T7.2 Business models and case development for iPRODUCE cMDFs

CBS

November 2021

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no. 870037.

DELIVERABLE INFORMATION	
Author(s)/ Organisation(s)	Isabel Fróes, Bruna Carvalho (CBS)
Document type	Report
Document code	D7.2
Document name	T7.2 Business models and case development for iPRODUCE cMDFs
Status	EU
Work Package / Task	WP7, T7.2
Delivery Date (DoA)	30 December 2021
Actual Delivery Date	20.12.2021 December 2021
Abstract	Deliverable 7.2 presents the first set of Business Models for the iPRODUCE cMDFs. The deliverable introduces the tools and the approach applied to carry out the workshops and help co-develop the main service offerings and how they align with the iPRODUCE platform. Furthermore, the workshops also focused on mapping existing barriers that need overcoming and how the platform can aid this shortcoming, while also providing a valuable space to exploit available assets.

DELIVERABLE HISTORY			
Date	**Version**	**Author/ Contributor/ Reviewer**	**Summary of main changes**
10/11/2021	V0.8	CBS/VLC	Changes regarding format and comments related to description changes
18/12/2021	V1	CBS/AIDIMME	Formatting and alignment with D3.1

DISSEMINATION LEVEL		
PU	Public	x
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)	

DISCLAIMER

iPRODUCE ● Grant Agreement: 870037 ● Innovation Action ● 2020 – 2022 | Duration: 36 months

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

Executive Summary

Task 7.2 focuses on developing a business model covering iPRODUCE cMDFs cases and processes. Through a series of workshops, shared visions and service plans were co-created during the first phase of the task. The Business Model Canvas template was applied to co-develop each local cMDF business model in order to fit with specific social, economic and political contexts. By having these customised business models, we were able to identify the intersecting aspects regarding service offerings and market opportunities to build novel cross-contextual business strategies with focus on consumer driven design and production. The business models were complemented by a value proposition assessment of these models including (a) Gains, positive aspects of the service proposition; (b) Pains, problematic aspects challenging the optimal experience; and (c) Customer jobs, what do customers need to do in order to engage with the service/product.

Deliverable 7.2 presents the first set of Business Models for the iPRODUCE cMDFs. We first introduce the tools and the approach used in workshops for the co-development of the main service offerings and how they align with the iPRODUCE platform. Furthermore, the workshops also focused on mapping existing barriers that need overcoming and on how the platform can aid this shortcoming, while also providing a valuable space to exploit available assets.

In the second leg of this task, we will carry out a second round of Business Model workshops to assess the assets, value and impact of iPRODUCE platform in relation to the service offerings and value propositions of the project cMDFs in comparison to the anticipated business models presented on this deliverable. This will be presented in D7.3.

Table of contents

List of Figures

List of Tables

List of Abbreviations

Abbreviation	Definition
DTP	Digital Treatment Planning
BMC	Business Model Canvas
BMU	BetaFactory Mobile Unit
cMDF	Collaborative Manufacturing Demonstration Facilities
F2F	Face to face
GDO	Garden Development Organisations
IoT	Internet of Things
MVP	Minimum Viable Product
OpIS	Open Innovation Space
R&D	Research and Development
RoI	Return on Investment
SME	Small and Medium Enterprises
TOC	Technology Oriented Company
VPC	Value Proposition Canvas

1. Introduction

This deliverable focuses on presenting the existing Business Models of the six iPRODUCE cMDFs.

Building on the analysis from T7.1 and on D3.1 - Lean Operational Model for cMDFs' Federations, task 7.2 took on developing business models covering iPRODUCE cMDFs cases and processes. With the help of each local cMDF, business models have been co-developed and deployed during the first phase of the project making use of the Business Model Canvas as a tool. Each local cMDF co-developed a business model that fits with their social, economic and political contexts. The business models help identify the intersecting aspects that can help build novel cross-contextual business strategies with focus on consumer driven design and production.

The business models have been complemented by the market cost-benefit analysis, assessing the value proposition of these models. This includes (a) Gains, positive aspects of the service proposition; (b) Pains, problematic aspects challenging the optimal experience; and (c) Customer jobs, what do customers need to do in order to engage with the service/product.

Through the deployment of the use-cases and a qualitative approach, including interviews, questionnaires, observations, the consumer driven urban production will be evaluated in its impact of customer satisfaction and efficacy in the second round of this deliverable.

1.1. Method

The workshops were composed of preparatory activities to describe and create a common understanding of the cMDFs goals, needs and resources. The first part of the workshop focused on preparing the participants to co-create a common vision for their partnership, together with assessing current services and products offered. The second part of the workshop focused on co-developing the Business Model Canvas and the Value Proposition Canvas. The third part of the workshop focused on assessing the models and visions within the iPRODUCE context and on how this knowledge should feed and help inform the upcoming available service.

The Business Model workshops ran from October 2020 to February 2021 with all 6 cMDFs. The workshops ran for an average of 3 hours each (the Greek workshop was held in 2 x 1,5 hours on two different dates). The workshop with the Danish cMDF was carried out in person at BetaFactory. Due to the pandemic, the other five workshops were carried out online using Zoom for video conferencing and Miro as the collaborative tool.

Table 1: Workshop dates

cMDF	Workshop dates
Danish cMDF	29/10/20
French cMDF	02/02/21

cMDF	Workshop dates
German cMDF	26/01/21
Greek cMDF	28/01/21 & 02/02/21
Italian cMDF	21/01/21
Spanish cMDF	21/01/21

1.2. Workshop Activities

The activities carried out during the workshops are described in the following:

1.2.1. Reverse Perspective

The reverse perspective is an exercise to reframe how companies describe themselves. Instead of asking them what they are, as this is a common and expected question, asking them what they are not helps make them rethink their service offerings, establishing some boundaries for their services and helping them identify core values as well as focus on viable and tangible product and service offerings. The Reverse Perspective was used as part of the Business Model workshops to bring the partners to look at their companies from a different angle, providing a reflexive response and framing their current competences and services.

1.2.2. Blue Sky Vision

The blue sky vision is an exercise to help identify a shared vision or goal among one or more teams. The exercise helps to identify the feasible expectations for collaboration among the teams and company members. It was used to help the different partners discuss and find a common reachable vision as a group. This facilitates establishing the ground of collaboration and the most promising and viable service offerings they can provide.

1.2.3. Minimum Viable Product (MVP)

The minimum viable product is an exercise to define the core service/ product that grounds the service offering and presents enough value to the market to generate future developments. This exercise helped the partners create a service baseline and a more targeted perspective for their current and upcoming cross-collaboration.

1.2.4. Business Model Canvas (BMC)

The Business Model Canvas is a strategic management template tool towards helping define and identify key business aspects for a functioning business model. The template was first suggested by Osterwalder in 2005 and it was further developed to become what we now use and apply as the Business Model Canvas (Osterwalder, 2005; Parry, 2014).

The BMC is composed of nine areas covering:

a. Value proposition of what is offered to the market – the core service/product offering
b. Target customer segments addressed by the value proposition – the different customers groups to have in focus while delivering and marketing the product.
c. Communication and distribution channels to reach customers and offer the value proposition – the means to distribute and reach customers
d. Relationships established with customers – the different types of relationships one can develop with the customers
e. The core capacities needed to make the business model possible;
f. The configuration of activities to implement the business model;
g. The partners and their motivations of coming together to make a business model happen;
h. The revenue streams generated by the business model constituting the revenue model;
i. The cost structure resulting from the business model.

These nine aspects organised in a structured layout provide a unified overview, helping businesses to reframe or develop from scratch an understanding of their products/services. In short, it provides an indication of the viability of the product/service, how it will operate and fulfil its goals.

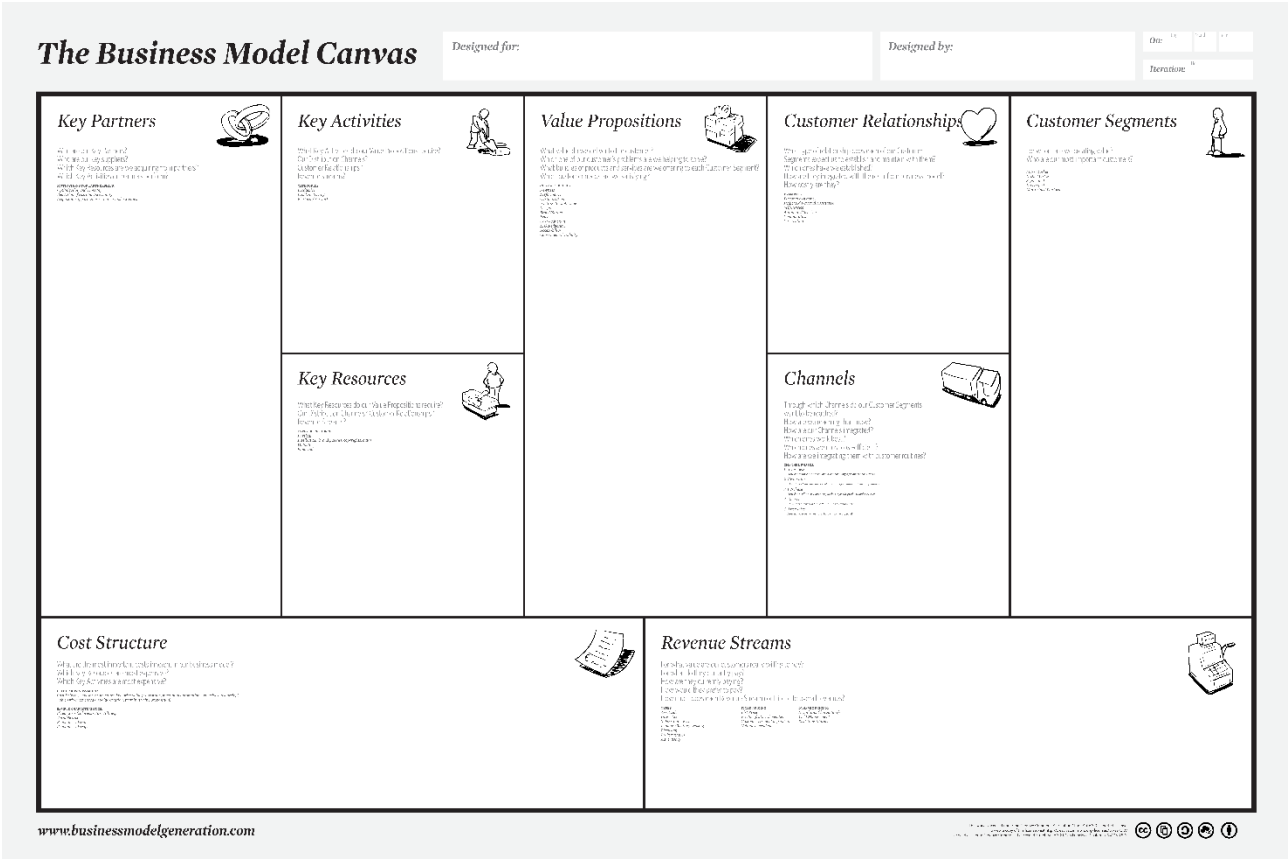

Figure 1. Business Model Canvas Tool

1.2.5. Value Proposition Canvas (VPC)

The Value Proposition Canvas is a complement to the BMC as it demonstrates the existing fit between the product offered and the current market. The template is composed of six areas, 3 covering the client and 3 covering the service/product provider.

The customer area covers:

a. Jobs to be done: reflects what the customer wants to do (e.g. customised place to organise books)
b. Pains: The current problems in getting that done (does not know how to do it, expensive, etc.)
c. Gains: Anything that would add unexpected value to the customer (good assembly experience, beautiful design, easy to customise)

The service/product provider covers:

a. Products & Services: what you offer as a service (customised production of various furniture)
b. Pain relievers: How do you minimise or remove the current pains (helps the customer decide, design and produce adaptable shelves)
c. Gain creators: (assemble for customer, shows how the shelf can be adjusted and modified with ease, so they can take it with them in case they move)

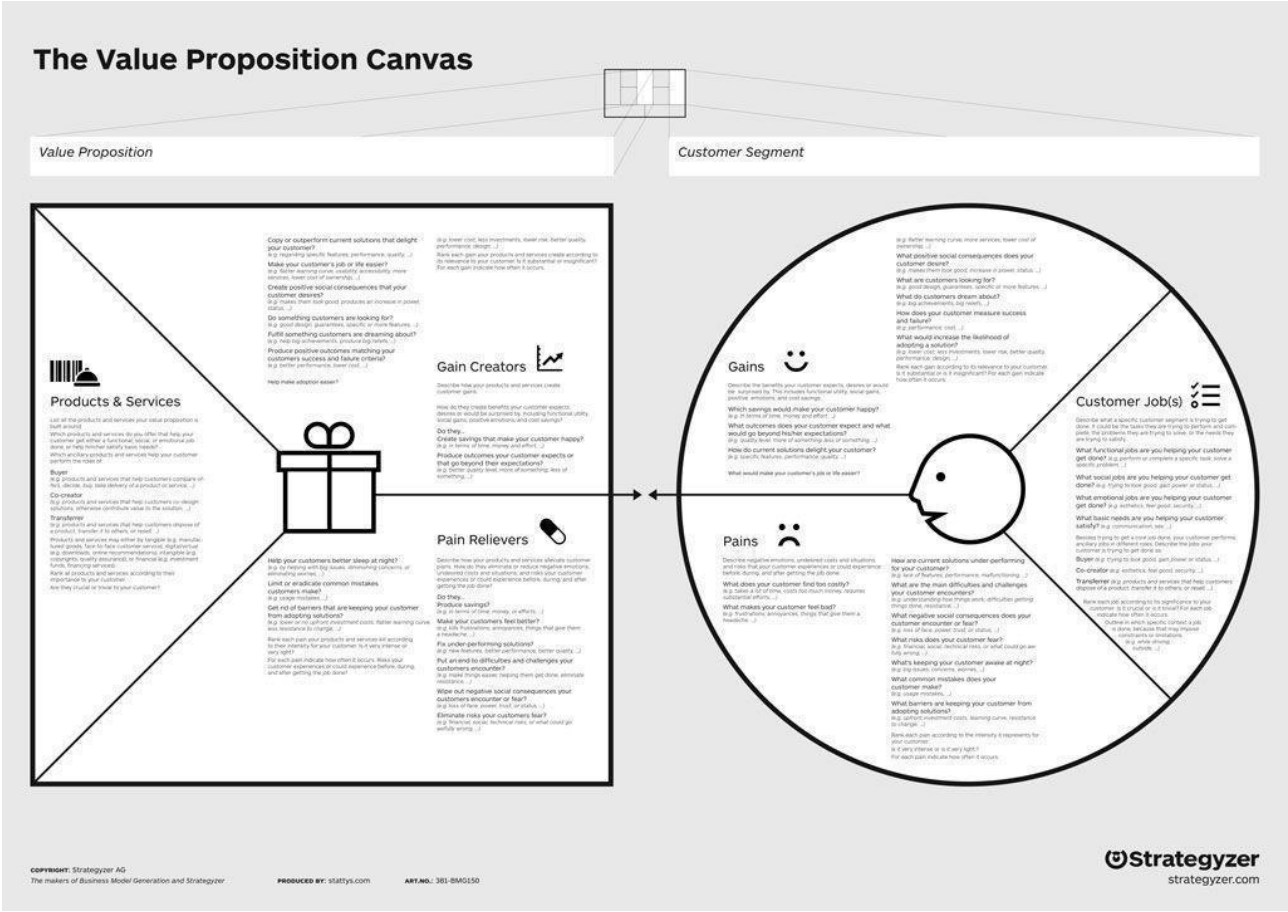

Figure 2: Value Proposition Canvas Tool

1.2.6. Stakeholder mapping

The stakeholder mapping is used to create an overview of direct and indirect stakeholders for the service offering. This exercise helped the cMDFs identify their key stakeholders for the co-defined MVP, as well as which ones were to be exploited in the iPRODUCE scenario. This way, each cMDF workshop produced two stakeholder-mapping outputs. First, and building on the thorough BMC analysis, a comprehensive list of stakeholders was created. This list was further discussed within each

cMDF team in the weeks following the workshop to produce a list of direct stakeholders of each iPRODUCE Use Case.

1.2.7. iPRODUCE offerings, barriers and assets:

The last part of the workshops helped the cMDFs assess the product/service offered to the iPRODUCE use cases, identifying the barriers and assets in the offerings.

These offerings were then aligned with the iPRODUCE platform planned services and required technology, combined with identifying the drives and barriers to use such technologies by the earlier identified stakeholders.

The workshop structure provided a good overview of how the cMDFs are equipped to provide specific services to the market and how these services align with opportunities to be exploited through the iPRODUCE use cases and platform.

2. Workshops per cMDF

The workshops covered the different aspects affecting the existing processes and offerings of the cMDFs products and services leading to the development of the current business models. Section 2.1 presents the overall results of the workshops' activities and Section 2.2 presents a thematic analysis of the data collected in the workshops. We use an inductive approach[1] to identify, analyse, and report repeated patterns (Braun and Clarke 2006) on the following workshop activities: Reverse Perspective, Blue Sky Vision, MVP, and Stakeholder mapping. For the Business Model Canvas (BMC) and Value Proposition Canvas (VPC), we adopt a deductive approach[2] using the predefined areas of each of these templates as coding themes. Finally, the analysis of the iPRODUCE offerings, barriers and assets consist of identifying the umbrella offerings across the cMDFs through an inductive approach[1] while also identifying their corresponding barriers and assets.

2.1. Workshop Activities Results

The workshop with the Danish cMDF was carried out in person at BetaFactory, while the other five workshops were carried out online using Zoom for video conferencing and Miro as the collaborative tool. The results of each workshop are presented using the actual visual materials produced on each workshop to ensure the highest level of accuracy.

2.1.1. Danish cMDF

The Danish cMDF is located in Copenhagen and is composed of two partners: BetaFactory (makerspace) and CBS (university). BetaFactory is a communal and membership-based space equipped with machinery for woodwork, metalwork, textiles and upholstery, electronics, prototyping, photography and graphic production. Building on the expertise and infrastructure of BetaFactory, the objective of this pilot is to deploy a Mobile BetaFactory Unit (MBU) in real case use scenarios in at least 10 Danish cities to evaluate the requirements for a sustainable long-lasting business case. The results will feed into how to best scale up the open innovation concept, to understand the consumer market, to better cater to actual needs, as well as to understand how future trends impact the concept

2.1.1.1. Reverse Perspective

The Danish cMDF's Reverse Perspective resulted in a wide range of definitions of what-the-business-is-not, from culture and values to technical specificities and market positioning. For instance, BetaFactory is not soulless nor unprofessional, it does want to rank in second place (N.2) in the market nor is it just a makerspace and it is not a mass production facility either. It has a larger facility than other makerspaces, making it almost an industrial space, however without a mass production capacity (where one would need a higher number of machines). The results of this activity can be found in full in Figure 3.

[1] Inductive analysis is a process of coding the data without trying to fit it into a pre-existing coding frame or the researcher's analytic preconceptions, but rather allowing the themes to arise from the data collected. In this sense, this form of thematic analysis is data-driven (Braun & Clarke, 2006).
[2] Deductive analysis is a process in which the coding frame is elaborated prior to the coding process, and it will be based on concepts of previous research or existing theories (Schreier, 2012).

Figure 3: Danish cMDF Reverse Perspective post-it notes

2.1.1.2. Blue Sky Vision

In alignment with the Reverse Perspective, the Blue Sky Vision defined for the Danish cMDF showcases growth and market leadership ambition such as becoming the Netflix of education and launching its own machine brand, a flair for completeness (<8 meaning all-under-one-roof) and sustainable impact through enabling climate inventions, partnering with researchers and promoting education as shown in Figure 4.

Figure 4: Danish cMDF Blue Sky Vision post-it notes

2.1.1.3. MVP

The MVP of the Danish pilot comprises the MBU and the management infrastructure for the MBU's operation. The building of the MBU took place prior to the realisation of the workshop and culminated in the development of a container-built makerspace blending maximum utility with mobility and space-optimization (Figure 6 and Figure 7). Thus, the MVP discussion focused on the definition of the remaining elements (i.e. quality management and business processes) for a successful mobile service offering. The MBU will inherit the core competencies of BetaFactory and will be operated in synergy

with it(e.g. shared personnel and procurement processes, maintenance and online educational resources). However, its operation is conditioned to the development of specific management infrastructure such as a dedicated booking tool, unit rental price list, and transportation of the unity to the client.

Figure 5: Danish cMDF MVP post-it notes

2.1.1.4. Stakeholder mapping

The Danish cMDF mapped the stakeholders pertaining to both the pre-existing makerspace and the MBU and classified them according to three segments: education, entrepreneurship and partnership (Table 2). The grouping of stakeholders per MBU or pre-existing makerspace is presented in section 2.1.1.5, areas “key partners” and “customer segments” in the Business Model Canvas.

Table 2: Danish cMDF Stakeholder mapping

Education	Entrepreneurship	Partnership
Schools	Engineers/Investors	Architecture firms and other furniture companies
Entrepreneurs	SMEs (startups/scale up)	Universities
Theatre and film production (props, studio, facilities? etc.)	Designers	Venture/seed accelerator
Contractor companies	Design studios	Consultancies
University Research centres		Festivals, shows, etc.
Evening school, elderly associations		Design studios
BetaAcademy (courses: machine, tech & product specific)		Public sector

		Theatre and film production (props, studio, facilities? etc.)
		Entrepreneur companies

Figure 6: Mobile Betafactory Unit

Figure 7: Mobile Betafactory Unit in action

With focus on the iPRODUCE Use Cases, the cMDF produced a dedicated list of direct and indirect stakeholders shown on Table 3 and Table 4 respectively.

Table 3: Danish cMDF Direct Stakeholders

Co-creation In Schools	Distributed Design Market	Temporary Architecture
Schools Students	Manufacturers (Large companies, SMEs), Municipalities Entrepreneurs	Architects Architecture firms

Table 4: Danish cMDF indirect Stakeholders

Co-creation In Schools	Distributed Design Market	Temporary Architecture
Municipalities Parents	Industrial associations Public sector	End-user/consumer

2.1.1.5. Business Model Canvas (BMC)

The Danish pilot builds on the expertise and structure offered by BetaFactory to deploy a Mobile Betafactory Unit (MBU) in real use case scenarios in at least 10 Danish locations to evaluate the requirements for a sustainable long-lasting business case. The results will feed into how to best scale up the open innovation concept, to understand the consumer market, to better cater to actual needs, as well as to understand how future trends impact the concept. To allow comparisons between the pre-existing makerspace (BetaFactory) and the mobile unit (BetaFactory MBU), we developed two BMCs: one referring to the BetaFactory pre-existing makerspace (Figure 8: Danish cMDF BMC), and another referring to the newly developed MBU (Figure 9).

Building on the previous activities and on the BetaFactory's BMC, the BMC for the MBU depicts a cMDF that will serve museums and municipalities, schools, architects and entrepreneurs through machine use training, on-site manufacturing, workshop facilities and product development services. To do so, the cMDF offers a mobile unit equipped with machinery for woodwork as well as expertise (applied knowledge), tools and training in digital design and prototyping. The main revenue streams come from memberships and unit rental, and fixed and dynamic pricing according to customized agreements. The cost structure is mostly composed of fixed costs (transport, space rental - they do not own the building they occupy -, material and maintenance).

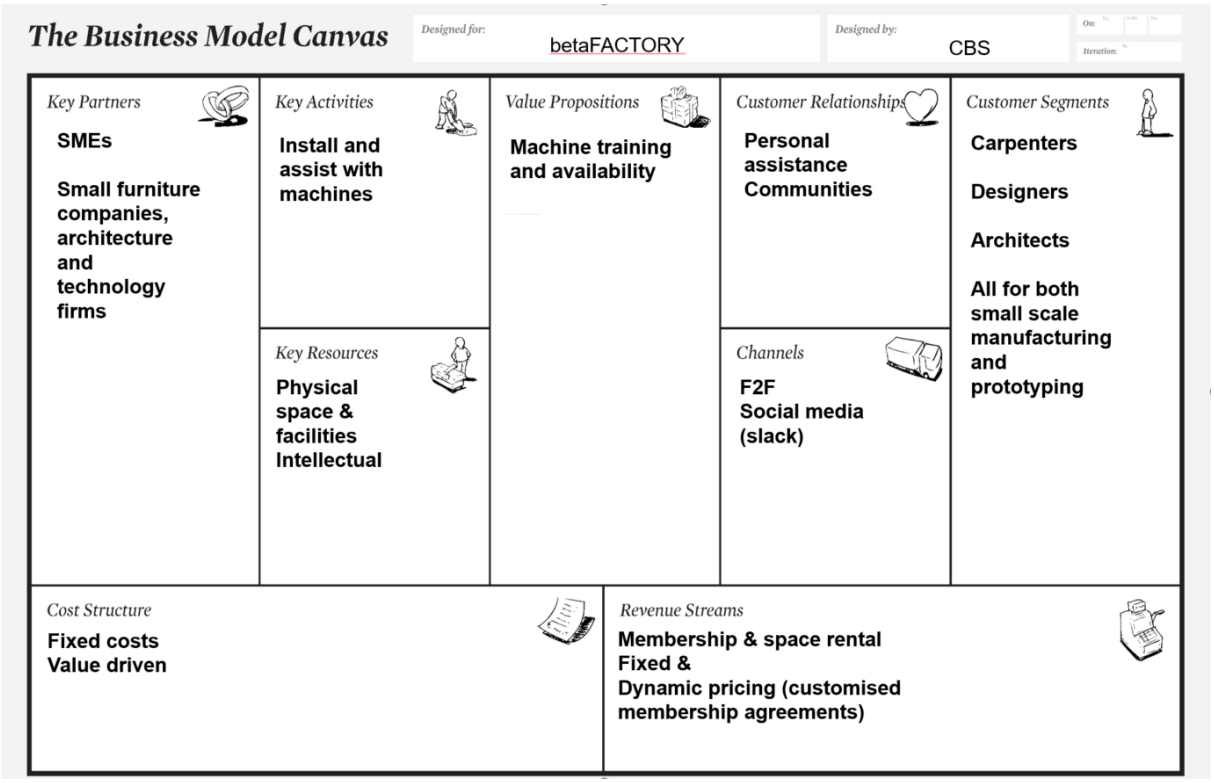

Figure 8: Danish cMDF BMC

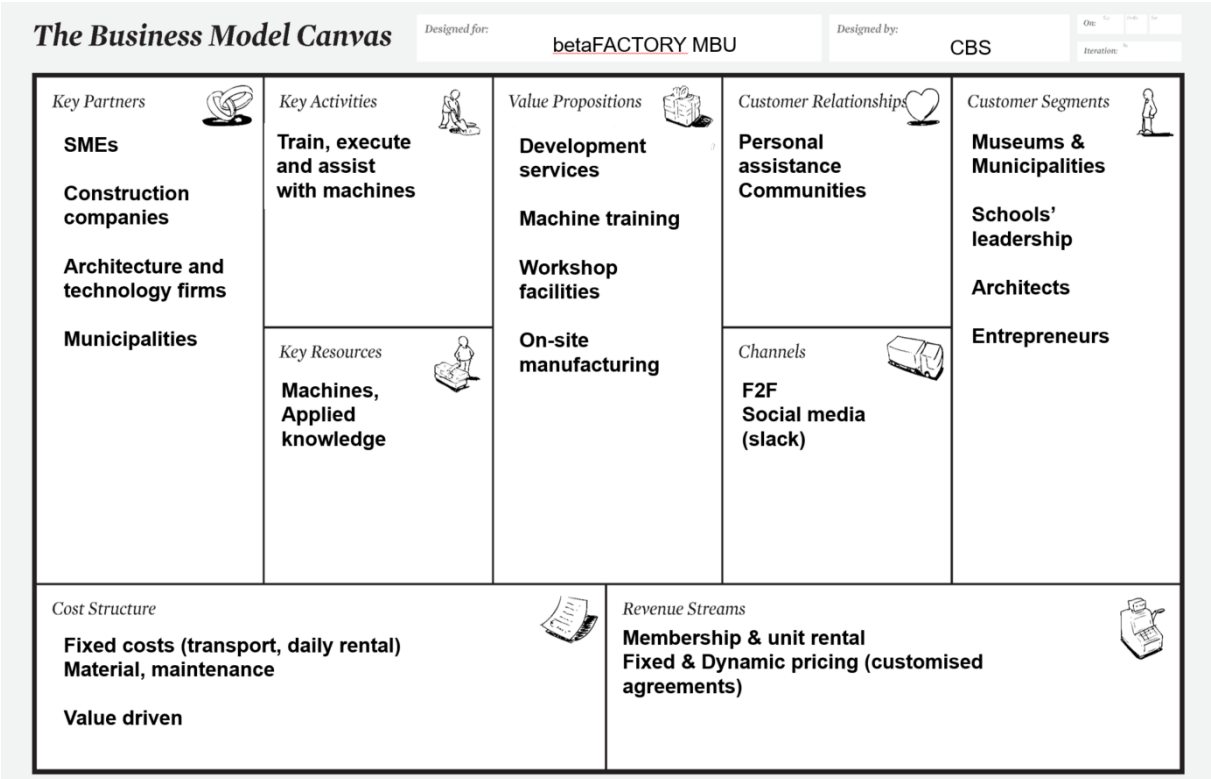

Figure 9: Danish cMDF MBU BMC

2.1.1.6. Value Proposition Canvas (VPC)

Building on the MBU's Business Model Canvas, the VPC (Figure 10) activity highlights the unmet market demand for on-site manufacturing with added value through training, mobility, circularity, and prototyping. By offering an all-in-one mobile unit that allows for prototyping, training and material reuse opportunities, the MBU is designed to close the identified market gap.

The current pains refer to inaccessible machinery, lack of skills and poor access to information regarding facility availability. BetaFactory plans to relieve these pains by promoting the MBU via targeted events and communications media.

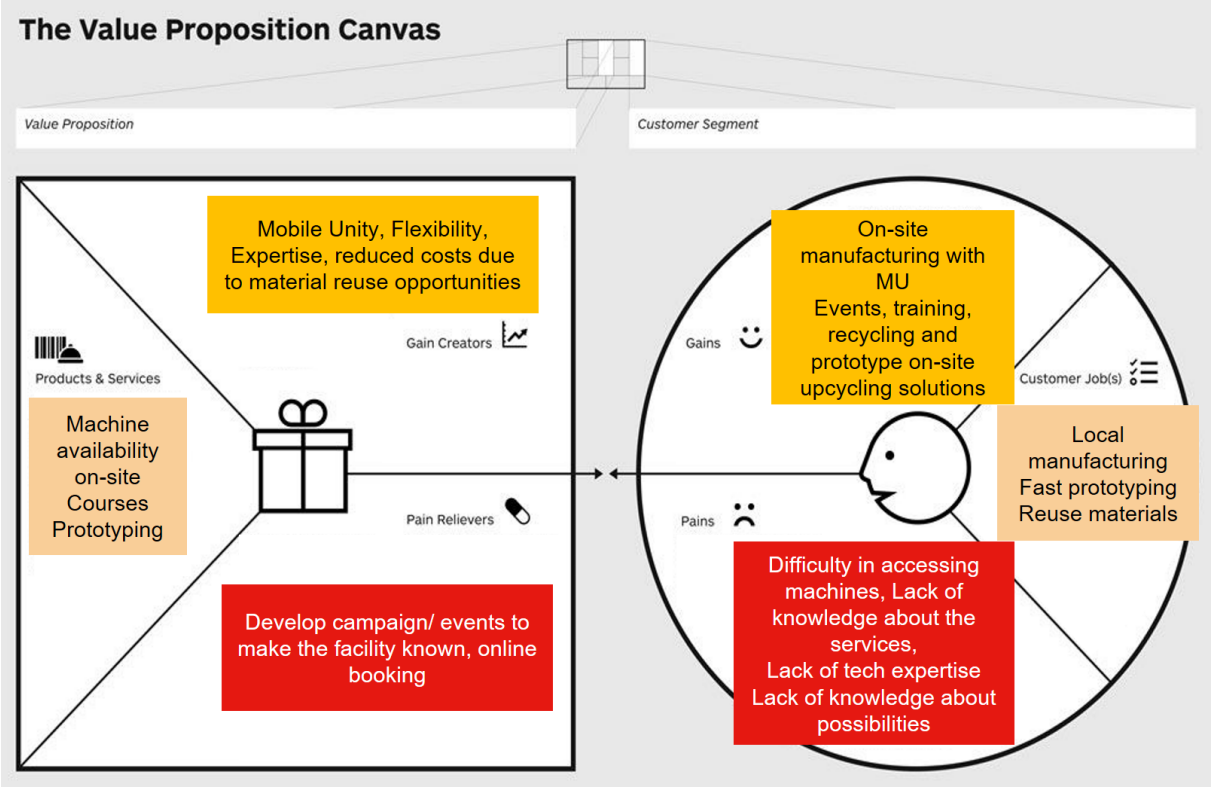

Figure 10: Danish cMDF VPC

2.1.1.7. iPRODUCE offerings, barriers and assets

The most relevant offerings of iPRODUCE to the Danish pilot are (1) the enabling of machine availability 24/7 with countrywide coverage through the MBU coupled with an online booking system and (2) the knowledge library and skills building function through online courses and tutorials. The offerings' enabling assets are the lab and infrastructure availability, lab mobility with countrywide coverage (MBU), the building of a community of (shared) knowledge and collaboration, and course certifications. The offerings' barriers concern the unavailability of personnel 24/7, the complexity of equipment and programs, the lack (or limited) knowledge about the machines and services offered by the cMDF. The overview of these aspects are shown in Table 5.

Table 5: Danish cMDF Offerings, Barriers and Assets

Offerings	Barriers	Assets
Machine availability 24/7	Availability of personnel Complexity of programs	Labs availability Internal know-how Community
Courses	Time required Lack of knowledge about offering	Certification
Prototyping	Lack of training in using machines, lack of knowledge about offering, lack of tech skills	Community Access to space and machines
Mobile Unit (on-site tools)	Lack of training in using machines, lack of knowledge about offering, lack of tech skills, personnel	Minimise on transport of material Local adjustments Local access

2.1.2. French cMDF

The French cMDF is nested within the French consumer goods industrial ecosystem, more specifically in the automotive/mobility fields. The French cMDF is composed of three partners, namely, Materalia (SME), Excelcar (Fablab), and FabLab-Vosges (Fablab). This pilot relies on co-design, co-creation and open-innovation methods and tools to accelerate the time-to-market and develop new production processes adapted to rapid demand and technology evolutions.

2.1.2.1. Reverse Perspective

The results of the French cMDF's Reverse Perspective indicate that the pilot does not identify itself as a technical or research centre, an engineering company, a (mass) manufacturing company or a factory, nor as a for-profit organization. The results of this activity can be found in full in Figure 11.

Figure 11: French cMDF Reverse Perspective Post-it notes

2.1.2.2. Blue Sky Vision

The French cMDF Blue Sky Vision (Figure 12) results highlight the intention to expand its service portfolio and to become a one-stop-shop for product design and development and a facilitator for project execution and teamwork, as well as the need to formalize agreements among the pilot's partners for the smooth running of the cMDF.

Figure 12: French cMDF Blue Sky post-it notes

2.1.2.3. MVP

The French cMDF defined three minimal features that together create enough value for their customer, namely, the offering of infrastructure and equipment for small-scale manufacturing, design

and prototyping, an interoperable service network among the partners, and guidance for product development (Figure 13).

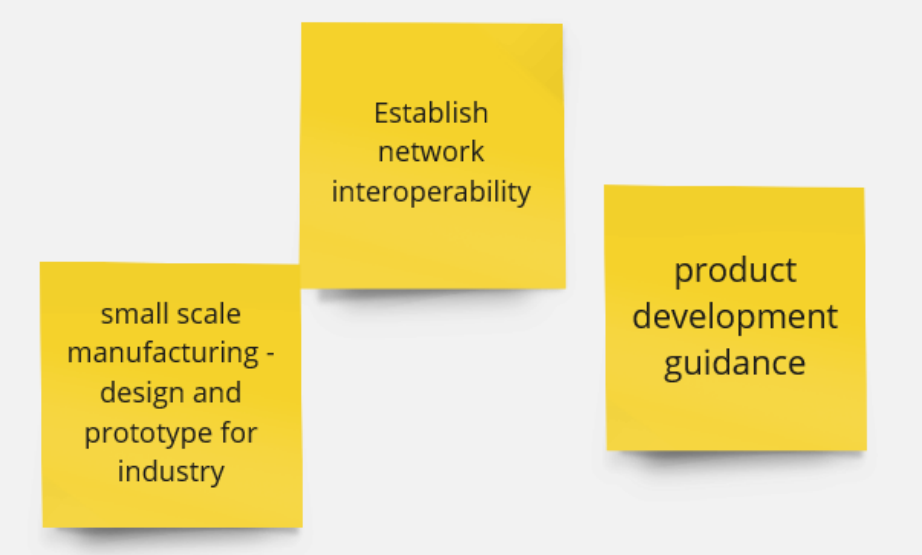

Figure 13: French cMDF MVP post-it notes

2.1.2.4. Stakeholder mapping

The mapping of stakeholders (Figure 14) comprises partner organizations such as FabLabs and incubators, service providers such as financial institutions, research partners, and customers such as consumer goods manufacturers and technical centres.

Figure 14: French cMDF Stakeholder mapping post-it notes

With focus on the iPRODUCE Use Cases, the French cMDF produced a dedicated list of stakeholders per Use Case (Table 6)

Prioritizing stakeholders

Table 6: French cMDF Stakeholders per Use Case

Online training (Digitalisation of services)	Development of mobility oriented product process
Fablabs	Project owner (SME, Startups, Entrepreneurs)
Customers	Incubators
Large manufacturing companies (e.g. Siemens)	Financial support institutes
Makers	Academics
	Cluster
	Makers
	Manufacturing companies
	Design and prototype companies

2.1.2.5. Business Model Canvas (BMC)

Building on the previous activities, the French BMC (Figure 15: French cMDF BMC) depicts a cMDF that will serve entrepreneurs, SMEs, fablabs and makers by offering training and equipment that enable the development of prototypes, as well as a specialized matchmaking to facilitate collaborations. The main revenue streams come from memberships, dynamic pricing (customized offers) and grants, while the cost structure is mostly composed of fixed costs (machinery, personnel, utilities).

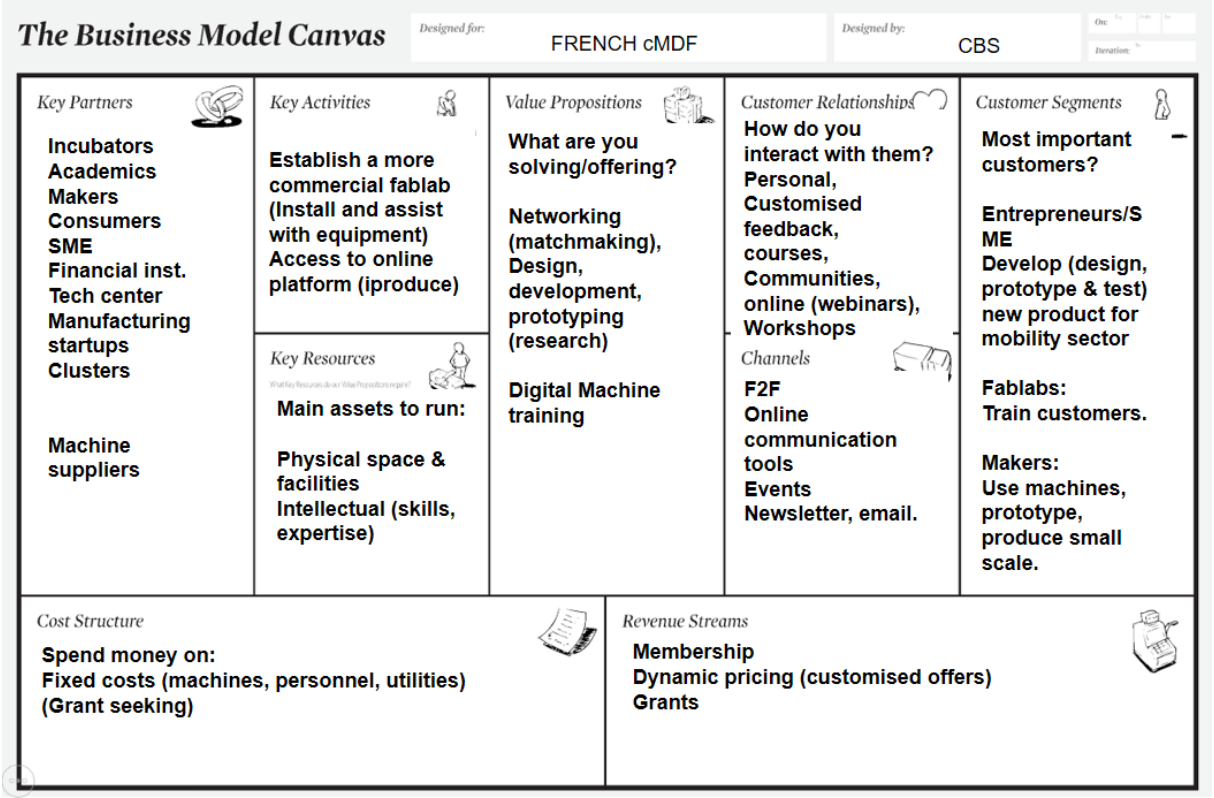

Figure 15: French cMDF BMC

2.1.2.6. Value Proposition Canvas (VPC)

Building on the Business Model Canvas, the VPC (Figure 16) activity identified a market demand for channels conducive to international visibility and networking, as well as for knowledge transfer. To serve this demand, the pilot's value proposition consists of enabling international networking within the industry, equipment availability and an environment that fosters knowledge transfer. To relieve the customer's pains, the French cMDF will facilitate collaborations and innovation through matchmaking and specialized support in areas such as financing, capacity building, product design and prototyping.

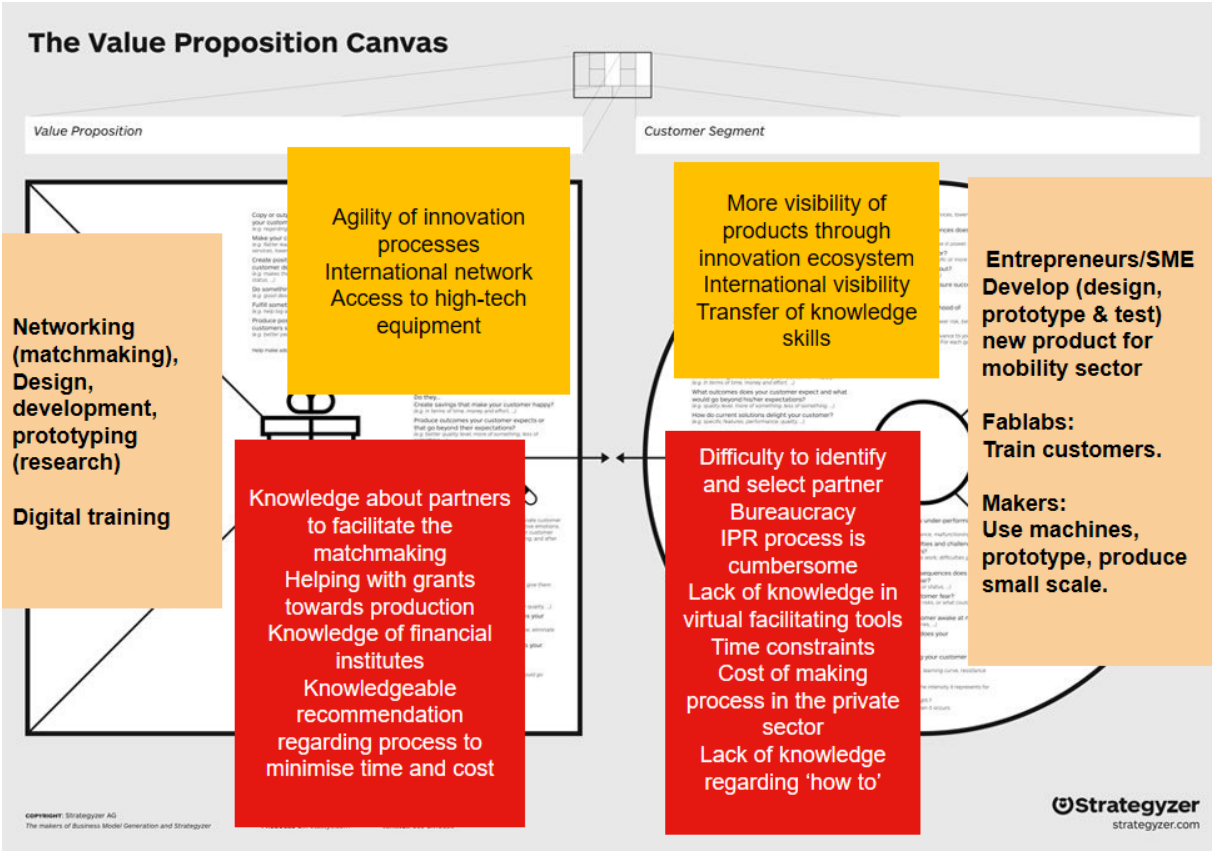

Figure 16: French cMDF VPC

2.1.2.7. iPRODUCE offerings, barriers and assets

Networking and matchmaking, prototyping, training and research are the most relevant iPRODUCE offerings to the French cMDF. The offerings build on the assets brought by the partners such as expertise in prototyping, financing options, their network and their ability to centralize information through iPRODUCE (be it for matchmaking, capacity building and digitalization, to mention a few). These assets will function as tools to overcome the barriers separating the customers from solutions, such as difficulty in identifying partners for matchmaking, bureaucracy and the IPR intricate processes, as well as time and knowledge constraints. Table 7 contains the full list of offerings, barriers, and assets.

Table 7: French cMDF Offerings, Barriers and Assets

Offerings	Barriers	Assets
Networking (matchmaking)	Difficulty to identify and select partners	Knowledge about partners to facilitate the matchmaking Centralization of information Customized recommendation regarding process and machines to minimize time and cost One-stop shop

Design, development, testing and prototyping	Bureaucracy IPR process is cumbersome Lack of knowledge in virtual facilitating tools Time constraints Cost of making process in the private sector Lack of knowledge regarding 'how to'	Knowledgeable recommendation regarding process to minimise time and cost Knowledge of financial institutes Digitalisation of bureaucratic processes (IPR) Higher RoI Wide-availability of machines across the network Expertise regarding services Access to consumers for rapid testing
Digital training	Cost of making process in the private sector Lack of knowledge regarding 'how to'	Have remote access to training Relieving human resources Widening the fablab audience
(research)	Time constraints Cost of making process in the private sector Lack of knowledge regarding 'how to'	Visibility Reach New business opportunities

2.1.3. German cMDF

The German cMDF is nested within the tech development scene (e.g. IoT) in Germany. This pilot relies on open consultation, collaborative product development, and collaborative learning to enhance the co-creation capacity of manufacturing SMEs for consumer product innovation. It is composed of three partners, namely, ZENIT (cMDF), Makerspace Bonn (Fablab), and Fraunhofer Institute - FIT (Research).

2.1.3.1. Reverse Perspective

The results of the German cMDF's Reverse Perspective reveal that the pilot is not an engineering company nor a large-scale production company/factory. The German makerspace is not owned by another company, so they have a degree of freedom and independence, and although they are involved in research, they are not an academic institution. Furthermore, it is partially for profit and it is primarily described as 'no hands on' production site, meaning that they provide the operation of machines themselves, instead of allowing outsiders to engage with them. The results of this activity can be found in full in Figure 17.

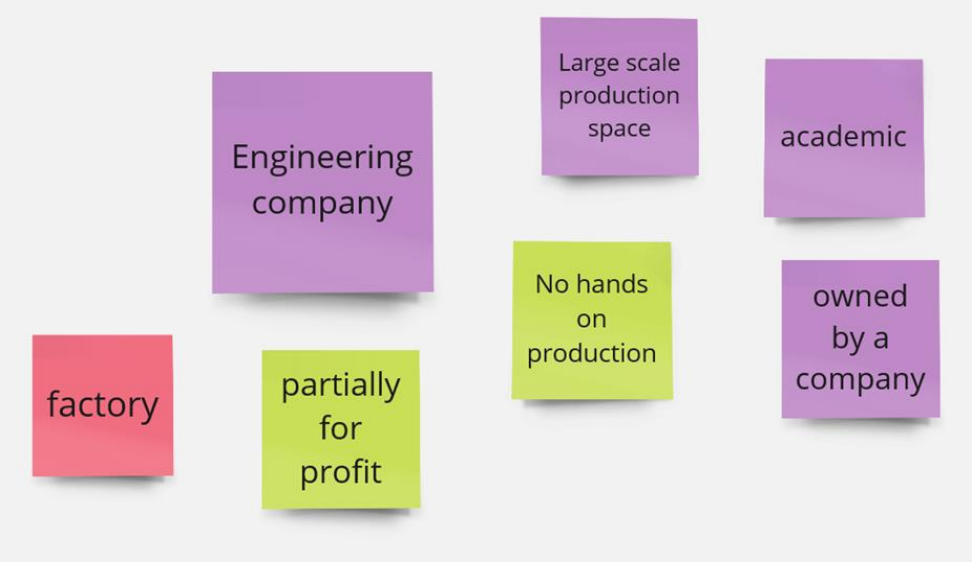

Figure 17: German cMDF Reverse Perspective post-it notes.

2.1.3.2. Blue Sky Vision

Aligned with the pilot's objective, the results of the German cMDF Blue Sky Vision (Figure 18) highlight the plan to design a portfolio of services that serve SMEs, especially regarding training in tech-related fields. Additionally, the pilot partners will work to establish work agreements for the smooth run of the cMDF.

Figure 18: German cMDF Blue Sky vision post-it notes

2.1.3.3. MVP

The German cMDF defined two minimal features that together create enough value for their customer base, namely, customised consulting services for the development of prototypes and specialized networking to optimize matchmaking and create collaboration opportunities shown in Figure 19.

Figure 19: German cMDF MVP post-it notes

2.1.3.4. Business Model Canvas (BMC)

Building on the previous activities, the German BMC (Figure 20) depicts a cMDF that will serve entrepreneurs, startups, makers and SMEs through Guided Product Development as a service, machine use training and by enabling co-creation opportunities. To do so, the cMDF offers a physical space with the necessary equipment for designing and prototyping as well as a community of knowledge and specific training to enable innovation and product development. The main revenue streams come from private memberships, customized offers, public grants and company memberships, while the cost structure is mostly composed of fixed costs (machinery, personnel, utilities, materials).

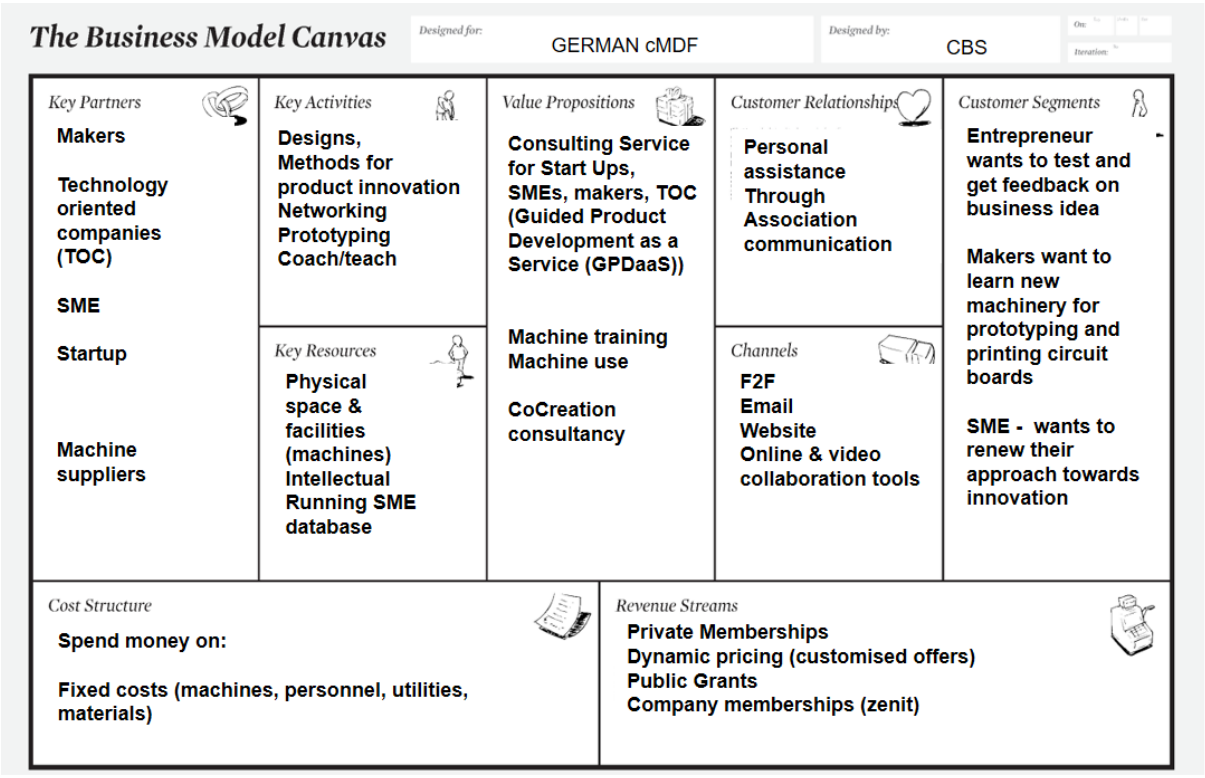

Figure 20: German cMDF BMC

2.1.3.5. Value Proposition Canvas (VPC)

Building on the Business Model Canvas, the VPC (Figure 21) activity highlights the market demand for prototyping and printing circuit boards training, opportunities to test and get feedback on business

ideas, as well as opportunities to reassess the approach to innovation. To serve this demand, the pilot's value proposition consists of offering a physical space, equipment, networking and partnership opportunities as well as a knowledge base that allows for prototyping and testing technical feasibility. To relieve the customer's pains of limited machinery and time, uncertainties regarding RoI (Return on Investment), lack (or limited) knowledge and communication limitations, the German cMDF will offer a resource management tool to support planning, will democratise access to methods based on the freemium model[3], and will add value to the customer experience (an example could be how the whole process should be smooth and convenient).

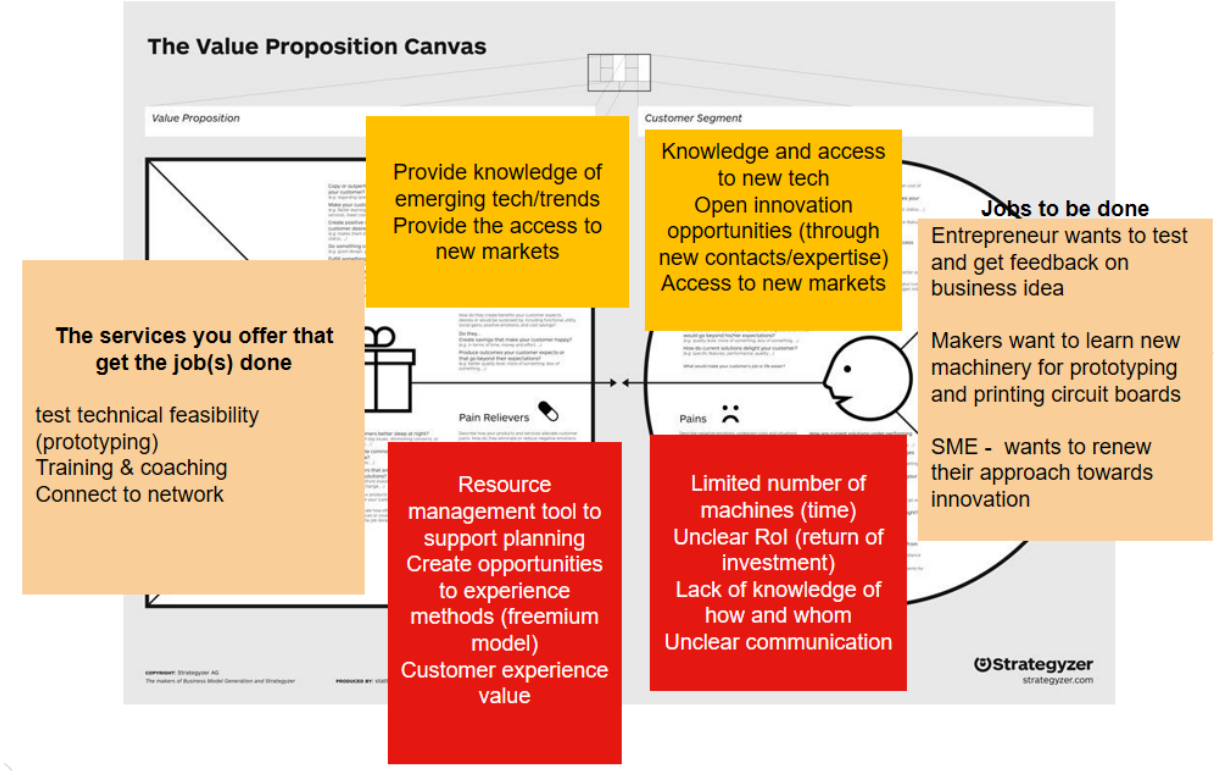

Figure 21: German cMDF VPC

2.1.3.6. Stakeholder mapping

The mapping of stakeholders (Figure 22) comprises SMEs, startups, makers and technology oriented companies.

[3] Freemium is a business model in which a company offers basic or limited features to users at no cost and then charges a premium for supplemental or advanced features.

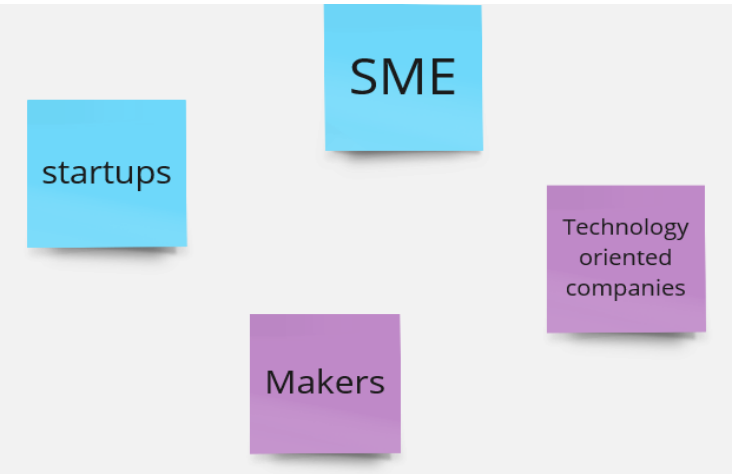

Figure 22: German cMDF Stakeholder overview post-it notes

With focus on the iPRODUCE Use Cases, the cMDFs produced a dedicated list of stakeholder shown on Table 8.

Table 8: German cMDF stakeholder overview

Guided product development as a service (GPDas)	Methodological training	Methodological consulting	New skills, MSB, IoT education kit
Technology oriented companies (TOC)	Technology oriented companies (TOC)	Technology oriented companies (TOC)	Technology oriented companies (TOC)
SME	SME	SME	SME
	Makers	Makers	Makers
Startup	Startup	Startup	Startup

2.1.3.7. iPRODUCE offerings, barriers and assets

The most relevant offerings of the iPRODUCE to the German pilot are the infrastructure (expertise and equipment) that allow for prototyping and testing technical feasibility, training and coaching, and networking. The offerings' enabling assets are the cMDF's specialized personnel that will provide customized guidance through the innovation and prototyping process, the availability of knowledge and access to emerging techs and trends, as well as specialized matchmaking to optimize opportunities for collaboration. The offerings' barriers concern limited equipment, limited access to networking and partner information, and difficulties in converting customers. The results of the offerings, barriers and assets analysis is displayed in Table 9.

Table 9: German cMDF Offerings, Barriers and Assets

Offerings	Barriers	Assets
test technical feasibility (prototyping)	Lack of enough machines Converting customers	Provide knowledge of emerging tech/trends Production of prototype /early testing
Training & coaching	Converting customers	Process knowledge Customised knowledge/guidance
Connect to network	Lack of information regarding network partners Engage in participation	Provide catered access to new markets/companies

2.1.4. Greek cMDF

2.1.4.1. Reverse Perspective

The results of the Reverse Perspective activity (Figure 23) of the Greek cMDF reveal that the pilot is not a FabLab, a makerspace, a training company, a factory, not an import company; it is also not an industrial manufacturer. Their focus goes beyond profit, allowing for research and experimental projects that do not necessarily bring a revenue, to take place.

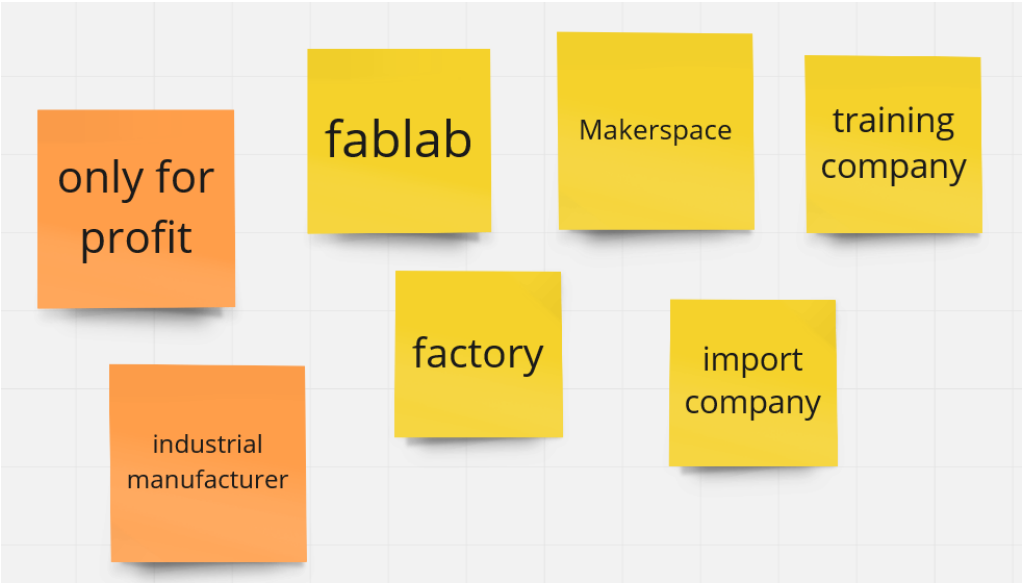

Figure 23: Greek cMDF Reverse Perspective post-it notes

2.1.4.2. Blue Sky Vision

Aligned with the results of the Reverse Perspective activity, the Greek cMDF Blue Sky Vision (Figure 24) envisions growth sustained by the receiving of more grants, the broadening of its (business) partners base; by amplifying the pilot's talent density; by adding more products (and services) to its portfolio including community-focused services; by increasing patent valorisation; and by acting as an incubator thus increasing spin offs.

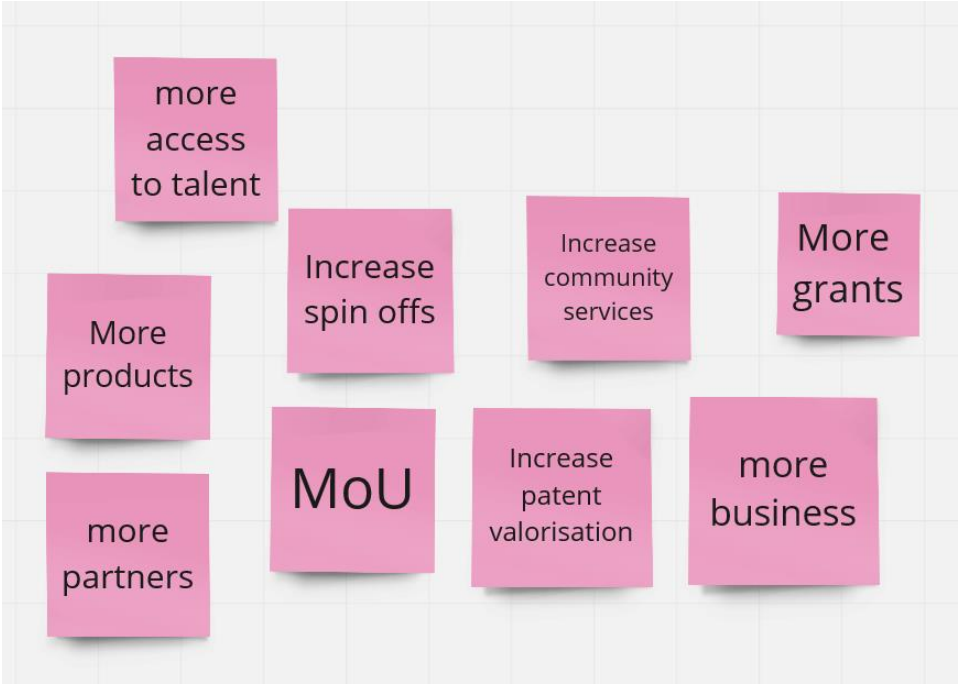

Figure 24: Greek cMDF Blue Sky Vision post-it notes

2.1.4.3. MVP

The Greek cMDF defined four minimal features that together create enough value for their customer base, namely, facilitated access to production infrastructure and rapid prototyping with industrial-level design and manufacturing resources, and support during the entire research and development process shown in Figure 25.

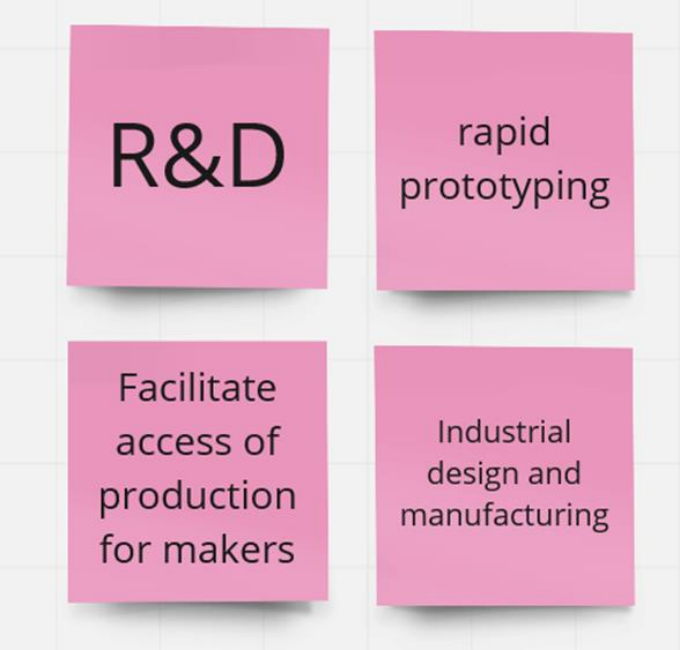

Figure 25: Greek cMDF MVP post-it notes

2.1.4.4. Business Model Canvas (BMC)

Building on the previous activities, the Greek BMC (Figure 26) depicts a cMDF that will serve medicine doctors and makers through research and development of customized medical appliances - including collaborative ideation and prototyping with patient participation - and the use of digital tools (e.g. IoT and 3D printing). Additionally, the cMDF will report findings to the (medical) scientific community, thus further developing knowledge in the medical field and fostering patient wellbeing. To do so, the cMDF offers the necessary equipment and physical space for prototyping, expertise in product development, raw materials and commercial and sales channels. The main revenue streams come from pay-per-use and dynamic pricing (customized offers) while the cost structure is mostly composed of fixed costs (e.g. machinery, personnel, licencing, marketing, utilities) and dynamic costs (e.g. conferences, clinical trials, travel).

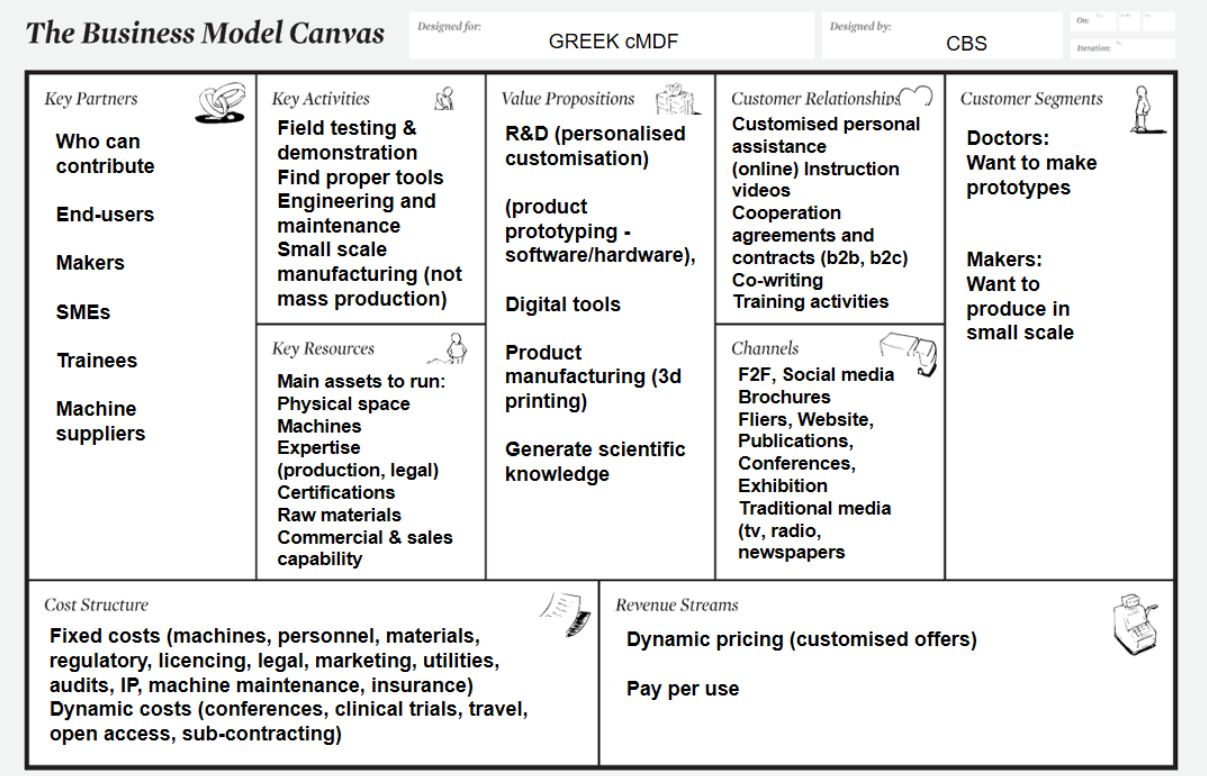

Figure 26: Greek cMDF BMC

2.1.4.5. Value Proposition Canvas (VPC)

Building on the Business Model Canvas, the VPC (Figure 27) activity identified a market demand for customized (orthopaedic) medical devices. To serve this demand, the pilot's value proposition consists of researching and developing these solutions in partnership with doctors and makers with the use of prototyping methods, digital tools and 3D printing. To relieve the customer's pains of engineering-doctor gap, machine unavailability, and lack of knowledge about manufacturing, the market and business best practices, the Greek cMDF will facilitate access to information, training and machinery, thus developing the capacities and equipment for customized product development.

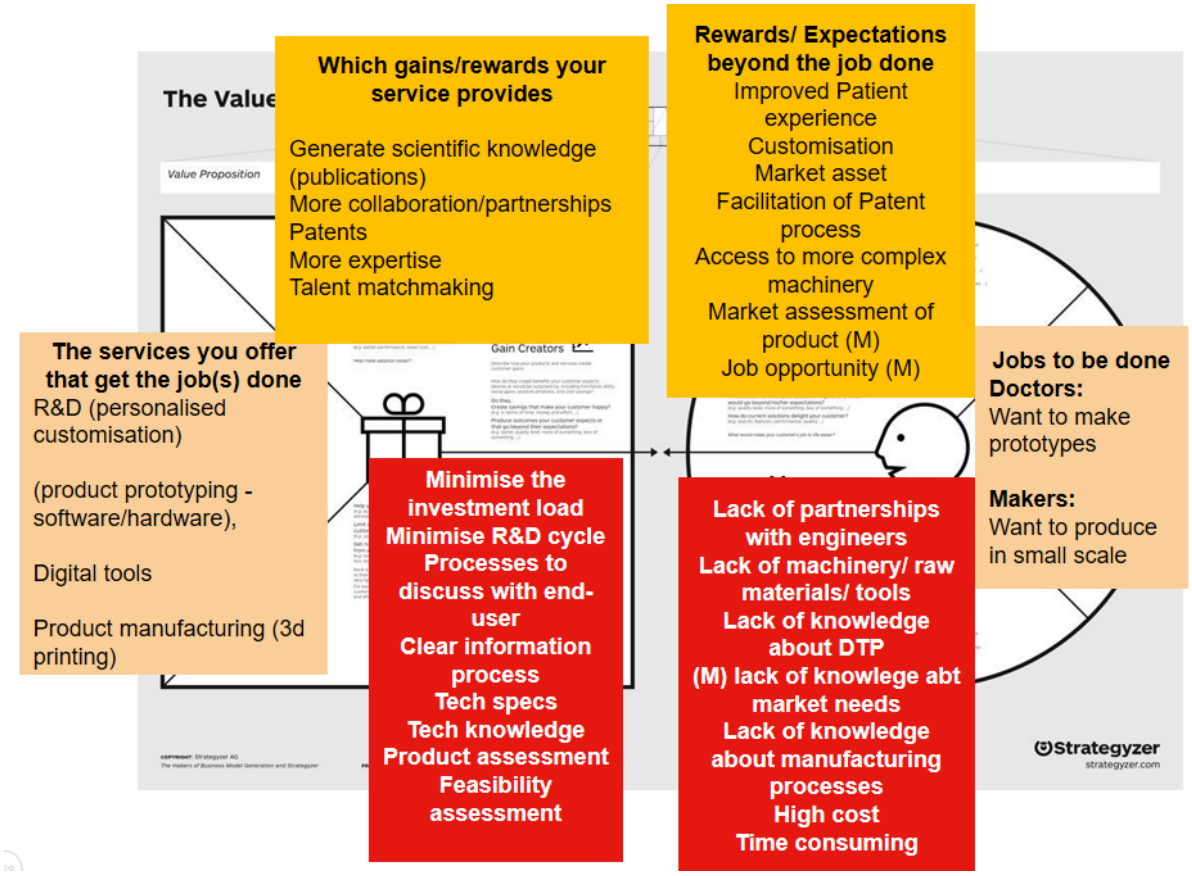

Figure 27: Greek cMDF VPC

2.1.4.6. Stakeholder mapping

The stakeholder mapping (Figure 28) comprises partner organizations such as manufacturers, industry and SMEs, as well as customer segments such as trainees, makers, and end-users.

Figure 28: Greek cMDF Stakeholder Mapping post-it notes

Additionally, the cMDF's partners CERTH and AidPlex expressed different levels of relevance of each stakeholder (Table 10) concerning the roles they play within the cMDF.

Table 10: Greek cMDF stakeholder list by partner

CERTH	AidPlex
1. Trainees 2. Makers 3. End-users (e.g. doctors) 4. SMEs 5. Consumers, Industrial stakeholders, Manufacturers	1. End-users (e.g. doctors), SMEs, Makers 2. Consumers 3. Manufacturers 4. Industrial stakeholders 5. Trainees

With focus on the iPRODUCE Use Cases, the cMDF produced a dedicated list of stakeholder shown on Table 11.

Table 11: Greek cMDF stakeholder prioritising table

Orthopaedic back braces	Protective face shields	Lightweight & skin friendly splints for pets/animals	Lightweight & skin friendly splints for children / adults	3D Printed Smart Luminous Artefacts
Doctors End-user SME	Doctors End-user Makers SME Trainees Students	Vets Animals (owners) SME	Doctors End-user SME	Children Trainees

2.1.4.7. iPRODUCE offerings, barriers and assets

The most relevant offerings of the iPRODUCE platform to the Greek cMDF are R&D, the digital tools, such as 3D visualisation, matchmaking, generative design, etc. embedded into the platform, the prototyping software and hardware, as well as a 3D printer for manufacturing. The offerings' assets are the minimization of investment loads and R&D cycle, the availability of tech specialists and tech expertise (methodology and assessments), end-user participation in the development phase, and tools availability. The offerings' barriers concern lack of partnerships with engineers focusing on dormant opportunities in the medical sector. The results of the offerings, barriers and assets analysis are displayed in Table 12.

Table 12: Greek cMDF Offerings, Barriers and Assets

Offerings	Barriers	Assets
R&D (personalised customisation)	Lack of partnerships with engineers Lack of machinery/ raw materials/ tools Lack of knowledge about DTP (M) lack of knowledge about market needs Lack of knowledge about manufacturing processes High cost Time consuming	Minimise the investment load Minimise R&D cycle Processes to discuss with end-user Clear information process Tech specs Tech knowledge Product assessment Feasibility assessment
Product prototyping - software/hardware	Lack of partnerships with engineers Lack of machinery/ raw materials/ tools Lack of knowledge about DTP (M) lack of knowledge about market needs Lack of knowledge about manufacturing processes	Minimise the investment load Minimise R&D cycle Processes to discuss with end-user Clear information process
Digital tools	Lack of software licenses (high cost)	Technology Feasibility assessment Access to tools
Product manufacturing (3d printing)	Lack of machinery/ raw materials/ tools	Product assessment Feasibility assessment Tech specs Tech knowledge

Generate scientific knowledge	Lack of specific knowledge related to the field	Tech specs Tech knowledge

2.1.5. Italian cMDF

The Italian cMDF aims to enable collaborative engineering between the microelectronics manufacturing companies, the cMDF and Fablabs, involving the community of experts and makers, local start-ups and SMEs to use the iPRODUCE tools and methods in product enhancement and creation. It comprises three partners, namely, PROM Facility (manufacturing), MUSE (FabLab) and Noitech (makerspace).

2.1.5.1. Reverse Perspective

The results of the Reverse Perspective activity (Figure 29) reveal that the three partners do not see the cMDF as an engineering company, mass manufacturer, SME, factory, nor as an academic institution or focused on theoretical research. The makerspace is also not for profit, as it is public funded, therefore not a competitor in the market as such, but they can support the market with the services offered.

Figure 29: Italian cMDF Reverse Perspective post-it notes

2.1.5.2. Blue Sky Vision

Aligned with the results of the Reverse Perspective activity, the Italian cMDF envisions a for-profit business model that is internationally recognized as a reference cMDF. They plan on exploiting market opportunities and on increasing the number of innovation initiatives (patents and knowledge transfer), as well as on engaging and co-producing with international partners and on formalizing the cMDF's agreements shown on Figure 30.

Figure 30: Italian cMDF Blue Sky Vision post-it notes

2.1.5.3. MVP

The Italian pilot identified three elements that (together) offer enough value to their customer base, namely, a holistic approach to service, the (software and hardware) structure for prototyping, and the set up to deliver on the iPRODUCE use cases shown in Figure 31.

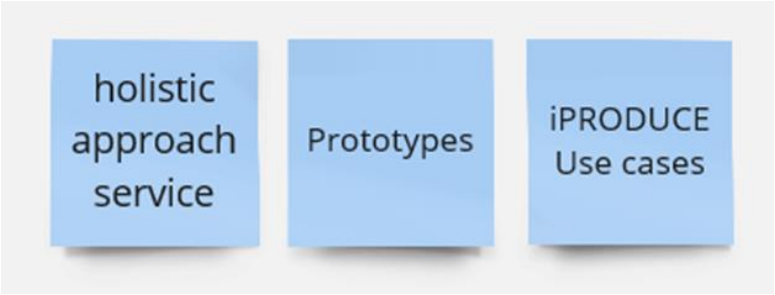

Figure 31: Italian cMDF MVP post-it notes

2.1.5.4. Business Model Canvas (BMC)

Building on the previous activities, the BMC (Figure 32) depicts a cMDF that will serve engineers and designers, inventors looking for industrialising their patent, and students and employees looking for hands on training through machine training and availability, prototyping equipment, expertise and specialised advice. To do so, the cMDF offers a physical space and facilities as well as expertise to support their customers, accompanied by support in finding financing options and matchmaking to induce collaborations. The main revenue streams come from pay per use, fixed and dynamic pricing and public grants, while the cost structure is mostly composed of fixed costs (e.g. machinery, personnel and utilities).

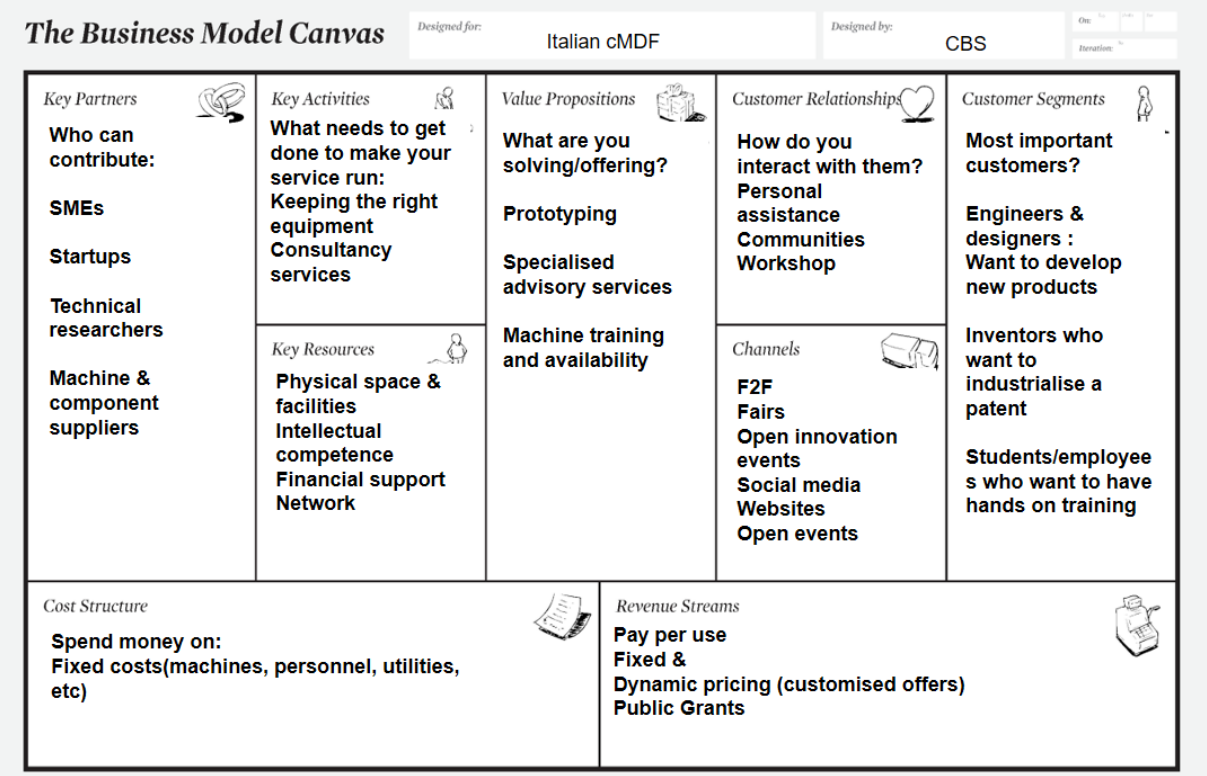

Figure 32: Italian cMDF BMC

2.1.5.5. Value Proposition Canvas (VPC)

Building on the Business Model Canvas, the VPC (Figure 33) activity identified a market demand for constant innovation and product development in the microelectronics sector. To serve this demand, the pilot's value proposition consists of specialised advisory service and prototyping facilitation, including support with product positioning and networking to foster collaborations. To relieve the customer's pains concerning the lack of competences, machinery, time and money, the Italian cMDF will facilitate collaboration and financing opportunities through matchmaking and its network, as well as will build capacities through training programs.

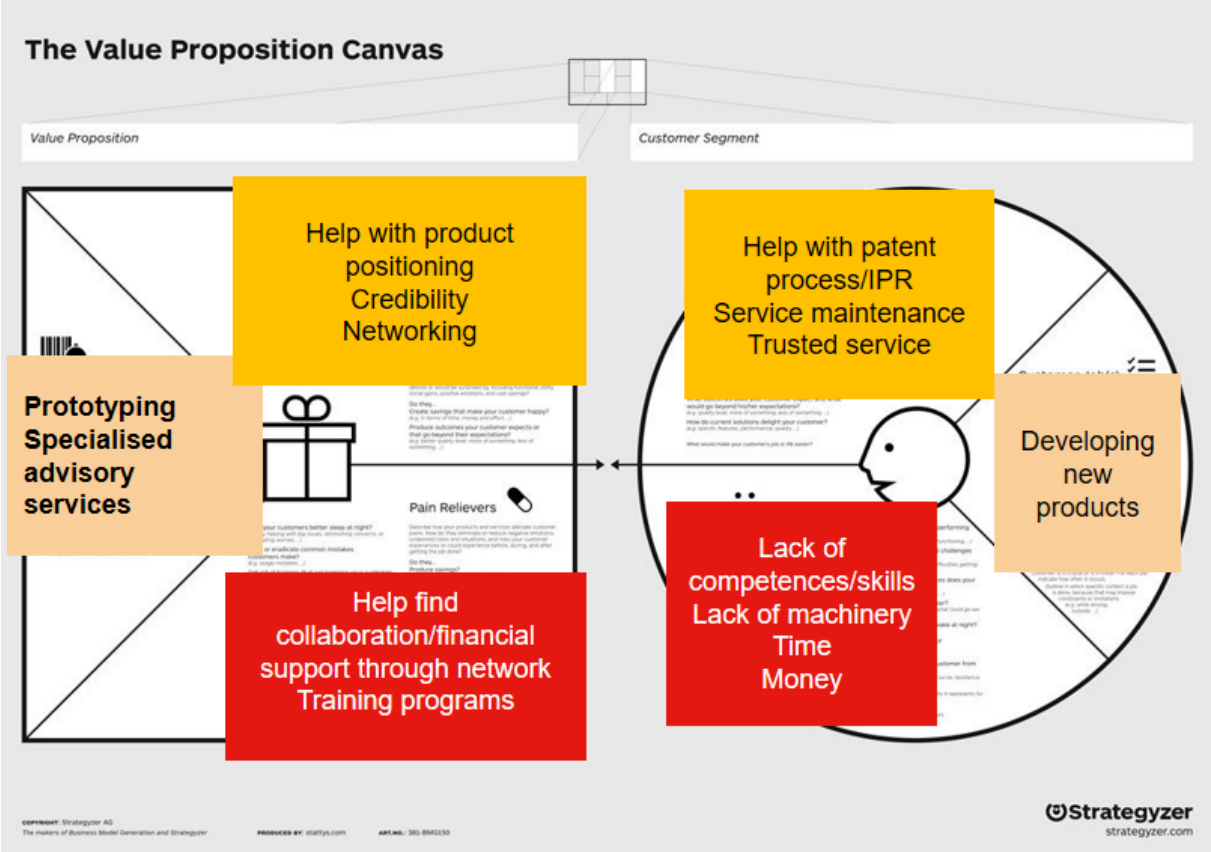

Figure 33: Italian cMDF VPC

2.1.5.6. Stakeholder mapping

The stakeholder mapping (Figure 34) comprises the SMEs and startups, as well as technical researchers.

Figure 34: Italian cMDF Stakeholder Mapping post-it notes

With focus on the iPRODUCE Use Cases, the cMDF produced a dedicated list of direct stakeholder shown on Table 13.

Table 13: Italian cMDF Direct Stakeholders

Roboshaker	Auto-watering system
Component suppliers SMEs	Component suppliers GDO hobbyists

2.1.5.7. iPRODUCE offerings, barriers and assets

Prototyping and specialized advisory services are the most relevant offerings of iPRODUCE to the Italian cMDF. These offerings build on assets such as partner skills and equipment availability, open-innovation, network and customization to overcome the barriers lack of innovation will, time and cost constraints, perceived risk and possible mistrust regarding sharing IP information with outside partners - the Ricardian contracts allow for explicit agreements, providing a safe environment for IP exchange. Table 14 contains the full list of offerings, barriers, and assets.

Table 14: Italian cMDF Offerings, Barriers, Assets

Offerings	Barriers	Assets
Prototyping	Time Cost Innovation will/credibility Lack of Investment in innovation Innovation resistance Risk RoI Scalability	Disruptive approach Skills Equipment Open innovation Network Risk assessment/mitigation plan
Specialised advisory services	Trust	Customisation

2.1.6. Spanish cMDF

The objective of this pilot is to enable collaborative engineering among furniture manufacturing companies, the cMDF and the FabLab jointly with the community of experts and makers, allowing them to develop customer-driven products with complex specifications that the furniture producer cannot tackle on his own. The Spanish cMDF comprises three partners, namely, AIDIMME (research), Lagrama (furniture manufacturer) and Océano Naranja (FabLab).

2.1.6.1. Reverse Perspective

The results of Reverse Perspective (Figure 35) reveal that the Spanish pilot does not identify itself as an IT company, nor a (mass) manufacturing, distribution or sales company. Furthermore, it is not 'just' a FabLab.

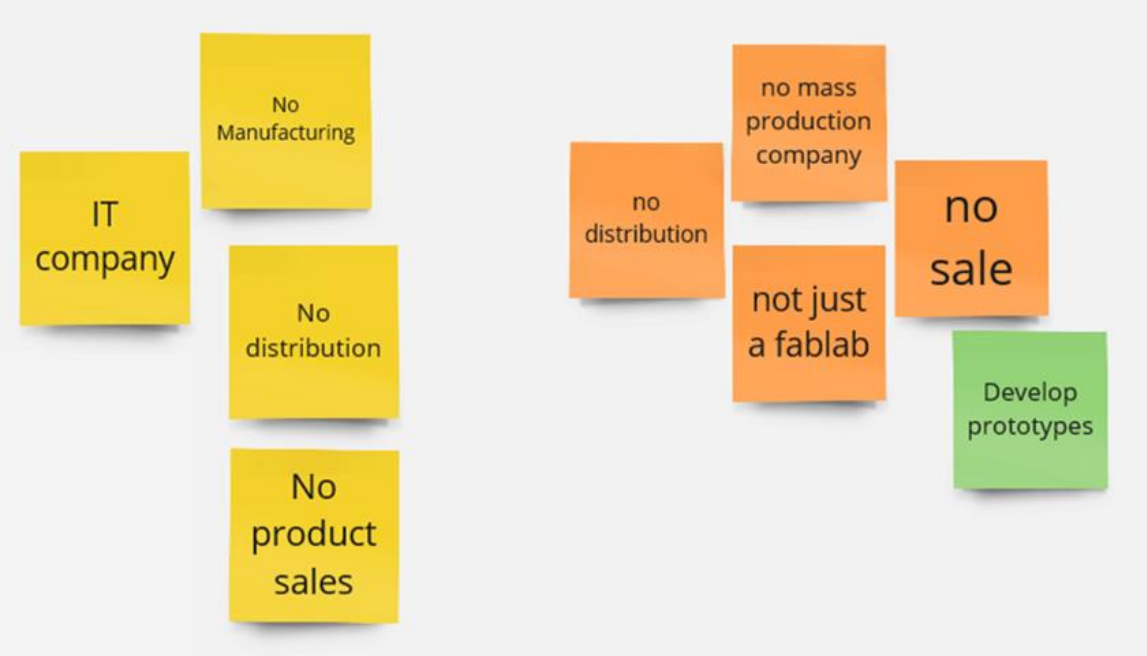

Figure 35: Spanish cMDF Reverse Perspective post-it notes

2.1.6.2. Blue Sky Vision

Aligned with the results of the Reverse Perspective activity, the Spanish cMDF envisions becoming an international reference centre and a reference in improving competitiveness. It plans on improving planning, automation, communication to achieve collaboration efficiency and longevity. In the short term, it aims to roll out the iPRODUCE use cases efficiently. Figure 36 contains the full list of elements of the pilot's Blue Sky Vision. The makerspace is currently run by a couple, whose hope is to sell it or to find run it sustainably through merging or changing the ownership.

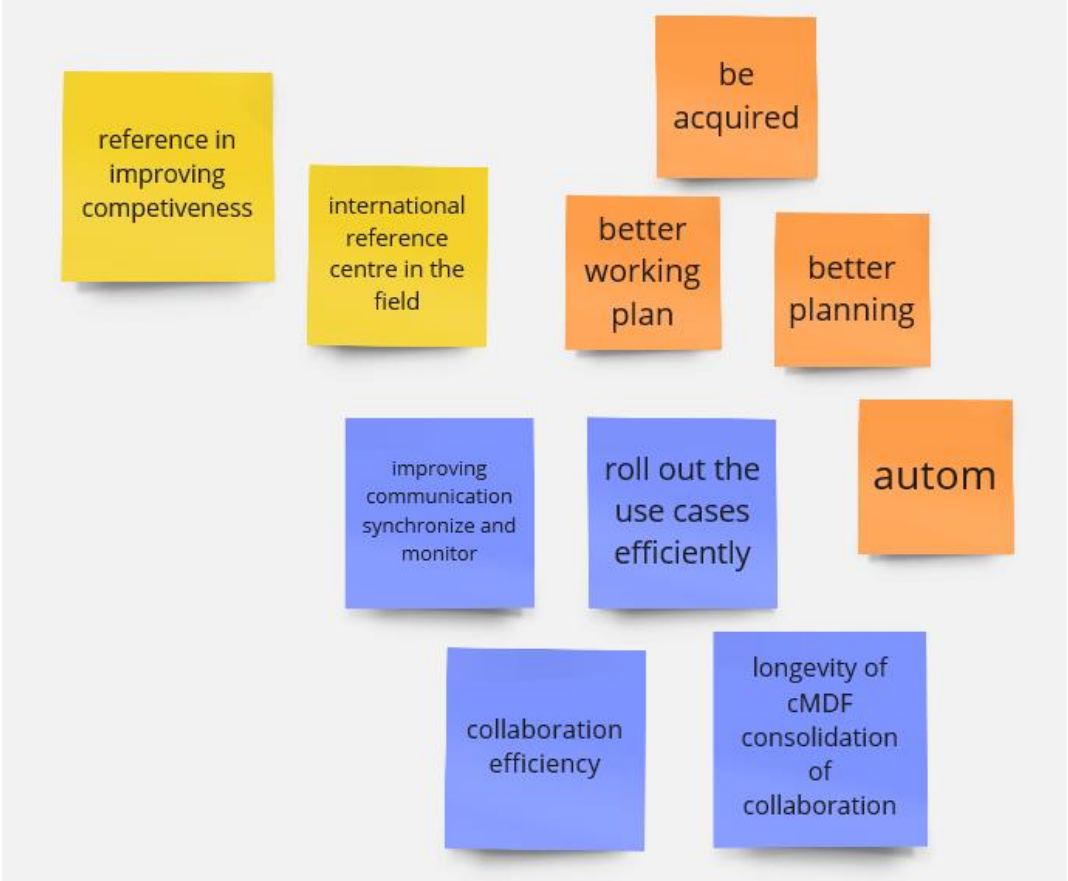

Figure 36: Spanish cMDF Blue Sky Vision

2.1.6.3. MVP

The Spanish pilot identified three elements that (together) offer enough value to their customer base, namely, a framework and service to support product development innovation, prototyping, lab-testing certification of products and R&D shown in Figure 37.

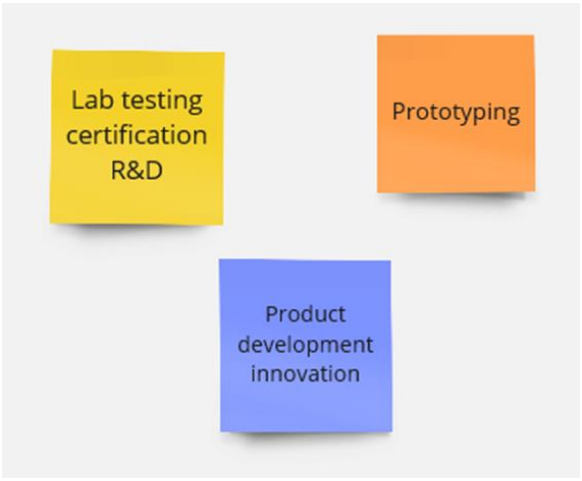

Figure 37: Spanish cMDF MVP

2.1.6.4. Business Model Canvas (BMC)

Building on the previous activities, the BMC (Figure 38) depicts a cMDF that will serve students, teachers, designers, makers, engineers and R&D/procurement managers through prototyping, R&D services and machine training and availability. To do so, the cMDF offers a physical space equipped with machinery as well as expertise in these fields. The main revenue streams come from grants, dynamic and fixed pricing, membership fees and pay per use, while the cost structure is mostly composed of fixed and ad-hoc expenditures such as machinery and personnel.

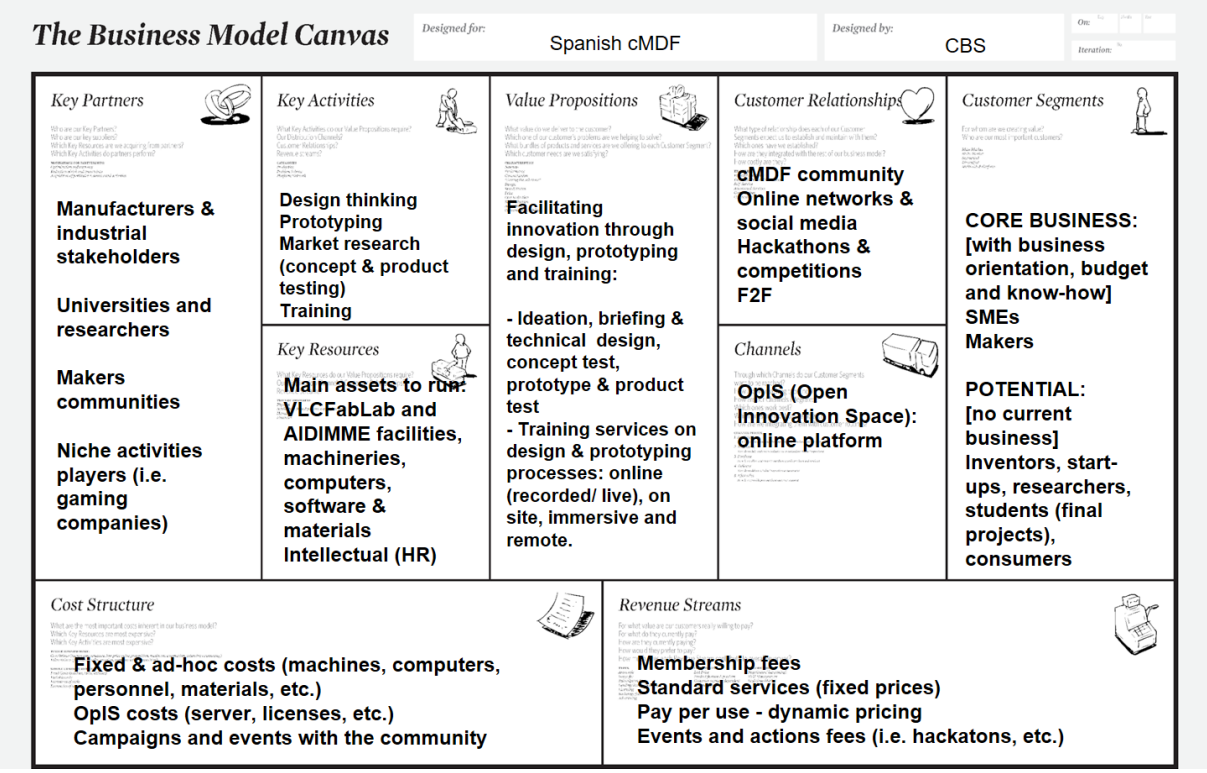

Figure 38: Spanish cMDF BMC

2.1.6.5. Value Proposition Canvas (VPC)

Building on the Business Model Canvas, the VPC (Figure 39) activity identified a market demand for training and financing for product development and innovation. To serve this demand, the pilot's value proposition consists of providing advice regarding the market, cost optimization and certifications. To relieve the customer's pains, the Spanish cMDF will support innovation initiatives in the look for financing opportunities.

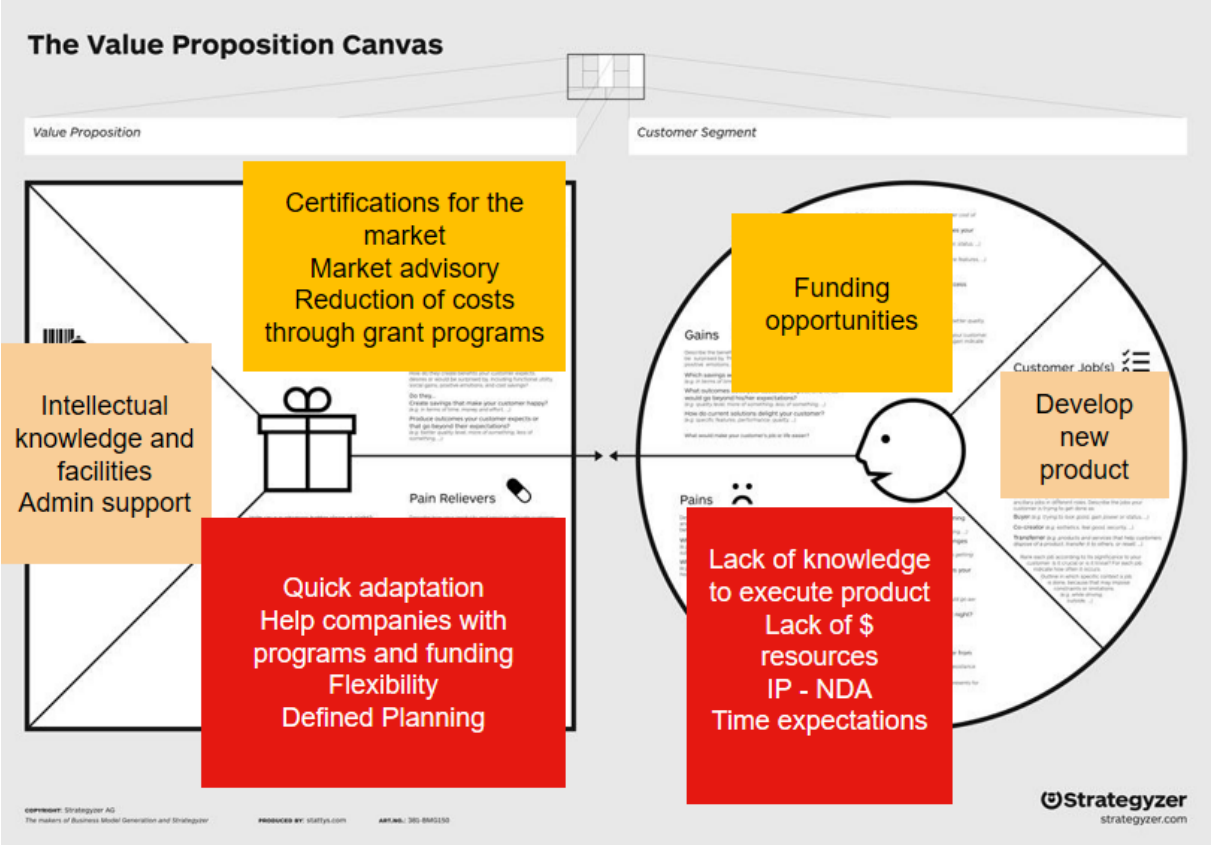

Figure 39: Spanish cMDF VPC

2.1.6.6. Stakeholder mapping

The mapping of stakeholders (Figure 40) comprises SMEs, startups, and large companies, makers, industrial associations and policy makers, governmental agencies, designers and architects.

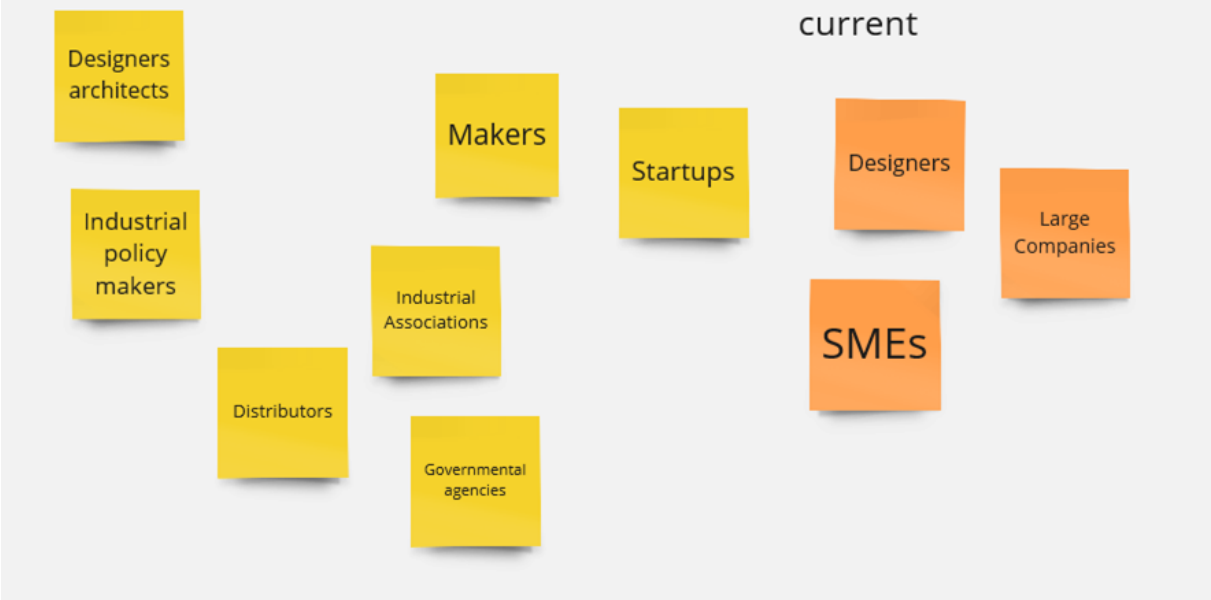

Figure 40: Spanish cMDF Stakeholder Mapping

Stakeholders to be exploited in iPRODUCE (Figure 41) are more of a targeted group that fits their use case goals, so students and end-consumers, manufacturers, entrepreneurs, carpentry companies, besides the machine suppliers, which the spaces depend on.

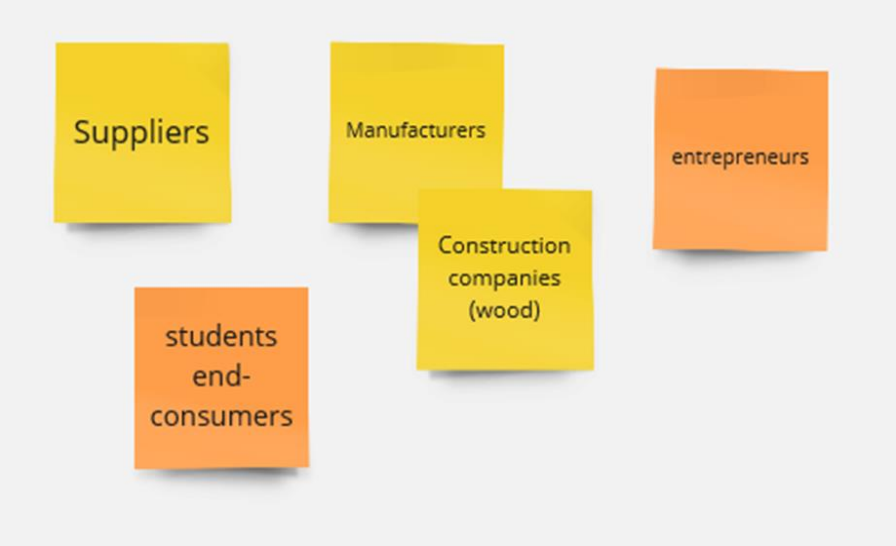

Figure 41: Spanish cMDF List of Stakeholders to be exploited in iPRODUCE

With focus on the iPRODUCE Use Cases, the cMDFs produced a dedicated list of stakeholders presented on Table 15.

Table 15: Spanish cMDF Stakeholders per Use Case

Smart bed headboard	Smart adjustable gamer chair	New product design
Manufacturers (Large companies, SME)	Manufacturer + gamers (Large companies, SME)	Makers, entrepreneurs End-user/consumer

2.1.6.7. iPRODUCE offerings, barriers and assets

Intellectual knowledge, facilities and administrative support are the most relevant offerings of iPRODUCE to the Spanish cMDF. These offerings build on assets such as internal knowledge of the cMDF partners, especially regarding certification schemes and policies. Yet, it faces barriers such as unavailability of personnel, customers' lack of capabilities or experience, operational systems' complexity, limited financial resources and technology barriers. Table 16 contains the full list of offerings, barriers, and assets.

Table 16: Spanish cMDF iPRODUCE offerings, barriers and assets

Offerings	Barriers	Assets
Intellectual knowledge and facilities Admin support	Confidentiality requests Availability of personnel Lack of Capability and experience of clients Complexity of programs Financial resources Technology barriers	Labs Internal know-how Certification of products (if they comply with legislation/etc.) Knowledge about specialised committees in certification and policies

3. Workshop Results Analysis

In this section, we present a thematic analysis of the data collected in the workshops. We use an inductive approach[4] to identify, analyse, and report repeated patterns (Braun and Clarke, 2006) on the following workshop activities: Reverse Perspective, Blue Sky Vision, MVP, Stakeholder mapping, and iPRODUCE offerings, barriers and assets. For the Business Model Canvas (BMC) and Value Proposition Canvas (VPC), we adopt a deductive approach[5] using the predefined areas of each of these templates as coding themes.

3.1. Reverse Perspective

We identified six umbrella themes regarding what the cMDFs are not, namely, Industry and activity, Business structure and ownership, Culture and values, Differentiation, Commercial relations, Strategy and positioning. The thematic analysis is presented on Table 17. All cMDFs described their negative scope regarding the industry in which they operate and activities they offer. None of them operates on an industrial/mass manufacturing/factory-like scale. There are multiple mentions of them not being an engineering company, nor just a makerspace/FabLab, a training company, an IT company, an import company, an academic or research centre, nor a storage centre. Except for Spain, all the cMDFs pondered about their profit orientation and occasionally regarding the business structure. Culture and values, differentiation and strategy elements were only mentioned by the Danish cMDF, with the pilot not being chaotic nor soulless nor unprofessional, not being hard to join nor stagnant. Regarding commercial relations, the Danish cMDF is not a place for everyone, while the Italian cMDF is not a customer nor a market competitor, and the Spanish cMDF does not distribute or sell products to other businesses.

[4] Inductive analysis is a process of coding the data without trying to fit it into a pre-existing coding frame or the researcher's analytic preconceptions, but rather allowing the themes to arise from the data collected. In this sense, this form of thematic analysis is data-driven (Braun & Clarke, 2006).
[5] Deductive analysis is a process in which the coding frame will be elaborated prior to the coding process, and it will be based on concepts of previous research or existing theories (Schreier, 2012).

Table 17: Reverse Perspective Thematic Analysis across the cMDFs

	France	Denmark	Germany	Greece	Italy	Spain
Industry/activity	Engineering company Mass manufacturing Factory Manufacturing company Technical centre Research centre	A storage centre Mass Production Not a 10K part production facility [just a] Wood Workshop Industrial A (traditional) makerspace An office, A full service provider	Engineering company Large scale production space Factory No hands on production Academic	Import company Industrial manufacturer Factory Fablab/makerspace Training company	Engineering company Mass manufacturer Factory Academic institution/Theoretical research	IT company Mass production company No manufacturing Not just a FabLab Develop prototypes
Business Structure and Ownership	For profit	Low-margin business Not reserved to single distributor	Partially for profit Owned by a company	Only for profit	For profit SME	
Culture and Values		Unprofessional At rest Soulless Chaotic Without a				

	France	Denmark	Germany	Greece	Italy	Spain
		culture/ethos/community				
Differentiation		Hard to join – we've got what you need Not a single workshop				
Commercial relations		A place for everyone Not a 1 company facility			Customer Competitor	No distribution No product sales/No sales
Strategy and Positioning		Stagnant N.2 Entry-level makerspace facility				

3.2. Blue Sky Vision

We identified five umbrella themes across the cMDFs' Blue Sky Visions, namely, Business structure, Services and growth, Branding and positioning, Internal business development, Non-commercial relations. The thematic analysis is presented on Table 18. As expected, it is possible to establish thematic connections between what the pilots are not (Reverse Perspective) and what the pilots ought to be (Blue Sky Vision), especially regarding business structure, services offered, market positioning and (non-)commercial relations appear in both activities.

Regarding business structure, all teams - except for the Danish pilot - pointed out the importance of formalizing agreements, such as the ones offered by Ricardian contracts, for the smooth operation of the cMDFs. Remarks regarding the services to be designed and/or provided and growth were abundant. For instance, the French cMDF plans on developing new services to facilitate networking and the design and development of products, while the Danish cMDF plans on offering education opportunities where people can develop skills for the design and production of products, preferably with potential to tackle the climate crisis. The German cMDF, on the other hand, chooses to focus on developing services for a specific target group, namely, SMEs. The Greek cMDF is specifically interested in growth, with plans to prospect more partners and to promote startups through spin offs and incubation. The Greek pilot also aims to increase community services and patent valorisation, expanding its IP portfolio, thus attracting more business opportunities to the cMDF. The Italian pilot aims at a future where more market opportunities are exploited and where they engage and co-produce with international partners, increasing the number of innovation initiatives (patents) and knowledge transfer. Contrary to the other pilots, the Spanish cMDF did not mention elements referring to service expansion and growth in the Blue Sky Vision activity. Regarding branding and positioning, three pilots - Denmark, Italy and Spain - desire to reach international recognition in the field. The French and Danish pilots' desire to offer a full range of services in their field is shown in the terms 'a one-stop-shop for all services', 'a jack of all trades', and 'do everything'. The Danish pilot goes beyond mentioning that they want to become the Netflix of education [in their field], to launch their own machine brand into the market, as well as to broaden their community impact by starting a foundation to support startups. The German and Greek pilots did not mention elements of branding and market positioning in their Blue Sky Vision map. Regarding internal business development, the Danish pilot wants to become a data-driven streamlined organisation while the Greek team aims for talent density and a wide portfolio of products and the Spanish pilot plans to devise an improved communication framework together with improving planning to reach collaboration efficiency. The French, German and Italian cMDFs did not mention elements of internal business development in their Blue Sky Vision map.

Table 18: Blue Vision thematic Analysis across the cMDFs

	France	Denmark*	Germany	Greece	Italy	Spain**
Business structure	Formalize agreements		Establish working agreements	MoU (memorandum of understanding)	Formalize the collaboration and structure For profit competitor	Consolidation of collaboration. Be acquired (makerspace)
Services/Growth	One-stop-shop for all services Leapfrog projects (springboard as a team) Establish new services (network, design, development)	Educational hub "Different maker trades Electro/wood/metal/software/ business development" Full circle value chain supplier Huge facility Design/production A place you come to work but also DIY Centre for climate inventions Large projects (without losing the	Establish SME relevant services	More partners Increase spin offs (incubator) Increase community services Increase patent valorisation More business	Engage & co-produce with international partners Increase number of innovation initiatives: patents, knowledge transfer	

	France	Denmark*	Germany	Greece	Italy	Spain**
		small ones) Scaled-up (studio as well)				
Branding and positioning	One-stop-shop for all services	Having own machine brand Netflix of education Makerspace on a stick Jack of all trades, do everything Making the impossible possible National/international position impact A place people come with the coolest projects A social place people come to hang and meet interesting people The centre of the			Internationally recognized as a cMDF reference	Reference in improving competitiveness International reference centre in the field

	France	Denmark*	Germany	Greece	Italy	Spain**
		area Foundation to support startups				
Internal business development		Data driven streamlined organisation		More access to talent More products		Improving communication synchronize and monitor collaboration efficiency Better working plan Better planning
Non-commercial relations		Preferred Research partner/hub		More grants		

* Two items mentioned by the Danish cMDF did not fit into the identified themes and therefore are not included in this table. They are “Loading production/innovation” and “Højskole/Refuge (residency)”.

** Three items mentioned by the Spanish cMDF did not fit into the identified themes and therefore are not included in this table. They are “Roll out the use cases efficiently”, “Automation”, “Longevity of the cMDF.

3.3. Minimum Viable Product (MVP)

Building on the Deliverable 2.5. - Definition of iPRODUCE demonstration framework, where the Use Cases were identified and defined, the cMDF teams focused MVP activity on defining the infrastructure and services necessary to deploy the Use Cases. Accordingly, Facilities and equipment, and Services are the two umbrella themes we identified across the cMDFs' MVP activity results. The thematic analysis is presented on Table 19.

Regarding services, the Italian pilot plans to use a holistic approach when developing and delivering services. This holistic - or rather comprehensive - approach is also present in the French pilot's MVP element "product development guidance"; in the Danish pilot's MVP element "customized consulting services with tested development of prototypes" and in the Spanish pilot's MVP element "product development innovation", as they all aim to cover many (or most) phases of product development and innovation. The German, Greek and Spanish pilots mentioned R&D and prototyping as necessary elements of the MVP, while facilitating networking is mentioned by the German and the French pilots' teams. Facilitated access to production is also an element of the Greek MVP, while in Denmark they envision becoming a cross facility work space, bridging various expertise from distinct areas, architecture, textile, furniture, metal, electronics workshops, maximizing cross-pollination and engagement from groups working in these and related fields.

Table 19: Minimum Viable Product Thematic Analysis across the cMDFs

	France	Denmark*	Germany	Greece	Italy	Spain**
Facilities and equipment	Small scale manufacturing - design and prototype for industry	*(Machine availability 24/7 with countrywide MBU coverage.)***	Rapid prototyping Industrial design and manufacturing		Prototypes	Prototyping
Services	Product development guidance Establish network interoperability	A cross facility work space that utilizes engagement	Customized Consulting services with tested development of prototypes Specialized networking	R&D Facilitate access of production for makers	Holistic approach service iPRODUCE use cases	Lab testing certification R&D Product development innovation

* The MVP analysis performed by the Danish cMDF included ambitions relating to the business that did not pertain to attributes of the MVP. Thus, we have not included them in this analysis. They are “Good value proposition”, “Financial viable model”, “Sought after”, “attractive”, “Known by the industry”, “Well-defined business processes” and “Well-managed”.

** This item is not included in the workshop sticky notes (Figure XX) but was repeatedly discussed throughout the workshop and must be highlighted in the MVP analysis. Thus, we have added it to this table.

3.4. Business Model Canvas (BMC)

We used the elements of the BMC, namely, Key Partners, Key Activities, Key Resources, Value Proposition, Customer Relationship, Channels, Customer Segments, Cost Structure and Revenue Streams as themes for this analysis, which is presented on Table 20.

All pilots' teams were unanimous in appointing SMEs as key partners, sometimes narrowing them down into more specific types of business such as startups, small furniture companies, incubators and architecture and tech firms. Differently from its peers, the Spanish cMDF included manufacturers and industrial stakeholders to its list of key partners without specifying the size of these partners. Except for Denmark, the list of cMDFs' key partners also include machine (and component) suppliers. Academics, trainees, technical researchers and educational institutions are mentioned by the French, Greek, Italian and Spanish cMDFs respectively, showing that partnerships with educational institutions are consistently present in the realm of cMDFs. The French, German and Greek pilots mention consumers, makers and end-users as partners, corroborating that the participatory setting of co-design and co-production permeates the cMDFs' development. Partners such as financial institutions, clusters, municipalities, industrial associations and advisory boards are occasionally mentioned according to specificities of each pilot.

It is possible to identify some overlapping between key partners and customer segments, as, for example, a customer who acquires training and prototypes using the iPRODUCE platform becomes a partner by contributing to the library of design and open-innovation embedded into iPRODUCE. Thus, SMEs, architects, manufacturers, makers, designers, municipalities, students, trainees and teachers are defined as customers across the cMDFs as well. Beyond the similarities between partners and customers, the customer segments across the cMDFs also present a certain evenness, with SMEs, entrepreneurs, designers and makers (to mention a few) being repeatedly mentioned. Yet, the Danish cMDF sees museums as an important customer segment of the MBU, while doctors are a specific customer segment to the Greek cMDF.

Regarding key activities, three services stand out: training, machinery operation, and R&D. These three elements function as pillars of the cMDFs. Furthermore, they are interconnected. For instance, training in machine operation, training in R&D, design - within R&D - that will define which and how machines are operated), however it is challenging to draw a line between them, which justifies the many different descriptions of them in the activity (e.g. train/coach/teach, R&D/design/prototyping/testing, machine installation/maintenance/assistance). Lesser recurring activities relate to networking, small-scale production, and certification. In the case of networking specifically, it is interesting to point out that only the German cMDF considers it as a key activity, although networking and matchmaking are an integral (and essential) part of iPRODUCE platform. Yet, networking is widely considered as an element of value proposition (see below)

Regarding resources, knowledge (knowledge, expertise, skills, intellectual, capabilities, and competences) and infrastructure (physical space, facilities, machines) are unanimously mentioned. Additionally, the German cMDF mentions SME database, the Greek cMDF mentions raw materials and commercial & sales capabilities, and finally the Italian cMDF mentions financial support and network.

The primary form of customer relation will be personal assistant, with all cMDFs mentioning it the form of in-house training/workshops and through the assistance with use of facilities and machinery. Yet,

online communications via online training and webinars as well as newsletters have also been mentioned. Four of the six cMDFs also mentioned the creation of communities (of knowledge and collaboration, either online or in-house). The lesser mentioned forms of customer relations relate to association communication, co-writing, agreements and contracts, and sales.

Accordingly, all cMDFs mention F2F (face-to-face) as their main channel of communication. Online communications channels such as social media, website, newsletter and e-mail are widely mentioned, while events and traditional media such as fliers, TV, radio, newspapers, fairs and exhibitions will be occasionally used. Academic publications and conferences are mentioned by the Greek cMDF only, although iPRODUCE is expected to generate multiple academic publications and presentations across all pilots.

Based on the elements mentioned in this section, the value proposition to cMDFs and iPRODUCE customers consist of facilitating access to knowledge, collaboration opportunities, machinery and R&D methods (including prototyping) through a wide range of services and equipment such as training, consultancy, co-creation, co-design, matchmaking, access to the open-innovation library, access to hardware, software and raw materials, and in the case of the Danish MBU, mobility and country-wide coverage.

To offer these services and equipment to the market, the cMDFs will incur in fixed costs to set up and maintain the facilities and equipment, payroll/personnel, utilities, insurance, and occasional costs such as travel, conferences, and admin expenditures for grant prospection. The revenue streams to cover these costs will come from membership plans, dynamic pricing (customized offers), pay-per-use, and (public) grants. In the specific case of the MBU, unit rental will make up for a significant share of the revenue.

Table 20: Business Model Canvas Thematic Analysis across the cMDFs

	France	Denmark*	Germany	Greece	Italy	Spain**
Key Partners	Incubators Academics Makers Consumers SME Financial inst. Tech centre Manufacturing startups Clusters Machine suppliers	SMEs Construction companies Architecture and technology firms Municipalities	Makers Technology oriented companies (TOC) SME Startup Machine suppliers	End-users Makers SMEs Trainees Machine suppliers	SMEs Startups Technical researchers Machine & component suppliers	Manufacturers & industrial stakeholders SMEs Industrial associations Machine suppliers Advisory board Educational institutions
Key Activities	Establish a more commercial FabLab (Install and assist with equipment) Access to online platform (iPRODUCE)	Train, execute and assist with machines	designs, Methods for product innovation Networking Prototyping Coach/teach	Field testing & demonstration Find proper tools Engineering and maintenance Small scale manufacturing (not mass production)	Keeping the right equipment Consultancy services	Lab testing certification R&D projects Prototyping

	France	Denmark*	Germany	Greece	Italy	Spain**
Key Resources	Physical space & facilities Intellectual (skills, expertise)	Machines, Applied knowledge Intellectual	Physical space & facilities (machines) Intellectual Running SME database	Machines Expertise (production, legal) Certifications Raw materials Commercial & sales capability	Physical space & facilities Intellectual competence Financial support Network	Physical space & facilities Intellectual (HR)
Value Proposition	Networking (matchmaking), Design, development, prototyping (research) Digital Machine training	Development services Machine training Workshop facilities On-site manufacturing	Consulting Service for Start Ups, SMEs, makers, TOC (Guided Product Development as a Service (GPDaaS) Machine training Machine use Co-Creation consultancy	R&D (personalised customisation) product prototyping - software/hardware Digital tools Product manufacturing (3d printing) Generate scientific knowledge	Prototyping Specialised advisory services Machine training and availability	Machine training and availability R&D Services Prototyping (self or produced by lab)

	France	Denmark*	Germany	Greece	Italy	Spain**
Customer Relationship	Personal, Customised feedback, Courses, Communities, online (webinars), Workshops	Personal assistance Communities	Personal assistance Through Association communication	Customised personal assistance (online) Instruction videos Cooperation agreements and contracts (b2b, b2c) Co-writing Training activities	Personal assistance Communities Workshop	Personal assistance, Newsletters Sales teams Advisory
Channels	F2F Online communication tools Events Newsletter, email.	F2F Social media (slack)	F2F Email Website Online & video collaboration tools	F2F Social media brochures Fliers, Website, Publications, Conferences, Exhibition Traditional media (TV, radio, newspapers	F2F Fairs Open innovation events Social media Websites Open events	F2F Social networks Campaigns Website & online store (SC meetings)

	France	Denmark*	Germany	Greece	Italy	Spain**
Customer Segments	Entrepreneurs/SME Develop (design, prototype & test) new product for mobility sector Fablabs: Train customers. Makers: Use machines, prototype, produce small scale.	Museums & Municipalities Schools' leadership Architects Entrepreneurs All for both small scale manufacturing and prototyping	Entrepreneur wants to test and get feedback on business idea Makers want to learn new machinery for prototyping and printing circuit boards SME - wants to renew their approach towards innovation	Doctors: Want to make prototypes Makers: Want to produce in small scale	Engineers & designers : Want to develop new products Inventors who want to industrialise a patent Students/employees who want to have hands on training	Students/teachers: classes Designers/makers Make Prototypes, test ideas Engineers: Make prototypes, Develop new machines Purchase & R&D managers: QA
Cost Structure	Fixed costs (machines, personnel, utilities) (Grant seeking)	Fixed costs (transport, daily rental) Material, maintenance	Fixed costs (machines, personnel, utilities, materials)	Fixed costs (machines, personnel, materials, regulatory, licencing, legal,	Fixed costs (machines, personnel, utilities, etc.)	Fixed & ad-hoc costs (machines, personnel, etc.)

	France	Denmark*	Germany	Greece	Italy	Spain**
		Value driven		marketing, utilities, audits, IP, machine maintenance, insurance) Dynamic costs (conferences, clinical trials, travel, open access, sub-contracting)		
Revenue Streams	Membership Dynamic pricing (customised offers) Grants	Membership & unit rental Fixed & Dynamic pricing (customised agreements)	Private Memberships Dynamic pricing (customised offers) Public Grants Company memberships (zenit)	Dynamic pricing (customised offers) Pay per use	Pay per use Fixed & Dynamic pricing (customised offers) Public Grants	Grants (R&D) Dynamic & fixed pricing (customised offers) Memberships fees (ON, very few, & Unis) Pay per use - dynamic pricing

* Combination of both MBU and overall services BMCs.

3.5. Value Proposition Canvas (VPC)

Building on the sections Customer Segments and Value Proposition of the BMC, the pilots' teams further explored to what extent their portfolio of products and services enable customers to create gains and relieve their pains. The overall comparison is presented in full on Table 21.

Product development is the main job that customers of the cMDFs want perform. This can be achieved by capacity building in R&D and by having access to facilities and equipment that allows for the concretization of ideas and projects. This unanimous element across the cMDFs is described in different ways, such as design, (fast) prototype and test, use of machines and small-scale production. Lesser mentioned elements regarding *Jobs* relate to the reuse of materials, idea testing and feedback, and renewing the approach to innovation, which we consider to be attributes to the main job of product development.

To support the customer base in developing products, the cMDFs offer expertise and consulting services in R&D, capacities building on R&D, machine operation and small scale production, access to facilities and equipment, and facilitated collaboration opportunities through matchmaking.

Differently from the uniformity in the Job(s) section, we observe that the Gains section of each cMDF often contains industry-specific results, benefits and aspirations as outcomes of product development. For instance, the **Greek** cMDF, which mainly works with customers from the medical field, listed gains relating to improved patient experience through appliance customization, which is supported by the access to equipment, IPR facilitation, and the market expertise and research offered by the cMDF. The gains of the **Danish** MBU customers, for instance, relate to on-site manufacturing and the reuse of materials to ensure sustainable practices. The customers of the **German** pilot, who operate in the tech/electronics field, see knowledge and access to tech, new markets and open innovation as gains of their product development efforts. The Spanish, Italian and French pilots, however, did not focus on industry-specific gains but on the gains of visibility and business development opportunities coming from IPR, consulting and R&D services offered by the cMDF throughout product development.

To support the customers in attaining the gains, the cMDFs operate in a collaborative atmosphere where expertise and knowledge are shared with customers to support the ideation and execution phases of R&D. In addition, where customers have access to high-tech equipment and hardware (e.g. 3D printers) and to the iPRODUCE platform, its embedded design, prototyping tools as well as the open-innovation library where designs can be stored, shared, adapted and improved. Besides enabling innovative ideas to come to life, the offerings are meant to simplify processes and create shortcuts that will save time and resources in the innovation and product development processes.

Regarding pains, the cMDFs customer segments often experience difficulties in finding business partners, suffer from inaccessible machinery, raw materials and tools as well as from limited competencies in the area of R&D (including prototyping). Time constraints, cumbersome and complex bureaucratic processes relating to IPR and grant/financing options, as well as uncertainties regarding Return on Investment (RoI) and the market dynamics, are occasionally mentioned as pains by some pilots.

To relieve the pain of difficult partner search, the cMDFs assisted by the iPRODUCE platform will manage information regarding potential partners and customers and will work as a matchmaking agent, thus facilitating collaborations and bridging individuals and businesses with convergent aspirations and complementary expertise. Additionally, the cMDFs overcome the pain of inaccessible

equipment and work space by offering and maintaining facilities and machinery for prototype building on a (affordable) membership basis or pay-per-use system. Through training, consulting, and the building of a community of shared knowledge and collaboration, the cMDFs aim to solve the pains of limited knowledge in R&D, about the market and commercial strategies, and in financing and grant seeking.

Table 21: Value Proposition Canvas Thematic Analysis across the cMDFs

		France	Denmark (MBU)	Germany	Greece	Italy	Spain**
Customer Segments	**Customer Job(s)**	Entrepreneurs/SME Develop (design, prototype & test) new product for mobility sector Fablabs: Train customers. Makers: Use machines, prototype, produce small scale.	Local manufacturing Fast prototyping Reuse materials	Entrepreneur wants to test and get feedback on business idea Makers want to learn new machinery for prototyping and printing circuit boards SME - wants to renew their approach towards innovation	Doctors: Want to make prototypes Makers: Want to produce in small scale	Developing new products	Develop new product

		France	Denmark (MBU)	Germany	Greece	Italy	Spain**
	Gains	More visibility of products through innovation ecosystem International visibility Transfer of knowledge skills	On-site manufacturing with MU Events, training, recycling and prototype on-site upcycling solutions	Knowledge and access to new tech Open innovation opportunities (through new contacts/expertise) Access to new markets	Improved Patient experience Customisation Market asset Facilitation of Patent process Access to more complex machinery Market assessment of product (M) Job opportunity (M)	Help with patent process/IPR Service maintenance Trusted service	Funding opportunities

		France	Denmark (MBU)	Germany	Greece	Italy	Spain**
	Pains	Difficulty to identify and select partner Bureaucracy IPR process is cumbersome Lack of knowledge in virtual facilitating tools Time constraints Cost of making process in the private sector Lack of knowledge regarding 'how to'	Difficulty in accessing machines, Lack of knowledge about the services, Lack of tech expertise Lack of knowledge about possibilities	Limited number of machines (time) Unclear RoI (return on investment) Lack of knowledge of how and whom Unclear communication	Lack of partnerships with engineers Lack of machinery/ raw materials/ tools Lack of knowledge about DTP (M) lack of knowledge about market needs Lack of knowledge about manufacturing processes High cost Time consuming	Lack of competences/skills Lack of machinery Time Money	Lack of knowledge to execute product Lack of $ resources IP - NDA Time expectations

		France	Denmark (MBU)	Germany	Greece	Italy	Spain**
Value Proposition	**Products and Services**	Networking (matchmaking), Design, development, prototyping (research) Digital training	Machine availability on site Courses Prototyping	test technical feasibility (prototyping) Training & coaching Connect to network	R&D (personalised customisation) (product prototyping - software/hardware), Digital tools Product manufacturing (3d printing)	Prototyping Specialised advisory services	Intellectual knowledge and facilities Admin support
	Gain Creators	Agility of innovation processes International network Access to high-tech equipment	Mobile Unity, Flexibility, Expertise, reduced costs due to material reuse opportunities	Provide knowledge of emerging tech/trends Provide the access to new markets	Generate scientific knowledge (publications) More collaboration/partnerships Patents More expertise Talent matchmaking	Help with product positioning Credibility Networking	Certifications for the market Market advisory Reduction of costs through grant programs

		France	Denmark (MBU)	Germany	Greece	Italy	Spain**
	Pain Relievers	Knowledge about partners to facilitate the matchmaking Helping with grants towards production Knowledge of financial institutes Knowledgeable recommendation regarding process to minimise time and cost	Develop campaign/ events to make the facility known, online booking	Resource management tool to support planning Create opportunities to experience methods (freemium model) Customer experience value	Minimise the investment load Minimise R&D cycle Processes to discuss with end-user Clear information process Tech specs Tech knowledge Product assessment Feasibility assessment	Help find collaboration/financial support through network Training programs	Quick adaptation Help companies with programs and funding Flexibility Defined Planning

3.6. Stakeholder mapping

The stakeholder mapping activity produced two outputs for each cMDF: a comprehensive list of stakeholders based on the thorough BMC analysis, and a list focusing on the direct stakeholders of each iPRODUCE Use Case. While working with the data, we noticed that post workshop discussions led to the listing of new direct stakeholders that were absent from the comprehensive list. Thus, prior to the analysis, we adjusted the comprehensive list by adding the newly defined Use Cases' direct stakeholders.

We identified five umbrella themes across the cMDFs' Stakeholder Mapping, namely, Education and Research, Stakeholder and Company Size, Industry-specific Stakeholders, Public Sector and Financing and Ecosystem Support. The analysis below is based on the complete list of stakeholders on Table 22.

Company size is one way the cMDF teams found to classify their corporate stakeholders. While SMEs (startups/scale ups, entrepreneurs, incubators, and seed accelerators) are mentioned by all the pilots, large organizations are mentioned only by the French, Danish, and Spanish teams. Like SMEs, individuals such as markers are stakeholders included in every cMDF list of stakeholders. All teams, except for the German pilot, mentioned stakeholders from Research and Education backgrounds (students, trainees, schools, technical centres, universities, academics and researchers).

As expected, it is possible to spot **industry-specific stakeholders** in the mappings. The Greek pilot, for instance, mentions doctors, end-users (patients), animals and animal owners, veterinarians and children as stakeholders in relation to their medical products. In the case of the Danish pilot, festivals, shows, theatres and film productions are relevant stakeholders of their MBU. Designers and architects (design companies and studios, architecture firms, furniture companies, contractor companies) are mentioned by the Danish and French cMDFs. The public sector/municipalities are only mentioned by the Danish MBU.

Financing institutions as well as ecosystem supporter actors such as incubators, seed accelerators and consultancies are mentioned by the Danish and French pilots. Finally, the Danish team highlights that municipalities and the **public sector** in general function as stakeholders of the MBU.

Table 22: Stakeholder Mapping Thematic Analysis across the cMDFs

	France	Denmark (MBU)	Germany	Greece	Italy	Spain**
Education and Research	Academics/Technical centres	Schools/Students Consultancies Universities/Research centres Night school, elderly associations betaACADEMY (courses: machine, tech & product specific)		Students/Children Trainees	Technical researchers	Students
Stakeholder/Company Size	Customers SMEs/manufacturing startups/entrepreneurs (Large) manufacturing companies (e.g. Siemens) Makers Cluster	Entrepreneurs SMEs (startups/scale up) Manufacturers (Large companies)	SMEs/startups Makers	SME Makers End-users Consumers	SMEs/startups	SMEs Manufacturer (Large and SMEs) Makers, entrepreneurs End-user/consumer

	France	Denmark (MBU)	Germany	Greece	Italy	Spain**
Industry-specific stakeholders	Design and prototype companies Consumer goods manufacturers	Festivals, shows, etc. Theatre and film production (props, studio, facilities? etc.) Contractor companies Engineers/Investors Designers/Design studios Architecture firms and other furniture companies	Tech-oriented companies	Industrial stakeholders Doctors	Component suppliers GDO hobbyists	Gamers
Public Sector		Public sector Municipalities				
Financing and ecosystem support	Incubators/Financial support institutions Fablabs	Consultancies Venture/seed accelerator				

3.7. iPRODUCE offerings, barriers and assets

Differently from the analyses presented above, this section analyses three elements simultaneously, namely, the offerings and their respective barriers and assets. To allow for a clear line of thought, we begin by analysing the offering lists and defining offerings that are common to the cMDFs, followed by the assets and barriers analysis. Table 23 depicts the offerings analysis and

Table 24 shows the offerings and their respective barriers and assets.

As expected, we identified that R&D is the main offering - or even the *raison d'être* - of the cMDFs. Interestingly, the Spanish cMDF does not mention R&D nor its elements and phases in their offering list. Looking back at the other activities, however, we identify several mentions of product development and prototyping in the Spanish MVP, as well as R&D and prototyping in their BMC. Thus, we assume that the lack of this item in the offering list is a mere omission to be adjusted in the final business model description (Deliverable 7.3).

Besides R&D, we identified three other iPRODUCE offerings, namely, Networking, Capacity Building and Infrastructure, which can act as standalone offerings or in support of the R&D processes. For instance, networking (matchmaking) services enable optimal partnership building based on complementary skills and convergent needs and/or ideas. Together, ideally matched cMDF customers can optimize their R&D process and will most likely accomplish their goals more efficiently. Through capacity building, the cMDFs customers will develop the skills they need to execute R&D phases - especially regarding prototyping - while infrastructure are the facilities and equipment where customers will find the resources (tangible and intangible) to transform ideas into products. Like the case of R&D, these three offerings are not mentioned by all cMDFs as offerings. Yet, they appear in the MVP and the BMC, thus we conclude that they are omitted in the offerings list but do belong to all cMDFs.

The main barriers hindering the R&D related iPRODUCE offerings services are the lack of customer's knowledge about the possibilities and services available through iPRODUCE, limited customers' knowledge in tech and manufacturing, high costs and time constraints, uncertainty about the market (needs), lack of innovation will (or resistance to innovation), lack of credibility in the market, limited facilities (lack of equipment), lack of knowledge of specific fields, cost (in)efficiency (on a systemic level), difficulties in converting customers and in consolidating partnerships with engineers. Additionally, the pilots' teams consistently mentioned the R&D's high costs and time consumption as important challenges endured by business in general.

Regarding assets, the cMDFs are designed to offer knowledgeable consulting services and efficiently guide customers throughout the R&D process, thus reducing lead times and costs. For instance, their expertise in financing options, the digitalization of bureaucratic processes/IPR, rapid testing through access to consumers and specialized personnel are strengths of the iPRODUCE R&D offering.

Given that R&D projects often require transdisciplinary knowledge (e.g. technical/manufacturing/prototyping knowledge, design knowledge, marketing knowledge, market (research) knowledge, legal knowledge, project management knowledge, finance knowledge, etc.) finding partners with complementary skills and convergent needs and desires is crucial for innovation. Yet, it is reported that the iPRODUCE target group finds it difficult to engage with potential partners and build fruitful business relationships. Naturally, these barriers to R&D function as barriers to the iPRODUCE offerings. As a solution, the iPRODUCE networking and matchmaking feature will bring

potential partners together, propelling innovation and functioning as a major asset for the entire iPRODUCE platform to help successfully the cMDFs support their customers in various ways.

Another relevant barrier to iPRODUCE is the lack of knowledge about the platform's offerings and about the innovation and R&D processes in general. For instance, innovators with entrepreneurial mind-sets will most likely not execute their ideas if they do not have the skills to ideate, prototype, test and go-to-market. To overcome this barrier, the iPRODUCE offering Capacity building is designed to provide training thus enabling innovation and product development. Training will range from machinery and equipment operation to technical design, materials and methods.

The offerings can only be provided through an infrastructure of tangible and intangible assets such design and open-innovation platforms, and facilities and equipment accompanied by training on how to operate them. Barriers to the Infrastructure offering are the unavailability of specialized personnel, the complexity of programs. Beyond the iPRODUCE boundaries, there is also a lack of training and skills in the target group, a market perception of high maintenance and operating costs related to R&D coupled with limited financial resources. To overcome these barriers, the cMDFs are designed to operate as an all-in-one facility where customers will find the necessary resources to go from ideation to execution with the support of skilled personnel and the iPRODUCE community, access to tools and methods (e.g. CNC, feasibility assessments, quality testing and assurance, certification, IPR). In the specific case of the Danish pilot, the facilities are mobile and have countrywide coverage.

Table 23: iPRODUCE Offerings Thematic Analysis across the cMDFs

	France	Denmark (MBU)	Germany	Greece	Italy	Spain**
R&D	Design, development, testing and prototyping (research)	Prototyping	test technical feasibility (prototyping)	R&D (personalised customisation) (product prototyping - software/hardware), Generate scientific knowledge	Prototyping Specialised advisory services	Admin support
Networking	Networking (matchmaking)		Connect to network			
Capacity building	Digital training	Courses	Training & coaching			Intellectual knowledge
Infrastructure		Machine availability 24/7 Mobile Unit (on-site tools)		Product manufacturing (3d printing)	Machine availability 24/7	

Table 24: iPRODUCE Barriers and Assets Thematic Analysis across cMDF

		France	Denmark (MBU)	Germany	Greece	Italy	Spain**
R&D	**Barriers**	Bureaucracy IPR process is cumbersome Lack of knowledge in virtual facilitating tools Time constraints Cost of making process in the private sector Lack of knowledge regarding 'how to'	Lack of training in using machines, lack of knowledge about offering, lack of tech skills	Lack of enough machines Converting customers	Lack of partnerships with engineers Lack of machinery/ raw materials/ tools Lack of knowledge about DTP (M) lack of knowledge about market needs Lack of knowledge about manufacturing processes High cost Time consuming Lack of specific knowledge related to the field	Time Cost Innovation will/credibility Lack of Investment in innovation Innovation resistance Risk RoI Scalability Trust	(Confidentiality requests) Lack of Capability and experience of clients Technology barriers

		France	Denmark (MBU)	Germany	Greece	Italy	Spain**
	Assets	Knowledgeable recommendation regarding process to minimise time and cost Knowledge of financial institutes Digitalisation of bureaucratic processes (IPR) Higher RoI Wide-availability of machines across the network Expertise regarding services Access to consumers for rapid testing (research) Visibility, Reach, New business opportunities	Community Access to space and machines	Provide knowledge of emerging tech/trends Production of prototype /early testing	Minimise the investment load Minimise R&D cycle Processes to discuss with end-user Clear information process Tech specs Tech knowledge Product assessment Feasibility assessment	Disruptive approach Skills Equipment Open innovation Network Risk assessment/mitigation plan Customisation	Certification of products (if they comply with legislation/etc.) Knowledge about specialised committees in certification and policies

		France	Denmark (MBU)	Germany	Greece	Italy	Spain**
Networking	**Barriers**	Difficulty to identify and select partners	(Community)	Lack of information regarding network partners Engage in participation			
	Assets	"Knowledge about partners to facilitate the matchmaking Centralization of information Customised recommendation regarding process and machines to minimise time and cost One-stop shop"					

		France	Denmark (MBU)	Germany	Greece	Italy	Spain**
Capacity Building	**Barriers**	Cost of making process in the private sector Lack of knowledge regarding 'how to'	Time required Lack of knowledge about offering	Converting customers			Confidentiality requests Availability of personnel Technology barriers
	Assets	Have remote access to training Relieving human resources Widening the FabLab audience	Certification	Process knowledge Customised knowledge/guidance			
Infrastructure	**Barriers**		Availability of personnel Complexity of programs Lack of training in using machines, lack of knowledge about offering, lack of tech skills, personnel		Lack of software licenses (high cost) Lack of machinery/ raw materials/ tools		Confidentiality requests Complexity of programs Financial resources

		France	Denmark (MBU)	Germany	Greece	Italy	Spain**
	Assets		Labs availability Internal know-how Community Minimise on transport of material Local adjustments (MBU) Local access (MBU)		Technology Feasibility assessment Access to tools Feasibility assessment Tech specs Tech knowledge		

4. 1st set of cMDFs Business Models

The anticipated set of BMs demonstrate the diversity and convergence of aspects that currently involve the different partners and stakeholders in the project pilot locations. In the most general perspective, these places have an ongoing number of projects, however, despite their capacity, there is little knowledge or current larger partnerships with industry partners.

Among the value proposition offers, R&D and digital fabrication services together with prototyping in both low and high definition are key offers to facilitate exploring and testing products. Furthermore, some of the current locations offer opportunities to help support the idea development through mentorship programs- In the locations where this is not yet established, there is a clear desire to implement a similar programme or at least partner with groups who might already be engaging in these types of consulting services.

In regards to the makerspaces and fablabs involved in the project, the majority of these spaces have a subsistence economy – in other words they are able to pay few employees and are still developing the business strategy to grow and expand their businesses to become profitable, or in the case on non-profit SMEs, to have an economically sustainable plan. Regarding the more established companies and research centres involved in the iPRODUCE project, they see the advantages in cross collaborating with makerspaces and fablabs, and want to establish and solidify the partnership through defined projects aiming for growth opportunities.

In Section 2.1, we presented the BMC and VPC of each cMDF and used a deductive approach to analyse, and report repeated patterns (Braun and Clarke 2006) across the Business Model Canvas (BMC), Value Proposition Canvas (VPC) workshop activities, using the predefined areas of each of these templates as coding themes. The comparative analysis of the BMs is presented in Section 3.4. Building on this analysis, we recommend a series of actions for the business development of the cMDFs (Section 4.1.)

4.1. Actionable Recommendations for the business development of the cMDFs

4.1.1. Danish cMDF

The BM of the Danish cMDF focuses on the opportunity of enabling local production through a mobile makerspace towards increasing the reach and expanding the stakeholder opportunity pool. The business model and VPC indicate a market need to reuse materials on site, creating opportunities to explore local material resources through digital fabrication, fixing and upcycling materials, providing means to reduce waste and costs to customers. To achieve this successfully, we recommend BetaFactory to:

- Develop a communication strategy for the BetaFactory Mobile Unit (BMU) and set up partnerships with companies;
- Secure existing partnerships with SME's, work on expanding the portfolio of companies.
- Set up partnerships with researchers and research institutes – labs/courses/developments (to ensure beta/discovery environment and maximum exploitation of BMU)
- Expand communication strategy for further customer reach.
- Support existing customers, ensuring customer fidelity and retention.

Core Use Case service: Mobile Local fabrication as a service.

4.1.2. French cMDF

The French cMDF works closely with incubators, academics, makers, consumers, SMEs, financial institutions, tech centres, manufacturing startups, manufacturing clusters, involving companies, makerspaces and other external expertise. The BM of the French cMDF focused on offering unique technical and market expertise towards new product developments. As a consultancy, the service proposition and product to be 'commercialised' needs to be clearly defined together with the procedure to deliver the services. Sharing knowledge is a key value proposition; to deliver a high quality service in this area; the partners need to develop both a structured package and marketing campaign to assist in its distribution and market reach. To achieve this, we recommend the French cMDF to:

- Due to the many partners involved, an agreement needs to be in place defining the responsibilities and the work distribution; creating a common agreement among its partners will facilitate future collaborations, defining the tasks assigned to the different partners upfront.
- Set up a product development educational package, which can be broadly sold to universities and incubators (both networking, digital training and the 'one stop shop' concept).
- Possibility for online courses (see domestika.org).

Core Use Case service: Specialised product development consultancy.

4.1.3. German cMDF

The German cMDF focuses on offering specialised services as consultants. More specifically, their core proposition entails providing a fully structured product development process, where creative development, prototyping and testing are supported and can be executed by the service providers. The German cMDF would be the one with the hands on work, so instead of just having people come to use the machines, they would focus on optimising the consulting time by making the prototypes and proof of concepts themselves to help the product to market time. To achieve this, we recommend the German cMDF to:

- Due to the partners involved, an agreement needs to be in place to define the responsibilities and how the work should be distributed;
- Set up collaborations with startup incubators; further define services for business exploitation.
- To develop further the network, organise events and courses to make the services more broadly known.

Core Use Case service: Specialised consultancy - Guided Product Development as a Service (GPDaaS)

4.1.4. Greek cMDF

The Greek cMDF focuses on offering health related production services, such as custom made 3D printed casts and related technologies that can generate a positive impact in the medical R&D field. The Greek cMDF works closely with doctors, veterinarians, health focused SMEs, industrial stakeholders, where they combine a set of qualified expertise to deliver high-level R&D services in the medical sector. To further develop this service offer, we recommend the Greek cMDF to:

- Have an agreement in place to define the responsibilities and how the work should be distributed among the various collaborators;
- Set up collaborations with hospitals and medical researcher's services to broaden the business opportunities.
- Further develop the network, organise events and courses to the target group (health practitioners) to make the services more broadly known.

Core Use Case service: Product development and prototyping for health services

4.1.5. Italian cMDF

The Italian cMDF focuses on offering specialised robotics development consultant services. More specifically, their service proposition offers a robotic related product development, where creative development, prototyping and testing are supported and can be executed by both the cMDF staff in collaboration with the clients. The cMDF can also provide access to other industry experts to support the process when necessary. To achieve this, we recommend the Italian cMDF to:

- Due to the many partners involved, an agreement needs to be in place to define the responsibilities and how the work should be distributed;
- Set up a training programme package, which can be broadly sold to schools and other related educational programmes. Possibility for online courses (see domestika.org).
- Continue with pay per use of facilities.
- Investigate opportunities for long-term SME memberships – from idea to patent.

Core Use Case service: Specialised service consultancy in robotics.

4.1.6. Spanish cMDF

The Spanish cMDF has specific expertise in specialised high quality furniture production, testing and certifications; they focus on offering specialised prototyping, testing and certification possibilities, which can decrease time to market and consequently earlier returns. The cMDF can also provide access to other industry experts to support the process when necessary. To achieve this, we recommend the Spanish cMDF to:

- Set up partnerships with gaming and related technology companies developing chairs with specific functionalities to enhance the various types of experience, such a gaming, etc.;
- To ensure open innovation opportunities, establish partnerships with universities and researchers – to run hackathons and competitions, being the innovation facilitator.

Core Use Case service: Specialised smart and innovative furniture consultancy.

4.2. Summarised BMC Analysis Across cMDFs

The BMC analyses presented in Section 3 highlight shared elements across the cMDFs' business models as well as specific elements of each pilot. While the specific elements are often context-specific (referring to e.g. type of industry, regional markets and ecosystems), the common elements often refer to the overarching market dynamics and trends (e.g. innovation, sustainability, open-innovation, technological development, the maker and prosumerism scene) that stretch over the six countries and beyond.

Observing the shared and specific elements across the cMDFs' BMCs is particularly important to further develop iPRODUCE, ensuring that the platform and the cMDFs are able to deliver on the **shared elements across the individual business models** while facilitating and/or being **flexible enough to enable each cMDF to serve the specific demands** of their customers and markets. To address the former, we have created the iPRODUCE BMC (Figure 42) based on the analyses presented in this report. To address the latter, the iPRODUCE project foresees a series of use case tests and demonstrations (WP4 and WP5). Together with the knowledge in this report and the second set of workshops to be held within WP7 (and reported on D7.3), the results of the demonstrations will inform the design of the final iPRODUCE business model.

4.2.1. Anticipated iPRODUCE BMC

The iPRODUCE BMC (Figure 42) highlights all cMDFs, their SME partners and suppliers as key partners, who will benefit from matchmaking, models and human resources (e.g library of knowledge, design and open-innovation) provided by the platform, as well as embedded online/in-person training (e.g. prototyping, machine operation) and facilitated partnership forming via Ricardian contracts. To do so, iPRODUCE offers a platform with production resources (e.g. design and engineering) where investors and makers can share and co-create online training tools and tutorials to develop digital fabrication skills, as well as guidance and the road mapping for patenting and IPR. The main revenue streams come from pay-per-use and dynamic pricing (customized offers) while the cost structure is mostly composed of fixed costs (e.g. maintenance and upgrades, domains and server costs for the platform operation), and marketing initiatives to prospect and retains users.

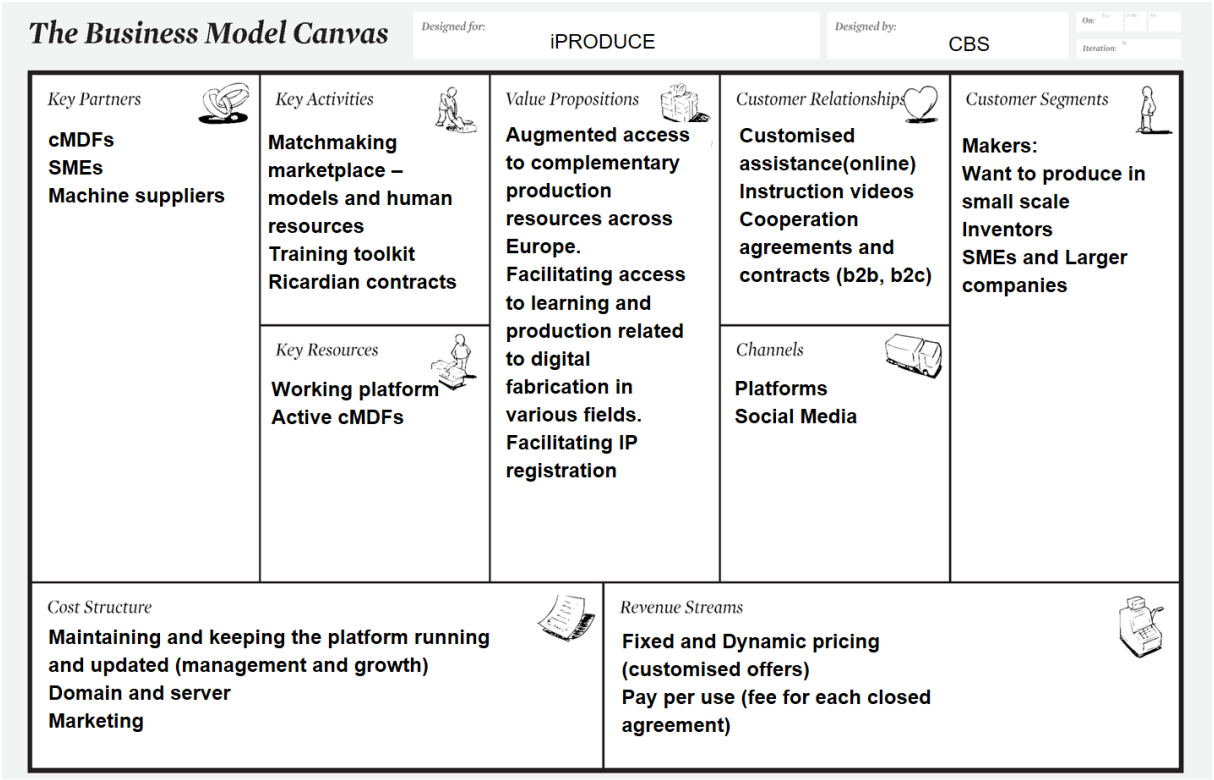

Figure 42: iPRODUCE BMC

4.3. Operational Model and Business Model Compatibility

D7.2 aligns with D3.1 which maps and examines the configuration of the network - ex ante analysis - and, through Kaizen, lean analysis and design activities carried out in T3.1, led to devising a Lean Operational Model of the Federation. By standardizing processes and systems, and defining a governance model, D3.1 lays the foundation for how the cMDFs – individually or in collaboration – will serve their customers.

Because the Operating Model Canvas takes its cue from the back end of the Business Model Canvas (see D3.1 Subtitle 3.3.3.), it is important to evaluate the findings reported on the present report against the findings and decisions reported on D3.1.

A detailed analysis of D3.1 identified three main contributions to iPRODUCE, namely, the Governance Model, the Lean Operational Model, and the Implementation Roadmap of the iPRODUCE Federation. Among these three, the Governance Model is relevant for the purpose of analysing the coherence and compatibility between D3.1 and D7.2.

As reported on D3.1, the 6 cMDFs considered 3 types of Governance Models for iPRODUCE:

1. Centralised model: offers the advantage of having a single figure ahead of the entire process, from order to delivery. The downside is the fact that this figure could be located far from the local hubs directly working on the project and therefore may not be completely in touch with these entities and the way they operate (language barriers can arise, etc.).

2. Decentralised model: removes the figure of a centralised Project Manager. The cMDF that has the competences to develop the project is in charge of defining specifications and a delivery date. This reality may be located far from the client, so the possibilities of creating a regional network are definitely lower.

3. Hybrid model: encompasses the advantages of having a specifically defined figure managing the project, together with the ability of local hubs to create a regional client network. The local hub defines project specifications, while other cMDFs act as suppliers whenever an outside contribution is needed.

Upon careful evaluation of the advantages and disadvantages of adopting each of the three models, the 6 cMDFs unanimously voted for the adoption of a hybrid structure, which, in our view, is compatible with the flexibility required for the operation of a network of varied bodies such as makerspaces, fablabs, manufacturing facilities, while harnessing synergies and creating unison across the cMDFs thus (see Section 4.2). Thus, we evaluate that the Hybrid Governance Model elected within the Operation Model development phase (WP3) is compatible with the findings of WP7 as of December 2021.

5. Initial recommendations for cMDFs & iPRODUCE exploitation

The workshops highlighted similarities (e.g. similar customer segments, market demand for innovation and sustainable solutions, growth of prosumerism and maker scene) but also specificities of each cMDF (e.g. type of industry, country and context). Building on this knowledge, we recommend the creation of an iPRODUCE Business Model that defines a high-level cross-contextual uniform business while also allowing for flexibility to suit the cMDFs specificities, ensuring focus on consumer driven design and production.

On a more detailed level, the results of D7.2 indicate key aspects that are relevant to the cMDFs in regard to fulfilling a successful outreach. Based on our findings, we recommend:

- the celebration of agreements defining the responsibilities and work distribution among partners;
- the setup of collaborations with a corresponding service portfolio to optimally harness business opportunities;
- the further development of a network coupled with the definition of a marketing strategy to make iPRODUCE and its services more broadly known;
- and the development of a monetization structure (cooperative, freemium, etc.) accompanied by financial recommendations for each cMDF.

5.1. Initial offerings and alignment with iPRODUCE platform

Regarding the offerings, prototypes, aligned with technical knowledge and testing for a wide range of fields, goes across as a common service resource across almost all cMDFs. These offerings match market needs, however, in order to widen their reach and make a valuable service offer, the cMDFs need to make themselves visible, facilitate the access to their services, develop marketing campaigns and actively engage with companies through both their own and remote network.

The iPRODUCE platform should fill a market gap, bringing together various tools and expertise under one umbrella. However, the platform needs to be kept active and relevant to the market, if it is to fulfil its role in bridging consumer needs to maker solutions.

5.2. iPRODUCE Business Model Outlook

Based on the recommendations presented in this report and the operational definitions reported on D3.1, the cMDFs have sufficient input to fine tune their management, collaborative and operational architecture for a fruitful exploitation of iPRODUCE's Open Innovation Space (OpIS). In the next 12 months, we will carry out a second round of Business Model workshops to assess the assets, value and impact of iPRODUCE platform in relation to the service offerings and value propositions of the project cMDFs. This pre-post comparison will be presented in D7.3.

6. References

Clarke, V., & Braun, V. (2014). Thematic analysis. In Encyclopedia of critical psychology (pp. 1947-1952). Springer, New York, NY.

Osterwalder, A. (2005). *Business Model Design and Innovation: What is a business model?* Blogger.Com. https://web.archive.org/web/20061213141941/http://business-model-design.blogspot.com/2005/11/what-is-business-model.html

Parry, Z. (2014). Book Review: Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. In *The International Journal of Entrepreneurship and Innovation* (Vol. 15, Issue 2). John Wiley and Sons, Inc., Hoboken, New Jersey. https://doi.org/10.5367/ijei.2014.0149

Schreier, M. (2012). Qualitative content analysis in practice. Sage publications.

7. Appendix

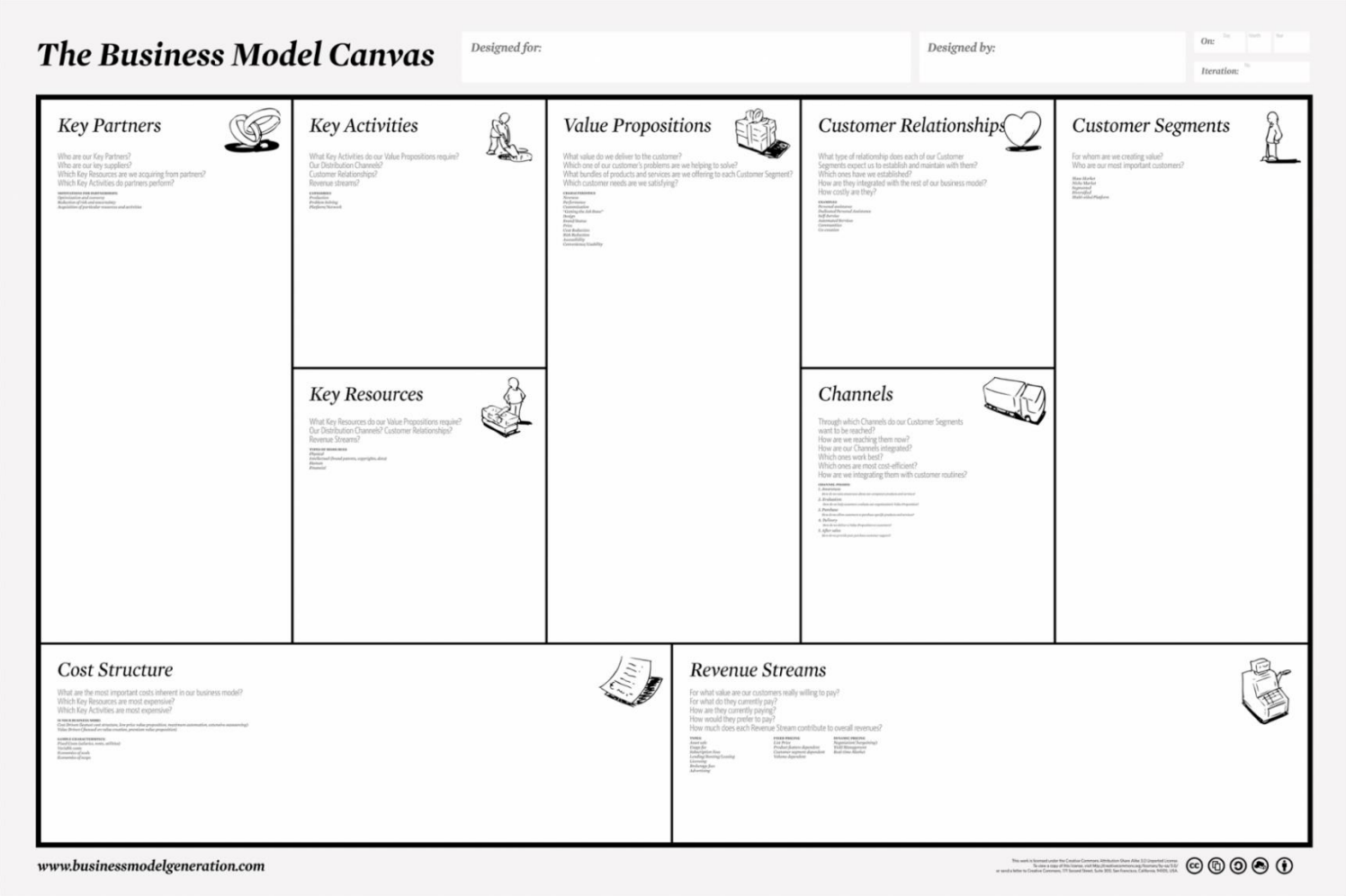

Figure 43: BMC Template large

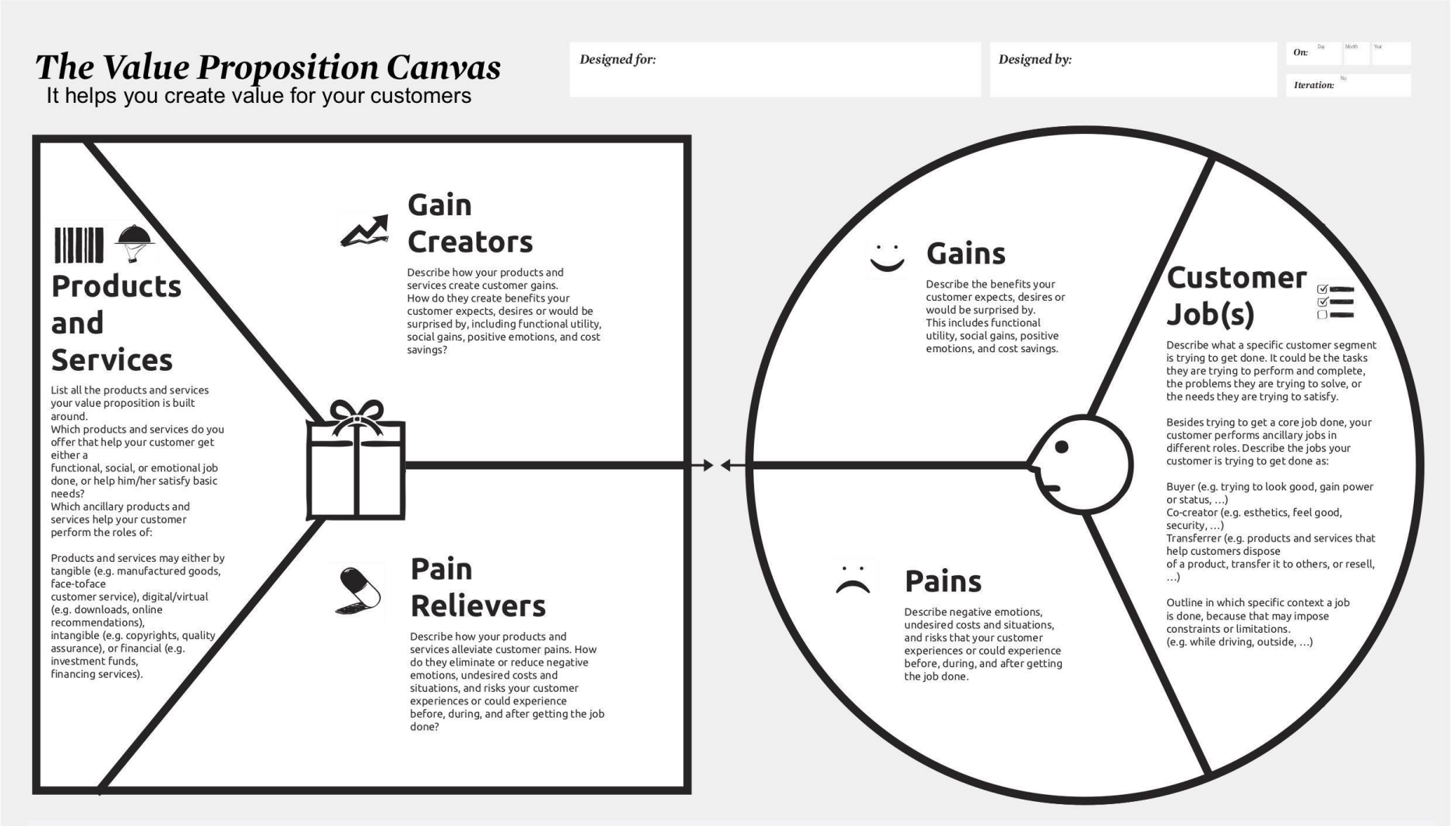

Figure 44: VPC Template Large

PRODUCE

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no. 870037.