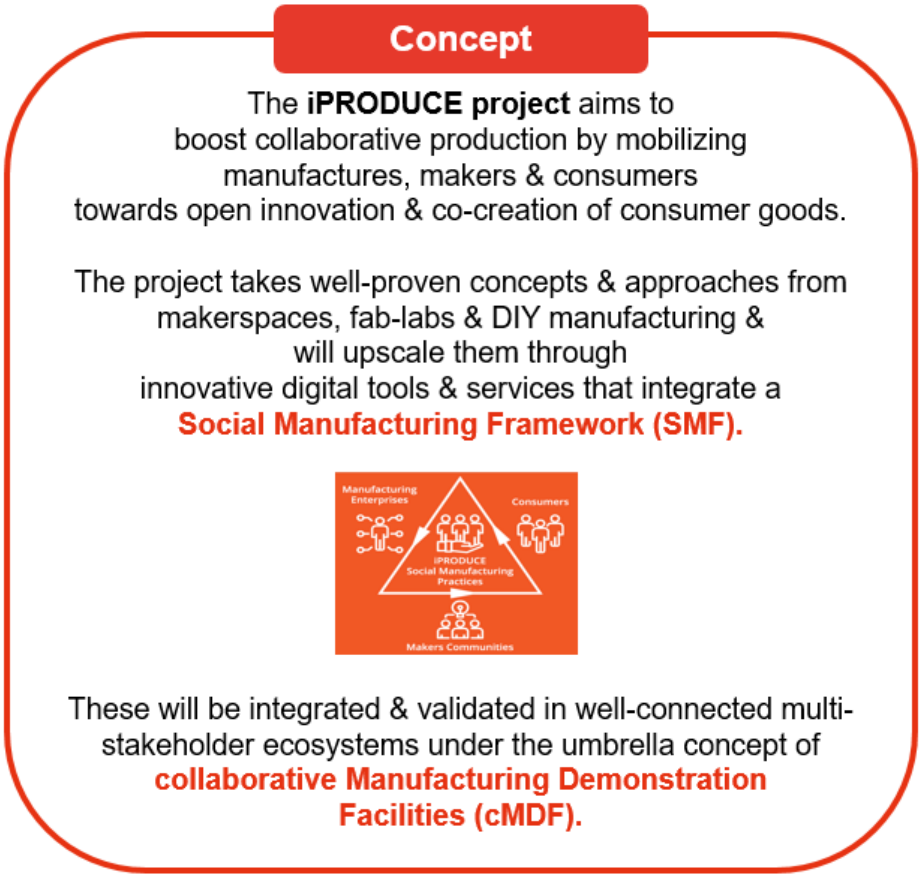

Figure 2 Concept of iPRODUCE project

2.3. iPRODUCE's CMDFs Social Manufacturing concept

The iPRODUCE project has successfully developed the OpIS digital platform, which integrates various use case scenarios from its five pilots, focusing on specific sectors, such as mobility, electronics, furniture, collaborative learning, and health. These pilots involve entities like Fablabs, companies, and research centers that utilize their knowledge to create uses cases aligned with the OpIS platform, meeting specific requirements of local ecosystems. Each cMDF, including the Spanish, German, French, Italian, and Greek, serves as a collaborative space for developing customer-driven products, strengthening relationships between SMEs and Makerspaces, enhancing accessibility to equipment, and bringing the gap between SMEs and Makerspaces. In particular, each cMDF plays a distinct role: the Spanish cMDF facilitates collaborative development of customer-driven furniture products, the German cMDF strengthens relationships between SMEs and Makerspaces, the French cMDF enhances accessibility to FabLab equipment, the Italian cMDF supports design and realization of IoT mechatronics appliances, and the Greek cMDF bridges the gap between SMEs and Makerspaces in the medical and 3D printing sectors. By integrating these diverse scenarios, the OpIS platform facilitates co-creation, connects stakeholders, and provides tailored support to meet industry needs, fostering collaboration, innovation, and addressing industry-specific needs with a dynamic and supportive environment.

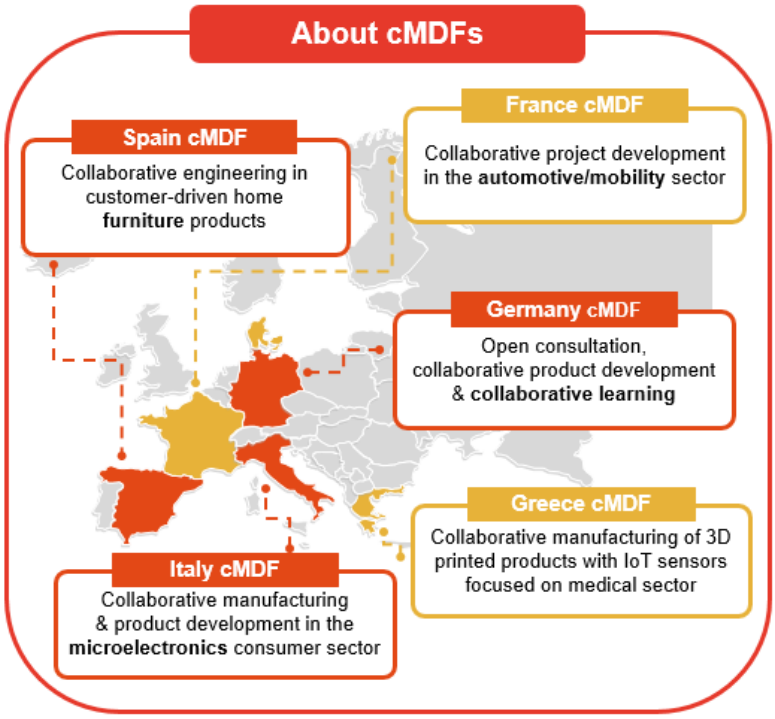

Figure 3 cMDFs' Role in the iPRODUCE project

The organization structure and the local ecosystem of each cMDF are visually depicted in the following figures, providing a comprehensive overview of their operational framework.

The founding members regarding the Spanish cMDF are AIDIMME, VLC Oceano naranja and LAGRAMA, including also their local ecosystem with signed NDA members as presented in Figure 4.

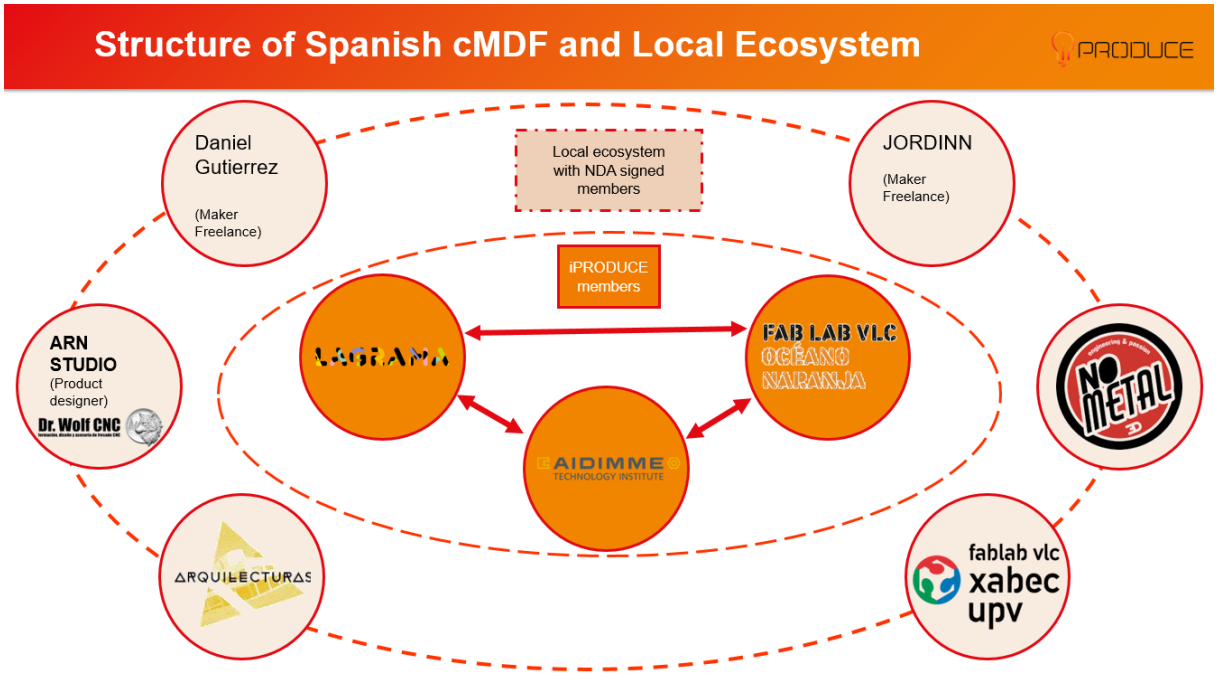

Figure 4 Structure of the Spanish cMDF and their local ecosystem

The founding members regarding the German cMDF are ZENIT GmbH, Fraunhofer FIT and Makerspace Bonn, including also their local ecosystem with signed NDA members as presented in Figure 5.

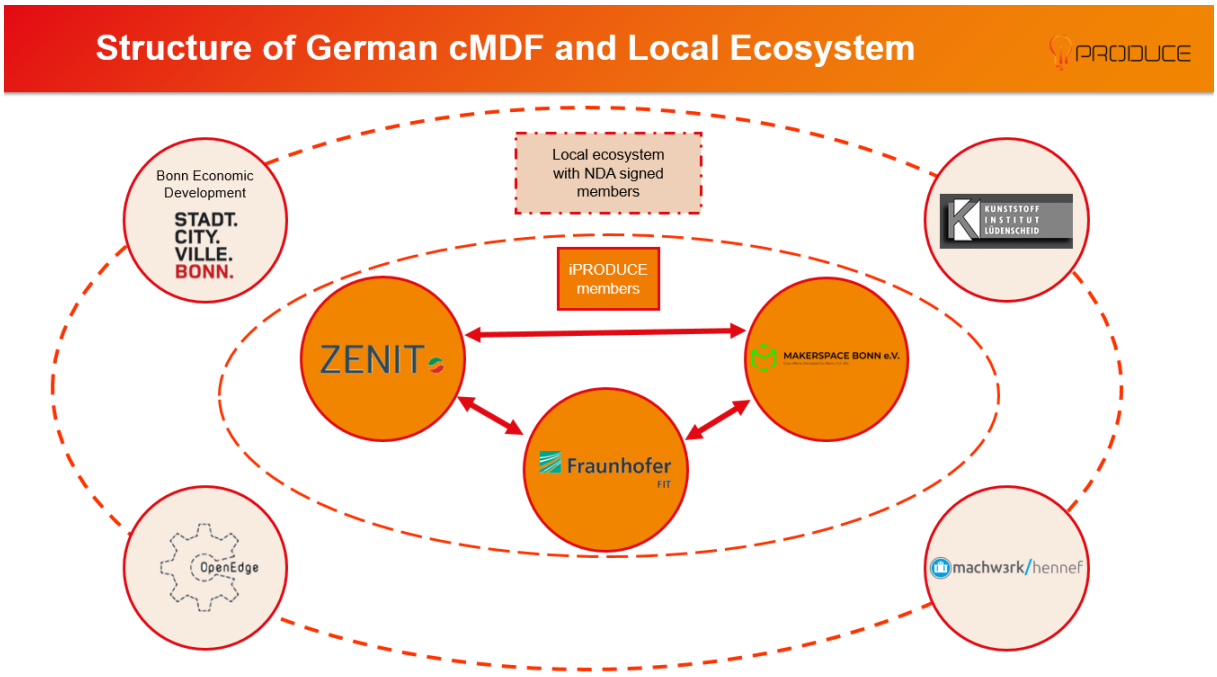

Figure 5 Structure of the German cMDF and their local ecosystem

The founding members regarding the French cMDF are Materalia, Excelcar, FABLAB Vosgues, including also their local ecosystem with signed NDA members as presented in Figure 6.

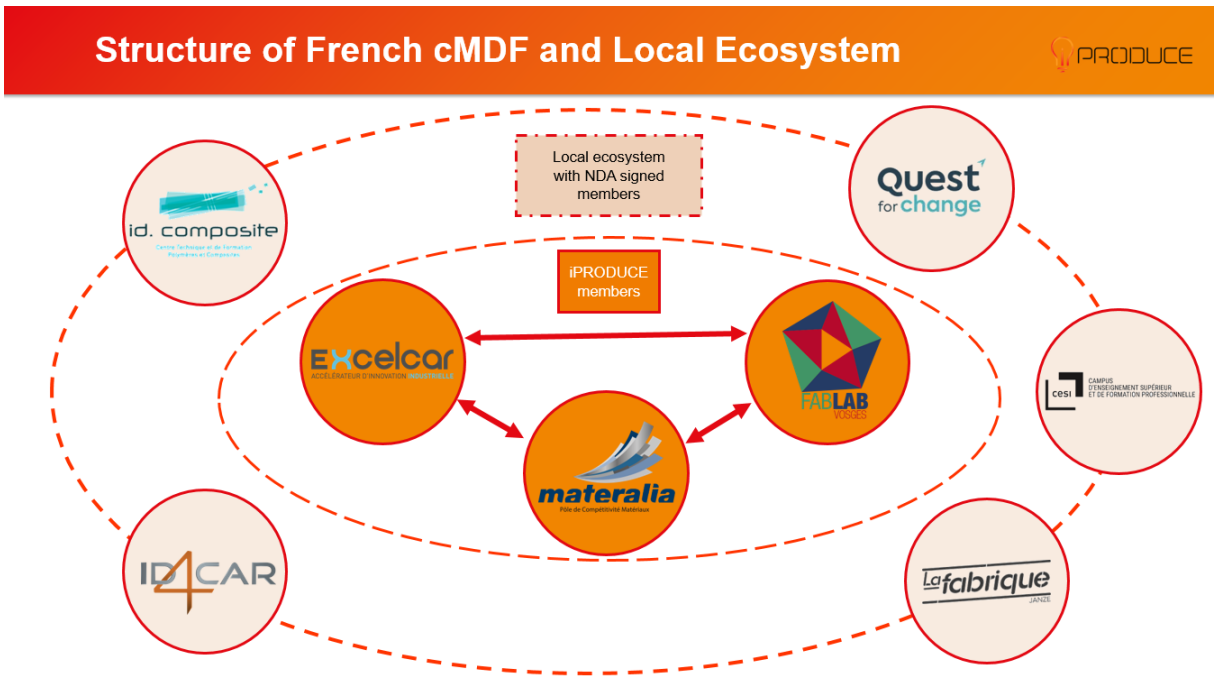

Figure 6 Structure of the French cMDF and their local ecosystem

The founding members of the Italian cMDF are Trentino Sviluppo (with its Facility named ProM), Hub Innovazione Trentino ("HIT") and Energy@Work, including also their local ecosystem with signed NDA members as presented in Figure 7.

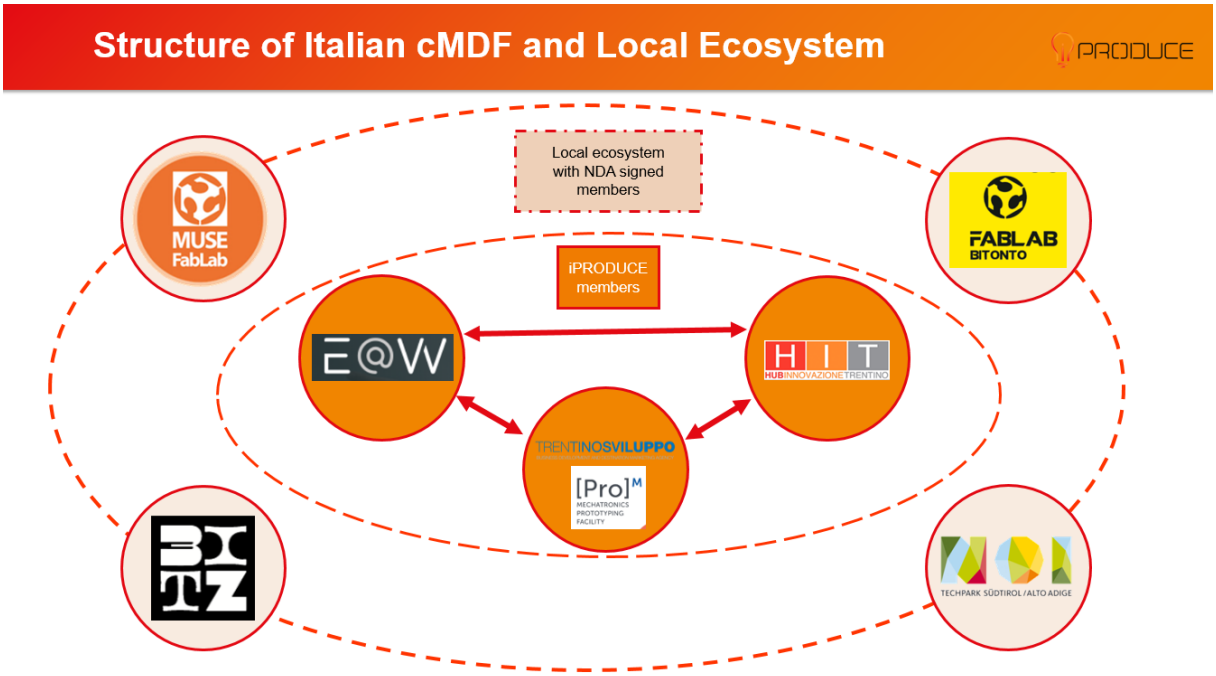

Figure 7 Structure of the Italian cMDF and their local ecosystem

The founding members of iPRODUCE project, regarding the Greek cMDF, are CERTH and AidPlex. And the local ecosystem with NDA signed members are: the INAB (Institute of Applied Biosciences) and the American Farm School, the RACHIS Spine Center, OK!Thess (start-up hub) and two vets, as presented in Figure 8.

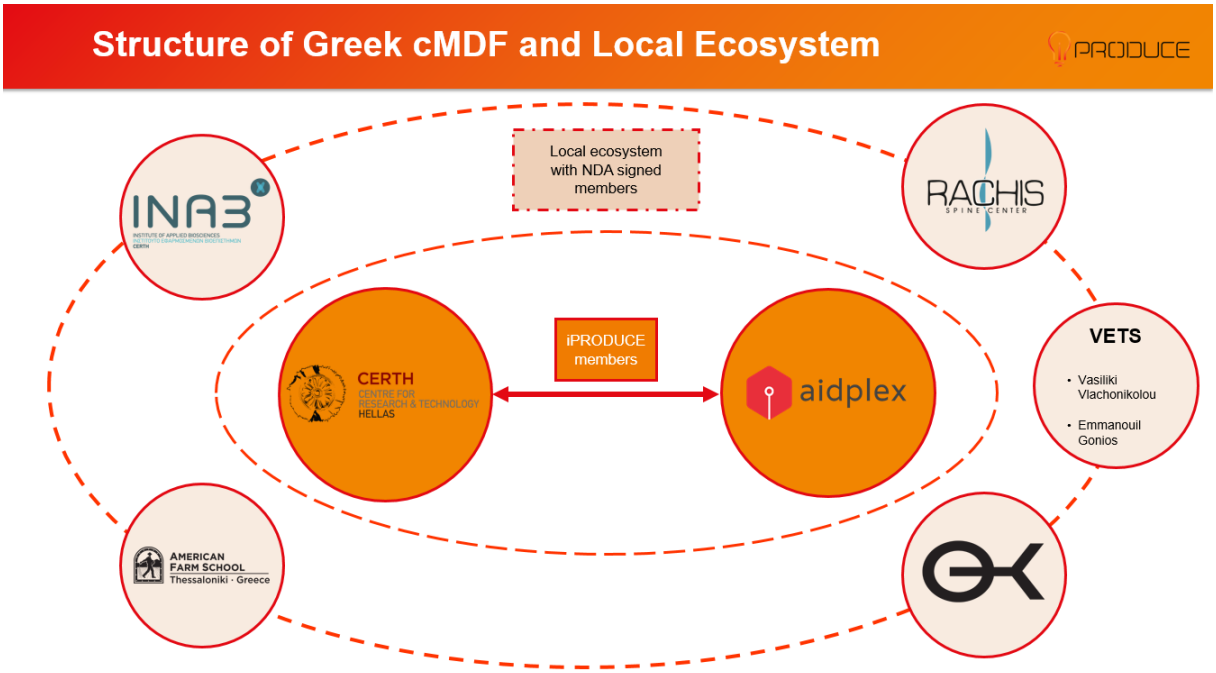

Figure 8 Structure of the Greek cMDF and their local ecosystem

2.4. CMDFs Use Cases Scenarios

A detailed table presents the use case scenarios of each cMDF, accompanied by brief descriptions and the corresponding sectors they belong to accordingly. This representation offers a concise overview of the diverse application scenarios within each cMDF.

Table 1 Use Case Scenarios per cMDF.

cMDF	Use Case Scenarios No.	Description	Sector
Spain	UC1	Intelligent Headboard	Furniture
Spain	UC2	Smart Adjustable Gamer Chair	Furniture
Spain	UC3	3D printed Components for Assembling Customized Furniture	Furniture
German	UC1	Co-creation – Introduction for SME's	Educational
German	UC2	Machinery Training	Educational
German	UC3	Product Forge (former Guided Product Development as a Service)	Educational
German	UC4	New Skilling/MSB IoT Education Kit	Educational
German/ (Danish)	UC5	Co-creation in schools	Educational
French	UC1	Virtual tutorials	Educational
French	UC2	Urban solutions for soft or electric mobility	Automotive/ Mobility
Italian	UC1	Customer-Driven Robo-Shaker for industrial application	Microelectronics
Italian	UC2	Customer-Driven Watering System	Microelectronics
Greek	UC1	IoT – based orthopedic back brace	Medical
Greek	UC2	Splints for fractures	Medical
Greek	UC3	Splints for pets	Medical
Greek	UC4	Customized face shields	Medical
Greek	UC5	3D printed smart luminous artifacts	Medical/ Educational
Greek	UC6	3D printed (bio) scaffolds	Medical/ Educational
Spain-Italy	Inter-cMDF UC	Sofa Chair	Furniture

3. Key Components and Policies for iPRODUCE's Social Manufacturing Framework

In addition to the specific topics covered in deliverable D2.6, this subsection provides a summary of the horizontal issues addressed at a strategic level. These encompass areas such as regulations, intellectual property management, data management and ethics, and occupational health & safety concerns, particularly in relation to the micro-manufacturing infrastructure. In addition, this section provides an overview of these key aspects, highlighting the guidelines and strategies developed to address them within the iPRODUCE project.

3.1. Federation of iPRODUCE cMDF

The federation of iPRODUCE cMDFs not only optimizes operations, but also facilitates marketing and business activities. This collaborative model enables knowledge sharing, resource and production facility sharing, and access to a larger customer community. The tools developed within iPRODUCE are designed to enhance these offerings, promoting efficiency and effectiveness. The federation operates at different levels of collaboration, providing accessibility and free access to resources within the network. This includes sharing dissemination, involving members of their own ecosystem when requests are made to the other cMDFs, priority outsourcing where a cMDF becomes the main reference provider, shared jobs with mutual responsibilities and benefits and free and transparent access to all cMDF resources from other cMDFs. These opportunities for collaboration and resource sharing are accessible to the network members, which include local cMDFs, local contributors, and other stakeholders involved in the iPRODUCE platform. Additionally, the networked operation of the cMDFs allows for expanded services, such as open innovation, training on co-creation and manufacturing with standardized security and knowledge sharing mechanisms.

3.2. Governance Principles

The governance principles of the iPRODUCE platform ensure the involvement of all network members, including local cMDFs and local users who can join through adherence or registration via the Marketplace component. These governance mechanisms, which encompass user management, automation, communication, transaction management, security, privacy, and intellectual property rights protection, are integral to the self-governance model of the iPRODUCE platform. In addition to these internal governance processes, the platform also considers post-project governance issues, such as platform maintenance, implementation of new services, and technology provisions. To address these concerns the platform incorporated user-oriented policies, platform policies defining rules and trust policies, and data management policies that govern data handling, confidentiality, and compliance with regulations. Furthermore, a Hybrid Governance Model was established in WP7 (as reported on D7.3) to offer a working framework for the federated network and the management of the platform. By incorporating robust governance mechanisms and policies, the iPRODUCE platform aims to ensure the stable growth and positive outcomes of the ecosystem, while also fostering collaboration, innovation, and secure data management.

3.3. IPR Management in a Social Manufacturing Environment

The management of Intellectual Property Rights (IPRs) within iPRODUCE has been successfully implemented based on general principles aligned with H2020 IPR recommendations, as presented in

detail in D2.6. The project's consortium agreement has defined the specific rules for IPR and knowledge management, ensuring a balanced and fair strategy that protects the interests of all stakeholders. The platform now facilitates the management of IPRs, offering options for copyrights, patents, and smart contracts. Distributed Ledger Technologies (DLT) and Ricardian Contracts have been integrated into the platform, providing robust, transparent, and efficient IPR management solutions. A dedicated visual authoring tool (i.e. IPR Authoring Tool) has been developed to encode human-readable language into machine-readable language, enabling a trustworthy IPR management process within the social manufacturing environment. Through these efforts, iPRODUCE has successfully achieved its goal of establishing a comprehensive IPR management framework.

3.4. Data Management Policies

The iPRODUCE project has successfully implemented a Data Management Plan (DMP) based on the updated version of the "Guidelines on FAIR Data Management in Horizon 2020". All data within iPRODUCE adhere to the General Data Protection Regulation (GDPR) and comply with ethical rules and standards outlined in HORIZON 2020 and the Charter of Fundamental Rights of the EU. The cMDFs and OpIS platform comply with relevant directives on personal data protection and privacy. Consent procedures for pilot trials in the cMDFs were carefully designed in collaboration with the ethical helpdesk of the iPRODUCE consortium, ensuring privacy and ethical considerations are respected. The two-stage consent procedure involved oral presentations and the signing of informed consent forms in both English and the local language. These measures demonstrate iPRODUCE's commitment to data management, privacy protection, and ethical considerations in social manufacturing.

3.5. Health & Safety

Throughout its 42-month duration, the iPRODUCE project successfully addressed health and safety concerns in collaborative manufacturing. While collaborative manufacturing faces similar risks to traditional manufacturing, it lacks the same level of protection for workers. iPRODUCE implemented ad-hoc safety policies and training in Fablabs, both within and outside physical buildings, considering specific population risks. The project adhered to international, EU, and national laws such as EU Directive 89/391/EEC, ensuring minimum safety and health requirements were met. The approach to health and safety was flexible, allowing for the inclusion of new ethical or safety issues that emerged. Continuous risk assessment and updated guidelines and procedures were implemented by the cMDFs. The risk assessment covered various aspects, including workflow, health and safety conditions, equipment, and regulatory compliance. Despite the challenges posed by the COVID-19 pandemic, the iPRODUCE project complied with regulations and ensured the safety and well-being of participants and workers involved in the research activities.

4. Holistic View of the OpIS User Flow

This section presents a comprehensive overview of the user flow within the OpIS Dashboard, incorporating the use cases from the five pilots of the iPRODUCE project. By considering the shared needs and requirements of the pilots, the OpIS platform offers a unified framework to ensure a cohesive user experience. It is noteworthy to mention that according to survey reported in D9.4, the OpIS presents sufficient level of development to support iPRODUCE, yet continuous improvement in UX is advised in the initial phases of exploitation to achieve the highest level of satisfaction among internal and external users.

The OpIS Dashboard houses a collection of digital components collaboratively developed by various partners within the iPRODUCE project. These components function in synergy to support users' social manufacturing activities and facilitate collaborative design processes and information exchange.

The following components make up the OpIS platform and enable the user interaction:

- **OpIS data Repository**
- **IPR Authoring Toolkit**
- **Marketplace**
- **AR/VR Toolkit**
- **Generative Design Platform**
- **Matchmaking and Agile Network Creation Tool**
- **Mobile App**
- **Agile Data Analytics**
- **Digital Fablab Kit**

In-depth technical analyses of these tools can be found in the relevant deliverables. Here, we present a comprehensive view of how stakeholders can utilize these tools to engage within a social manufacturing framework. The following sections describe the user flow for various processes within the platform:

- **Registering user accounts and new products:** This section outlines the process of creating user accounts and registering new products on the platform.
- **Collaborating and Co-designing products with other users:** It explains how users can collaborate and engage in co-design activities with other platform users to develop innovative products.
- **Visualizing products in 3D:** This section details the capability of the platform to visualize products in three-dimensional (3D) representations, enhancing the user experience and facilitating design decisions.
- **Purchasing products:** It describes the process of purchasing products from the platform, including the steps involved in selecting, ordering, and finalizing transactions.
- **Receiving support through the Digital Fablab Kit:** This section outlines how users can access support and guidance through the Digital Fablab Kit, which provides resources and assistance for fabrication and manufacturing processes.

These sections offer a comprehensive overview of the user's journey and engagement within the platform, covering registration, collaboration, visualization, purchasing, and support aspects.

4.1. User Registration and the Marketplace

The user registration process is essential for all the Use Cases of the five pilots of the iPRODUCE project and the main starting point for providing access to all parts of the IPRODUCE ecosystem.

The OpIS Dashboard acts as the central hub where all the tools are located. Users can see it as the entry point where also the initial registration takes place.

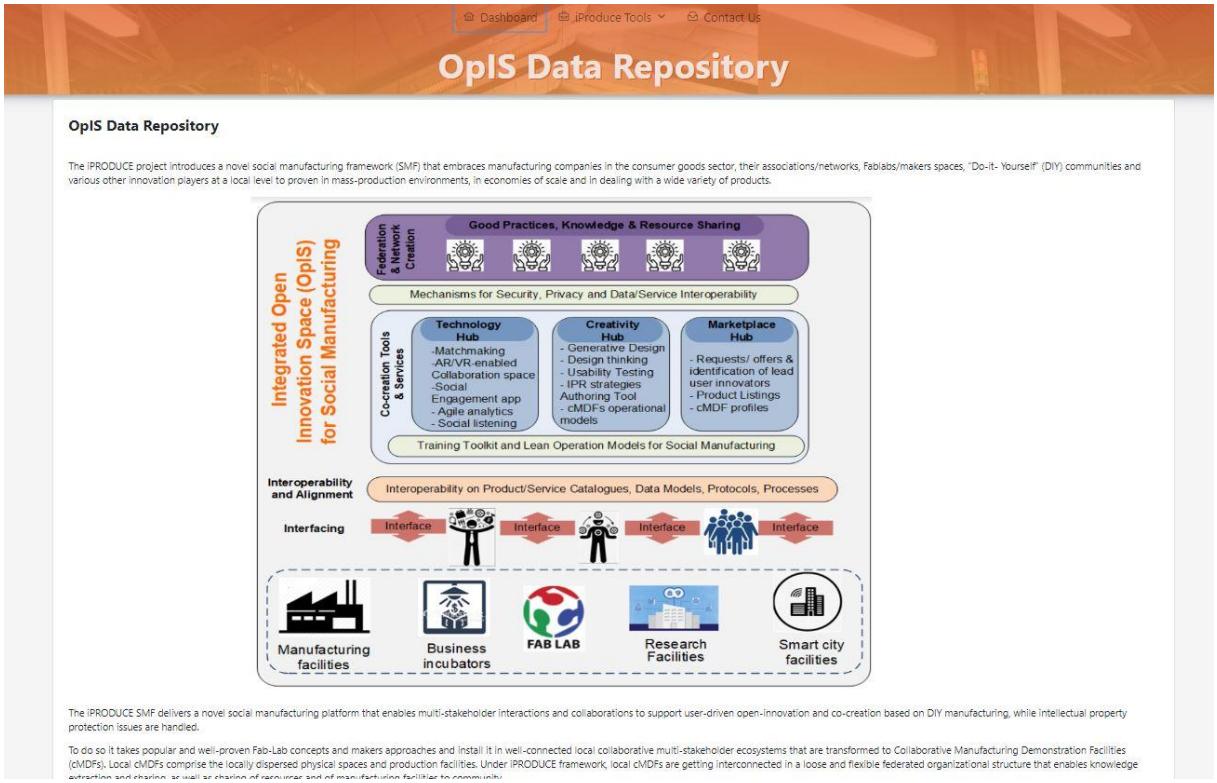

Figure 9 OpIS Dashboard

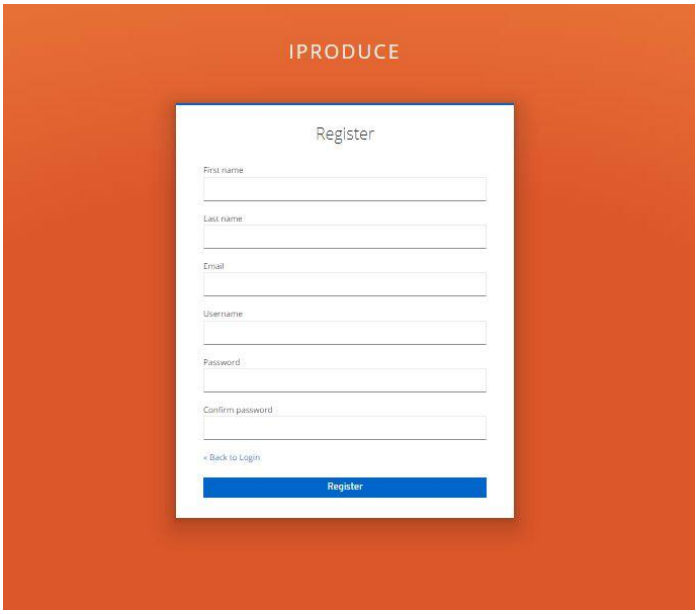

Figure 10 OpIS Dashboard Registration

Once the user is authenticated from the central OpIS Dashboard hub, they are granted access with no further authentication to the rest of the tools. All the tools have an internal page where their internals are explained accompanied with the appropriate links. The **Marketplace** can be selected through that list.

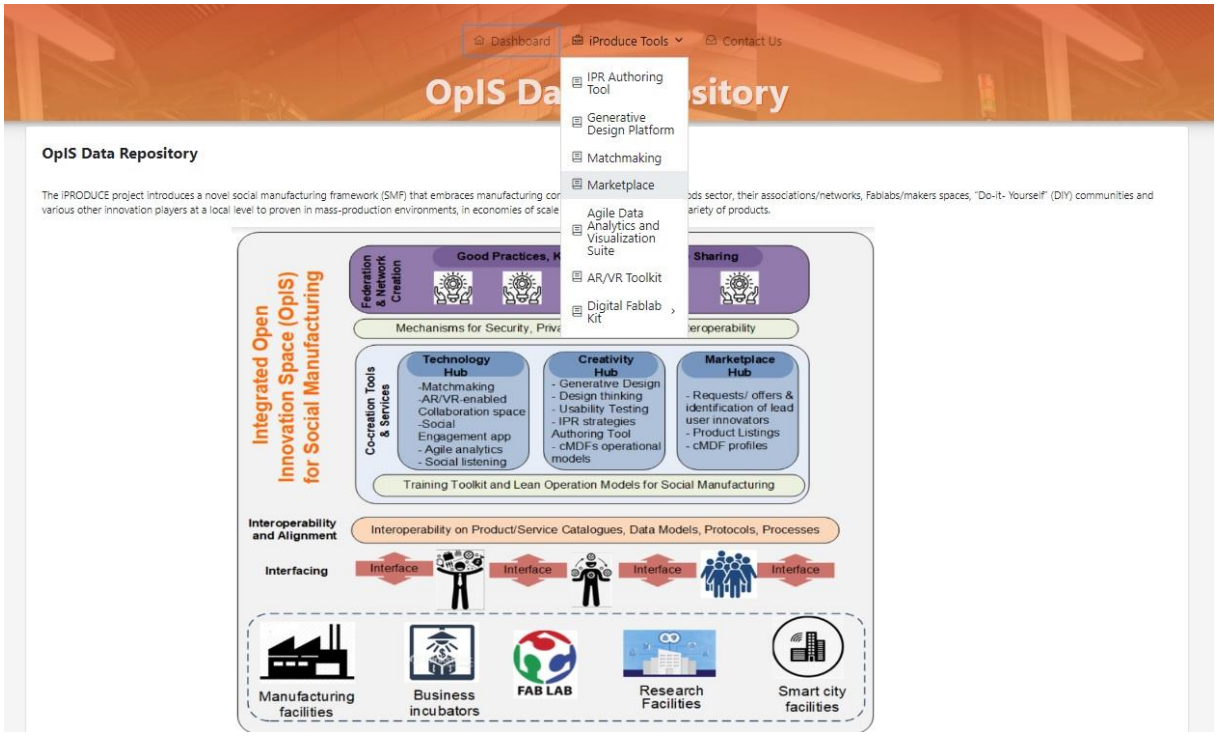

Figure 11 OpIS Dashboard Tools

Users through the **OpIS Dashboard Marketplace page** can be forwarded to the central **Marketplace** page.

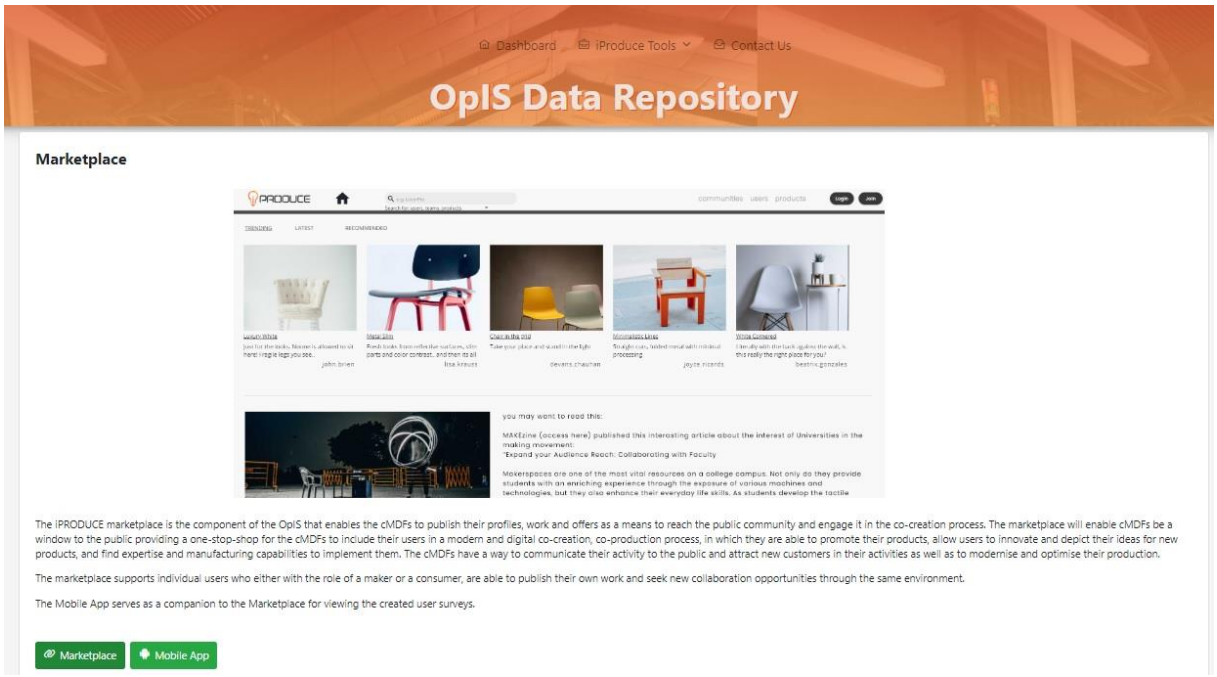

Figure 12 OpIS Dashboard Marketplace Page

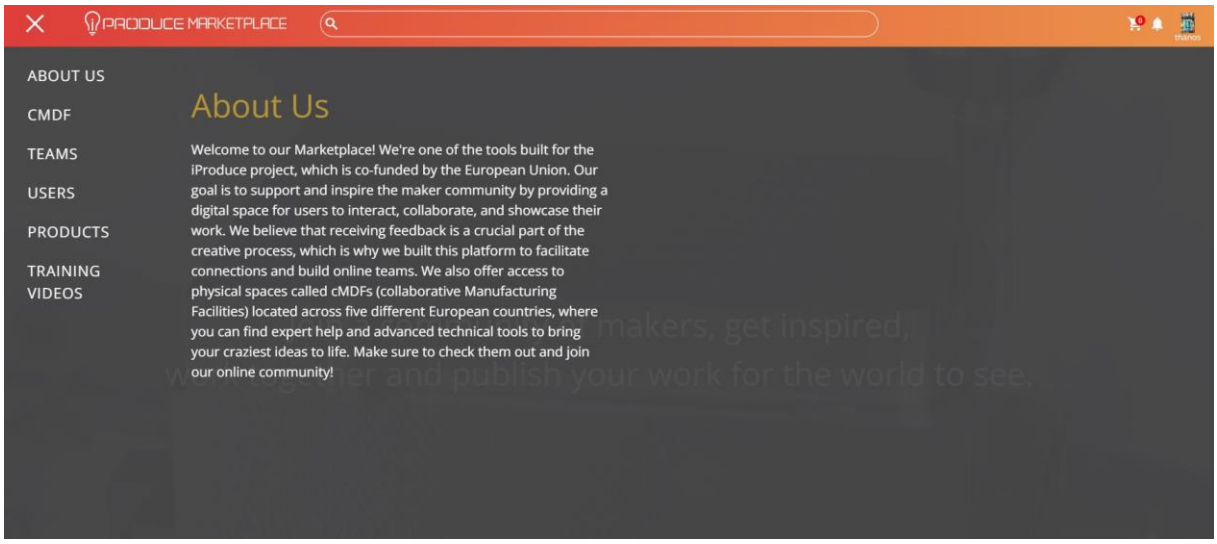

Figure 13 Marketplace Main Page

Through user elements in the interface of the Marketplace users have the ability to select among various functionalities, such as:

- **Browsing through the involved CMDFs**
- **Browsing through the registered Teams**
- **Overview of User Profiles**
- **Product registration and browsing**
- **Marketplace Training Videos viewing**

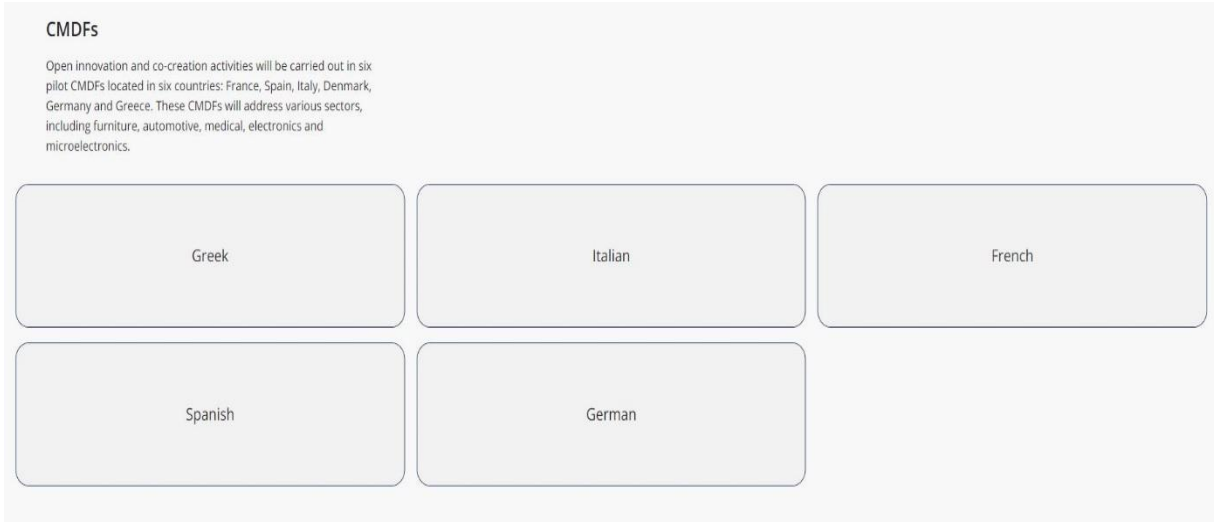

Figure 14 Marketplace cMDFs

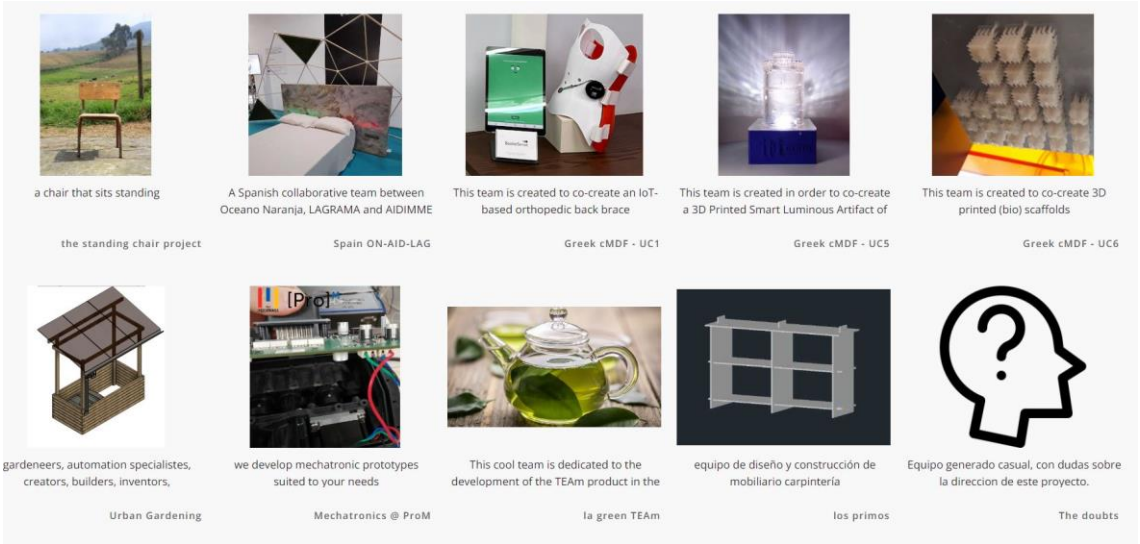

Figure 15 Marketplace Teams

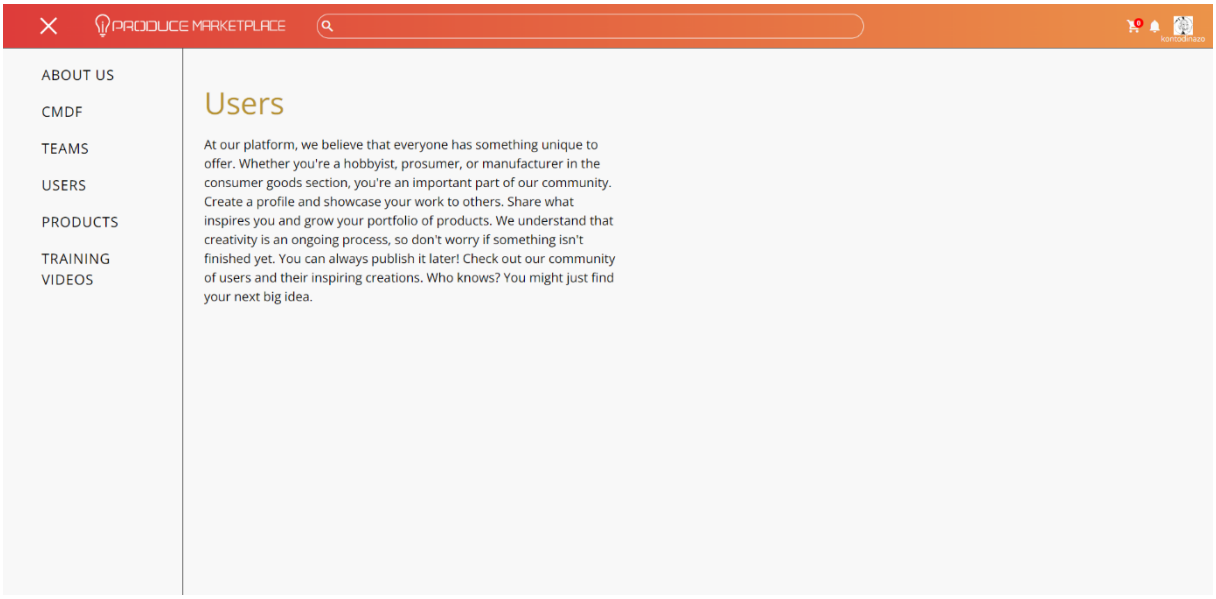

Figure 16 Marketplace Users

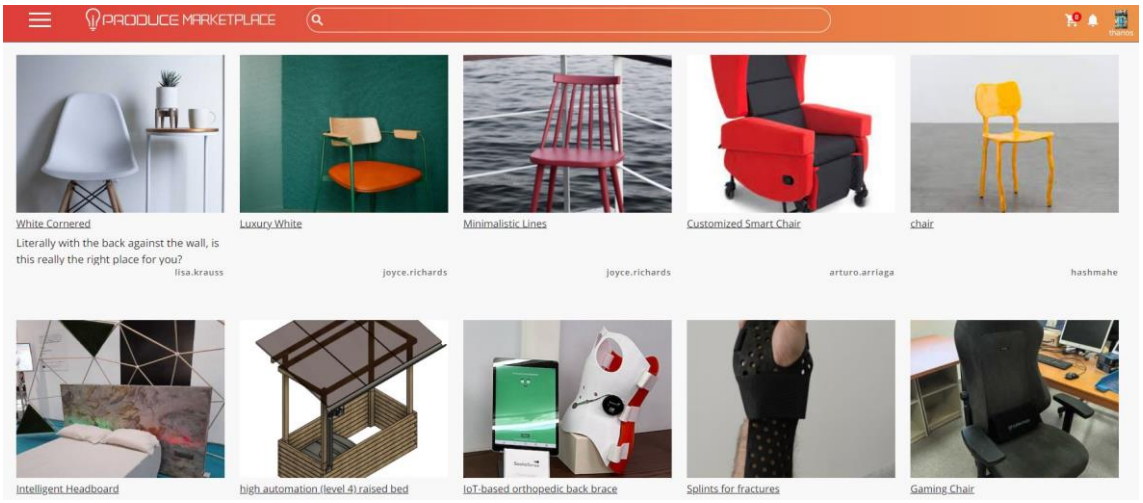

Figure 17 Marketplace Products

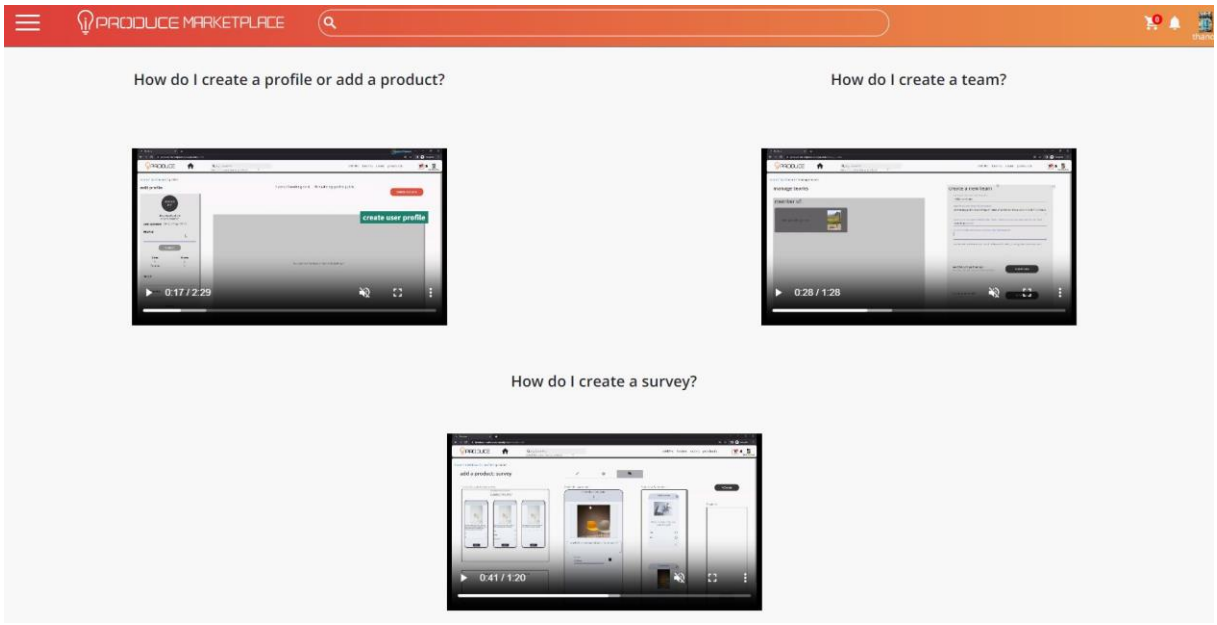

Figure 18 Marketplace Training Videos

4.2. Collaborating and Co-designing

Collaborating and co-designing are the core of the IPRODUCE platform. The creation and registration of a product through the **Marketplace** serves as the first step in the process of co-designing that leads to use of the **AR/VR Toolkit** and the **Generative Design Platform.**

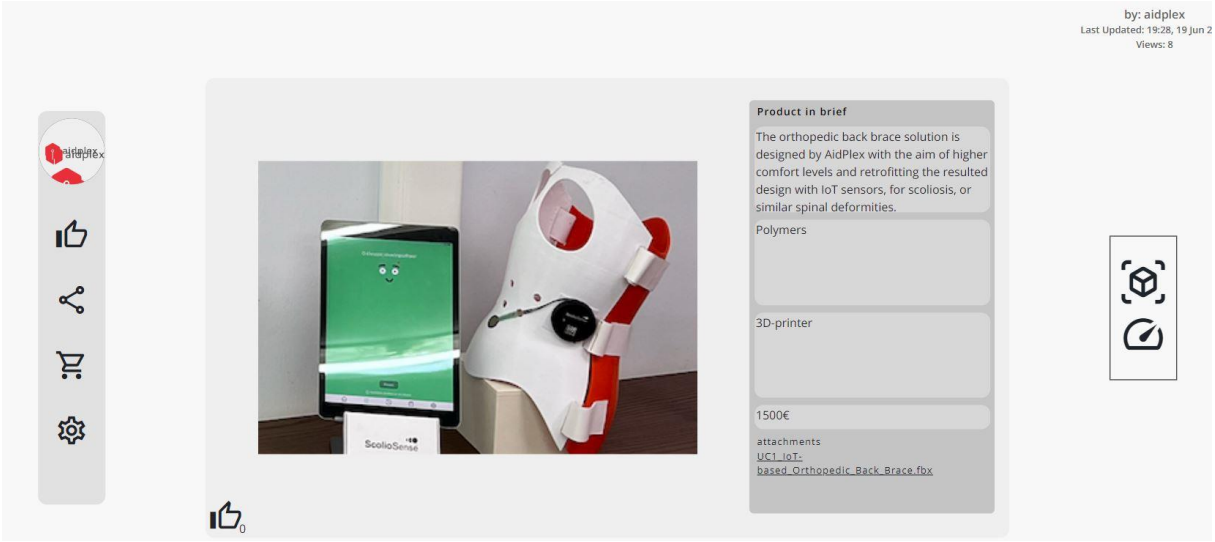

Figure 19 Marketplace Product Entry

In addition, Users can create teams from within the Marketplace to enable the collaboration procedures on product collections. This panel provides the appropriate user interface element for team management, product entry and information exchange through the interactive chat feature.

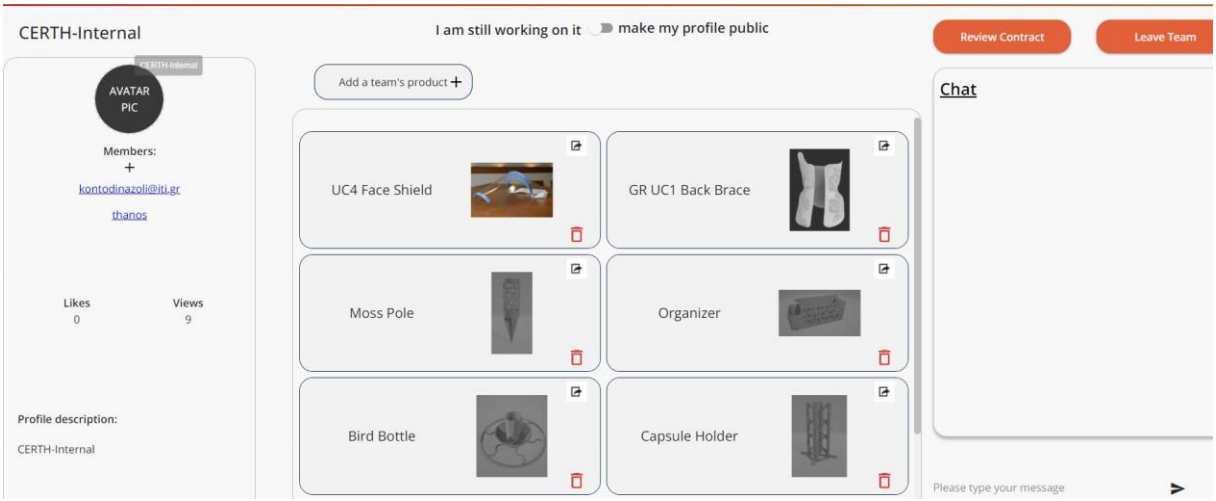

Figure 20 Marketplace Team Formation

4.2.1. Matchmaking

Users can use the interactive creation panel to create a team as well as use the matchmaking feature to find the appropriate team members searching through the registered user list.

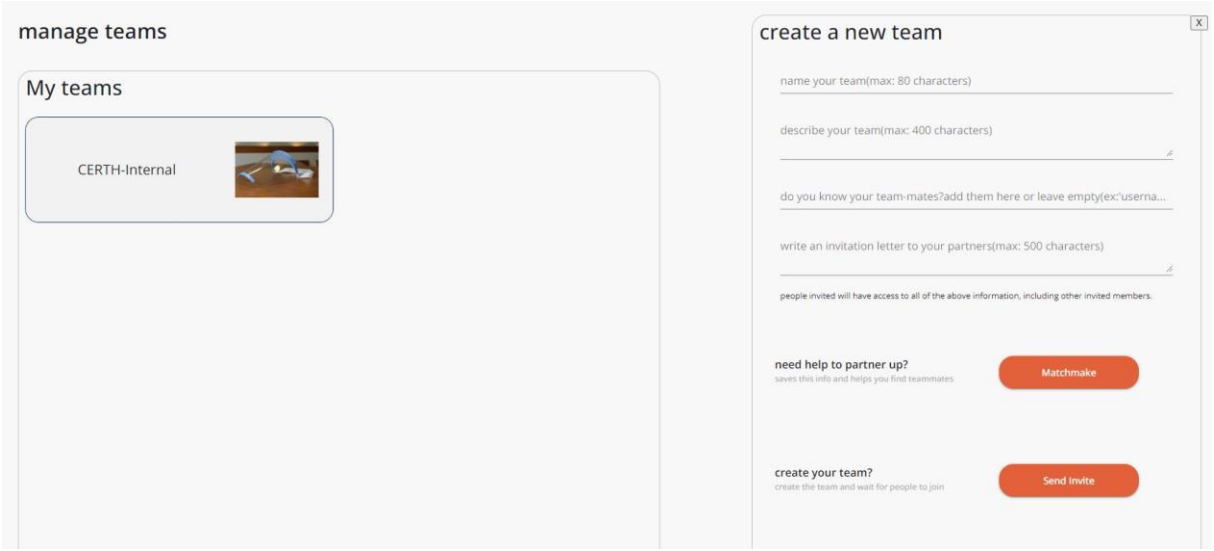

Figure 21 Marketplace Team Creation Panel

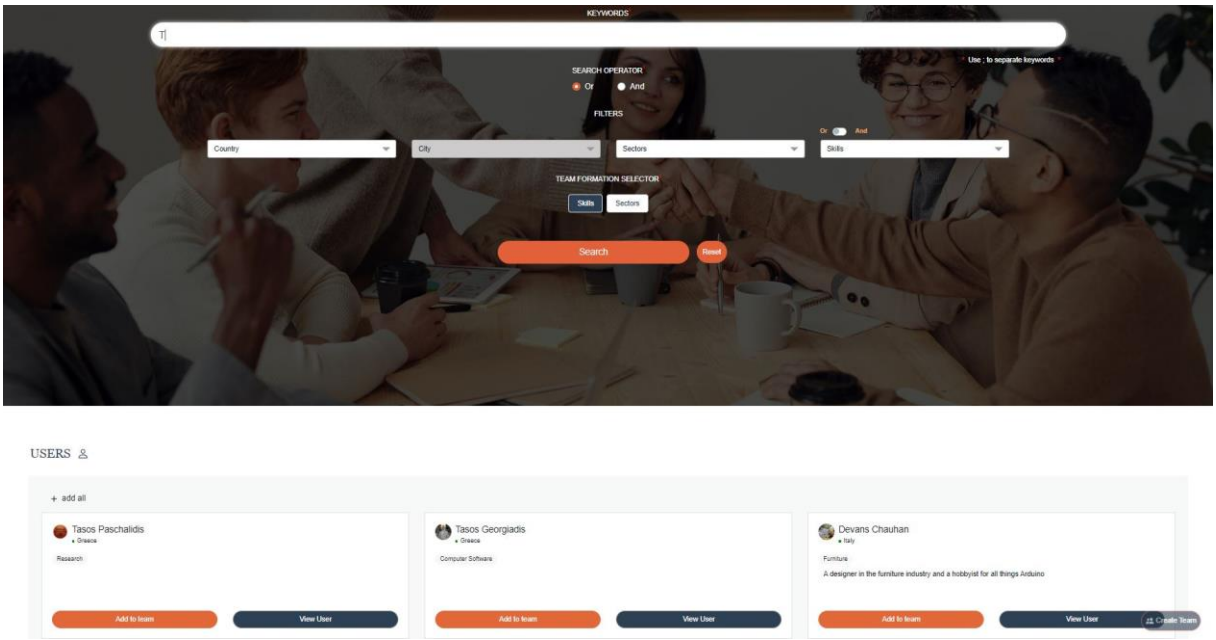

Figure 22 Marketplace Matchmaking

4.2.2. IPR Authoring Tool

The **IPR Authoring Tool** can be accessed directly from the OpIS Dashboard as the rest of the tools.

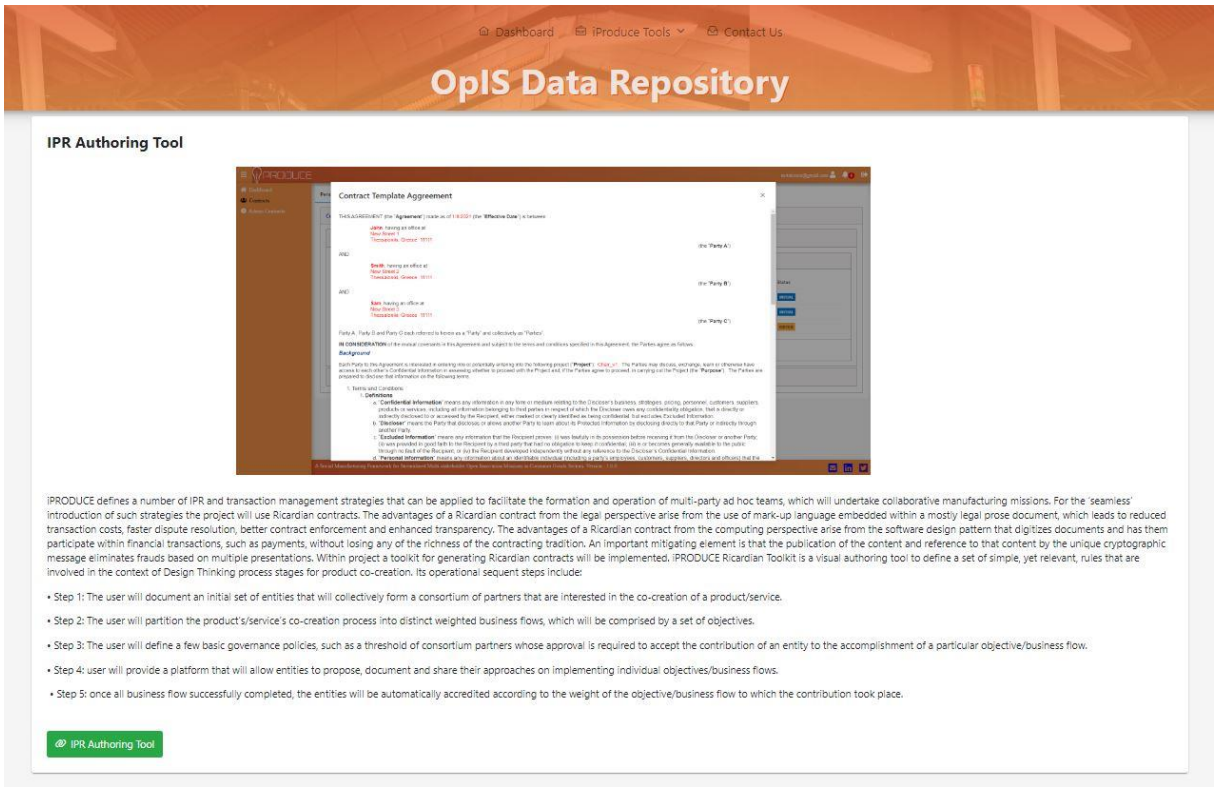

Figure 23 OpIS Dashboard IPR Authoring Tool

In addition, once a product is added, the involved users and members of a team receive a notification on their user profile inside the Marketplace. When the user clicks on the notification, they are forwarded to the IPR Authoring Tool page.

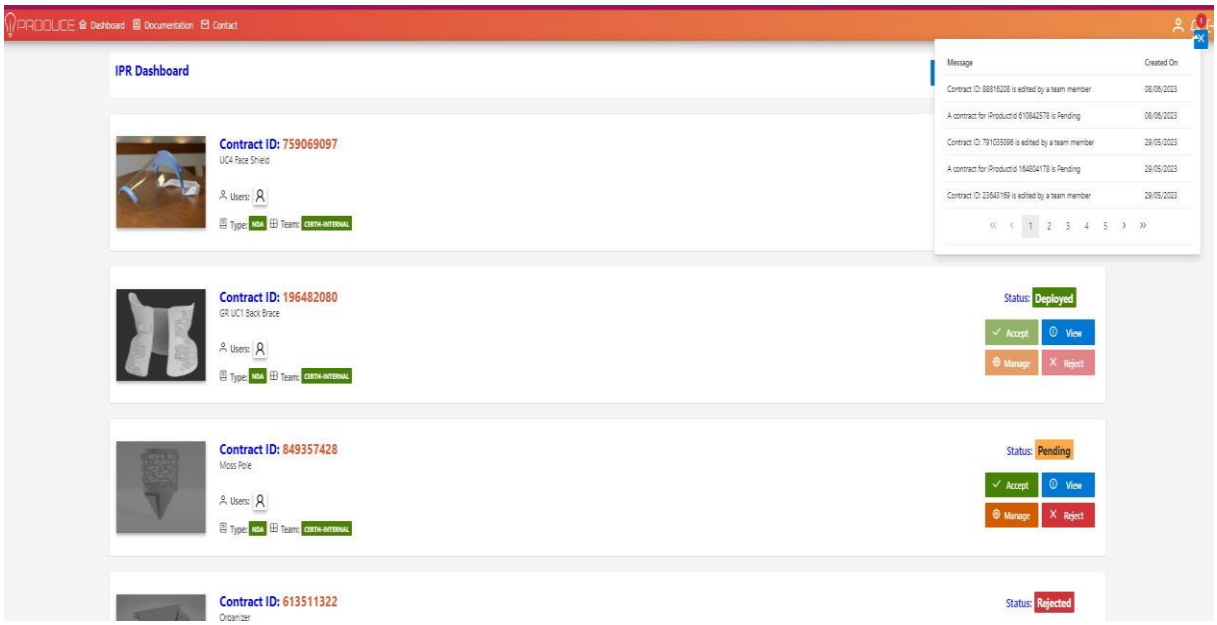

Figure 24 IPR Authoring Tool Page

In this page, users can accept, reject and view their contracts.

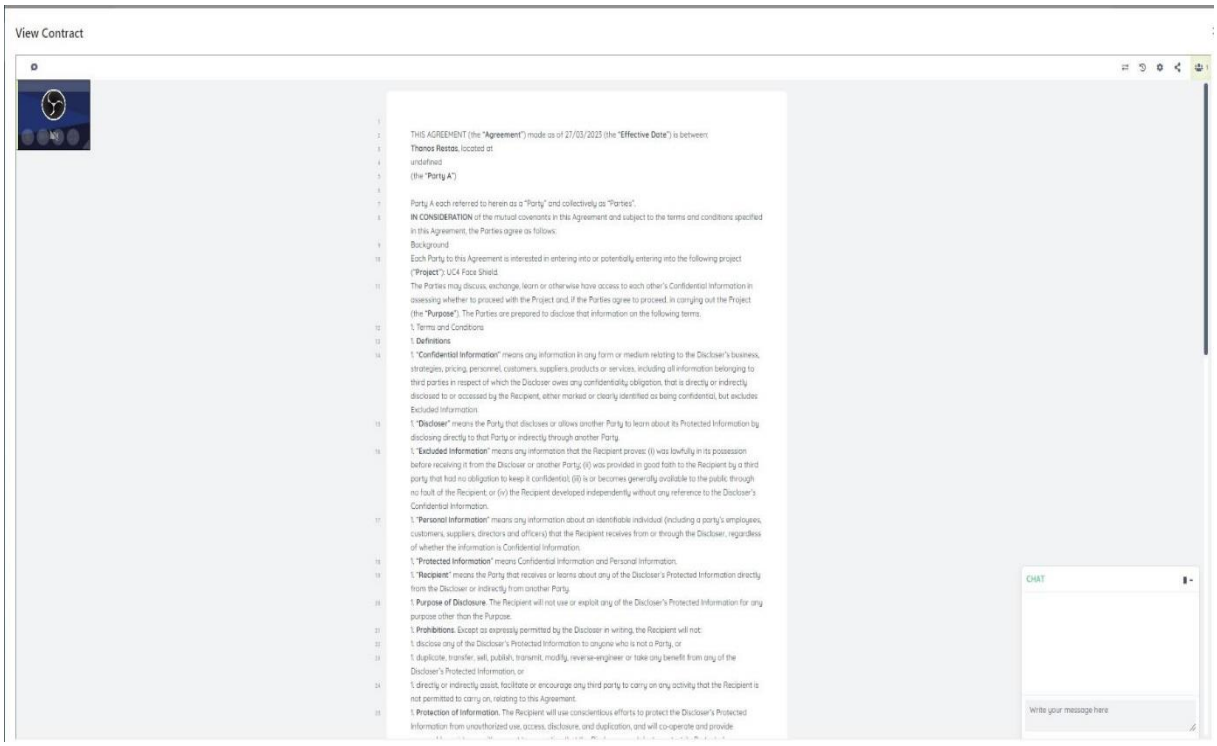

Figure 25 IPR Authoring Tool Contract Page

Functionalities such as text and video chat support the Contract managing process.

4.2.3. Generative Design Platform

The **Generative Design Platform** is available through the OpIS Dashboard.

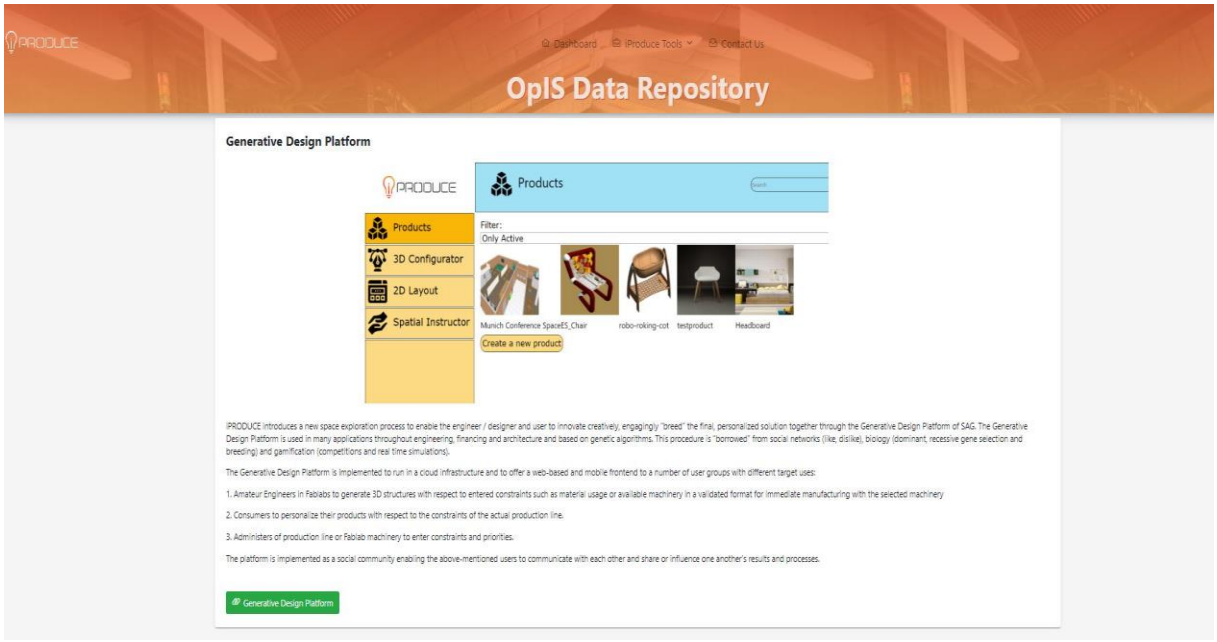

Figure 26 OpIS Dashboard Generative Design Platform

Users are also be forwarded to the Generative Design Platform by clicking on the Optimizer button on a product's entry.

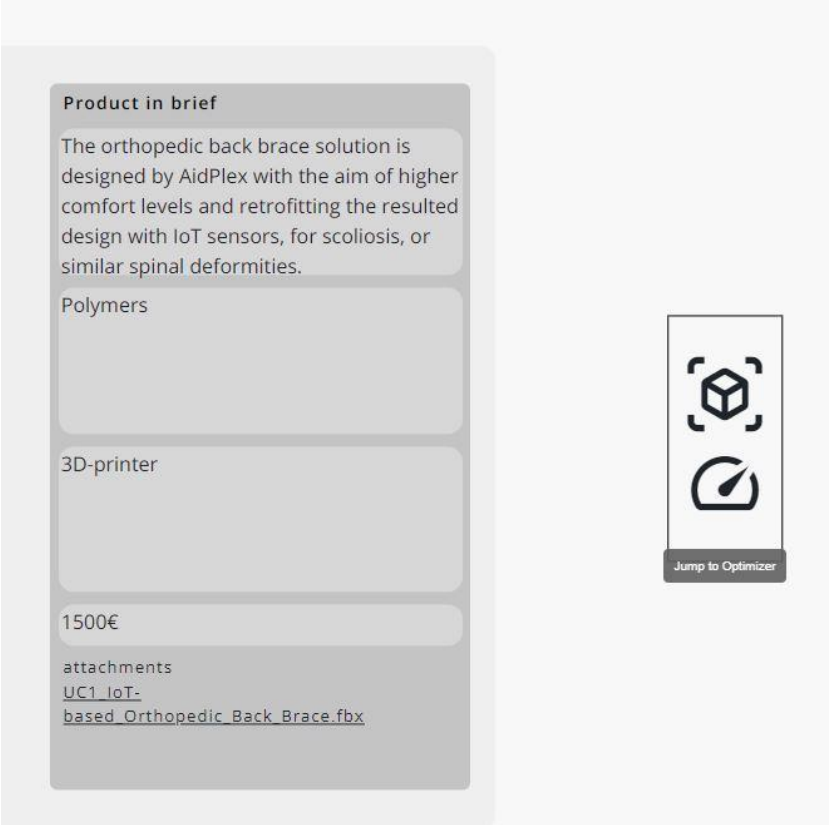

Figure 27 Marketplace Optimizer

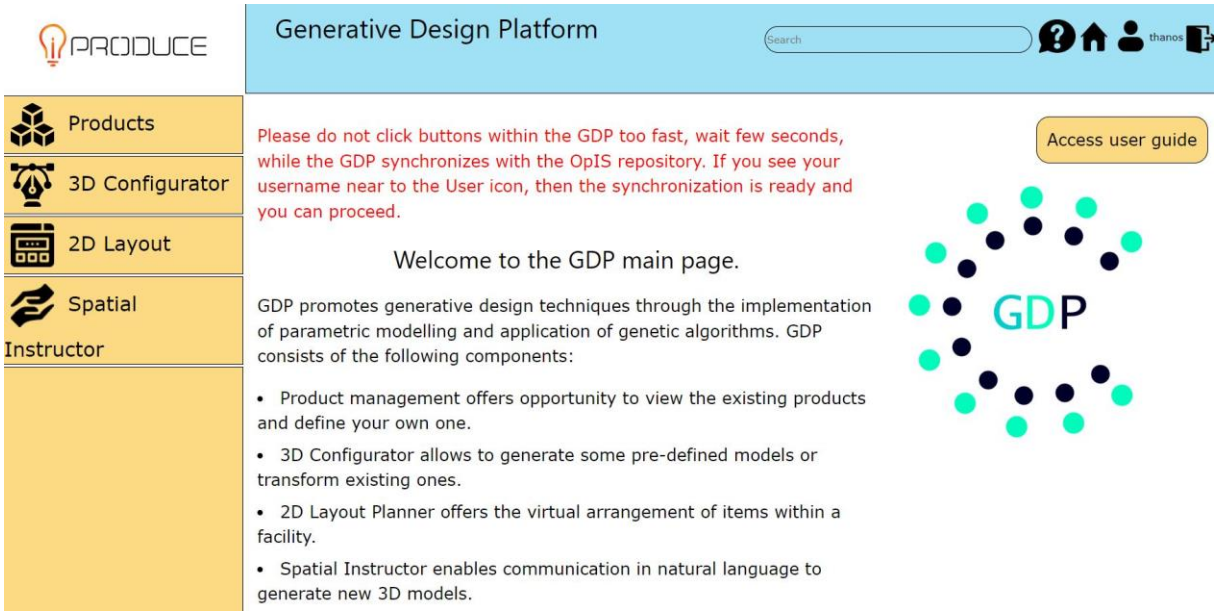

Figure 28 Generative Design Platform

Through this tool, the users have the ability to furtherly modify a product.

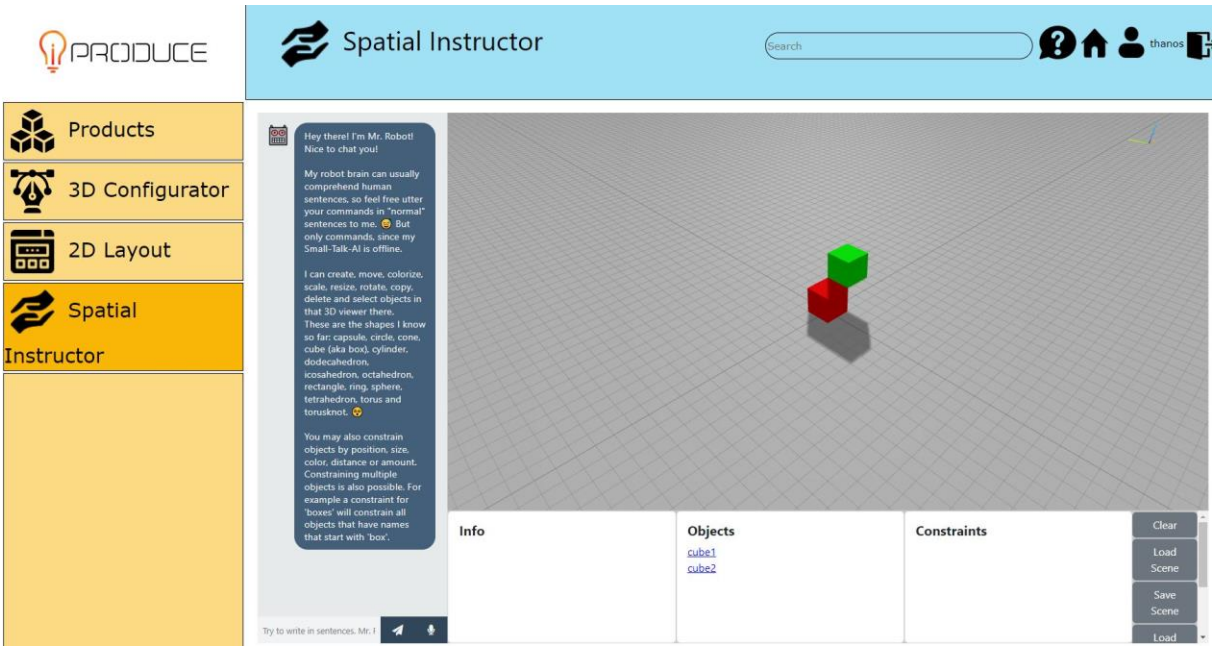

Figure 29 Generative Design Platform Configurator

4.2.4. AR/VR Toolkit

The **AR/VR Toolkit** can be accessed from the OpIS Dashboard.

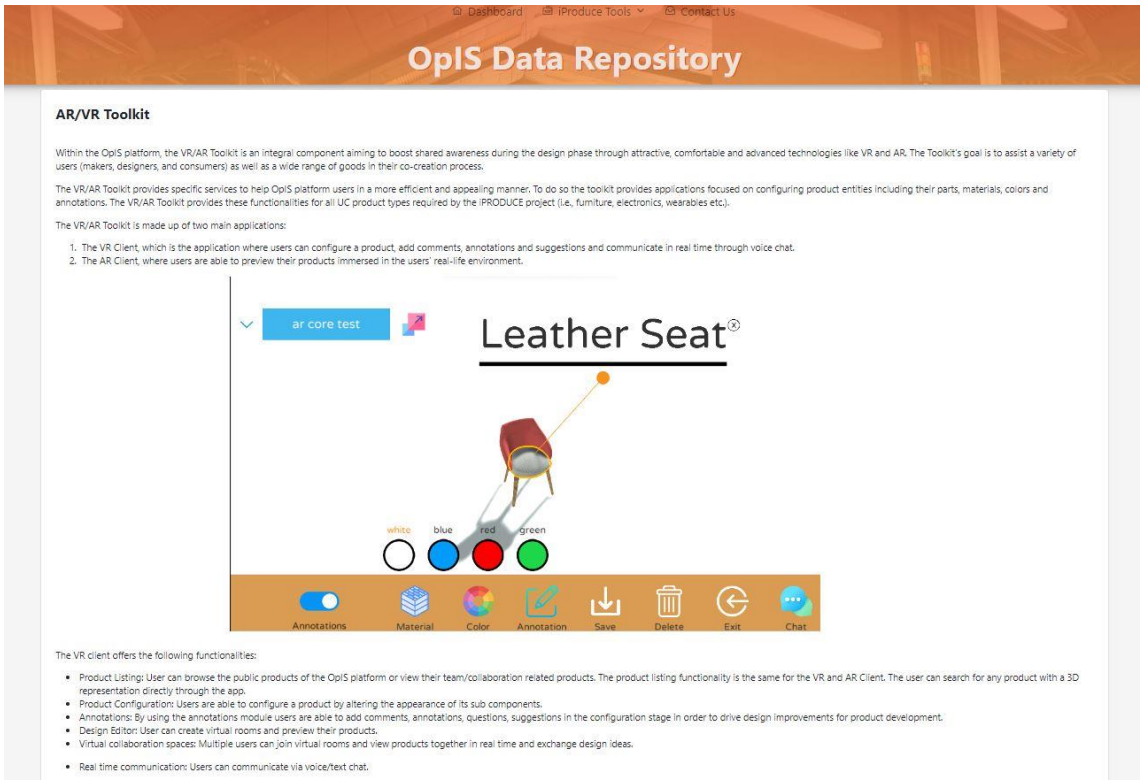

Figure 30 OpIS Dashboard AR VR Tool

In addition, the AR/VR Tool can be also accessed directly from the Marketplace through the **Jump to VR** button next to a product's entry.

Figure 31 Marketplace Jump to VR

Users are forwarded to the AR-VR Tool's Web Client and once the loading process is finished, they can access their team's products through the dedicated **Team Products Tab.**

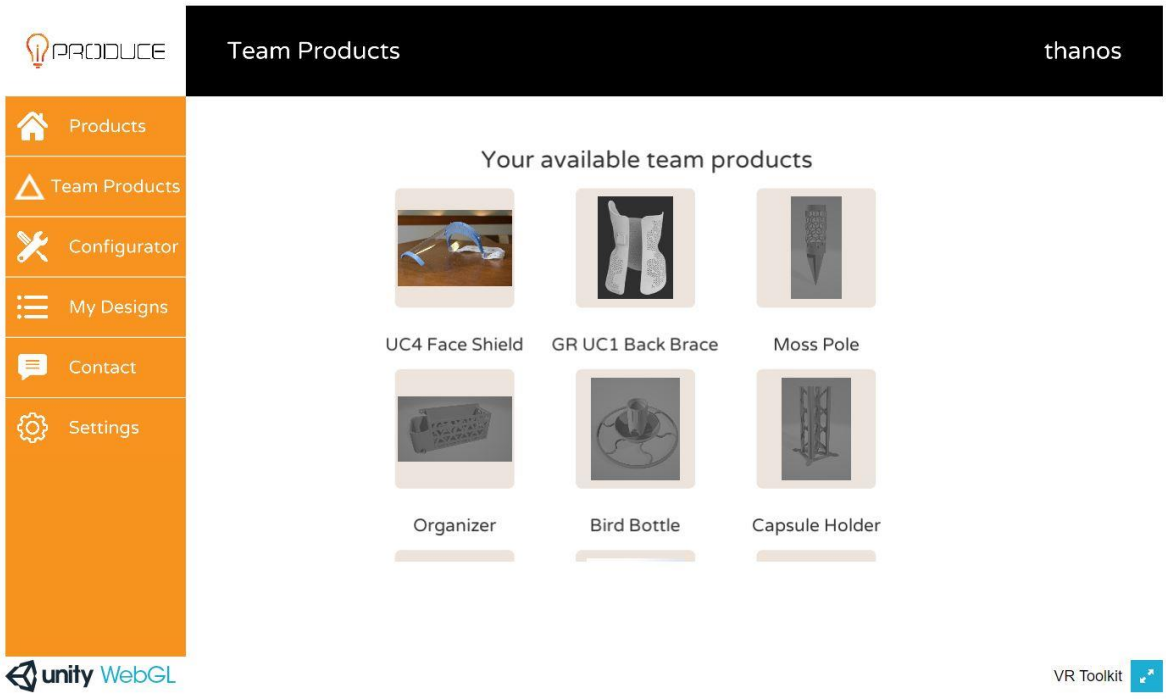

Figure 32 VR Tool Web Client Team Products Tab

Products can be added to the user's personal **Configurator** collection for further modification.

Figure 33 VR Tool Web Client Configurator

4.2.5. Mobile Application

The **Mobile Application** companion is available through the OpIS Dashboard entry of the **Marketplace**. Users are forwarded to the Google Play Store application page, and they are able to install the application on their personal Android devices.

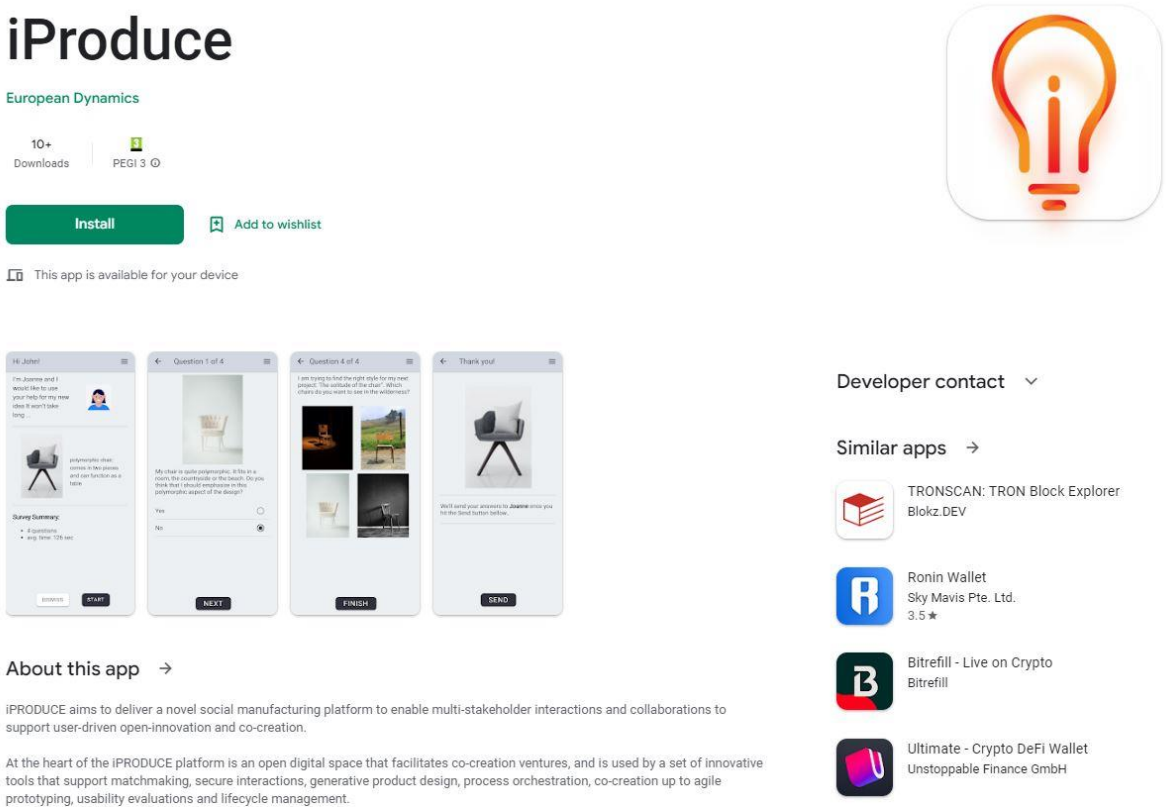

Figure 34 Mobile App Google Play Listing

The Mobile application facilitates communication and feedback among all participating partners, including the teams formed through matchmaking and agile network creation. Users can utilize the app to create and publish surveys, enabling them to gather feedback from other registered users of the OpIS platform regarding products and services. This functionality enhances collaboration and promotes active engagement within the platform.

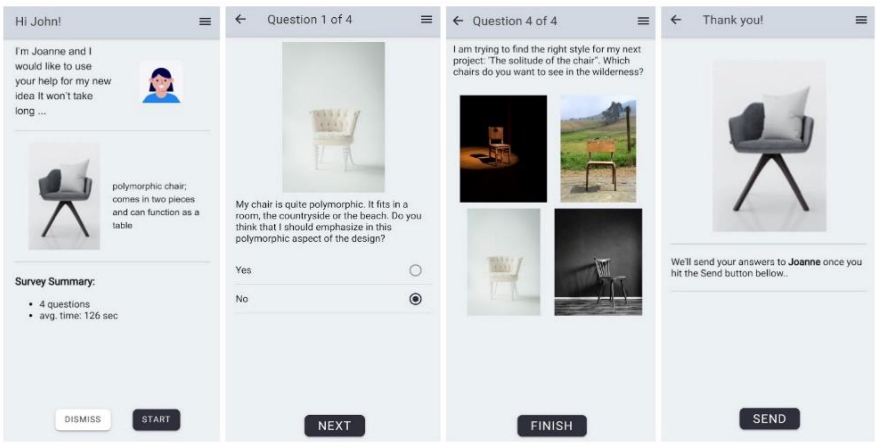

Figure 35 Mobile App Overview

4.3. Data Visualization

The **Agile Data Analytics and Visualization Suite** is available within the OpIS Dashboard.

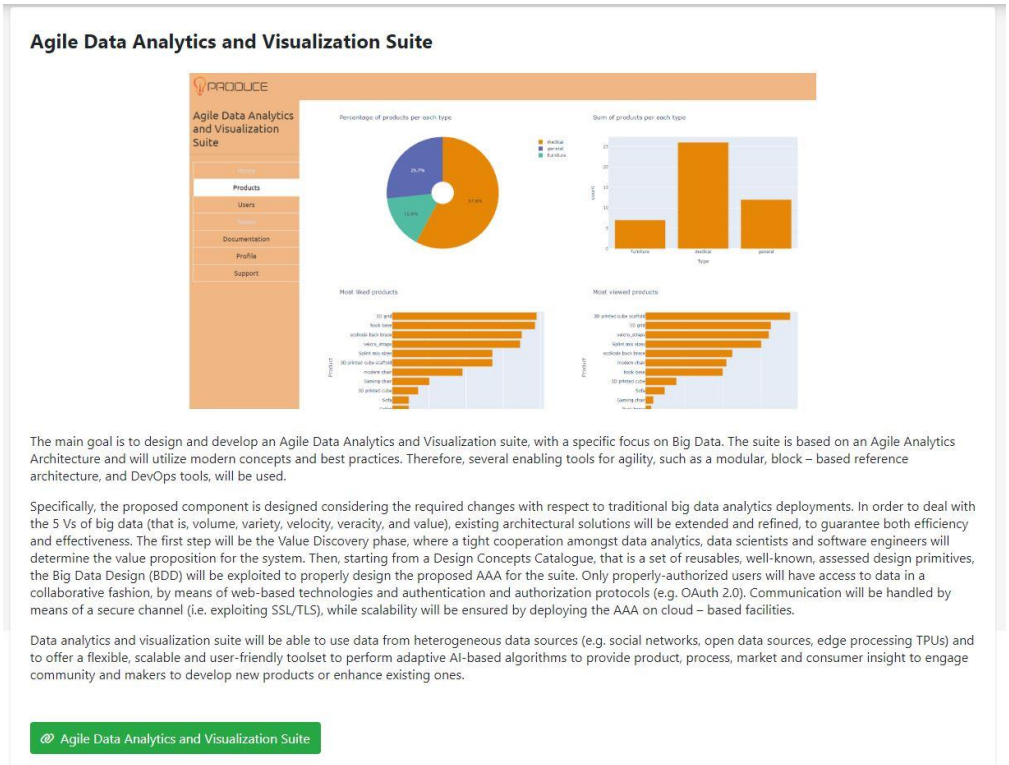

Figure 36 OpIS Dashboard Agile Data Analytics

Each component of the platform, such as the Marketplace, AR/VR Toolkit, Generative Design Platform, IPR Authoring Toolkit, Mobile applications, and Matchmaking, contributes data to the visualization suite for analysis.

To facilitate this, the Data Ingestion and Storage module manages all the data, interacting with the OpIS Data Repository. This integration extends the functionalities of the OpIS platform, enabling the retrieval of valuable data for analysing user behaviour, preferences regarding marketplace products, and potential relationships between user interests in different products.

4.4. Digital Fablab Kit

The **Digital Fablab Kit** comprises two components: the Training Support Tool and the Process Automation Tool. The Training Support Tool within the Digital Fablab Kit serves as a resource to provide instructions and training on the usage of specific machinery available in a maker space. It is designed to assist inexperienced users in becoming acquainted with unfamiliar equipment, facilitating the learning experience.

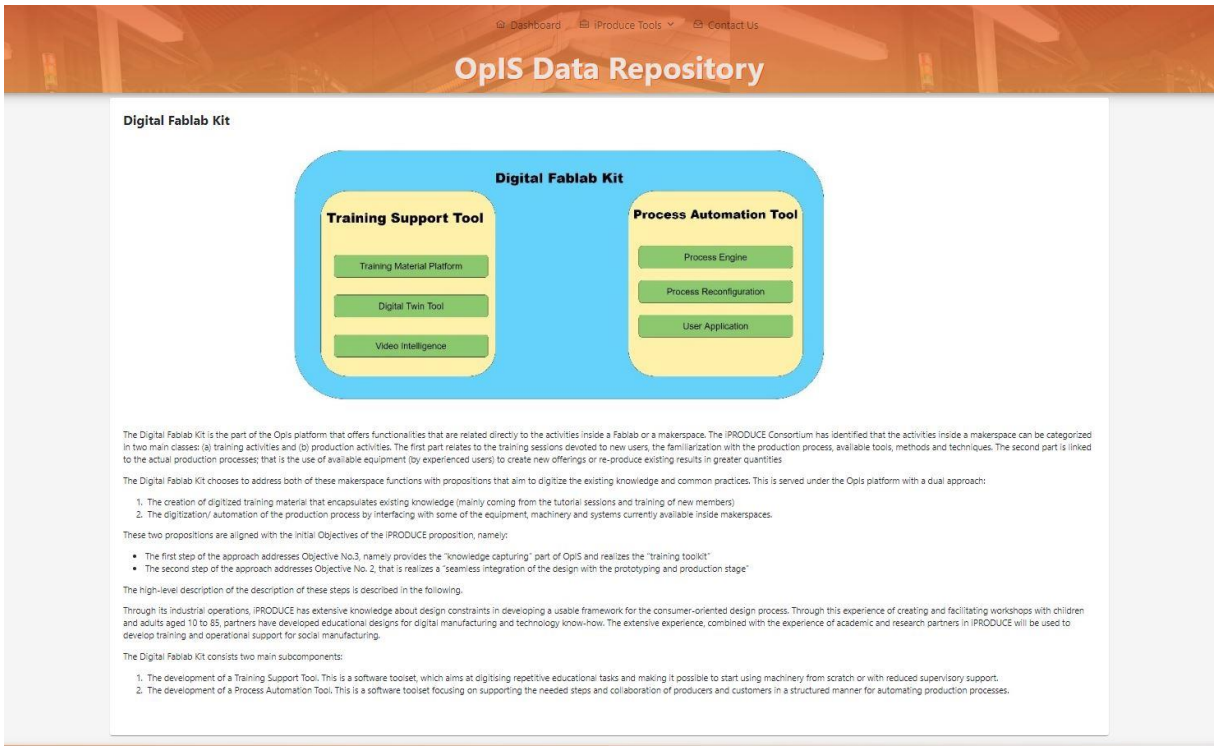

Figure 37 OpIS Dashboard Digital Fablab Kit Page

Workshop Conductors utilize the Training Support Tool to develop training materials such as AR Training procedures, training videos, and digital twin tutorials. At the core of this tool is the **cMDF Training Platform**, which encompasses the **cMDF Training Flow** and **View** applications. These components enable the creation and delivery of comprehensive training content, empowering Workshop Conductors to enhance the learning experience for users.

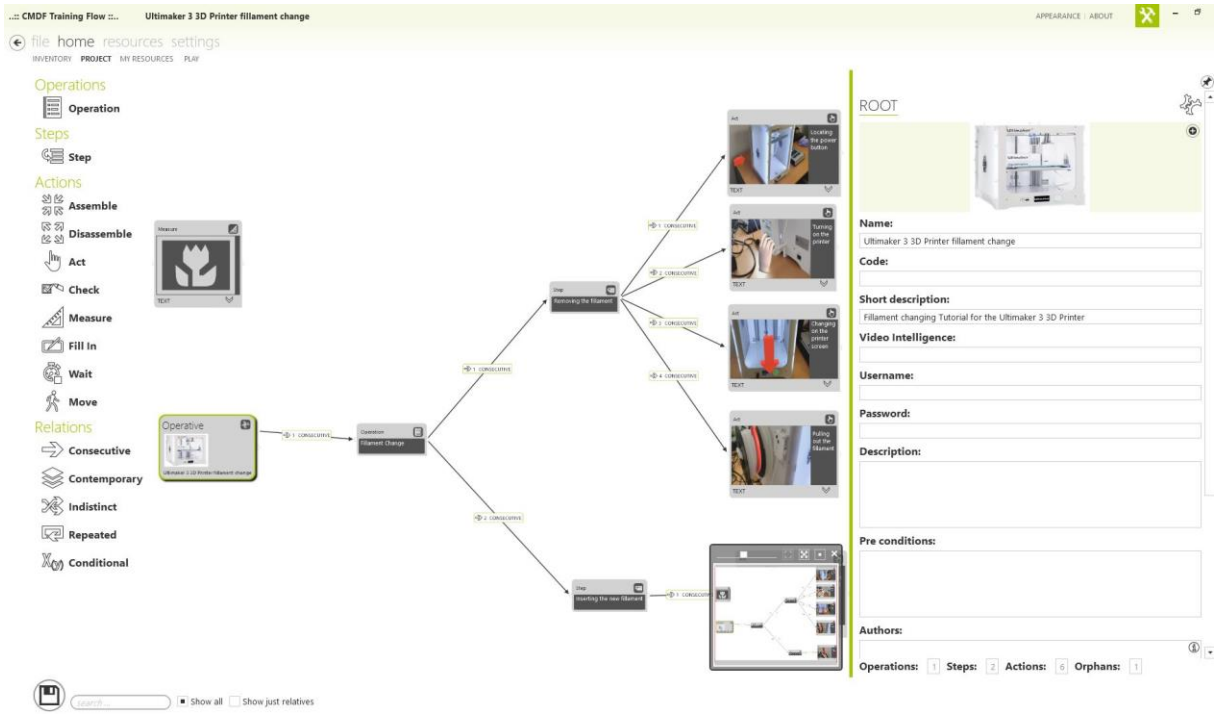

Figure 38 cMDF Training Flow

The **cMDF Training View** mobile application enriches the training experience for inexperienced users by incorporating Augmented Reality (AR) technology. Through this application, users can receive AR-enhanced training, enabling them to gain practical knowledge and skills in a more interactive and immersive manner.

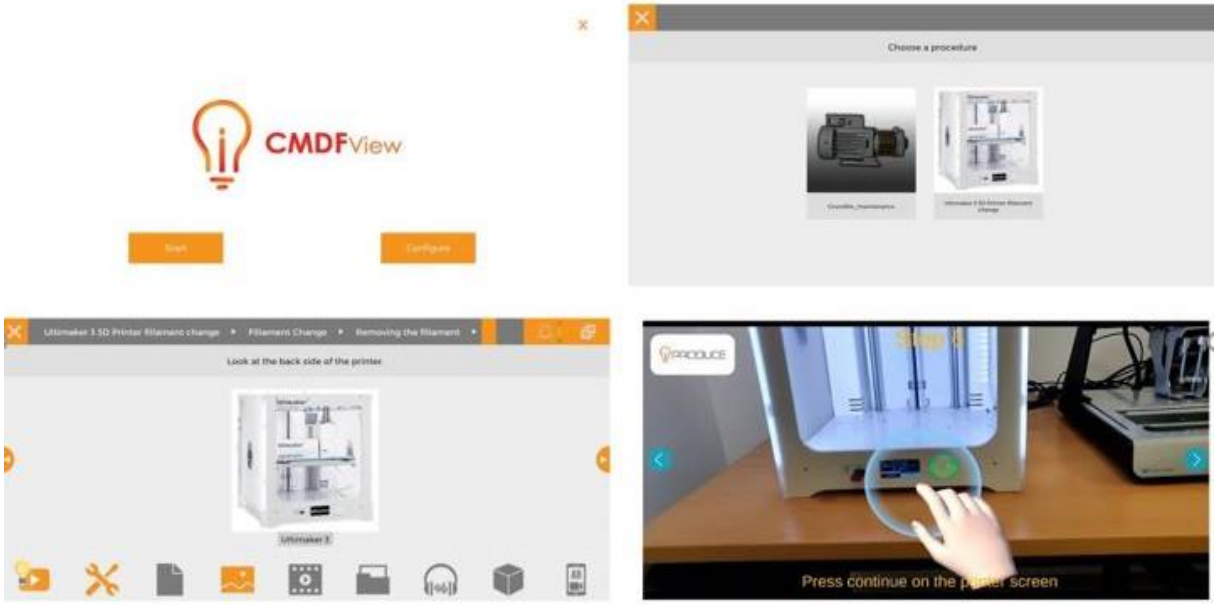

Figure 39 cMDF Training View

5. Scope & Contents of OpIS Platform

5.1. OpIS Platform

The OpIS is a platform that integrates various innovative tools and technologies to transform collaborative manufacturing processes. In this section, the significance and necessity of OpIS by exploring the unique features and advancements offered by each tool within the platform is highlighted. We delve into the Generative Design Platform, IPR Authoring Tool, Marketplace, Matchmaking, AR/VR Toolkit, Mobile App, and Agile Data Analytics and Visualization Suite. By leveraging these tools, OpIS enables seamless collaboration, enhances communication, and optimizes the co-creation and co-production of products. A comprehensive analysis of the innovation of each tool is provided, highlighting the essential role of need OpIS platform in driving innovation, fostering creativity, and accelerating the growth of collaborative manufacturing is emphasized.

Collaborative manufacturing has emerged as a key driver of innovation, enabling engineers, designers, and consumers to actively participate in the product development process. However, traditional collaborative manufacturing approaches often face challenges related to communication, data sharing, and coordination among stakeholders. OpIS aims to address these challenges and revolutionize the collaborative manufacturing landscape through its innovative toolset. The innovations of each tool within OpIS are explored and outlines their significance in creating a robust and efficient platform.

5.1.1. Generative Design Platform: Enabling Creative and Personalized Solutions

The Generative Design Platform offered by OpIS introduces a novel approach to product development. By leveraging genetic algorithms and borrowing concepts from social networks, and gamification, this platform enables engineers, designers, and users to collaboratively innovate and “breed” personalized solutions. The cloud infrastructure and web/mobile frontend make it accessible to a wide range of users, including amateur engineers, consumers, and administrators. The Generative Design Platform not only streamlines the design process but also optimizes material usage and machinery compatibility, leading to immediate manufacturing capabilities. This tool empowers users to engage creatively, fostering co-creation and enhancing the overall product development experience.

5.1.2. IPR Authoring Tool: Facilitating Collaboration and Transaction Management

Effective collaboration and seamless transaction management are crucial for successful collaborative manufacturing. The IPR Authoring Tool embedded within OpIS offers a comprehensive solution to address these needs. By utilizing Ricardian contracts, OpIS significantly reduces transaction costs, enables faster dispute resolution, and enhances contract enforcement. The integration of mark-up language and legal prose ensures transparency and clarity in contractual agreements. Furthermore, the cryptographic message eliminates fraud by preventing multiple presentations of the contract content. The IPR Authoring Tool provides a secure and efficient framework for collaborative manufacturing endeavors, fostering trust and reliability among stakeholders.

5.1.3. Marketplace: Fostering Co-Creation and Modernization

The marketplace component of OpIS serves as a central hub for collaborative manufacturing activities. By providing collaborative manufacturing digital co-creation and co-production processes, the

marketplace empowers cMDFs) to showcase their profiles, work, and offers to a wider audience. Additionally, individual users can utilize the marketplace to publish their own work, seek collaboration opportunities, and engage with the cMDFs. This tool enables effective communication between stakeholders, promotes innovation, and helps optimize production processes. The marketplace not only benefits cMDFs by attracting new customers and expanding their activities but also provides users with a platform to innovate and contribute to product development.

5.1.4. Matchmaking: Enhancing Collaboration through Intelligent Connections

OpIS incorporates a sophisticated matchmaking tool that utilizes extensive data mining and advanced techniques to analyze user profiles and match stakeholders effectively. By leveraging the data gathered from the marketplace component, the matchmaking tool provides suitable matches based on users' search criteria. This intelligent connection fosters collaboration by bringing together stakeholders with complementary skills, capabilities, and product offerings. The team formation algorithm ensures the formation of agile networks capable of jointly meeting specific needs and requirements. Matchmaking plays a vital role in facilitating collaboration, expanding networks, and unlocking new possibilities for collaborative manufacturing endeavors.

5.1.5. AR/VR Toolkit: Boosting Collaboration and Shared Awareness

OpIS integrates an Augmented Reality/Virtual Reality (AR/VR) Toolkit to enhance collaboration and shared awareness during the design phase. This tool leverages ubiquitous and wearable computing technologies to create, share, manipulate, and access information in specific design situations. By providing common user interfaces and interaction techniques, the AR/VR Toolkit promotes flexibility and adaptability. Stakeholders can collaborate in real-time, make changes, and share them seamlessly. The AR/VR Toolkit empowers users to visualize and experience products in a virtual environment, enabling efficient design iterations and minimizing errors or misunderstandings.

5.1.6. Mobile App for Social Media-Enabled Consumers & Makers Feedback: Empowering Customer Listening

The digitization of the creation and interaction process has expanded the need for customer feedback and input. OpIS addresses this requirement through its Mobile App, which allows makers to obtain real-time feedback from the community of social media users. By leveraging surveys and questionnaires, makers can solicit the Voice of Customer feedback, gain insights, and stress test their ideas. The Mobile App also enables the gathering of genuine feedback, identifies industry challenges, and enhances the understanding of consumer preferences beyond existing customer feedback channels. This tool empowers makers to improve their products, generate new ideas, and create a more customer-centric approach to collaborative manufacturing.

5.1.7. Agile Data Analytics and Visualization Suite: Leveraging Big Data for Actionable Insights

To unlock the full potential of collaborative manufacturing, OpIS incorporates an Agile Data Analytics and Visualization Suite. This suite enables the collection and analysis of data in order to provide valuable insights into product, process, market, and consumer trends. The suite's agility and scalability ensure that stakeholders can perform real-time analysis, make informed decisions, and identify opportunities for innovation and improvement. The Agile Data Analytics and Visualization Suite empowers the OpIS community to develop new products, enhance existing ones, and drive continuous improvement.

5.2. Overview of the OpIS Platform Scope

In conclusion, OpIS platform for Collaborative Manufacturing, represents a solution that leverages innovative tools and technologies to revolutionize collaborative manufacturing processes. By integrating the Generative Design Platform, IPR Authoring Tool, Marketplace, Matchmaking, AR/VR Toolkit, Mobile App for Social Media-Enabled Consumers & Makers Feedback, and Agile Data Analytics and Visualization Suite. The OpIS platform addresses the challenges associated with collaboration, communication, and innovation in the manufacturing industry. Through seamless collaboration, enhanced communication channels, and optimized co-creation and co-production, OpIS empowers stakeholders to unlock their full potential and drive innovation in the field of collaborative manufacturing. By embracing OpIS, manufacturers, designers, and consumers can actively participate in the product development process, foster creativity, and accelerate the growth of collaborative manufacturing in the digital era.

6. Conclusions

By incorporating the insights gained from this task, iPRODUCE has already established a solid foundation for the implementation of social manufacturing in the consumer goods sectors. The alignment with existing manufacturing reference models ensures seamless integration with other platforms, enabling efficient information exchange and collaboration. This accomplishment represents a significant milestone in iPRODUCE's journey towards realizing its vision of user-driven open innovation and co-creation within the manufacturing industry.

With the completion of this final version, the iPRODUCE platform has positioned itself as a leading Social Manufacturing service to be exploited in the market, well equipped to address the challenges of the consumer goods sectors. The comprehensive overview provided in this deliverable highlights the platform's robustness and sets the stage for successful adoption and utilization by stakeholders. By leveraging the advancements made in iPRODUCE, businesses can confidently embrace social manufacturing, enabling them to adapt organizational structures, foster collaborative production, and drive sustainable innovation in the consumer goods domain.

PRODUCE

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