D2.3. Benchmarking Report on Makers Approaches and Tools for collaborative production engineering manufacturing

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Executive Summary

The aim of this research work has been to carry out a survey and benchmarking study, based on knowing what is the situation in the European context of maker and digital manufacturing spaces, through their main actors, describing the available operating conditions and technological adaptation. The main goal is to find answers that help the partnership of the iPRODUCE project to specify more effectively how is the model of space that allows the implementation of the CMDF concept in a collaborative framework with the industry.

This task has been achieved with an exhaustive and updated research of the ways of working, the values and the way of organizing these spaces, together with the technologies used and existing state-of-the-art solutions that support the philosophy of collaborative social production and manufacturing, which are established as success factors in the fablab and makerspace approaches. The final objective is to be able to introduce it for the benefit of manufacturing companies and SMEs in the consumer goods sector.

The first part includes the objectives, context and methodology used in this study (first three chapters), which has collected the response of 44 spaces of the project's partner countries and the opinion of the experience of those in charge in the different spaces, from partners and non-partners, in order to obtain contrasting conclusions.

The second part (focused on chapter 4) presents the results of the study, and compiles the description of the spaces, their values and strategies, collaborations and funding, their internal composition, the way they communicate, the software they use and the technologies employed in their spaces.

The third part shows, in a complementary way (in its fifth chapter), cases of emerging models that focus on creating products, services and experiences from different perspectives, beyond the collaborative work and access to technologies that usually happens in a maker or fablab space. These initiatives have emerged around innovation hubs, universities, companies and collaboration between spaces.

The fourth part (chapters 6 and 7) describes the first elements from this study collected in the previous points, that can and must facilitate the further development of the project iPRODUCE, as a thread, data and force ideas, on which to base the progress of the work of other WP (the global management, how to establish the collaborative model to offer the best service to companies, the definition of the CMDFs, detailing how the network platform will be between the different CMDFs, the toolkit that will facilitate the co-creation and training of the different teams and even, what will be the reference indicators to evaluate and validate the working model of these spaces between users, makers and consumer goods companies). Results are presented from a comparative perspective of European countries and the total of the results as a whole. These conclusions are highlighted with different opinions that clarify certain reasons of the obtained answers and end up by completing a conclusive SWOT that summarizes the study.

The eight chapter shows us the conclusions about the current state of the spaces, and the report ends by thanking those people who have contributed most to providing data, participating in the focus groups and helping us with their expert opinion. There is a short bibliography of the most

significant studies and papers that have supported this work, and finally the annexes with the questionnaires that have allowed us to collect the information.

The results obtained are particularly relevant for European public institutions and technological entities (companies, laboratories, research centers and universities), as well as for the society, individually or represented through the maker movement or its different forms of collaborative work (hacker or maker spaces, fablabs, associations or educational centers).

European administrations can find a detailed analysis of the state in 2020, of the situation in Europe of creation and digital manufacturing technologies, fed back through the data, registered perceptions and current perspectives analyzed in relation to the present and future of these spaces, their structure, the human and technological resources they have, and the possibilities they have in a collaborative way, the different formats of relationship with the society and the companies, and their presence in local, national and international networks.

The partners of iPRODUCE have at their disposal, through this report, a detailed expectations of their different WPs and the whole project from this moment on, regarding the model of reference of these studied spaces and their different current experiences and emerging experiences around digital creation and manufacturing, their users, their projects and their technologies This report is emphasizing the opportunities that have not been covered or are in scarce development to raise the CMDFs that are intended to be constituted.

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1. Introduction

The iPRODUCE project promotes collaboration between manufacturers, consumers and small and medium-sized manufacturing enterprises (SMEs). The iPRODUCE project has three specific objectives:

1) To bring together communities of makers, manufacturers and consumers (MMC) at a local level;
2) To involve these communities in the challenges of co-creation, for the manufacture of new consumer products and the introduction of new engineering and production (eco)systems;
3) To provide practices, methods and instruments to be used both by makers and manufacturing companies (specifically, micro-enterprises and SMEs).

Part of this project involves the evaluation, by means of this prospective and benchmarking study, of the situation in Europe of the main players and spaces, the conditions under which they operate and the technological adaptation available to them.

The purpose of this activity is "to be closer to the consumer in order to validate proposals and recognise needs, develop new possibilities for products and services by introducing technology, or facilitating and improving the product design and development process by co-designing with professionals, makers and/or users".

1.1. Scope of the Deliverable

The iPRODUCE project introduces a new framework of social manufacturing that includes companies in the consumer goods sector, their collaboration networks, maker spaces, DIY communities and other innovation actors that can influence locally. To do this, it takes the well-known and well-proven way of operating FabLab and maker approaches, and introduces them into local ecosystems by transforming itself into a collaborative manufacturing model thanks to the installation of a demonstration pilot (cMDF). English). Under the iPRODUCE project, local cMDFs will be interconnected in a flexible organizational structure that enables the exchange of knowledge as well as the exchange of human and technical resources. In this context, the objective of the iPRODUCE project is threefold: a) Bringing together the communities of makers, manufacturers and consumers at the local level; b) Involve them in the challenges of joint creation for the manufacture of new consumer products and the introduction of new (circular) engineering and production systems; and c) Merge the good practices, methods and tools used by both manufacturers and manufacturing companies (specifically SMEs). Local cMDFs are expected to become the main accessible technology drivers to launch, promote and carry out planned collaborative engineering and co-creation activities, while capitalizing on new approaches to consumer engagement.

Regarding the present Benchmarking study, this task intends an exhaustive and updated investigation of the existing state-of-art methodologies, architectures, technologies and solutions that support the philosophy of production and collaborative social manufacturing that are established as success factors in the approaches fablab and makerspace, as an objective to introduce manufacturing companies and SMEs in the consumer goods sector. In addition, traditional and current tools used in the industry will be considered to support co-design / co-production scenarios on a larger scale and with greater impact. Systems that incorporate knowledge-based networks, which provide factory and supply chain information and feedback, will also be revised to help promote continuous optimization in the production process and manufacturing system. Data processing and analysis, combined with advanced simulation techniques and AR / VR, will also be studied, in order to predict the characteristics of future products and facilitate online interactions, while also maintaining quality standards. All this will be complemented with an analysis of the solutions called "Autonomous Validation", in which the systems adjust to the needs of the users and are recalibrated to the level of usability. Research with primary sources will be carried out in close collaboration with focus groups of end users and solution providers. Particular attention will be paid to approaches inspired by product design-oriented social engagement, as well as the use of collaborative economy-oriented marketing.

2. Contextualization of the purpose of the research

2.1. Theoretical framework

2.1.1. The trend towards digital manufacture: the productive citizen

The development of additive and numerical control technologies is very significantly increasing the flexibility of production, allowing the mass customisation of products. Although at first it was thought that this might kill off traditional production, the evolution observed to date points in the opposite direction. Progressive cost reduction, together with the development of ever more accessible software, is opening up a world of new opportunities for creativity, as it allows anyone to construct their ideas in their own way and to perform more complex tasks in collaboration with other users or by combining different types of technology more rapidly, simply and inexpensively.

Since the 1990s, significant progress has been seen in virtual modelling, CAD-CAM and prototyping systems. Today, there already exist 3-D printers capable of manufacturing objects from digital designs and they are much more affordable than twenty years ago. In turn, *fabbing*[1] (VON DER GRACHT, 2008), the personalised production of three-dimensional objects, is already a reality. The popularisation of these technologies is revolutionising the manufacture and distribution of objects of all kinds.

In this context appear *fablabs*, makerspaces and hackerspaces, laboratories at the disposal of creatives and inventors that allow significant reductions in production costs and democratise access to new technologies. One of the weaknesses of these systems is that they can lead to the reduction of the footprint of the creative (minimisation of the use of physical resources and reduction of development time) and increase the rapid design and manufacture of objects.

In recent years, the increase in the number of spaces dedicated to digital creation and manufacture has continued unabated throughout the world, and also in Spain. In this time, 3-D printing has become popular, the idea of industry 4.0 heralds a new industrial revolution based on a distributed collaborative model, and we are already talking of new models, such as fablab 2.0[2] (PEEK, 2016). For most people, these concepts may sound strange, even in areas traditionally considered to be scientific.

One of the elements which in recent years has become especially relevant is the growth that has been seen in the democratisation of technology and inventions, with the spread of open hardware (3-D *RepRap* printers), open software (Arduino), the creation of networks (where we find ever more 3-D repositories) and the maker culture, which facilitate access to technology, creative inspiration, co-creativity and self-production (TESCONI & ARIAS, 2015)[3]. The popularisation of this type of technology is revolutionising the manufacture and distribution of objects of all kinds, where young

[1] Von Der Gracht, Heiko A. (2008). The Future of Logistics: Scenarios for 2025. Col. Einkauf, Logistik und Supply Chain Management. Ed. Gabler Verlag.
[2] Peek, N. (2016). Making Machines that Make: Object-Oriented Hardware Meets Object-Oriented Software. Submitted to the Program in Media Arts and Sciences. Massachusetts Institute of Technology
[3] Tesconi, S; Arias, L., 2015. *The Transformative Potential of Making in Teacher Education: A Case Study on Teacher Training Through Making and Prototyping*. Third International Conference, DAPI 2015, Held as Part of HCI International, Los Angeles, CA, USA, August 2-7, Proceedings. pp. 119-128

people and designers interested in the technological aspects express digital change through this new way of doing things (LIPSON & KURMAN, 2010):[4]

"Today's consumers, particularly young consumers, expect to be able to make their own digital articles and products. They will soon have the tools to make their own physical articles and products."

In 2005, Neil Gershenfeld, creator of the FabLab concept, wrote 'Fab' about his own experiences and those related to CEBIT at the MIT, which revolved not so much around technical innovation as educational and social innovation (GERSHENFELD, 2005). In his book, he predicted how, just as had occurred with personal computers, the same would happen with the concept of manufacture and that personal fabricators (PFs) would eventually appear[5].

2.1.2. The Maker Culture

The term *maker* was coined in 2005 by Dale Dougherty, of O'Reilly Media, when he launched 'Made', a publication on DIY (*Design & Do It Yourself*) projects and, in 2006, a series of fairs in the USA, the *Maker Faires*, were the first meeting point for this movement. The maker movement can be defined as a growing number of people who share the following characteristics:

- Interest in doing things themselves (*Do-It-Yourself* - DIY) and in collaboration with others (*Do-It-With-Others* - DIWO)
- The use of desktop digital tools to create new products or objects, to reproduce elements and develop prototypes.
- A culture of sharing designs on the Internet and collaborating in online communities so that anyone can access the information and create products using the appropriate manuals.
- The use of standard design files which allow anyone to send their designs to manufacturing services and produce them in any quantity.

All of the makers, (to give a common denomination to different types of creatives, designers, engineers, architects, artists and inventors), share a number of common characteristics, even taking into account that the working disciplines involved are very different. In this respect, in 2013, Mark Hatch (co-founder and CEO of Techshop), published 'The Maker Movement Manifesto', a book aimed at makers, designers and entrepreneurs, in which he showed how anyone could develop and create new products, bringing positive change to society while making a profit (HATCH, 2013)[6]. In the book, he establishes a series of guidelines for innovation in the new environment of hackers, artisans, creators, etc., which could be summed up as making (physically), sharing (personal recompense), giving (knowledge, or a gift), learning (in a natural, practical manner), having equipment at one's disposal (in an attractive space), playing (seriously and disruptively), participating (sharing common interests among the community), supporting (the creation of these maker communities) and changing (the view of the world and of oneself).

Other demands of the maker movement to be found in a similar format are the *Self Repair Manifesto* (IFIXIT, 2017)[7], *The Maker's Bill of Rights* (MAKE, 2006)[8] and *The Fixer's Manifesto* (MAKE, 2006)[9].

[4] Lipson, H.; Kurman, M., 2010. *Factory@Home: The emerging economy of personal fabrication*. Washington D. C.: US Office of Science and Technology Policy.

[5] Gershenfeld, N., 2005. Fab: the coming revolution on your desktop – from personal computers to personal fabrication. Basic Books, Nueva York.

[6] Hatch, M., 2013. Maker Movemet Manifiesto. McGraw-Hill Education, 2014.

[7] Ifixit, 2017. *Manifiesto de la Autorreparación*. [online] Available at: <*https://es.ifixit.com/Manifesto*> [Accessed 9 April 2018].

As García Sáez (2016) noted, all of these texts share a number of fundamental ideas, such as: the need for manufacturers to facilitate the reparability of their products, the freedom of users to open objects and to learn how they work, the freedom and independence gained through knowing how to repair things oneself and the greater sustainability of this approach (GARCÍA SÁEZ, 2016)[10].

What began as a cultural change has become a change in the manufacturing model, and both public bodies and private companies are beginning to understand the great economic and social potential that this entails. Proof of this is that some of the leading design software and 3-D printing companies (Autodesk, PTC, 3Dsystems, etc.) have focused on the maker movement and have begun to launch free design software for non-professionals, targeting young people and children, with cloud-based services that allow designs to be uploaded and manufactured on 3-D or laser cutter printers in any nearby *makerspace*. Similarly, although many projects may become clearly entrepreneurial and may be financed through *crowdfunding*, some large corporations are also investing in companies related to the maker movement. Since the beginning of this century, different public spaces equipped with resources and equipment for the design and manufacture of different kinds of objects have appeared. These spaces receive different names, depending on the activity undertaken or the objectives and function of each one:

- *Hackerspace*. This concept was developed in Europe and refers to a space with shared resources used above all by groups of computer programmers (hackers). One of the first spaces (the not-for-profit association, *C-base*), was created in Berlin in 1995 with the aim of increasing knowledge of all things related to computing and their applications. These spaces later spread to the rest of Europe and, above all, the United States (NYC Resistor, HacDC, etc.). As well as everything related to programming, these spaces also include workshops for the design and manufacture of electronic circuits and devices, as well as prototyping tools to make physical models, normally in the area of hardware component modification related to computing. From these spaces emerged important businesses, such as MakerBot Industries (2009), which have significantly promoted the 3-D printing industry, from 2013 onwards.
- *Makerspace*. Although the concept appeared in 2005 in 'Maker Magazine', it did not become popular until 2011, when the domain 'makerspace.com' was registered, and it began to be used to design publicly accessible spaces for manufacture and creation (often in the context of youth spaces). The objective of these spaces was to provide access to equipment, tools and knowledge to a community in order to facilitate design, prototyping and manufacture in projects that would normally not be possible without these resources. In them, professionals, amateurs and/or experts are able to work. These spaces may be organised through companies, not-for-profit organisations, universities or schools, among others. They are representative of the democratisation of education and access to technology, and today they are beginning to incubate or accelerate projects with a significant economic impact. Examples of recognised makerspaces around the world are Artisan's Asylum and the Columbus Idea Foundry. Among the best known makerspaces are the international FabLabs network, oriented more towards prototyping through different means of digital manufacture. Together with Techshop, which recently closed, they existed before the term makerspace existed and

[8] Make, 2006. *The Maker's Bill of Rights*.[online] Available at: <*https://makezine.com/2006/12/01/the-makers-bill-of-rights/*>[Accessed 9 April 2018].

[9] Make, 2006. *The Maker's Bill of Rights*. [pdf] Available at: <*https://s3-eu-west-1.amazonaws.com/sugru-web-assets/Fixer_Manifesto_2.0_type_only.pdf*>[Accessed 9 April 2018].

[10] García Sáez, C., 2016. (Casi) Todo por Hacer. Una mirada social y educativa sobre los FabLabs y el movimiento Maker. Fundación Orange.

are today probably the best known for their impact, with a network of over ten thousand laboratories throughout the world.

Alongside these physical spaces, there is an avid online community which also recommends a series of manuals and resources where information can be obtained for the establishment and management of creative spaces, offering guides with information and ideas for anyone who wishes to create a makerspace in an educational or community centre (MAKE, 2017)[11]. The best-known, 'The Makerspace Playbook', can be downloaded free of charge by registering on the website. This guide explains the origins and meaning of the maker movement, shares experiences from different centres, lists possible projects to be undertaken and offers a range of support documentation to ensure smooth operation (templates, forms, lists). It also explains how to create and organise a space of this type properly in practice and what the factors to be taken into account are (roles and skills of the different participants, security rules, recommended tools and materials, topics to be developed, etc).

It is a simplification to associate the necessary change in the model solely with technology, since other conditioning factors have an equally important influence (such as social, cultural, educational and territorial and structural factors). Nevertheless, technological capacity and the ability to establish the appropriate strategies in these fields are part of an essential framework to guide future development.

With manufacturing activities becoming delocalised and transferred to emerging economies under cost reduction strategies, it is no longer possible to compete on price, but on service and added value, displacing consumption towards products and services embodying more technology. In sectors in contact with the final consumer, it is necessary to incentivise actions aimed at disseminating the technologies involved in the manufacturing process and at getting closer to the consumer, informing them of the influence of technological development on the consumer's well-being and quality of life (health, environmental, demographic, socio-economic aspects, etc.) (BUTLER & GIBSON, 2011)[12].

2.1.3. The EU context

Despite a number of common characteristics, the wide variety of spaces that exist all over the world make it difficult to establish an advanced common system of classification.

The latest study that we have seen is by the University of Santander, and although it took an international sample, the paper covers 60 spaces in European countries, like those referred to in this study. The purpose of the paper was not to interpret data or to offer conclusions, but it may serve as a reference to what has occurred over the last five years since the research. It includes an interesting SWOT analysis.

Perhaps, the summary of the aforementioned study is better reflected in the SWOT with which the aforementioned authors concluded (LENA AND GARCÍA, 2016)

[11] Make: Makerspaces, 2017. Makerspaces represent the democratization of design, engineering, fabrication, and education. [online] Available at: <*http://spaces.makerspace.com*>[Accessed 9 April 2018].

[12] Butler, J. S.; Gibson, D. V. (2011). Global Perspectives on Technology Transfer and Commercialization: Building Innovative Ecosystems. Ed. Edward Elgar Publishing.

TRENGTHS	WEAKNESSES
Allow access to Open culture. Bring technology closer to l students. Build a community around technology. Facilitate rapid prototyping and 3D design. Collaborate with multiple groups and associations. Provide specific technology training. Be part of the FabLab Network. Development of several joint programs with other entities. Bring the Maker world closer to the city. Include technology and art. Provide new tools for research. Have a free space for creation. Allow the development of student projects.	Get the right staff. Obtain the necessary financing. Bringing digital manufacturing closer to the world. Improve or expand machinery. Build an adequate ecosystem. Get more space on the premises. Economic sustainability. Project documentation. Maintain an Open culture. Achieve attraction of more users and increase participation. Generate a suitable business model. Achieve greater collaboration with FabLab outdoors. Development of projects of FabLab itself. Achieve institutional independence. Lack of time.
THREATS	OPPORTUNITIES
Not having a sustainable business model. Lack of independence. Bad management by the host institution. Geographic situation. Lack of innovative culture. Unfair competition in the FabLab network itself. Financing difficulties and sustainability. Lack of timely space. Lack of new ideas. Little understanding of the FabLab concept. Loss of support from institutions. Supply parts and concrete products. Lack of experts on FabLab staff. Lack of connection with other FabLabs. Lack of infrastructure for other projects. Lack of timely staff.	Location close to universities. Establish collaboration with multiple entities. Build a true community of Makers. Collaborate with other entities to expand the FabLab culture. Situation in a business incubator. Large capacity of project teams. Great novel ideas. Great versatility. First FabLab in the region. The Maker movement begins to be known. Being part of an institution with a large number of users. Inclusion of art and technology projects. Integration of digital manufacturing and digital design in education. Growth potential of rapid prototyping

Table 1. Makerspaces SWOT (Lena and Garcia, 2016)

Source: Lena-Acebo, F.J., García-Ruiz, M.E., 2016. FabLab Global Survey. Results of a study on the development of collaborative culture. Raleigh, USA. Editorial LuLu.com.

Other international studies, such as that of the Helmut Schmidt University (Germany), highlight (in the case of the FabLabs) the lack of a formalized operational structure and having unified communication platforms (networked) among other limitations. This arises as two of the main impediments to the full effectiveness of the initiative of the spaces (OSUNYOMI et al., 2016). Also, another study from the same university mentions that it is difficult to quantify all the spaces, but the following factors were used as determinants of the success of FabLabs (OLADELE-EMMANUEL et al., 2016):

1) 1] Contribution to innovations and R&D
2) 2] Contribution to human development (that is, to the empowerment of people)
3) 3] Achievement of your goals and objectives
4) 4] Types of users
5) 5] Contributions to entrepreneurship and business development
6) 6] Accessibility for users
7) 7] Sustainability
8) 8] Collaboration within the FabLab network
9) 9] Frequency of use
10) 10] Availability of raw materials

Of these indicators, their authors coincide in the conclusions of the Osunyomi study, but they affect pending questions such as the development of a sustainable business model, which impede effectiveness in the fablab initiative. They conclude that it is necessary to show the important potential that these regional networks have, through: (1) providing assistance to new companies, (2) creating adequate networks (3) having good communication for the exchange of ideas and information, (5) the national and international visibility of each facility, and (6) building a more credible business model in terms of marketing and financing.

It must also be considered that, given the differences that occur between the various manufacturing laboratories, the possibility of a flexible set of guidelines may be considered, in which each group of CMDFs could design a service, according to the specific needs of ecosystems premises and the capacity of existing manufacturing laboratories in your environment. Some of this happened in the case of the FabLabNet project, funded by the Interreg Central Europe program, which considered different approaches by countries around their business models (FELLIN & BARCUCCI, 2017):

- Connection with communities (Italy, Slovenia, Poland, Czech Republic), promoting digital transformation within the local production ecosystem, both in industrial manufacturing and in crafts,
- Business connection (Hungary, Italy, Slovakia, Croatia, Germany), supporting business incubation, acceleration and development,
- Connection with education (Austria, Slovakia, Czech Republic, Croatia, Slovenia, Poland, Germany and Italy), which affects training and education formats. Regarding open sharing, there is also a debate given the nature of the spaces so oriented to open culture (WOLF and al., 2014).

The vast majority exhibit attempts to share their open source knowledge and work with open innovation processes, but the other two characteristics that characterize open access, such as open software development, and having open content in education and open science, are not common. This informal communication between peers can be part of a conscious construction of a community, and allows generating an important production of knowledge. This is a detail that will be important to evaluate in the case of iPRODUCE. Regarding published cases of experiences on spaces connected to the business world, we have known few of them, such as the recent model of the Intelligent Production Laboratory (Smart Lab) designed and launched by the Industrial Management Institute of the FH Joanneum University of Applied Sciences (Austria), for the transfer of knowledge of the digital transformation processes for the company. The methodology that they use focuses mainly on the validation of prototypes (TSCHANDL et al., 2020). On the other hand, already consolidated spaces, such as FabLab Lisboa (of municipal management), trust that the future will go more through professionalized services such as, for example, supporting business incubation and acceleration (GAEIRAS, 2017).

On the other hand, in the case of co-creation tools with users within the spaces, perhaps there have been more noted experiences of integrating these people in the design process, and based on user-centered design methods, beyond storytelling or the customer journey maps (LOBBÉ et al., 2019).

In general, the topic of spaces is still not sufficiently addressed from scientific literature (SAVASTANO et al., 2016), and if there is, it has focused more on educational and training aspects (40%), than on user scopes. final (20%), technological (15%) or organizational (20%). Still, FabLab or makerspace-type initiatives are of great importance to most authors to ensure innovative and sustainable development of communities, both in developed and developing countries, and are also economically important to support business efforts, as iPRODUCE intends. Therefore, both spaces and other digital manufacturing initiatives are good ways to facilitate adequate value creation.

3. Methodology

3.1. Hypothesis, general objectives, specific objectives and indicators of the research

The initial hypothesis of this benchmarking research is as follows:

"Opportunities (niches) for innovation and outreach to the business and professional sectors are being generated around new technologies and, specifically, the activities of digital creation and manufacturing spaces. In the case of companies producing consumer goods, these opportunities offer a partner with which to come closer to consumers in order to validate proposals and recognise consumer needs, to develop new possibilities for goods and services by introducing technology, or to facilitate and improve product design and development processes, by co-designing with professionals, makers and/or users".

3.1.1. General Objectives.

On the basis of this initial hypothesis, the following general objectives were set:

- To validate the intervention methodology of the iPRODUCE project, aimed at the future launch of CMDFs, taking as a starting point knowledge of the sector and of the different digital creation and manufacturing spaces to be found in European models of fablabs, makerspaces and hackerspaces, which justify the new opportunities for connection between maker activity and producers of consumer goods, generated by the sustained growth of these spaces and their potential development. To this end, it is useful to understand the business model, values, strategies, conditions for access and the adaptation of these spaces, as well as their business potential.
- To identify and evaluate their service portfolio, the type of project demand according to the professional or business profile, and the skills required in the activities that have been surveyed, which is related to the strengthening of soft skills and technology, with industry 4.0., in order to facilitate in the near future a means of intervening with the different agents in the system.

3.1.2. Specific Objectives.

In order to achieve the above general objectives, the research proposed the following specific objectives:

- To determine the recent evolution of economic and social activities in makerspaces in Europe through the country partners in the project, analysing the future expectations of the spaces in relation to their values, and the strategies that will allow them to achieve their objectives over time.
- To identify the type of activity by user, the type of project they undertake and the user profile to be found in the spaces, in order to determine the services, clients and agents involved in each business, and where they obtain their funds and make their investments. To determine the working teams in these spaces, in terms of their number, gender and age, as well as their professional qualification and the basic requirements for entry into the team, examining especially how communication with clients and users takes place, and the technical and

human resources at their disposal. Finally, we wish to identify the technologies (software and hardware) available in these spaces to provide services and attend to users.

3.1.3. Indicators

Table 2 shows the indicators chosen for the research in accordance with the General Objectives and Specific Objectives.

GENERAL OBJECTIVES, SPECIFIC OBJECTIVES AND RESEARCH INDICATORS.	
GENERAL OBJECTIVE 1: To validate the intervention methodology of the iPRODUCE project, aimed at the future launch of CMDFs, taking as a starting point knowledge of the sector and of the different digital creation and manufacturing spaces to be found in European models of fablabs, makerspaces and hackerspaces, which justify the new opportunities for connection between maker activity and producers of consumer goods, generated by the sustained growth of these spaces and their potential development. To this end, it is useful to understand the business model, values, strategies, conditions for access and the adaptation of these spaces, as well as their business potential.	
SPECIFIC OBJECTIVES	INDICATORS
To determine the recent evolution of the economic and social activities in makerspaces in Europe through the country partners in the project.	1. To determine the organisational model, type of participatory network and the thematic area addressed by these networks and where they fit into the activity of the spaces (three closed questions, with suggested responses and a possibility of an open response in the last question). 2. To determine the age of these spaces, taking as a reference point the implementation little more than one decade ago of fablabs, and to determine the current status of activity by the organisation (closed question on the year of creation and closed question with suggested responses).
To determine the future expectations of the spaces, in accordance with their values, and the strategies that will allow them to achieve their objectives over time.	1. The main values which they consider to form part of their expectations and transversal values which define their social commitment and business philosophy (two closed questions with suggested responses, with the option of an open response in the second question). 2. The means by which those values are transmitted to society and to clients (one closed question with suggested responses and one option of an open response at the end). 3. Identification of the business model: presence, accessibility, online activity, adaptation and scope of action. (Four closed questions with suggested responses).
GENERAL OBJECTIVE 2: To identify and value their service portfolio, the type of project demand according to the professional or business profile, and the skills required in the activities that have been surveyed, which is related to the strengthening of soft skills and technology, with industry 4.0., in order to facilitate in the near future a means of intervening with the different agents	

in the system.	
SPECIFIC OBJECTIVES	INDICATORS
To identify the type of activity by user, the type of project undertaken and the user profile to be found in the spaces.	1. Determination of the type of activity undertaken in the space (hierarchical question, suggested responses). 2. Identification of the user profile from their qualifications or the activity undertaken, such as researchers, students or inventors (closed question, suggested responses). 3. Identification of the type of project by speciality (closed question, suggested responses)
To identify the services, clients and agents involved in the business, and where they obtain their funds and make their investments.	1. Identification of both the clients and the entities to which services are provided, and the fundraising resources (three closed questions, suggested responses). 2. Determination of the target of investments (one closed question, suggested replies).
To determine the working team in these spaces, in terms of number, gender and age, their professional qualifications and the basic requirements for entry into the team.	1. Identification of the number of persons in the team and the persons with decision-making power (two closed questions, with suggested replies). 2. Determination of the level of qualifications, age-range and gender (three levels of questions with non-comparative scales). 3. Determination of skills, both soft skills and transversal knowledge (two closed questions, suggested responses, with one open response option). 4. Determination of the training requirements for access to employment (one closed question, suggested replies).
To identify the means of communication with clients and users, and the human and technical resources available.	1. Identification of who is responsible for communication and the resources used to ensure its efficiency (two closed questions, with suggested responses). 2. Description of the frequency and updating of the information about the activities in each space (one closed multiple-choice question with suggested responses). 3. Determination of presence in the media and the type of medium in which the space usually appears (one closed question, suggested responses with one open response option). 4. Identification of the technical resources for communication with clients and users (one closed question with suggested responses).
To identify the technologies (software and hardware) available to the spaces in order to provide their services and attend to users.	1. Determination of the software usually employed in the spaces (closed question with suggested responses). 2. Determination of the technological resources available in European spaces, the

	majority being digital (one multiple-choice question with 13 suggested responses, and one open multiple-choice question).

Table 2. General and specific objectives and indicators of the study

Source: In-house

3.2. Methodology: type of research, research techniques and tools

3.2.1. Type of Research

Due to the prospective nature of the study, it was decided, on the one hand, to undertake exploratory research and, on the other, complementary research of a descriptive nature.

3.2.2. Research techniques and tools

Qualitative and quantitative techniques have been used together to achieve the general and specific objectives laid down for this research.

A total of 44 in-depth surveys were made, with 35 questions, translated into the six languages of the EU partner countries in the consortium: Greek, Italian, Danish, German, French and Spanish. The survey was structured and divided into six areas: general description of the organisation (questions 1 to 5), values and strategies (6 to 15), collaboration and funding (16 to 19), internal composition (20 to 27), communication and tools (28 to 32) and technology (33 to 35).

A universal, multi-platform Internet survey tool was used, so that the survey could be answered by phone, tablet or computer. It was structured in each language in order to obtain information for each country and a global tally. A link in each language was used in order to be able to send communications by WhatsApp or email.

Two expert panels were also held. The first was made up of managers and directors from Spanish spaces, as representatives of one of the consortium countries, and the second, of makerspaces and fablabs that are members of the partnership. The meetings did not last more than ninety minutes, and the debates centred around three main questions: (1) about the current situation, (2) about the future, and (3) about the economic and social demand for the activities in the most significant spaces.

The introduction consisted of a rapid reading of these objectives and then the questions were thrown open for the experts to answer one by one. When comments on the sections were closing, if any concerns or matters considered critical were raised, they were discussed, with a free exchange of views.

These three sections took approximately 25 minutes, depending on the interest they aroused in each meeting, and if all of the answers were not forthcoming, the experts were asked to complete them later, briefly and quickly. (This happened in the second case, with the makerspace and fablab partners of the project). Finally, if time was available, any further matters or comments regarding aspects which arose during the session were heard.

The sessions were recorded in order to record aspects that would confirm the quantitative data obtained from the surveys, as well as comments that could inform aspects of the final study.

4. Report on results

4.1. Type of organisation

4.1.1. Organisational model

Most of the organisations surveyed were SMEs (or microenterprises), which made up the largest group among the organisations, at 20.4% of those participating in the survey.

Other participating groups included, on the one hand, professional or business associations which host a fablab or makerspace within their structure and, on the other, universities or university research groups. Each group represented 15.9% of the total.

Another fairly representative group were NGOs, not-for-profit associations or foundations, representing 11.3% of the total.

There were also organised informal user communities (9.1%) and spaces attached to public corporations or institutions (also 9.1% of the total).

With 4.5%, we found primary and secondary schools and, in the same proportion, spaces in technology centres. Finally, there were cases of a start-up, a cooperative, an occupational training centre, a non-university higher education centre and a fablab in a start-up accelerator.

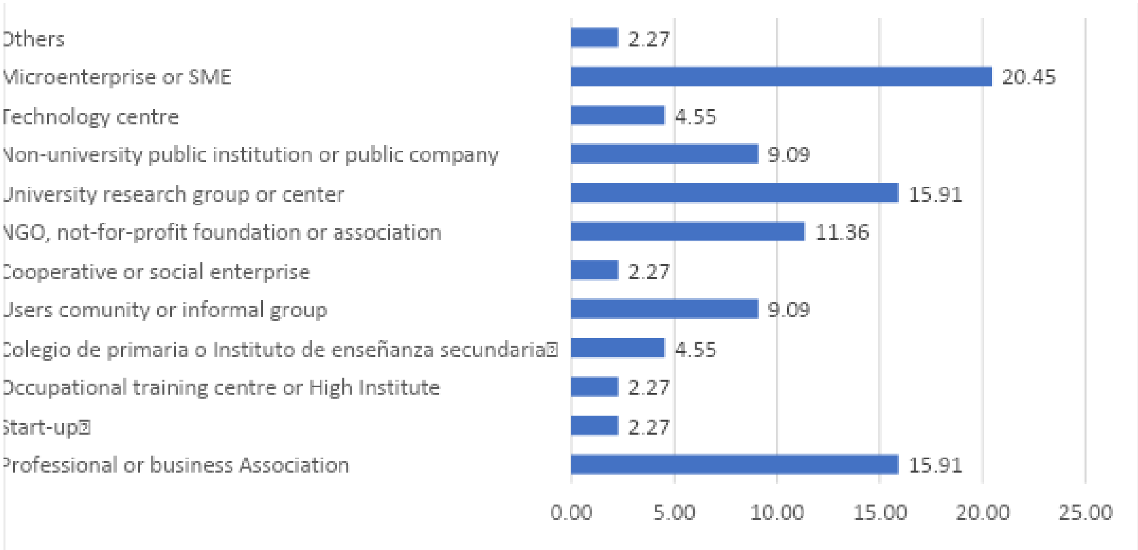


Figure 1. Organisational model on entities in the survey

4.1.2. Participation in networks

These organisations are very active in local and national networks, with 65.9% being present, and with a high level of international presence (68.1%).

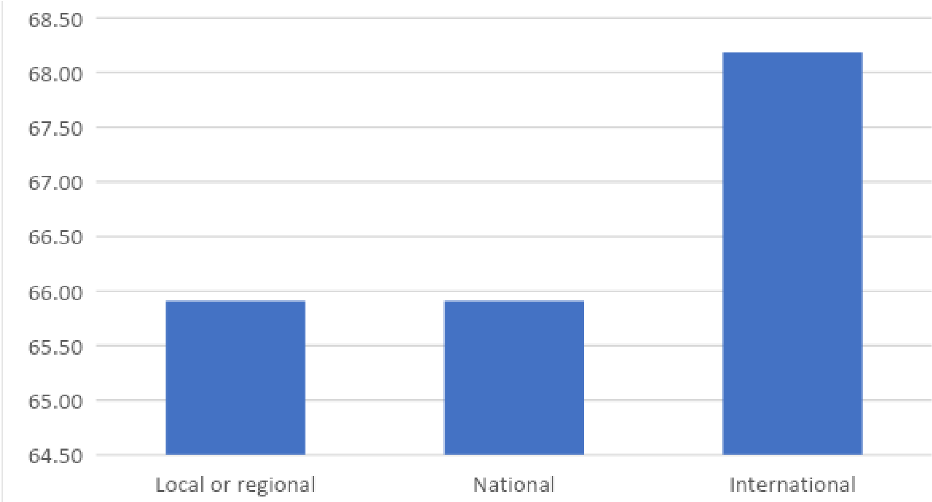


Figure 2. Networks entities work with

They work or participate fundamentally in networks related to 3-D printing (70.4%), collaborative digital creation and manufacturing networks (63.6%), in Do-It-Yourself or networks working with digital manufacturing resources other than 3-D printing (both with 61.3%). Other networks where they can habitually be found are design-related networks (54.5%) and hardware or electronics networks (52.2%).

They were less well represented in institutional (31.8%) and business networks (38.6%), and there was very little presence on commercial platforms (4.5%). There was one case of participation in an educational network and one in Deep Tech.

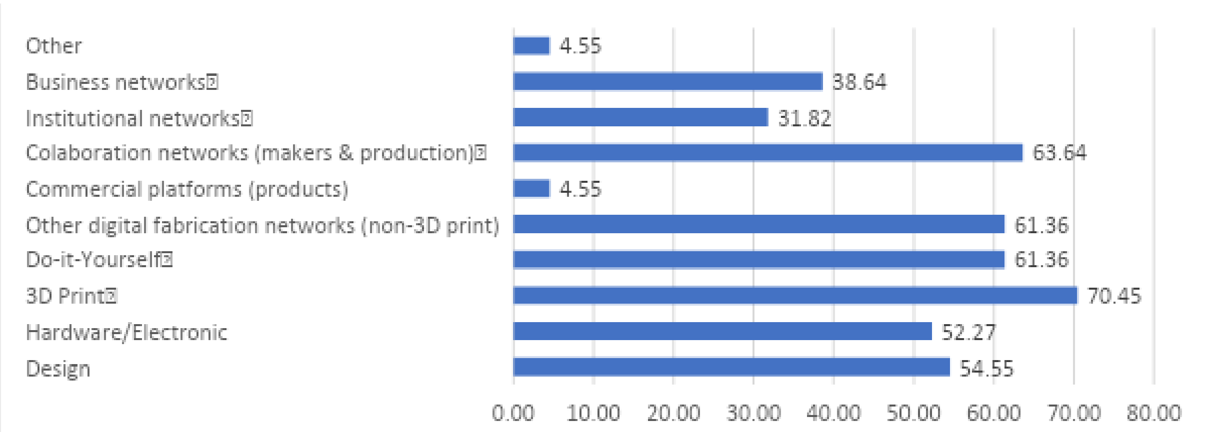


Figure 3. Types of participated networks

4.1.3. Year of creation

Most of these organisations were established between 2013 and 2017 (over 59% of the spaces), with the high point coming in 2015 (with 15.9%). With the exception of 2012, the decade now closing has seen the creation of most of the organisations included in the survey, representing 70.4% of the total, compared with 13.6% in the previous decade, while 15.9% of the spaces were created in the last century.

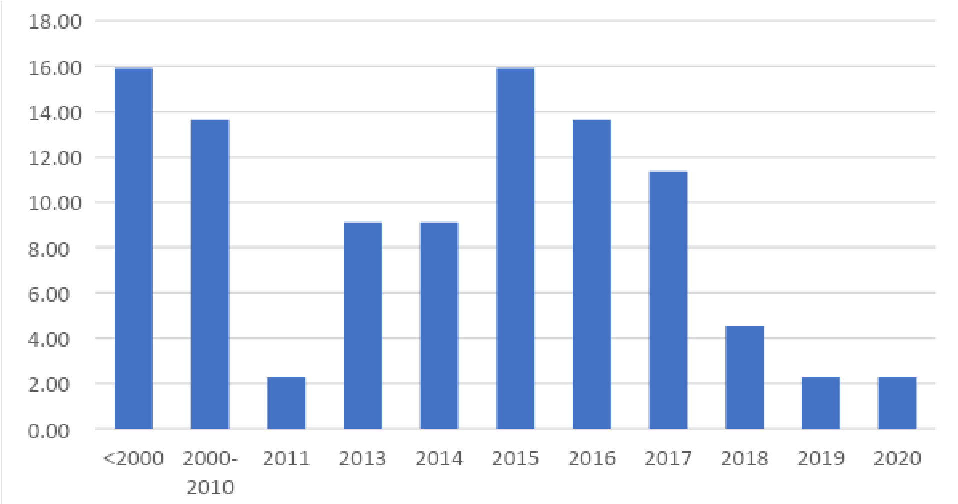


Figure 4. Year of creation

4.1.4. Current activity status

The situation with respect to the activity of these spaces is that 56.8% are commercially active, 18.1% are in operation but not commercially active, and 25% are in some way pending activation or reactivation.

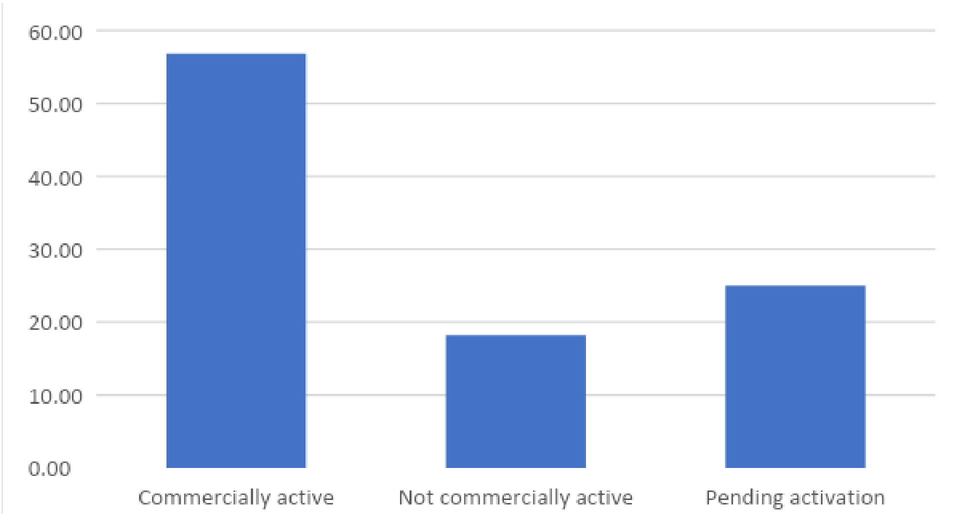


Figure 5. Current activity status

4.2. Values and Strategies

The second section comprises a whole series of values on which the work carried out in these spaces rests, and which form part of their day-to-day spirit, meeting their business objectives and fulfilling a function in our society.

4.2.1. Core values

The main aim of most of the spaces is technological empowerment. In 86.3% of the cases, the objective is for the people participating in or using a makerspace to have access to and to learn about the technology in order to develop their own ideas and projects. In line with this, the second value is self-learning, with 68.1%, followed by open hardware design, with 65%, in Europe as a whole. Values falling below the mean are technological observatory functions (40.9%) and the promotion of hacktivism (34%).

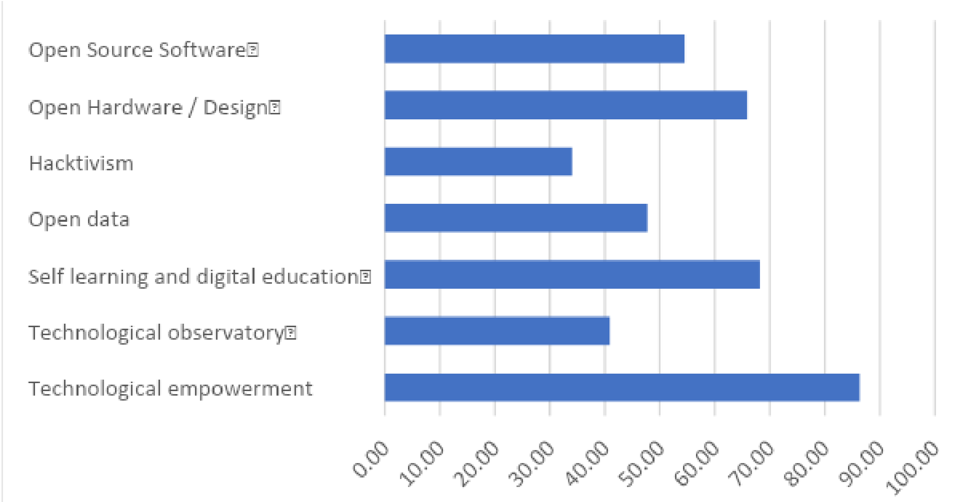


Figure 6. Core Values

By country, technological empowerment is fundamental for all of the spaces in Italy and Spain. The fields of self-learning and digital education are present in all the spaces in France, and also significantly in Germany (83.3%) and Spain (81.8%). Open hardware and open source in general has a predominant place in Spain (a mean of 81.8%) and Denmark (open hardware, with 71.4%). The survey also tells us that open data culture is being promoted in countries such as Spain (63.6%), Italy and Denmark (57.1% each), the idea of a technological observatory is found more in Denmark, France and Greece, while hacktivism is a more common value in Denmark (71.4%) and Germany (66.6%) compared with the Mediterranean countries.

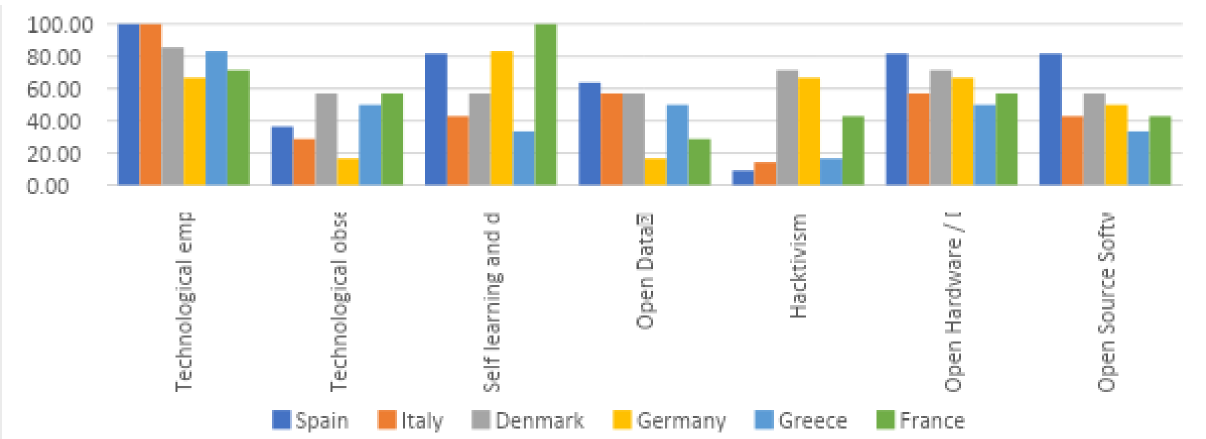


Figure 7. Core Values per country

4.2.2. Transversal values

With respect to other values which expand or complement the activities of the spaces, there is a significant trend towards digital inclusion, which enhances the empowerment and the self-learning process mentioned in the previous point, with a prevalence of 70.4% in Europe as a whole.

Other above-average values which are found include urban innovation (almost 60%) and the circular economy (56.8%). Other values, such as activist design and other specific topics addressed in certain spaces, are found in only 36% of the spaces as a whole.

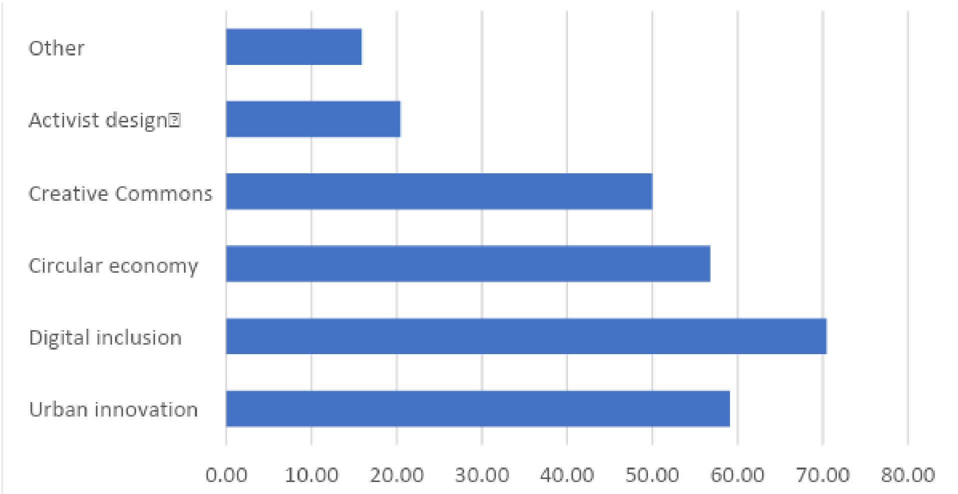


Figure 8. Cross-cutting Values

Digital inclusion is found widely in Spain (90.9%), Germany (83.3%) and Italy (71.4%). Urban innovation stands out in Germany (also 83.3%), Greece (66.6%) and Spain (63.6%). Another important aspect which should be highlighted is the circular economy, which is found in all the spaces in Germany, also followed by Greece and Spain. It is also notable that, in Denmark, the highest value is Creative Commons, at 85.7%, higher than in the rest of Europe (in France, it is one of the highest scoring data in this part of the survey).

Other, less relevant data found in some spaces were values related to technology transfer or dissemination (two spaces), values related to team or collaborative work (three), local manufacture and entrepreneurship (one each).

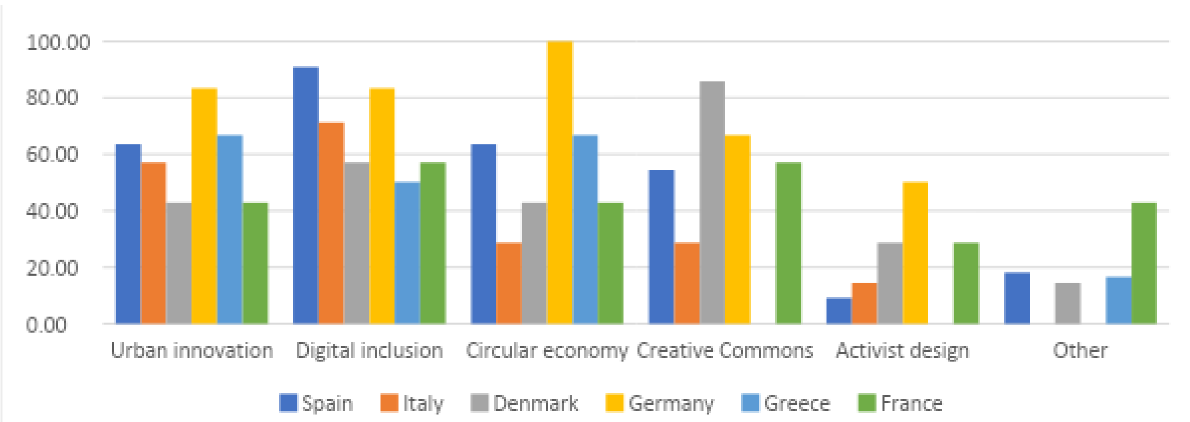


Figure 9. Cross Cutting Values per country

4.2.3. Channels of transmission of these values

These values are transmitted through different channels, the most common activity being the organisation of workshops and courses, with 81.8% in Europe as a whole. In a distant second place, but above the average, is transmission through the management of the spaces themselves and the provision of free technological support, at 54.5% each. The lowest scores are the management of community networks (27.2%) and development of open software (38.6%).

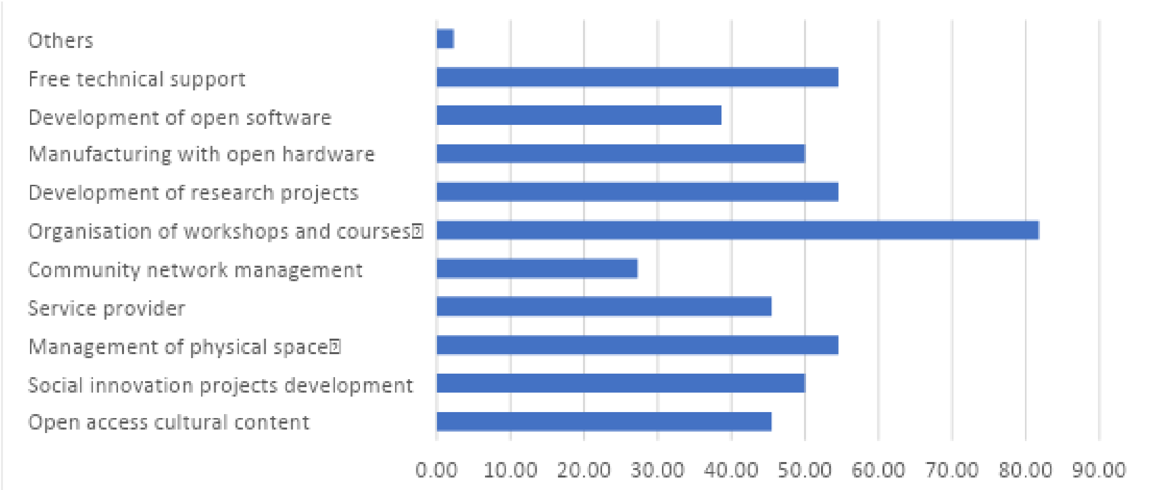


Figure 10. Main transmission channels

Knowledge of these values is acquired in the workshops and courses run in Greece, France and Spain in all of the spaces. The lowest score is seen in Denmark, with 42.8%. Germany has a high score in working and manufacturing with open hardware (83.3%), with the management of spaces in Denmark and Spain exceeding 71% in both cases. The development of research projects holds an important place in Spain (72.7%) and Germany, and providing these services is an important factor for the transmission of these values in Italy (71.4%). In comparison with other countries, Germany stands out in the development of open software (66.6%) and France in free technological support (71.4%). Only in France have other considerations, such as support for entrepreneurs, been found in a space.

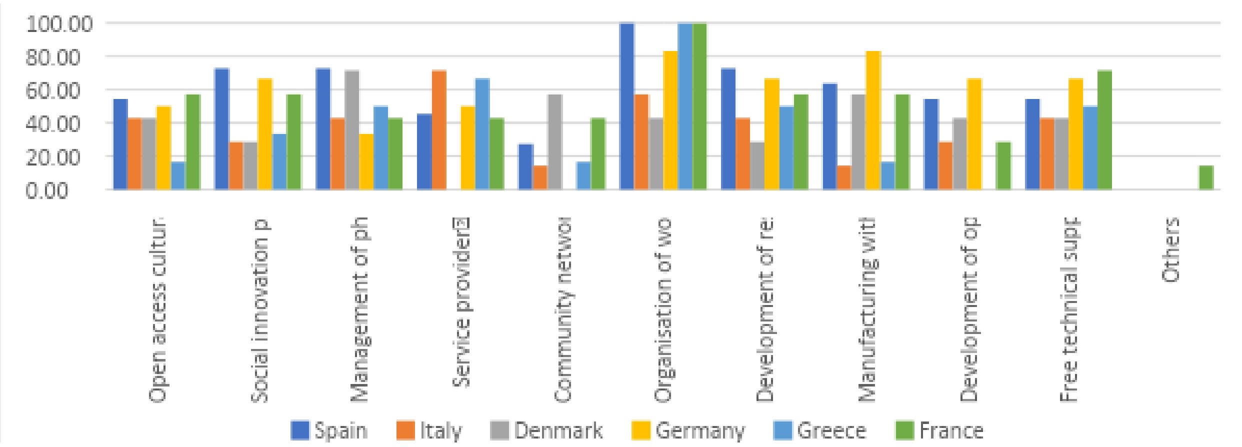


Figure 11. Transmission channels per country

4.2.4. Model of activity

Almost all the activities undertaken in these spaces in Europe require physical presence. Even so, online experience is now widespread and both modes are combined in 75% of cases. In only 22.7% of spaces do all activities require physical presence (offline). Only 2.2% of the spaces surveyed did not have a physical presence, but virtual spaces with online sessions (the case of one space in Denmark).

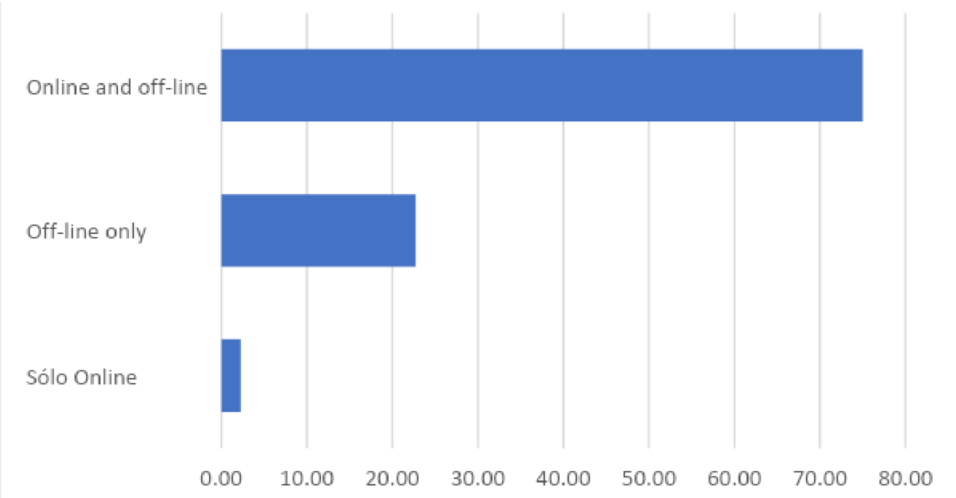


Figure 12. Online and offline activitie (%)

On this point, all Italian spaces opt for combined activities, followed by Greek makerspaces (83.3%). Activity requiring only physical presence is found with a certain frequency in countries such as France (42.8%), where online activity appears to be the lowest in the survey.

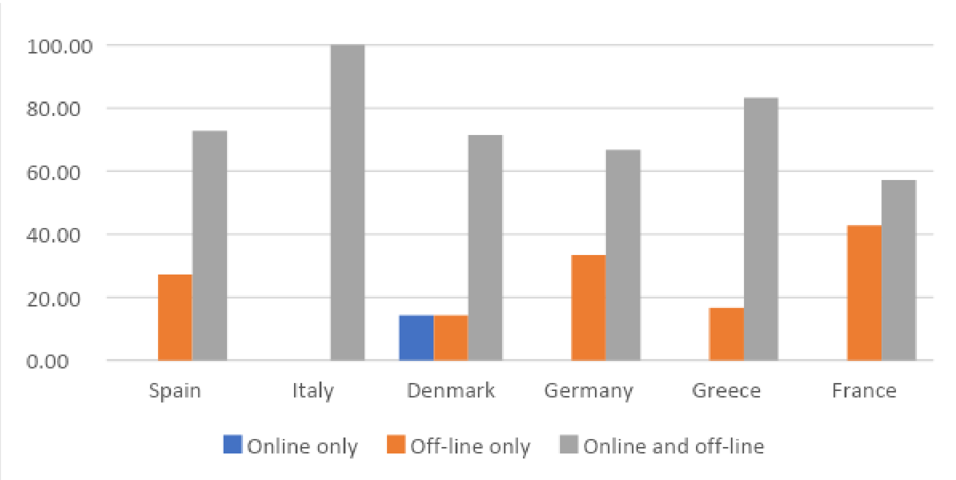


Figure 13. Online and offline activities per country

4.2.5. Access to the spaces

The types of European space surveyed show that 34.09% have restrictions on access, compared with 22.7% without access conditions. Among the spaces which have these conditions, 29.5% are public spaces with large-scale attendance capacities, and 13.6% are not business or institutional, that is, they are free or open since they are NGOs or neighbourhood, citizen or trade union associations.

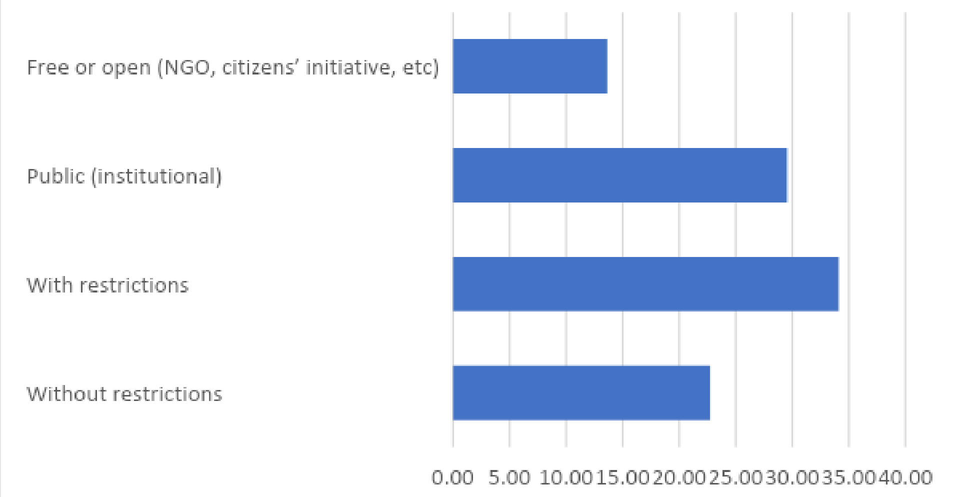


Figure 14. Public acess to facilities (%)

The country with most unrestricted spaces is Denmark, and most restrictions are found in Italy and Greece (an average or above average number). Half of the spaces in Germany are public centres and in France, 42.8% are free spaces which do not depend on businesses or the institutions.

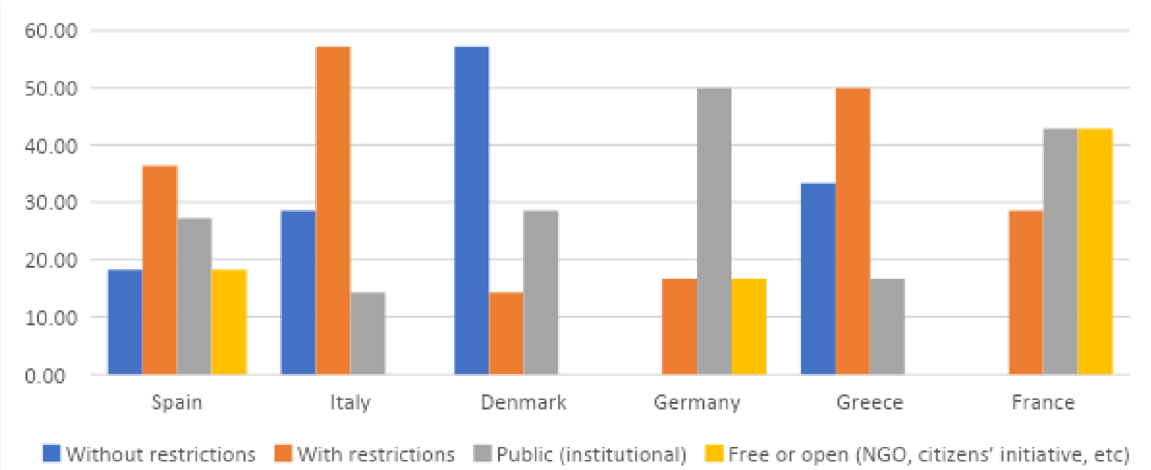


Figure 15. Access to facilities per country

4.2.6. Adaptation of the space

A study of whether the spaces are sufficiently adapted to the needs of users (they may not have sufficient technology, or suffer other deficiencies or difficulties), shows that 45.4% of European spaces believe that they are fully adapted and prepared to attend to their public, while 43.1% consider that, although they provide a service, they are not fully prepared, in technological and organisational terms, to fully attend to users. The proportion of spaces, which were beginning or had not yet commenced their activities came to 6.8%, and 4.5% of the sample were constituted but not yet adapted.

Italy was the country with the highest number of prepared spaces in Europe, at 74.1%, while France had no spaces in this situation (85.7% of its makerspaces were partially adapted). At the initial starting stage were three spaces in Denmark, Germany and Greece, and the one space ,which was not adapted although it had been constituted, was in Denmark.

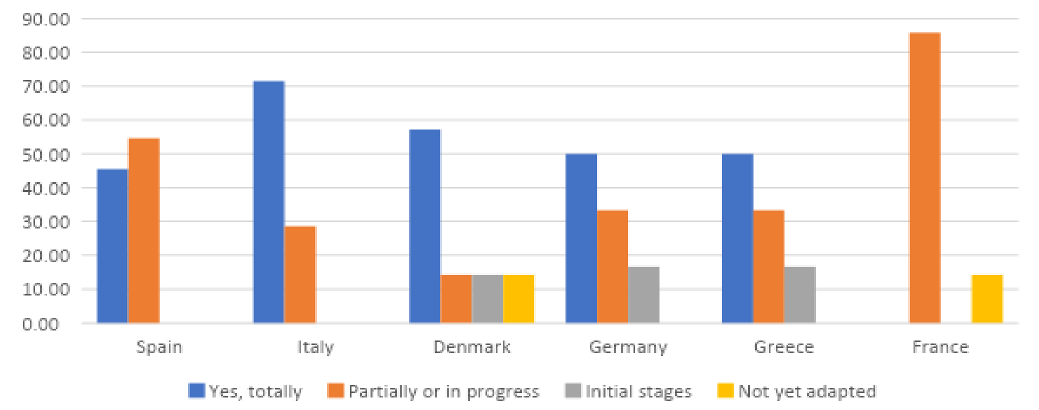


Figure 16. Suitability of spaces for servies per country

4.2.7. Scope of influence

With regard to the scope of their activities and the strategies of the spaces surveyed, they were mainly municipal (68.1%) and regional (61.3%). A significant percentage undertook actions in Europe (36.3%) and internationally (over 34% of cases).

Neighbourhood or district activity is considerable only in Denmark, with 85.7%, France (71.4%) and Germany, in half of the cases. However, in Italy and Greece, this is not considered a strategic area of activity. In France, all of the spaces have a municipal area of action, in the city, as do a very significant percentage in Germany (83.3%). Regional activity is more highly valued in Germany and Spain, with over 80% of the sample in both cases. The scope of action at a national level is high in Germany (66.6%), followed by Spain and Greece, which also return significant figures for their spaces with respect to Europe and the rest of the world (in the latter, over 80%). Spaces with the least engagement at this level are Denmark, especially, as well as France and Italy.

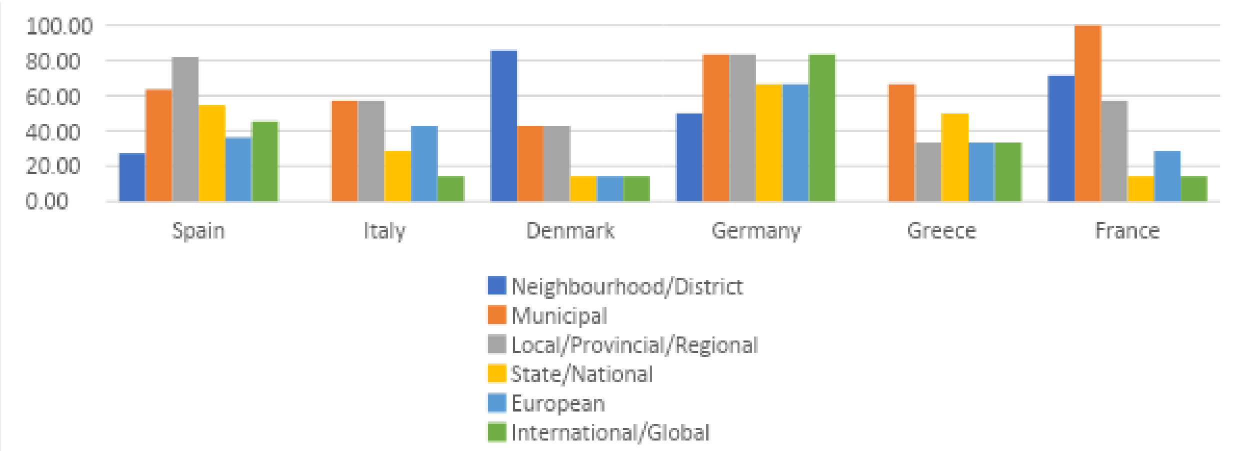


Figure 17. Geographical scope of activities

4.2.8. Activities broken down by user

In this point of the survey, the spaces were asked, even though they may not have sufficient data, to describe approximately the type of activity normally carried out in their facilities, which has given us some approximation ratios, where 1.2 was the lowest value and 3.4, the highest.

The activity undertaken in European spaces, broken down by user, with the highest ratio were professional or business projects for prototype construction, with a ratio of 2.98, followed by personal initiatives or projects, with a ratio of 2.70 of the activities registered. In third place came personal hobbies, with 2.28, and fourth, with 2 points, was home DIY or handiwork, meeting the need to repair objects using digital technology.

Regarding the first aspect, professional projects, Italy led (3.4, which was the highest ratio scored) together with Greece (3.3). With respect to personal initiative projects, Greece led (with a ratio of 3 points), followed by Denmark (2.9) and Spain (2.8).

Regarding activities more closely related to hobbies than professional initiatives, Germany scored 2.8, while Spain and Italy both dropped to 2 points. In home DIY, or handiwork, France was most active, with a ratio of 2.6, compared with other countries with lower figures, such as Denmark (2), Germany and Greece (below 2 in both cases).

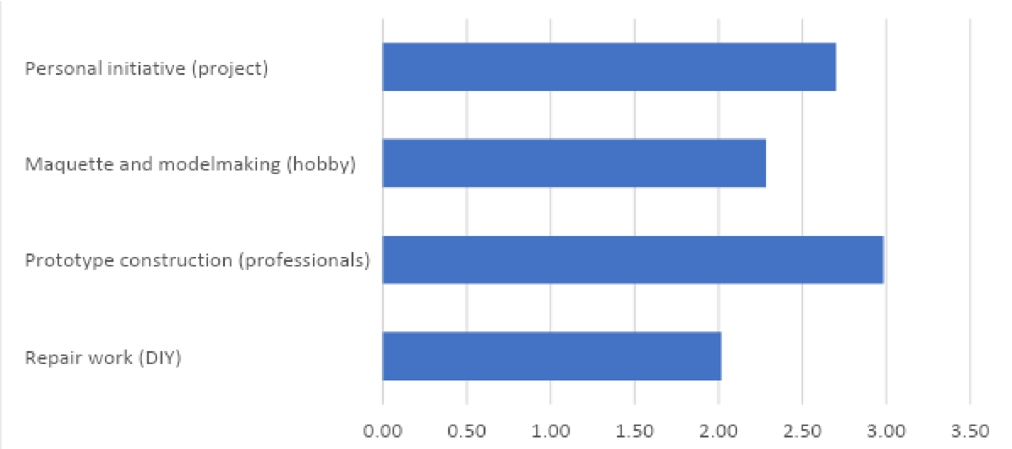


Figure 18. Activities and users

4.2.9. User profile

A very important aspect in this study was the profile of the user who is normally present in the spaces, identified on the basis of their qualifications. This definition of users is more useful than knowing whether the user is professional or not or whether they come from a company or not, which is information already provided in some way in the previous question. The only registers of 'non-specialisation' are the profiles of inventor (with no formally recognised studies or non-technological studies), student (since his/her project comes from the school or is a final thesis project), technology teacher (specific area) and researcher (related to a university or technology centre), which are transversal.

The results confirm that designers are the users who most use these spaces (68.1%), followed by 'inventors' (with 63.6%, and who lack any specific qualification or degree), with students in third place (61.3%). Professions and qualification related to IT (38.6%) and mechatronics (43.1%) have the least registers.

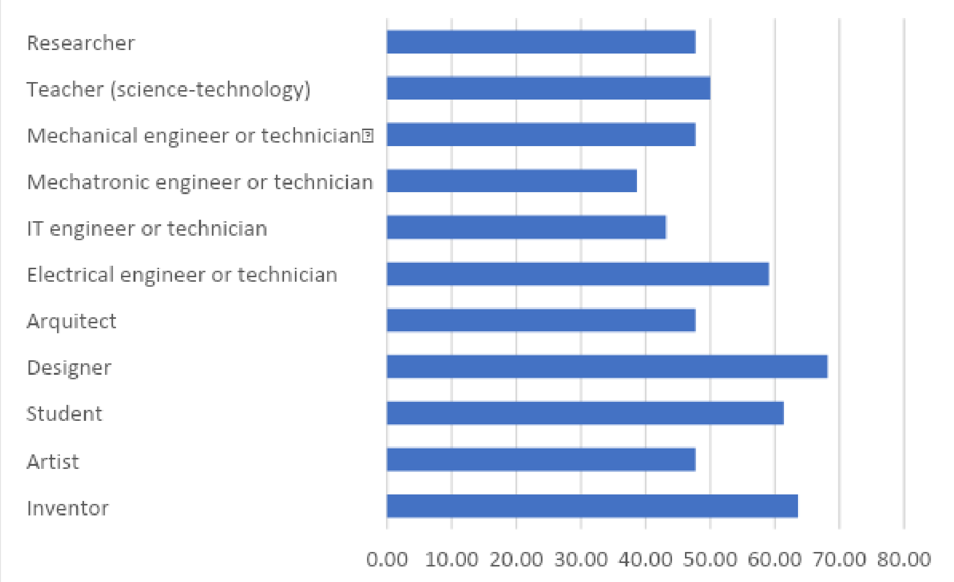


Figure 19. User profile

By country, it was found that inventors used all of the spaces in Germany, but used them least in Italy and Denmark (42.8% of the spaces in both cases). In France, students used all of the spaces, in contrast to Denmark, where the figure was very low (14.3%). Designers were high-volume users in Spain (90.9%) and France (85.7%). Electronic engineers and technicians were heavy users in countries such as Italy (85.7%) and Germany (83.3%). In these same countries, there were also a large number of mechanical engineers and technicians, with similar figures in Germany and slightly less in Italy (71.4%). Researcher profiles were closely associated with German spaces (83.3%), though their figures were fairly low in Italy and Denmark. Technology teachers were present in numbers in Spanish spaces (72.3%), but were not found in any of the Greek makerspaces. Artists were not present in either Italy or Denmark, but were significant users in France (71.4%) and Spain (72.7%). IT engineers and technicians were only seen in significant numbers with respect to other profiles in Germany, where they exceeded 80%.

4.2.10. Type of project

With respect to the most relevant types of a project carried out at European fablabs and makerspaces, the most frequent are related to the design of products or objects (70.4%), followed by electronics (59%) and training for children/young people and for adults (with 56.8% each). In contrast, projects related to communication are relatively infrequent (20.4%), being mainly signage or the production of merchandising items or publicity.

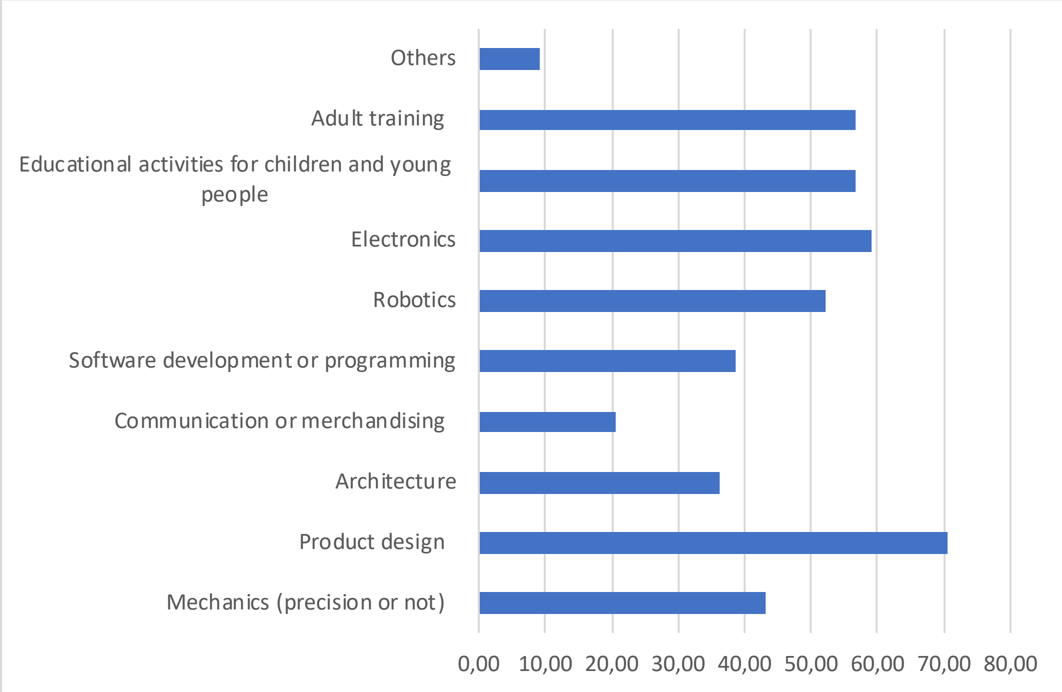


Figure 20. Projects developed

There are very high figures for youth and adult training (90.9%) in Spain and they are very high in France (71.4% and 85.7%, respectively), but low in Denmark (14.9%). Electronic and product design projects are very significant in Germany (83.3% in both cases), together with architecture (66.6%), product design, especially in France (85.7%), robotics in Spain (72.7), mechanical projects in Denmark (71.4%) and software development and programming in Italy (also 71.4%). The lowest figures were in communication projects, which were only found in 50% of the cases in Germany and there were none in any of the spaces in Denmark. The "Others" (9% of the total in Europe), were all different (social inclusion, building construction, training for the creative industries and bio-projects).

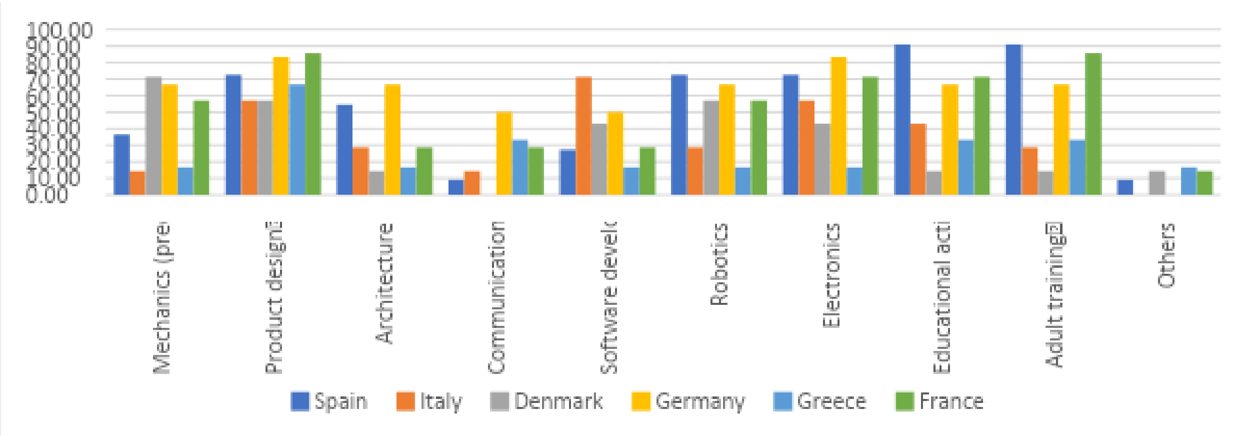


Figure 21. Projects developed per country

4.3. Collaboration and Funding

4.3.1. Collaborating with entities

The European spaces collaborate and work with different types of organisation, especially non-educational public institutions (84% of all the cases). They are followed equally, at 75%, by companies and individuals persons, and at a distance by educational institutions (54.5%). Little work is done with neighbourhood associations (38.6%) or NGOs (36.3%).

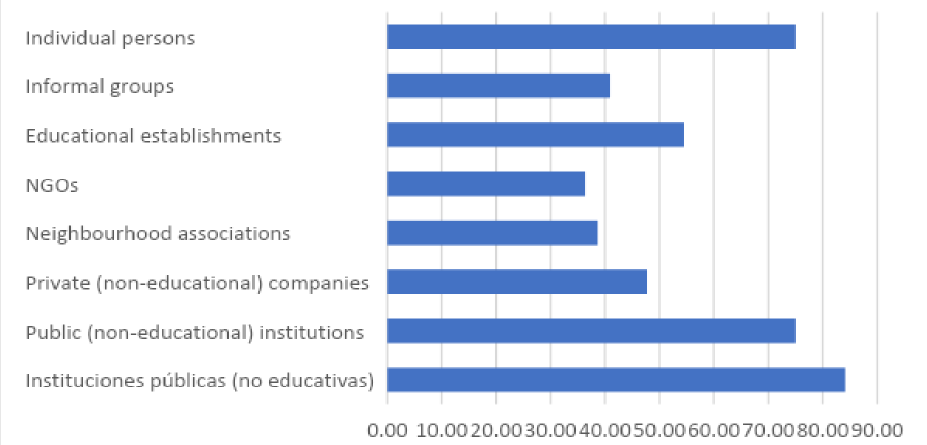


Figure 22. Collaborations

By country, all of the spaces in Spain and Italy work with some public institution. All of the Spanish and Greek spaces also work with individuals.

Denmark has fewer cases of collaboration with public institutions, though above the average, with 57.1%. In the case of companies, Italy (85.7%) and Greece (83.3%) have the most connections, though the figures are high everywhere in Europe, with Germany in the last place, with 66% of its spaces. With respect to work with business or professional associations, Greece and Germany take the leading positions, while Italy has the fewest cases (28.5%). Germany also has the highest percentage of work with neighbourhood associations and NGOs (50% and 67%). In contrast, Italian spaces have no business relationship with these organisations. Other countries with low levels of collaboration or work with these clients are Spain (27.2% for neighbourhood organisations) and France (28.5% for NGOs). It is striking that Italy has a low figure for work with educational establishments (little over 14%), informal groups (14.2%) and individuals (28.5%). In contrast, Spain has a high number of spaces that work with or for educational establishments (90.9%).

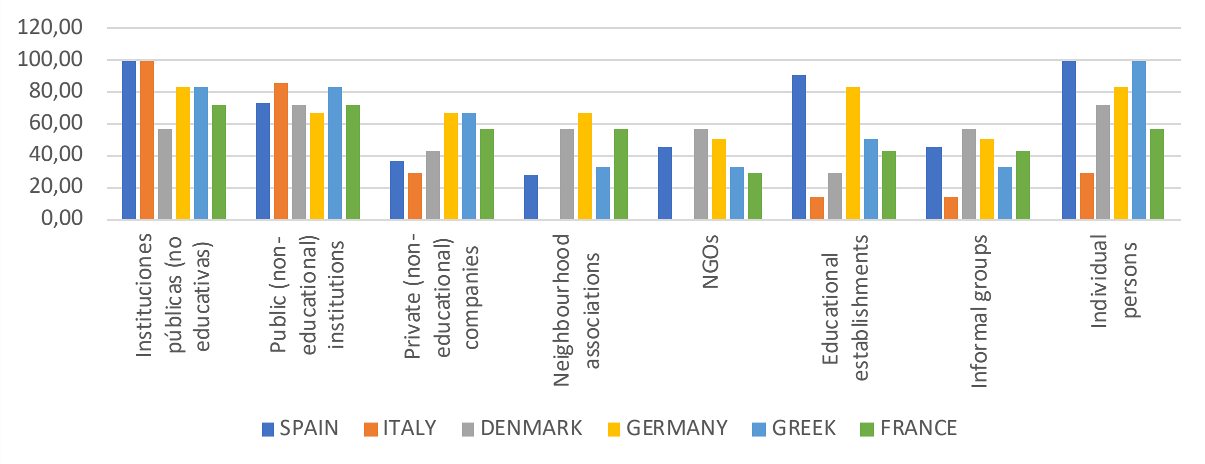


Figure 23. Collaborations per country

4.3.2. Funding of the spaces

With respect to support and funding received by the spaces from public and private sources, of which some form part, some run projects for these entities, and we believe it is relevant that half of the spaces surveyed do not receive any outside support and rely on their own resources. Of the European spaces, 54.4% state that they receive or have received support from public institutions. It is particularly significant that 40.9% receive some kind of support from not-for-profit organisations, either because they are, or they form part of, an association or foundation, or because they receive some kind of direct aid or support through projects promoted by these organisations.

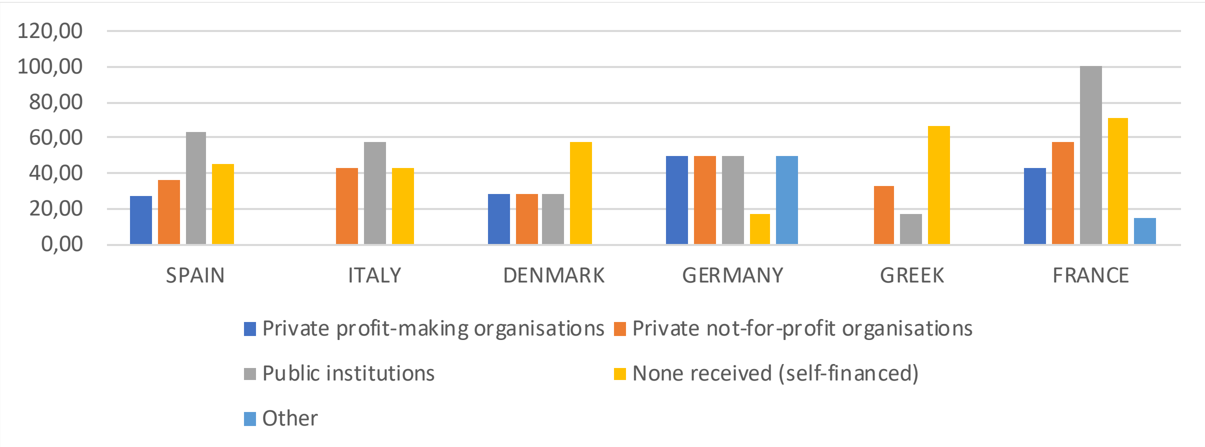


Figure 24. Funding sources

The case of France is significant, since 100% of its spaces declare that they have received funding from a public institution, followed by Spain (63.6%) and Italy (57.1%). Greek spaces receive the least support from the institutions (16.6%). In France, funding is also generated through the spaces' own resources in 71% of the cases, followed by Greece (66.6%) and Denmark (57.1%). In Germany, on the other hand, half of its spaces receive funding through profit-making entities. France receives more through not-for-profit associations (57.1%). Only half of German spaces and one space in France have used other, more extraordinary sources of funding (venture capital, business angels, etc.).

4.3.3. Portfolio of services and fundraising

The activities undertaken in the spaces which receive funding or which form part of the portfolio of services are (in no particular order, as they all have the same percentage, 43.1%, of the sample): projects with public funds, prototyping services, R&D services and training activities. These are the four pillars which usually support the business of these spaces, although, significantly, the survey shows that 29.5% receive donations and 22.7% also receive funding from the budgets of the organisations to which they belong. Very little funding comes from informal contributions, crowdfunding (which has only been attempted by 6.8%) or by organising Maker Faires (only 4.5%, or two of the spaces surveyed).

All of the spaces in France receive public funds, and there is very little evidence of revenue generated from the organisation of events (especially in Germany and Greece, which do not receive funds for their organisation), and the use of membership fees from members is only significant in Spain (36.3%). The rest of the countries, with the exception of Italy, do not use this formula. Informal contributions are only found in Germany (33.3%).

France is the country which most resorts to the leasing of space as a service (42.8%) followed by Italy, while in the other countries, the figures are not significant (spaces in Germany and Greece do not use this resource at all). A case which is striking, as we suppose that it is a habitual practice in fablabs, is the hire of machinery, which is only significant in Italy and France (with 28.5% in both cases), while in Germany, the spaces surveyed do not use this method of funding.

Italy leads in prototyping (57.1%) and R&D services (71.4%), the highest percentages for these services, and, in contrast, Denmark has the lowest figures (28.5% in both cases) in Europe. France has the highest figure for sponsorship (42.8%) followed by Greece. Greece has the highest percentage for the invoicing of technical assistance services (83.3%), while France and Denmark have no activity registered in this category. Participation in competitive subsidised projects is seen above all in Germany (half of the spaces) and Spain (45.4%), while France has a very low percentage and in Denmark, no space receives this type of subsidy. Maker Faires are only organised in German and French spaces, according to the survey, generating income for the spaces, and crowdfunding has only been used in France (28.7%) and Spain (9%). The rest of the countries have not used this resource.

Training activities generate significant income in Spain (72.7%) and Italy (57.1%) but, in contrast, in France and Denmark they generate almost no revenue. Donations are made mainly in France (in 71.4% of cases) and Germany, in half of the spaces. Half of the German spaces also receive financial support from the organisations to which they belong, whereas the rest of the spaces surveyed do not use this formula.

4.3.4. Investment policy

Regarding the targeting of investment in the business of European spaces, the results are overwhelming with respect to the maintenance of the space and of the technology, with 93.1%, and the acquisition of machinery and technology (86.3%). Of the spaces surveyed, 75% declare that money is spent on fees for collaborators and on the payroll. The least frequent expenses are related to volunteer work and investment in communication (the latter, in only 15.9% of the cases).

All of the spaces in France, Greece, Germany and Spain devote their investments to the maintenance of the space and of the technology. Denmark is the country which spends least on this, but even so, 71.4% of the spaces make these investments. All of the spaces in Denmark also devote revenue to the expenses of their activities (transport, accommodation, materials, etc.), while in Italy, no revenue is dedicated to such expenses. Italian spaces spend the most of all the European countries on publicity and dissemination, at 28.5%, while Denmark makes no investment whatsoever for this purpose. Spain is the country which devotes the highest proportion of its spending to the payment of salaries and the fees of collaborators, and the purchase of materials and consumables (90.9%), whereas Denmark is the country with the lowest spend on salaries and fees (57.1%) and on the purchase of materials (14.2%).

France invests most in the acquisition of machinery and technology (in all of its spaces) followed by Spain (90.9%). The only countries which spend some of their revenue on the expenses of volunteers are France and Spain, though the amounts are not significant, while Italian spaces spend significantly on the ongoing training of their team (57.1%), followed by Denmark (42.8%).

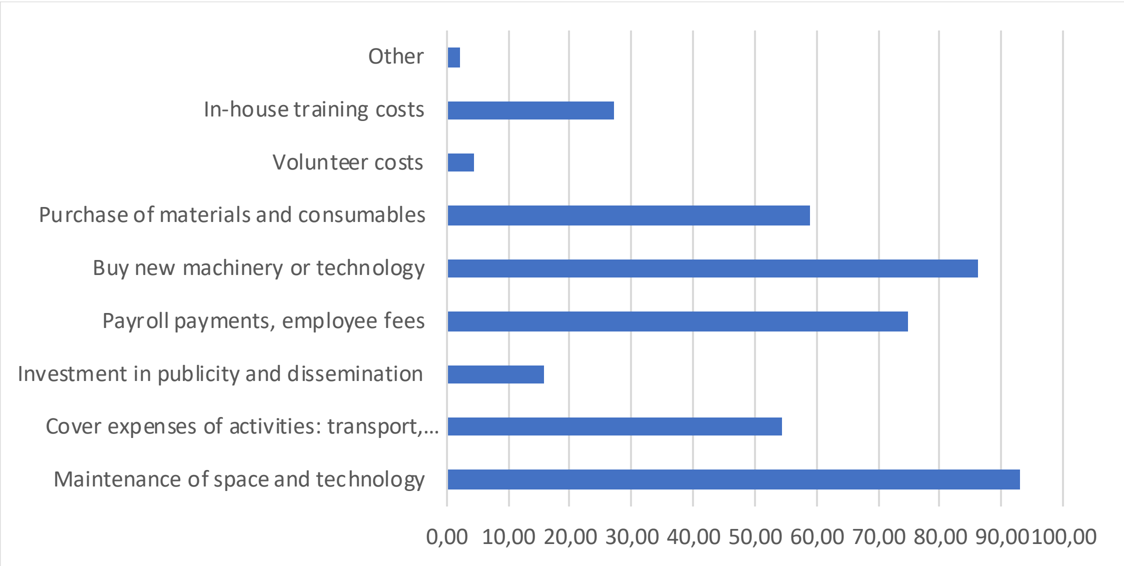


Figure 25. Destination of investments

4.4. Human Resources

This section defines, within the organisational model of European spaces, the main characteristics of the persons who make up the sector, including their number and who takes the decisions, their educational level, gender and age range. An outline is given of the soft skills and other skills which are considered to form part of the know-how of these teams, in order to ascertain the minimum training requirements to work in the spaces.

4.4.1. Number of persons in the organisation

With respect to the number of persons involved in the organisation, most have between 1 and 10 (defined in the EU as a micro-SME), which is the situation in 54.5% of European spaces. These spaces are followed, with less than 50 workers (considered in Europe to be an SME), by 31.8% of the spaces (of which 25% have between 11 and 30 persons). Finally, a little over 9% have over 50 employees (a medium-sized enterprise under the EU definition, which is up to 250 employees), of which 6.8% have over 100. This significant number, which in no case exceeds 200, is due to the spaces which form part of large organisations or whose policy is to consider all users as partners or affiliates of the space.

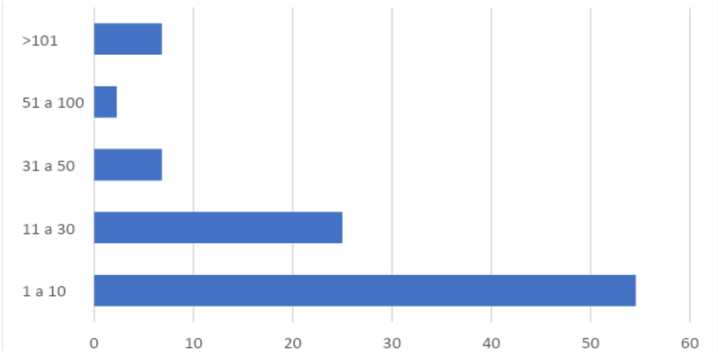


Figure 26. Staff count

By country, spaces with four (57.1%) or five persons (28.5%) predominate in Italy. In Spain, it is more usual to find six persons (27.2%) and in Greece, seven (33.3%). In countries such as Germany (66.6%) and France (57.1%), there are strong organisations with between 11 and 30 persons. Only three spaces with over 100 were found in Spain, Germany and Denmark.

4.4.2. Decision-makers

The next question examines how many persons take the decisions in these teams. The survey revealed that in 68.1% of cases, the decisions were taken by between one and five persons (in 47.7% of European spaces, normally by two or three persons). 22.7% told us that decisions were taken by between six and 10 persons in the team, and only 9% took decisions between more than 10 persons.

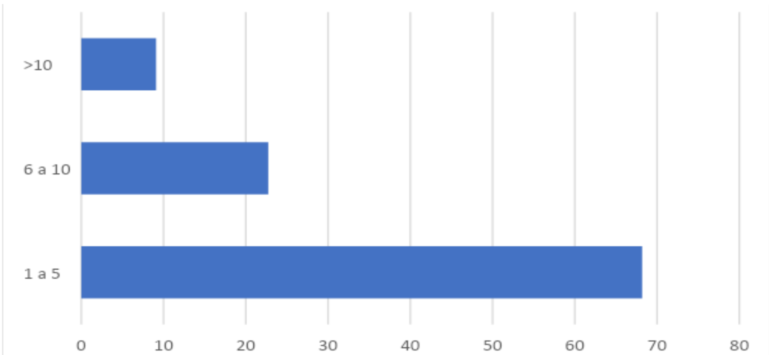


Figure 27. Decision makers within the entities

Basically, in Spain, it is usual for decisions to be taken by two persons (54.5%) while in Italy, decisions are in the hands of three (57.1%). In France, the number rises to four (28.5%) and the range of between six and ten persons returns a figure which is also above 57%. In Denmark, the decisions are consensuated between more than 10 persons in 28.5% of the spaces.

4.4.3. Educational level of the team

The educational level of the persons and teams in the spaces include 61.5% with university studies, 24.9% with technical non-university qualifications, 9% with secondary education and 4.5% with basic education.

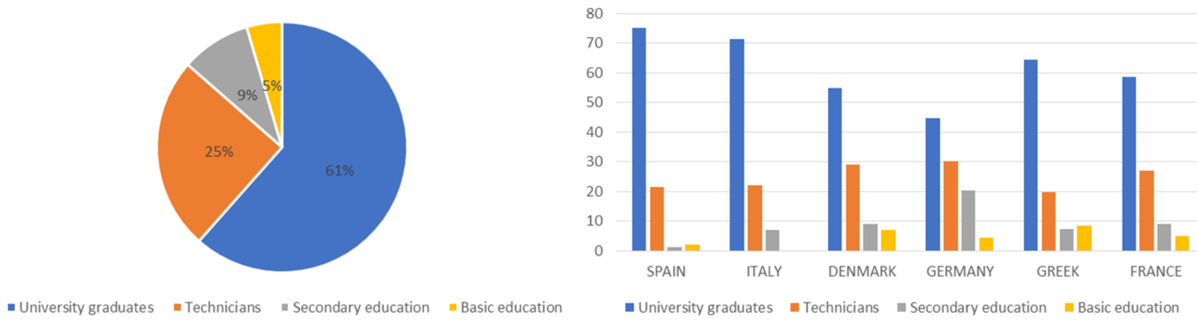


Figure 28. Staff Education Level

By country, Spain has the highest number of university-educated workers (75%) followed by Italy (71.5%). In contrast, Germany, which has the lowest number of university graduates, brings together the largest number of professionals with technical qualifications (30.3%), contrasting with Greece (19.8%). Germany also has the highest number of people with secondary education qualifications (20.5%) in contrast to Spain, which has almost none (1.2%). Greece stands out for having the highest number of persons with basic education (8.5%) compared with countries like Italy, where there are no such spaces.

4.4.4. Gender divide

It is important to record the presence of women in these spaces due to the barriers faced by women to entry into technological areas and entities. The survey shows that this data is mirrored, and the gender difference is seen in Europe as a whole, with 28.4%. In countries such as France, the figures are better (38.4%) and Spain, Greece and Italy also exceed the threshold of 30%. In contrast, Denmark has the lowest level, with 11.1%.

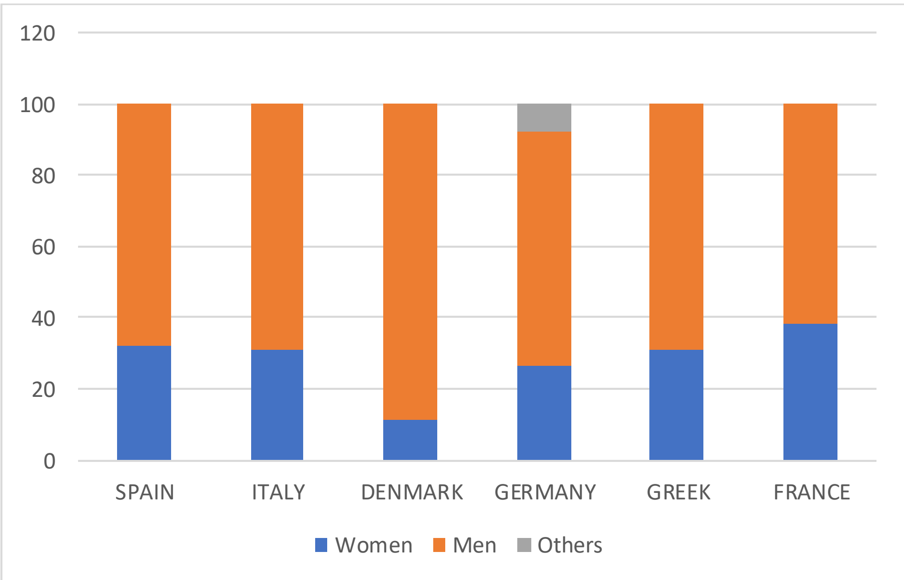


Figure 29. Gender divide

4.4.5. Age range

With respect to the age range in the organisations, the majority are adults, with 52.4%, while the younger public make up 42.4% in the spaces. Persons over the age of 60 make up 5.1% of the users, which is, nevertheless, a significant number.

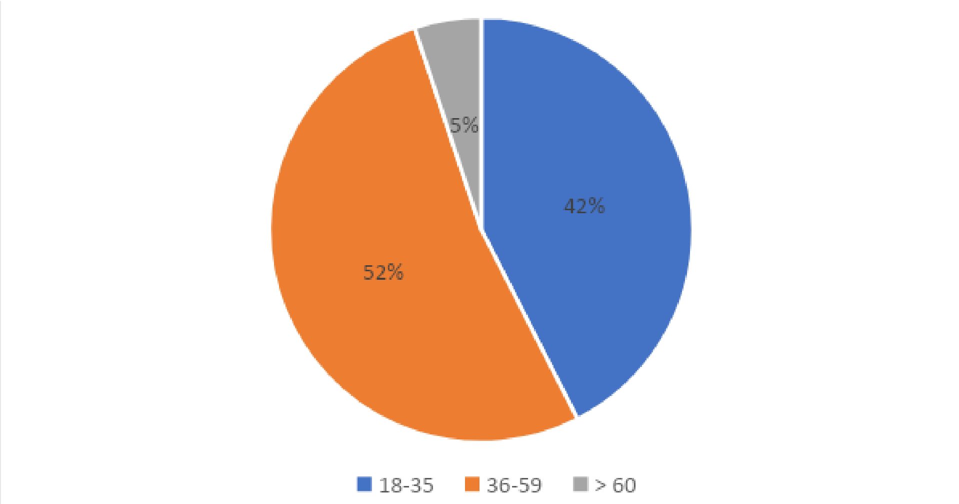


Figure 30. Age

By country, Spain has the highest proportion of an adult public, with 68.9%, compared with Germany, which has the highest number of young people in the organisation. As well as Spain, two countries, Italy and Greece, also exceed the 56% threshold (between 36 and 59 years of age) and, together with Germany, they are followed by countries like Denmark and France which exceed 43% (18 to 35-year-olds). Only Denmark and Germany have over 10% of users over the age of 60, while Spain only has 1.4% of this age range in the spaces.

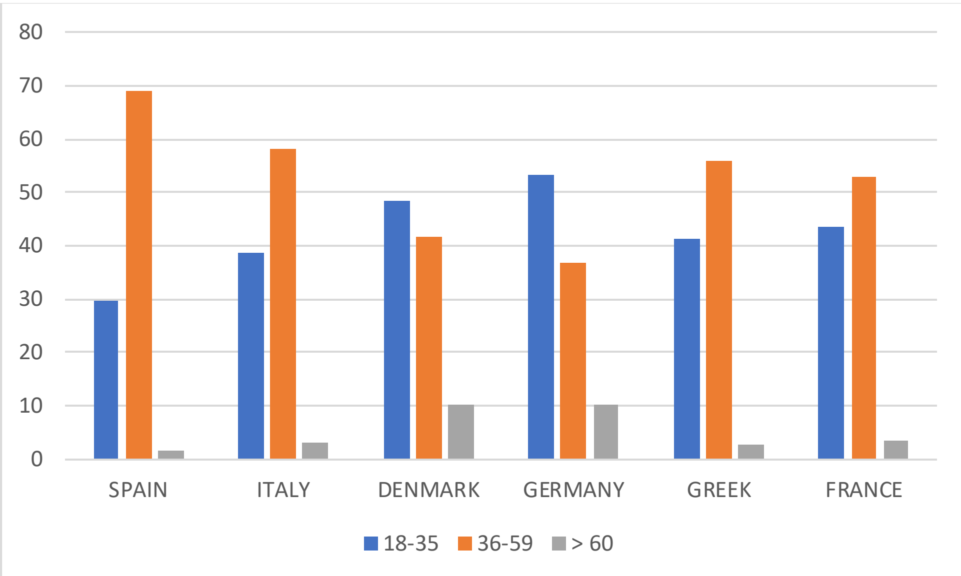


Figure 31. Age range by country

4.4.6. Soft skills

In this study, we were also interested in recording the non-technological skills (we are taking for granted that they do have such skills, both from the user profile and the type of technology used), which are considered important or which are developed in these spaces. With respect to soft knowledge, creativity stands out above all others (with 88.6%) and teamwork (72.7%), while, in contrast, the capacity to document processes or results is found in little more than 34%.

The best results on creativity are found in France (in all of the spaces) and Spain (over 90%). France achieves the same result with respect to teamwork, followed by Greece and Germany, which both exceed 83%. Italy and France both score 71.4% for management and organisation of the spaces, Germany score 100% on communication skills, while Greece does not reach the average. Germany also sees the need to keep records, with 66.6%, compared with Italy, which does not exceed 15%. Only one case is found in the category “Others”, which is related to entrepreneurship.

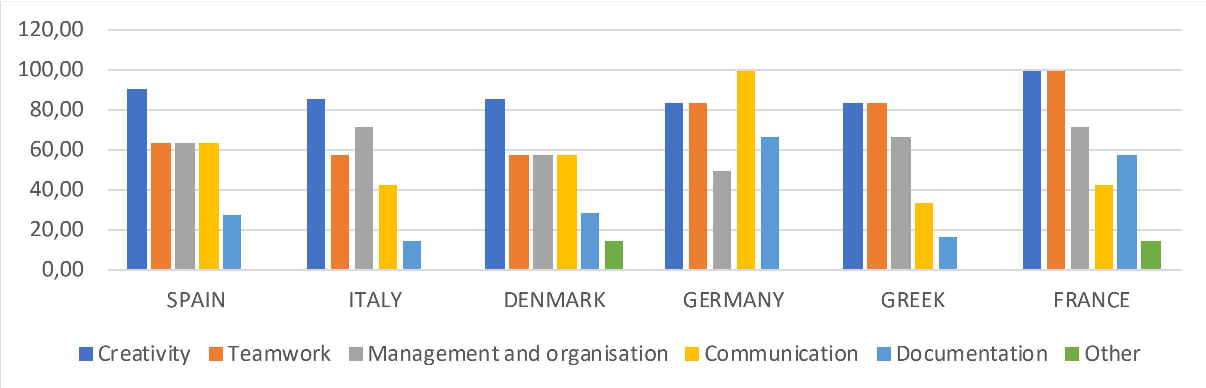


Figure 32. Soft skills

4.4.7. Other skills

Other training aspects in which the members or teams of the spaces surveyed stand out are related, above all, to innovation (75%), compared with other aspects. This is followed by quality criteria (45.4%) and aspects of economics-administration and the environment, with 38.6% each.

By country, France stands out, as all of the spaces show innovation, followed by Germany and Greece with 83.3% each, and Spain with 81.8%. Meanwhile, in Italy, there is more focus on quality, at 85.7%, and on the economy and administration, with 71.4%. Germany shows a preference (66.6%) for environmental affairs and in France, together with Spain, 27% of the spaces have knowledge of marketing or journalism (in Denmark, there are no records in this category). Denmark and France also focus on safety and occupational risk, with 57.1% each, while Greece did not have a single space active in this field. Denmark stands out (42.8%) in the matter of intellectual property rights, something which is not seen in any of the spaces in Spain or Greece.

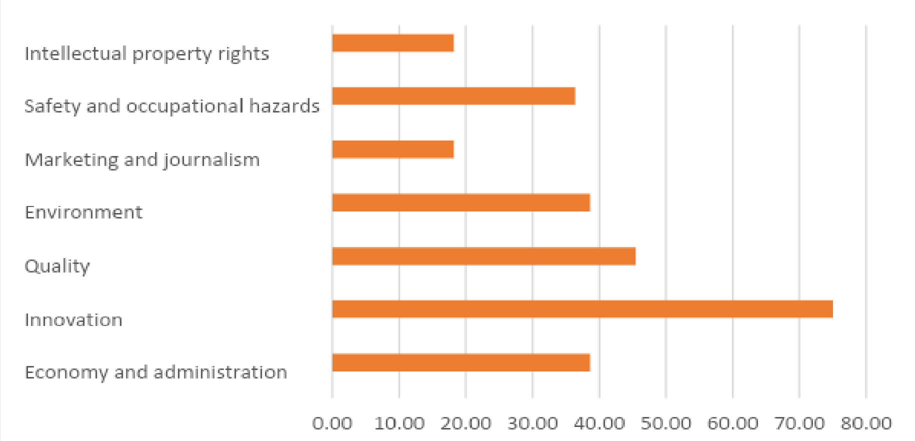


Figure 33. Other skills

4.4.8. Training prerequisites

The last point in this section asked whether any training was offered in order to form part of the organisation, and there was no majority response. On the one hand, 43.1% undergo initial training and, although not official, 40.9% undergo training through informal guidance.

With the exception of France, skill training is given in all of the countries, and in Greece it is offered by half of the spaces surveyed. In Germany, initial training is given in 66.6%, and in France, 57.1% of the spaces. Furthermore, in Germany, continuous training is offered to employees in half of the cases, and in Italy, in 42.8% (unlike France, where it is not offered in any of the spaces). In Spain, informal guidance and training is offered in 63.6% of the spaces, and in 57.1% in France, in contrast with other European spaces.

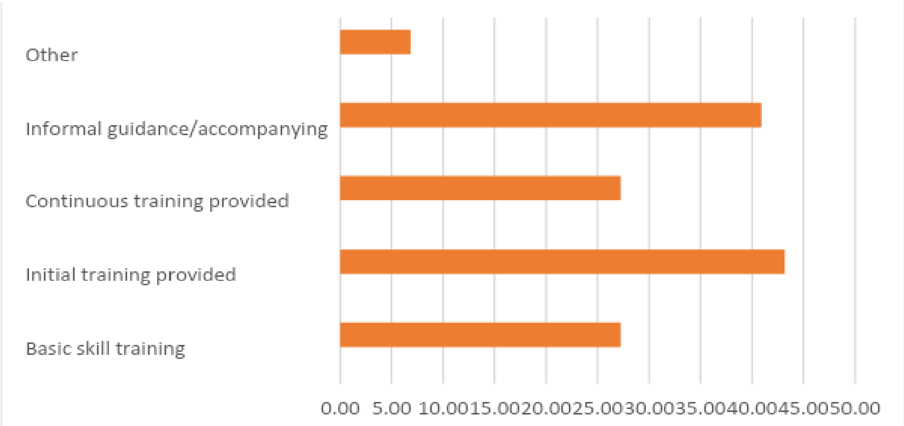


Figure 34. Internal training offered

4.5. Communication and Tools

The purpose of this section is to determine the human and technical resources in European spaces available for the transfer, dissemination and publicity of the work carried out in the spaces. Their social and business activity requires a certain media profile, which we have attempted to survey.

4.5.1. Personnel working in communication

The standout result is that many spaces do not have anyone dedicated to communication (47%), and if they do, most are not specialised (25%). Only 15.9% have their own specialised personnel, and only 11.3% outsource these functions.

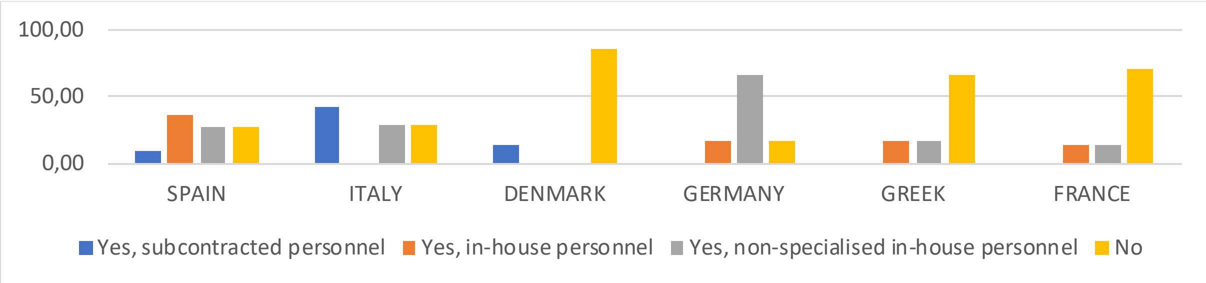


Figure 35. Communication

These processes are subcontracted most in Italy (42.8%) but countries like Germany, Greece and France do not do this in any of their spaces. In Spain, 36.3% of the spaces have personnel specialised in this area, while in Italy and Denmark there are none. Germany has personnel dedicated to these functions but they are not from the world of communication and in Denmark, most spaces do not devote any resources to these functions (85.7%).

4.5.2. Communication resources

With respect to communication resources, the survey shows a distribution that is marked by digital tools (available to 65.9%) and only 15.9% do not devote any resources to communication.

By country, Italy devotes the most human resources, reinforcing the previous question, with 71.4%, followed by France (Greece being the country that devotes least). Spain (with 81.8%) is the country which devotes or disposes of most digital resources, together with France, in contrast to the countries that devote least resources, such as Italy. However, Italy is the country which devotes more of its budget within the organisation (42.8%) to communication, while this is not done in any Danish or Spanish space. The country which in general devotes least resources to communication is Greece and those which devote resources to communication in all of their spaces are Italy and Spain.

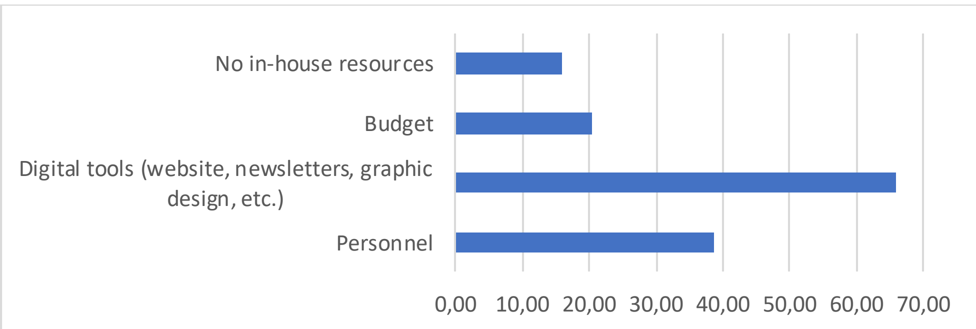


Figure 36. Communication resources

4.5.3. Updating the information

This question refers to the frequency with which information is updated, or the work of the spaces is documented or communicated. It is divided into two questions, one about the frequency of releasing news and documenting the work of the space, and the other regarding the frequency of updating the website for external communication.

In the first case, European spaces usually update their information and document their work monthly (29.5%) or weekly (20.4%), and the same occurs with the updating of the website (22.7% and 20.4%, respectively). It is striking that 11.3% do not engage in this exercise and that 9% only update the website annually.

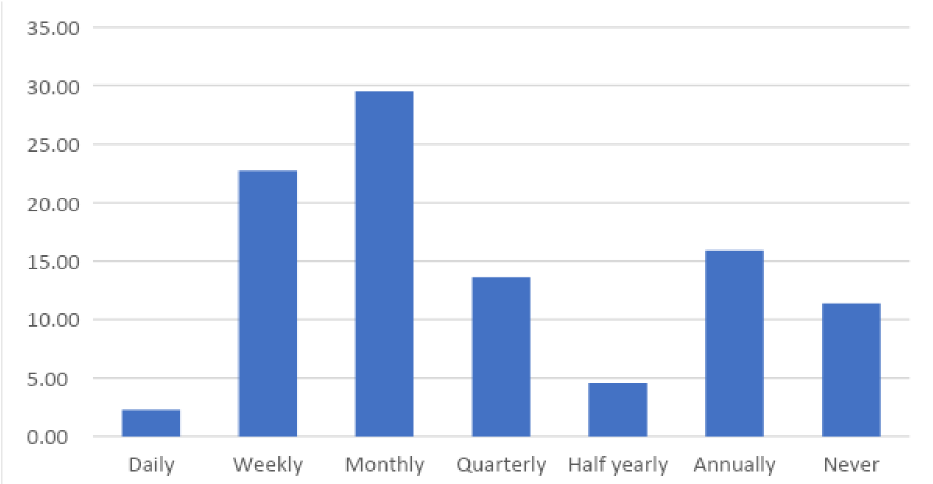


Figure 37. Frequency of releasing news (%)

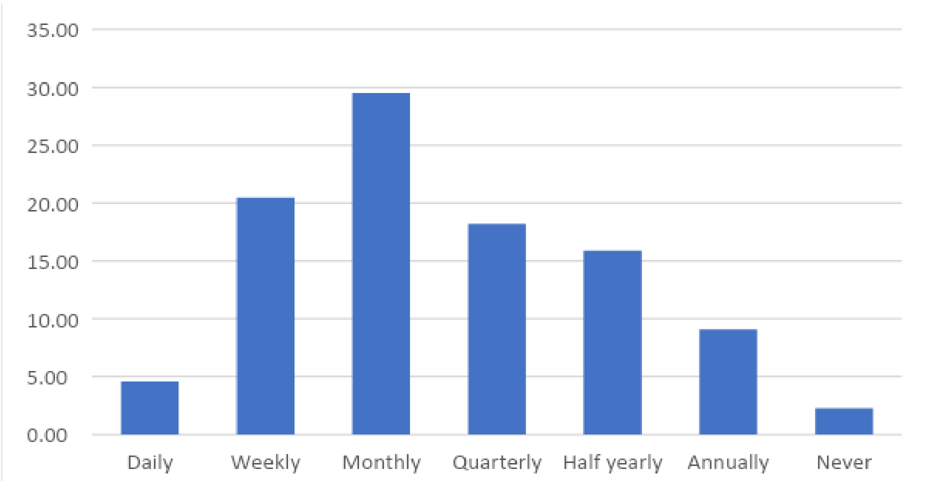


Figure 38. Frequency of updating website

Germany is the country which performs most updating or other informative actions weekly (66.6% and 50%, respectively). Spain documents the work monthly on average in 45.4% of cases, Italy quarterly or half yearly (42.8 and 14.2%). Finally, Spain documents its work annually in 36.6% of the cases, and 18.1% of the spaces update their websites once a year.

Germany (50%), together with Italy and France (42.8% in both cases), update their websites every month, while Greece does so quarterly (66.6%). Denmark does not offer information in 71.4% or update the website in 14.2% of the cases.

4.5.4. Media presence

The appearance of the spaces in the media is mainly through interviews (79.5%) and the daily news or current affairs in written or digital press (63.6%). Of those surveyed, 6.8% do not appear habitually in the media.

Interviews are the most frequent appearances in all cases in Germany and Greece, though less so in Spain (63.6). With respect to current affairs, this is the most habitual appearance made by spaces in France and to a lesser extent in Italy and Denmark (with 42.8% each). Denmark (57.1%) and Spain (54.5%) are the countries where the spaces appear most frequently in debates or talks to which they are invited. The figures for these appearances are lower for Italian and French spaces. News reports are seen most in Greece (83.3%) and least in Italy (14.2%). It is striking that Denmark stands out in the "Others" category, with no media appearances by 28.5% of the spaces.

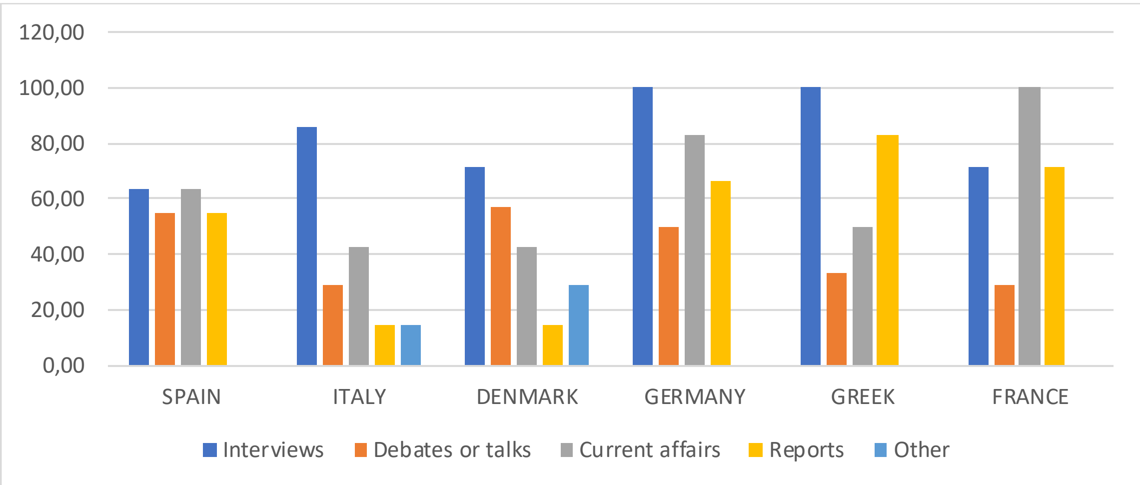


Figure 39. Types of media appearances

4.5.5. Communication with users

Finally, regardless of appearance in the media, the type of communication with the public or users in the spaces surveyed is mostly through social networks (90.9%) and e-mail (88.6%). Written communication by mobile phone is also a significant resource, being used in 63.6% of the cases.

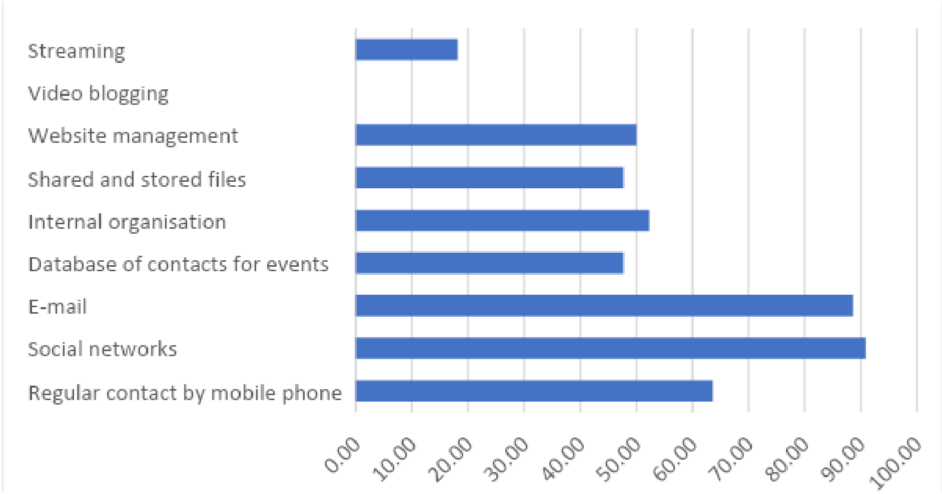


Figure 40. Communication resources

Social media are used and frequented by all of the spaces in Spain, Greece and France, while the Danish are those who least use social media (71.4%). E-mail is used above all in Spanish and French spaces, and least in Greece (66.6%). Denmark is the most regular user of communication by mobile phone (85.7%) while Germany uses it least. However, German spaces make significant use of databases to contact with their users, while Denmark is the country which most organises these functions internally (71.4%).

Italy and Denmark (57.1% each) share and store files, with a digital tool that is useful to users of the spaces. Greece has website management resources that improve communication in all of its spaces, and in Germany, these tools are used in 83.3% of cases. Greece uses streaming tools (33.3%), but these are not used in Germany, and none of the spaces surveyed used video blogging tools.

4.6. Software used in digital manufacturing spaces

With respect to the type of software found in the spaces, the most common is 2-D and 3-D design software, together with manufacturing software. They were found in 24% and 21% of the total cases, with a weighting of 84.5 and 72.2 in the survey as a whole. This shows that it is the most widely used software in fablabs and makerspaces in Europe.

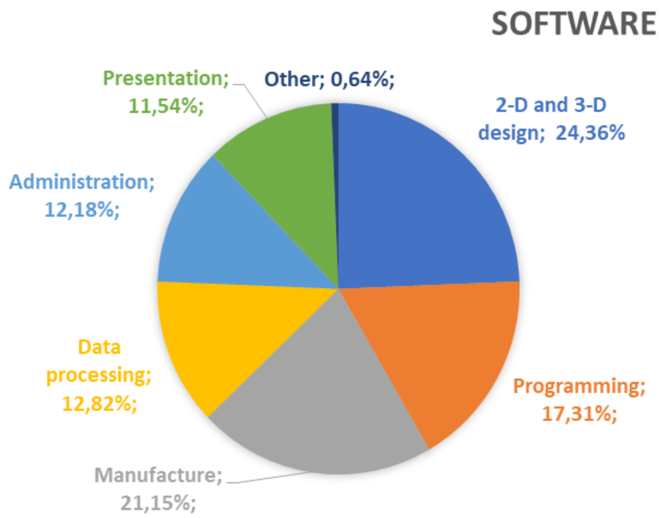


Figure 41. software tools used

By country, 2-D or 3-D software is found in 100% of the spaces in France, Denmark and Spain, and the only country falling below the average is Italy, which is more oriented towards programming software.

Programming software lies in third place, with a weighting of 57.6 in Europe as a whole, and is below the average in France and especially in Greece. Spain (90.9%) and Italy (57.1%) lead in the percentage of users of this software in their spaces.

Data processing software is used mainly in countries such as Denmark and Germany, which are above the average (45.3%), but it is much less widely used in France, Italy and Greece.

Administrative software or presentation programs are used in less than 41% of the spaces, though their use stands out in Spain (63.6%) and Germany (83.3%). There are no other significant cases, except for 2.7 % of spaces that use videoconferencing tools.

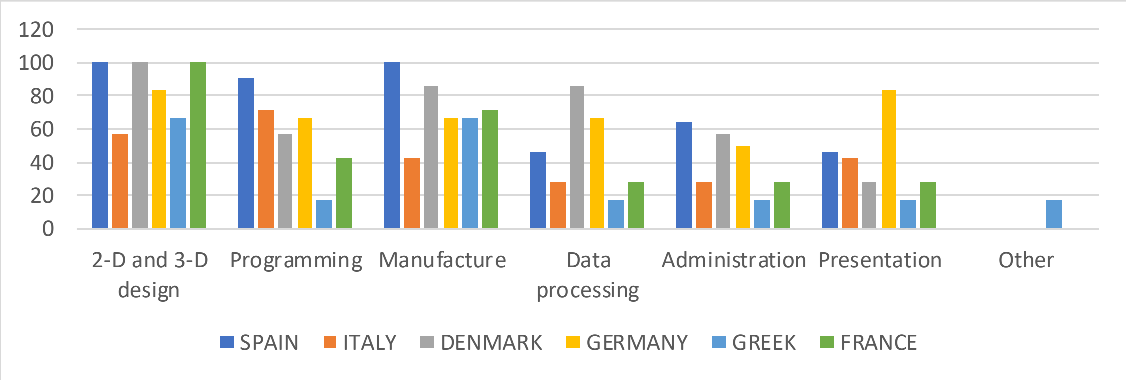


Figure 42. Softwarte tools used by country

4.7. Technology

4.7.1. Laser

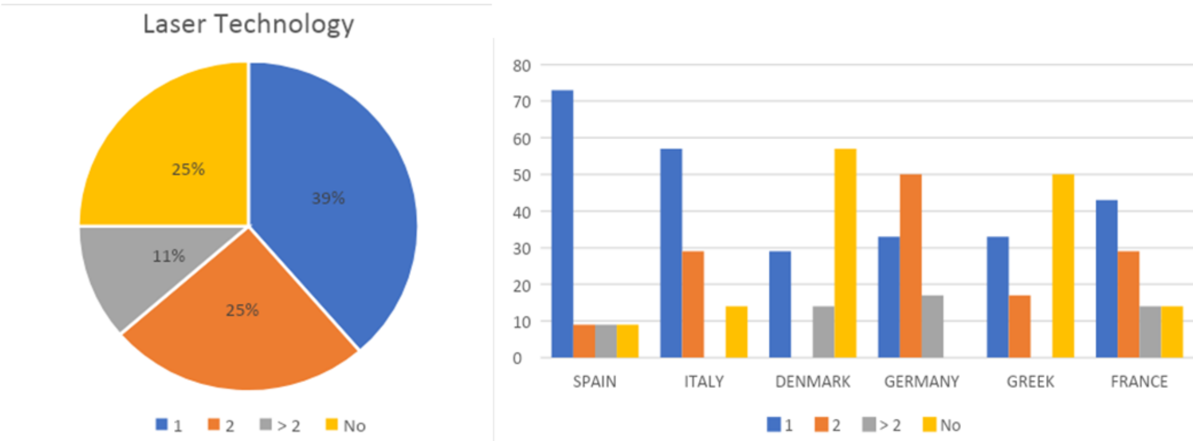


Figure 43. Laser technology availability

Laser cutting and engraving technology is found in 76% of the spaces surveyed, and there is at least one laser in 58% of European spaces (representing 39% of the total).

With an average of more than one laser per space, we found, above all, Spain (73%) and Italy (57%); two lasers were found mainly in Germany (in 50% of the spaces), although high figures were also found in France and Italy; and more than two in Germany (17%) and Denmark (14%). In contrast, the countries with fewest lasers per space were Greece (50%) and Denmark (57%).

4.7.2. 3-D Printing

In the case of 3-D printing (all of the different systems), the number of printers per space is over two in 68.3 % of spaces across Europe. This number is very high with respect to the rest of the technological devices.

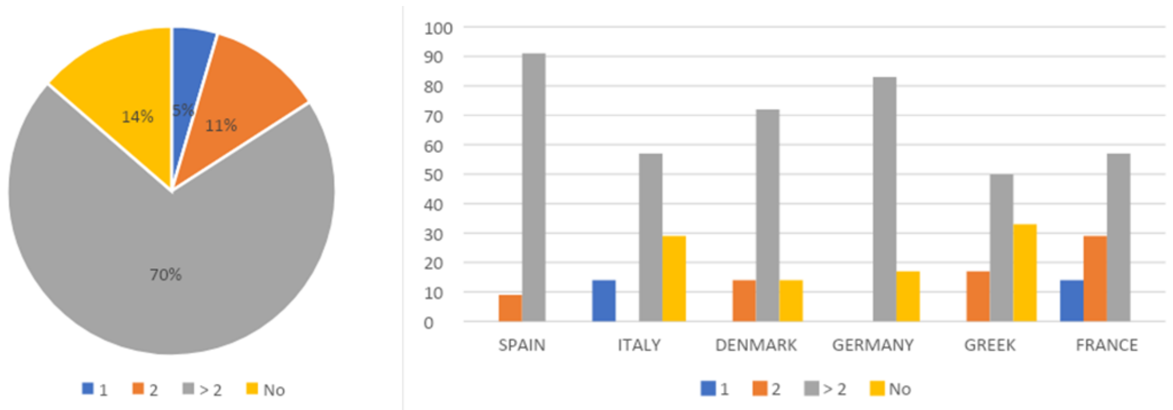


Figure 44. 3D printing availability

Italy and France still have some spaces where 3-D printing is not a central activity. The countries with the highest number of printers per space are Spain (91%), Germany (83%) and Denmark (72%), which are above the average. Only 15.5% of the spaces surveyed do not have printing systems, with Greece and Italy having the most spaces with no 3-D printers (33% and 29%, respectively).

4.7.3. CNC Milling

In Europe, 48% and 50% of the spaces have at least one medium-large and/or small milling machine, respectively. In most, there are 3-axis milling machines. In 32% of the spaces, there are no digital tools of this type for 2-D or 3-D manufacture.

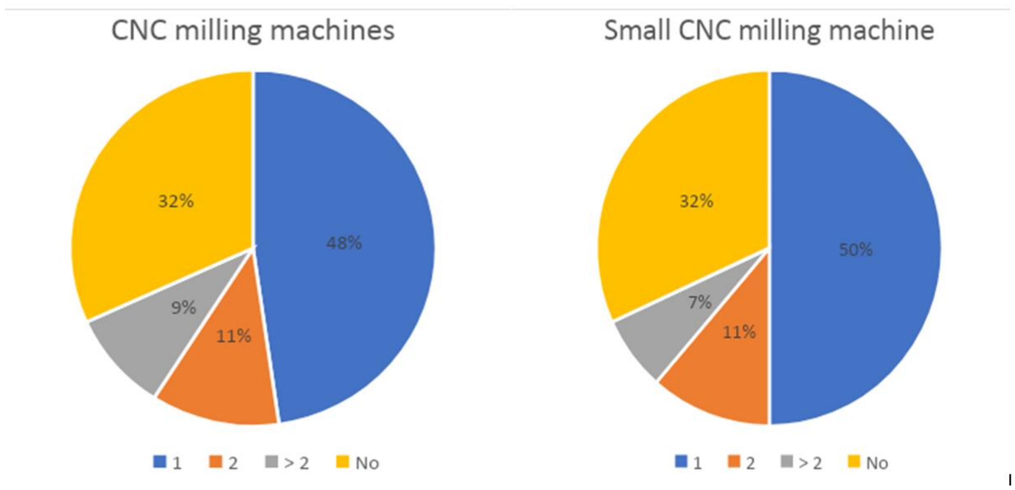


Figure 45. Milling machines

Germany (83%), followed by Spain (70%) and Italy (57%), are the countries which most have one medium or large milling machine per space, and these figures are above the average. France (29%), Greece (17%) and Denmark (14%) lead them in the number of spaces with two milling machines per space, and only Denmark (43%) and Germany (17%) have spaces with more than two of these machines.

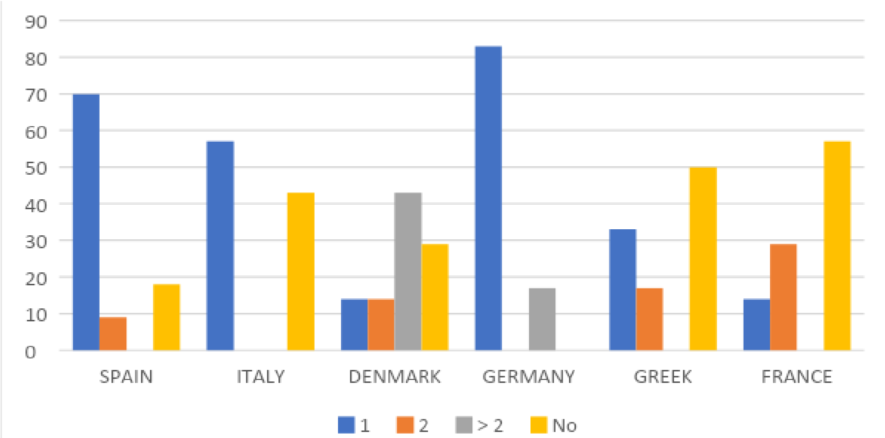


Figure 46. Milling machines per country (%)

France (57%), Greece (50%) and Italy (43%) are the countries with most spaces which do not have these devices, and Denmark (29%) and Spain (18%) have least, while in Germany, all of the spaces surveyed have milling machines.

With respect to small milling machines, Spain (73%) and Italy (57%), together with Germany and Greece (50% in both cases) have percentages which are significantly above the average, with one small milling machine per space. There are two devices of this type in spaces in Spain (18%), Germany (17%), Italy and France (14% each). In Denmark (14%), France (14%) and to a lesser extent in Spain (9%), there are spaces with more than two small milling machines.

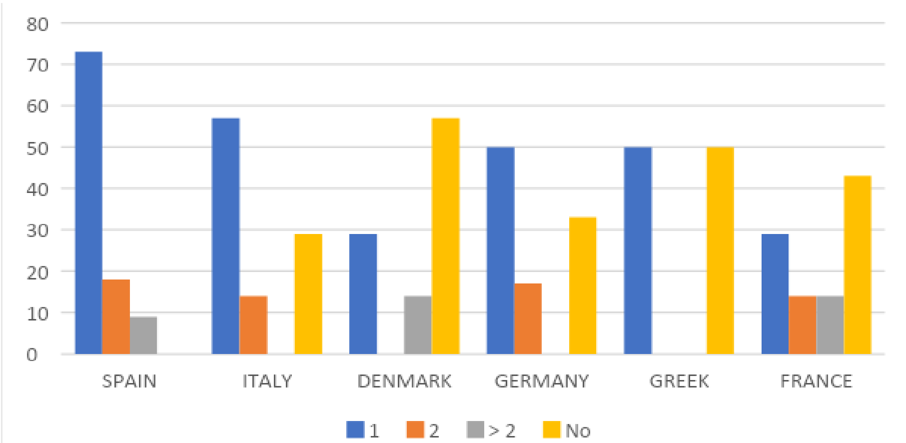


Figure 47. Small milling machines per country (%)

In a general tally, both of these digital manufacturing devices are found in very similar numbers in spaces throughout Europe, with a certain preference for medium-large machines rather than small machines. This equipment is found more in Germany and Spain, though it is more widespread in the former than the latter, where small machines are more common. In contrast, France and Denmark are the two countries with the most spaces with few milling resources, with France having the lowest number of medium-large milling machines, and Denmark having fewest small CNC devices.

As well as the resources that we have referred to, which we consider to be the most widely used in makerspaces and for digital manufacture, there are other technologies which complement or expand the capacities of the spaces, and which are not seen very frequently. We shall now describe their presence in Europe:

4.7.4. CNC metal cutting

Of the spaces surveyed in Europe as a whole, 82% do not have this type of cutting machinery. The rest of the figures are also very low, and we can only highlight that France (29%) and Germany, with 17%, have systems of this kind. Denmark is the only country in Europe which has two of these machines per space (in 14% of the cases), and only Italy and France have spaces with more than two, representing 4.6% of all European spaces. We found none of this digital manufacturing equipment in Spain or Greece.

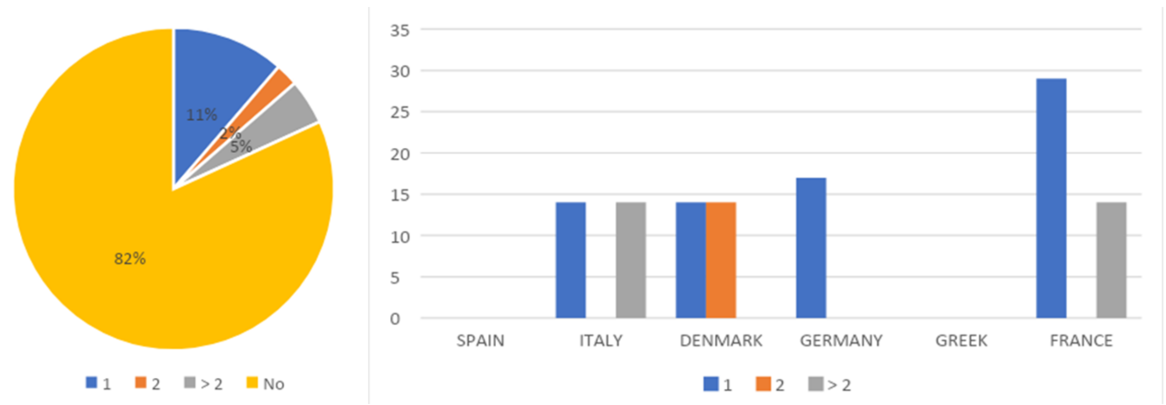


Figure 48. CNC Metal cutting

4.7.5. Thermoforming

Another technology with a relatively low presence in European spaces is thermoforming. Only 45% of the spaces have this type of resource in Europe. It is true that it is not a digital manufacturing technology, but as a complementary technology it allows shock-resistant polystyrene pieces, or PETG, to be made from mechanised patterns or moulds, enabling short production runs and very reliable prototypes.

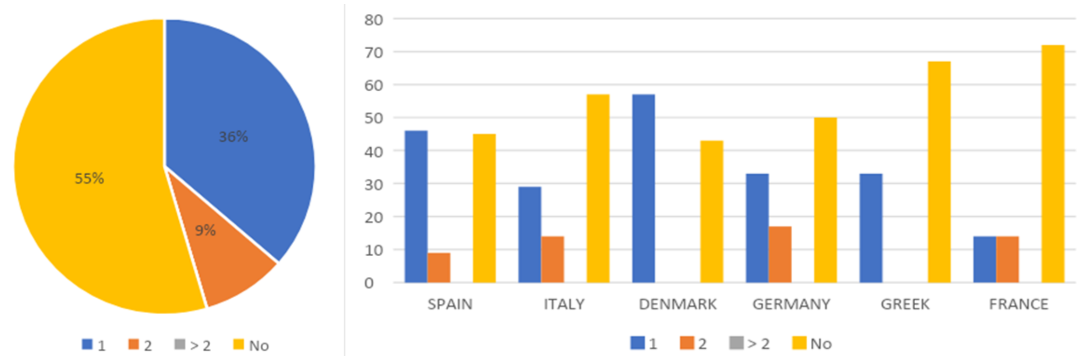


Figure 49. Thermoforming technology availability

We have found that 55.6% of the spaces do not have any vacuum system for thermoforming.

Denmark (57%) and Spain (46%) have a higher number of spaces with a thermoforming system than the rest of Europe. However, Germany has the highest percentage (17%) of spaces with two machines. No space in Europe has more than two machines of this type.

4.7.6. Print and cut plotters

Systems to complement those mentioned above and digital medium- or large-scale print and cut systems are found in several spaces. In 55.8% of the spaces, there are cutting plotters for vinyl or cardboard, and 45.7% of European spaces have print plotters.

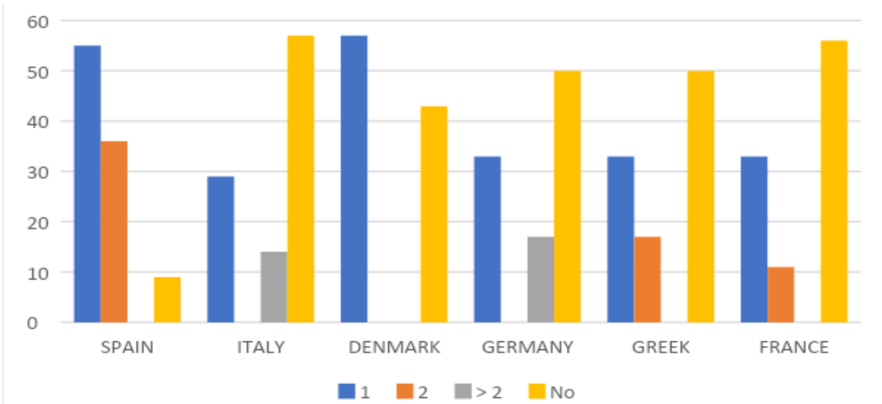


Figure 50. Vinyl plotters per country

In Denmark (57% have one) and especially in Spain (55% have one and 36% have two), these vinyl cutting devices are found in a significant number of spaces. Denmark (71%) has the highest number of print plotters.

In contrast, Italy has the fewest cutting systems (57% have none) and Spain has the fewest medium or large plotters (82% of the spaces have none).

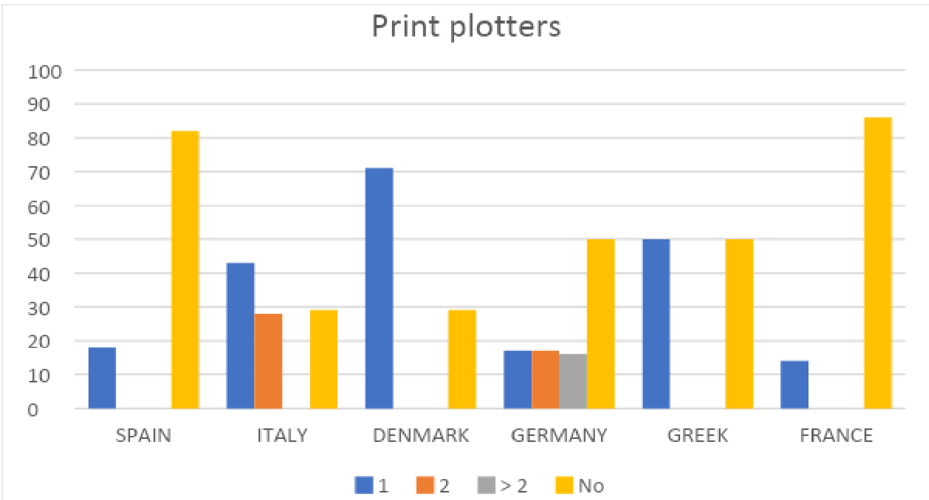


Figure 51. Print plotters per country

4.7.7. 3-D Scanning

In all of Europe, 63.5% of the spaces have at least one scanner. In Italy, Denmark, France and especially Spain, the figures are above the average, and in Spain, 46% of spaces have one of these systems, while 36% have two. In France, 28% have more than two 3-D digitalisation systems. The countries with fewest 3-D scanning devices are Germany and Greece, although this is the case in only half of the spaces surveyed.

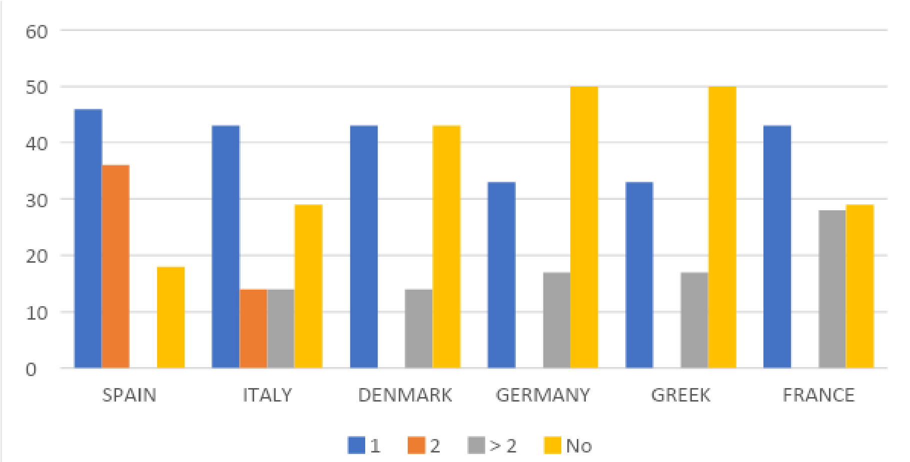


Figure 52. 3D scanners per country

4.7.8. Sewing and embroidering machines

We have not distinguished between digital and non-digital devices in this part of the survey. We understand that it is more usual to find digital embroidering equipment and conventional sewing machines in makerspaces. One of these two tools can be found in 52.3% of the spaces, where textiles or other flexible materials that can be sewn are used, and they are considered necessary machinery by users. In this case, there are some countries where they are not considered in this way, such as Greece (where 83% of the spaces do not have them), France (57%) and Spain (55%) but, in contrast, in Italy, especially in Denmark and significantly, in Germany, they are much more common. In Germany, 67% of the spaces have more than two machines while in Denmark, 29% have more than two.

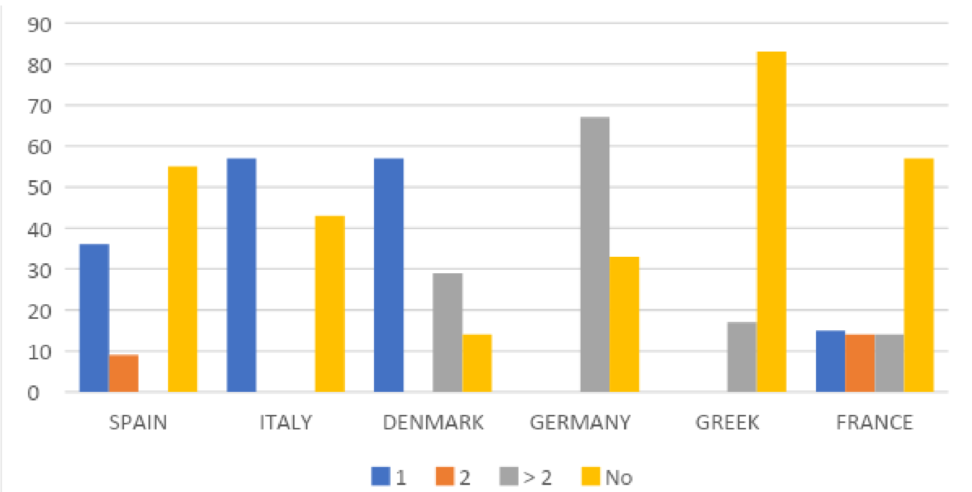


Figure 53. Sewing/embroidering machines avaliability

4.7.9. Electronic devices

Of the European spaces, 60.4% have equipment for the development of prototypes and other electronic applications. We detected differences between countries, with Spain having the highest number of spaces with this equipment (91%), followed by Germany, which was above the average. However, countries such as Greece and Denmark, at 67% and 57%, respectively, do not have spaces with these devices.

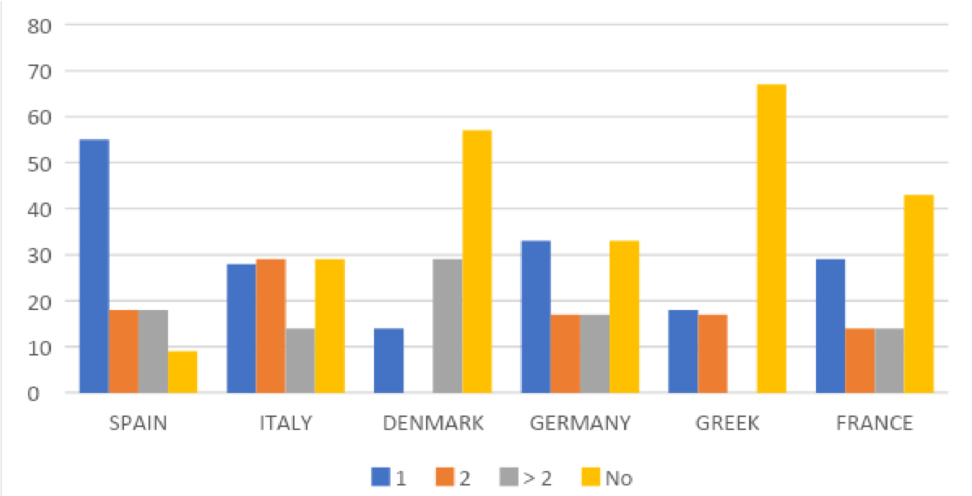


Figure 54. Electronic development equipment availability

4.7.10. Metrology equipment

Only 18.5% of the spaces have metrology devices. It is the type of equipment that we find least in the spaces. In fact, countries such as Greece have none at all, only 9% of Spanish spaces have them, and the only countries with a significant level are France, where 29% of the spaces have two systems, and Germany (17%) or Italy (14%), which have more than two systems in their makerspaces.

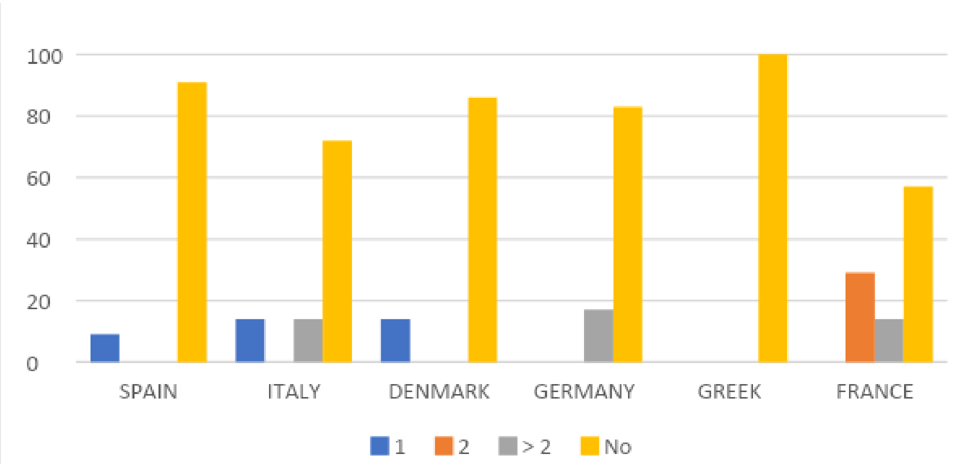


Figure 55. Metrology equipment availability

4.7.11. Virtual and augmented reality equipment

In 51.7% of European spaces, there is at least one piece of virtual or augmented reality equipment, mainly glasses which allow 3-D visualisation and interaction experiences.

There is also a disparity in the availability of these digital tools between the different countries. The country which stands out for the amount of this type of equipment is Germany (50% of the spaces have more than two devices and 83% have some equipment). In contrast, Denmark has the least equipment, which can be found in only 14% of the spaces surveyed.

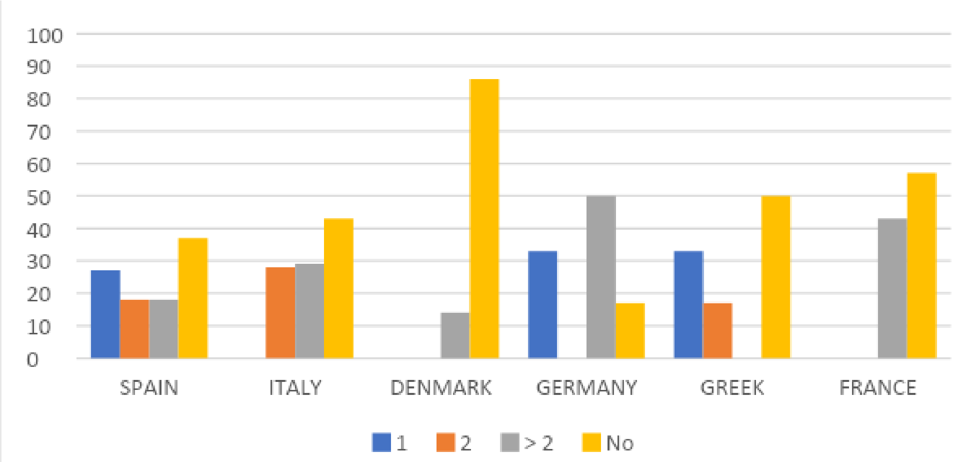


Figure 56. Virtual or augmented reality per country

4.7.12. Other equipment

The last question of the survey checked whether the digital devices or complementary processes mentioned in the previous point have conventional equipment or tools (manual, semi-electric, electric or automatic tools) to facilitate the assembly or finishing of pieces or equipment.

In this regard, in Europe, there are mainly mechanical tools (54.1% have these resources), compared with electronic tools (39.8%) and painting equipment, which is found in only 6% of the spaces.

In Germany, mechanical resources are available in all cases, while in Greece, 67% of the spaces have electronic tools (the figure in Italy and France is 50% of makerspaces), and painting tools are only found in spaces in Spain (26%) and Denmark (10%) for this part of the processes.

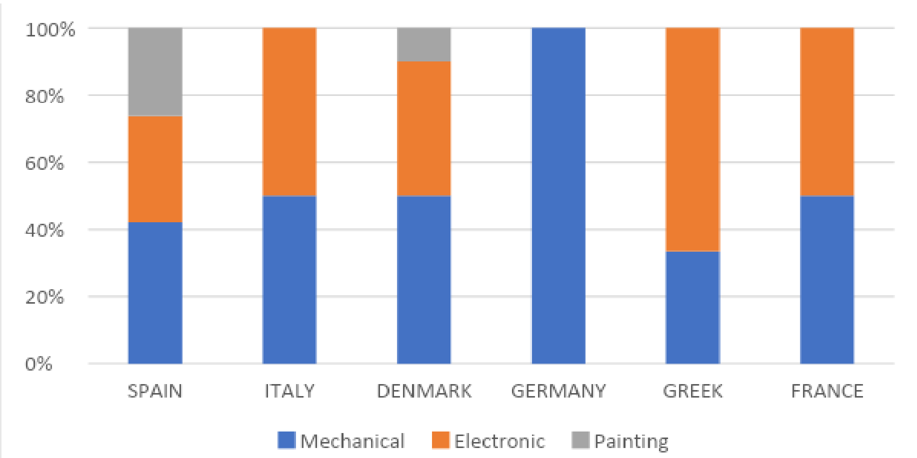


Figure 57. Other equipment

5. Emerging Spaces

5.1. Fab Café

Name of fablab or makerspace:		*FabCafé Barcelona*			
Year founded:	*2013*	Address	*MOB, Makers of Barcelona*		
Country			*Bailén, 11*		
Spain		Postcode	*08010*	City:	*Barcelona*

Website	*https://fabcafe.com/es/barcelona/fab/*	E-mail	*info.bcn@fabcafe.com*	Nº of workers	*8*

Instagram	Facebook	Twitter
https://www.instagram.com/fabcafebcn/	*https://www.facebook.com/FabCafeBCN*	*https://twitter.com/fabcafebcn*

This is a hub of imagination, where it is possible to turn designs into reality, with a laser cutter, 3-D printers and a 3-D scanner, while enjoying a coffee and a snack.

5.1.1. Origin

This is one of a series of innovation laboratories specialising in the creation of products, services and experiences of the future. Here, manufacturing enthusiasts, companies and ordinary people can have access to digital manufacturing tools and experiences in areas from fashion to biotechnology. Founded in 2012, the global FabCafé network promotes creative communities in 11 cities around the world, including Bangkok, Barcelona, Hong Kong and many more.

In Japan, the first FabLab Japan was opened in the spring of 2010. In autumn of that year, in Tokyo Designers Week 2010, FabLab Japan created a temporary FabLab with a room to create (Fabrication Container), and a room to test ideas and see how they could be used (Assembly Container). During this experience, they experimented with the creation of a café, and this test became the prototype of the FabCafé we know today. In the summer of 2011, FabLab Japan and Loftwork (an ecosystem for creative innovation) jointly organised a FabLab training camp, inviting creatives from different fields, for two days and one night. In order to maintain this enthusiasm after the training camp, KotaroIwaoka, a member of FabLab Japan, proposed the FabCafé plan to the operator of the Loftwork creative community and, in 2012, the first one was opened in Tokyo.The idea was expanded as a network to other countries, with the activity beginning in Barcelona in 2013, through MOB, Makers of Barcelona.

5.1.2. From where does it receive aid?

Since its beginnings, FabCafé has been part of MOB, which is a creative centre with three spaces in the heart of Barcelona, the home of the first community of entrepreneurs and creatives in the city. Since the opening of its first space in 2011, MOB has supported entrepreneurs and business people, offering them the infrastructure,

Figure 58. MOB. C/ Bailén in Barcelona

connections, skill-building, advice and commercial opportunities that they need to power and grow their businesses. Over 400 freelancers, professionals, entrepreneurs, creatives, technicians and innovators have chosen MOB as their co-working space.

5.1.3. Star product or service

FabCafé Barcelona was established to become a place where people of all ages and disciplines could meet and manufacture everything they had previously thought was impossible, using digital tools, in a creative atmosphere full of synergies. But much more than just manufacturing while having a drink or a snack, FabCafé is a worldwide network of creatives. They form part of a larger team, which can be found in Tokyo, Taipei, Bangkok and New York. With global thinking and local action, they promote change in today’s structures and in the way we produce and consume, so that the user can actively become a part of that change.

To give an example of the network in Europe, together with Toulouse and Strasbourg in France, Spain has a single FabCafé, in Barcelona, where, every day, dozens of people enjoy visiting the premises, which are located in the MOB. Apart from the physical space, it also offers unique corporate services to companies and schools. Collaborative manufacturing, team training workshops for companies, original events, branding campaigns with limited-edition merchandising, etc., all thanks to the use of co-creation tools and technology within the reach of all.

The star product is 100% customised events, since it has its own design and production team. Users simply enjoy while the organisers take care of the rest: bespoke catering, ambience, decoration, music, projections and sound, etc., with capacity from 50 to 200 persons (depending on the space) in signature locations in Barcelona, totally adapted to user needs.

Event in the FabCafé

5.1.4. Technologies and sources of innovation

Its members are delighted to think that very different persons can join forces to create something incredible together. Among the possibilities that may be developed or undertaken through FabCafé, is the following predesigned catalogue of proposals:

- Gifts of a miniseries of exclusive souvenirs for attendees at one of your events;
- Personalised card wallets for each of your clients;
- Make them eat your slogan (yes, we can put your slogan onto food);
- Surprise your worker of the year with a different, emblematic trophy;
- Decorate the walls of your shop with 500 limited-edition figures;
- Produce a life-size maquette of a new model of a car;

- One of the reasons why digital manufacturing has developed so much in recent years is in order to mass-customise, or personalise mass-produced objects, and make them unique, or to create unique pieces in production runs of up to 100 and not have to wait an eternity (your time is money).

Technological tools are available for these activities:

- Physical prototyping;
- Digital prototyping;
- Arduino;
- Raspberry Pi;
- 2-D and 3-D design;
- 3-D printing;
- Laser cutting and engraving.
- As well as co-design methods and techniques, such as:
    - Brainstorming;
    - Design Thinking;
    - Rapid prototyping;
    - New technological applications and tendencies.

Workspace for personal computers and devices

5.1.5. Usual working process

Problems are solved through challenges, and the basis of the processes used is knowledge. They like to confront problems in the belief that these are learning spaces. The learning method is through combined practical-theoretical sessions, with challenges addressed by teams, empowering participants so that they are much stronger together. The following integrated workshops are run:

- Hackathons: This is an event lasting one or more days where a product is explored to find new ideas and to expand its possibilities. The workshops are open to the public.
- Product Brainstorming: Sessions to seek alternative and creative uses for a specific product.
- Product Hack: Sessions to find alternative uses by adapting and modifying a product.
- Innovation Bootcamp: These are two-day training sessions for companies, seeking radical solutions from a multidisciplinary perspective, applying business strategy, innovation, design thinking, technology and prototyping.
- Product Testing: Designed for companies that want to test their product and allow the general public to try it.

5.1.6. Type of public or user

zTaking advantage of digital manufacturing tools, the FabCafé space and co-working facility (MOB) into which they are integrated, they mainly attract companies and educational establishments and offer them the opportunity to take part in the workshops,

Sharing coffees, drinks and snacks close to a 3D printer training the students and professional teams in a dynamic, innovative way.

5.1.7. Recognition and awards

In 2014, the world Fab Café network received a Good Design Award:

http://www.g-mark.org/award/describe/41896?locale=en

Since 2012, they have organised the YouFab Global Creative Award every year:

https://www.youfab.info/

For its part, FabCafé Barcelona was a co-founder of Omplim Magatzems during COVID and it was recently mentioned by Forbes:

https://bit.ly/forbesFabCafeB

5.2. FabLabs Social

Name of fablab or makerspace:		*Solidarity FabLab– FabLabs Sociales*			
Year founded:	*2016*	Address	*Several in Spain*		
Country					
Spain		Postcode		City:	

Website	*http://fablabssociales.org/mundo-breakers/*	E-mail	*fundacion.es@orange.com*	Nº of workers	-

Instagram	Facebook	Twitter
https://www.instagram.com/fablabssociales/		*@fablabssociales*

The concept of Fablab Social was developed in Spain as part of the Breakers project, a programme aimed at young vulnerable persons, which encourages them to learn technical design skills, electronic prototyping and digital manufacture, together with other transversal skills.

5.2.1. Origin

The project forms part of the *Solidarity FabLabs* initiative launched internationally by Fundación Orange. This initiative focuses on unqualified young people or young people facing different types of difficulty, who can participate in projects run in different spaces all over the world. These projects have been run in more than 60 FabLabs in 11 countries. In Spain, they began in 2015 with the *YAMakers* experience, a training programme for young people with Asperger's, and run at the Ateneu de Fabricació Les Corts in Barcelona, and *Young Social Makers*, a project at MediaLab Prado for young people from different disciplines working together to address a specific social challenge.

The term "breakers" comes from adding the idea of breaking barriers to the term "maker" and it is also associated with interruption, which means that these young people will have the opportunity to explore an attractive environment, such as technology, and also take the initiative to decide and change their own future. It has been able to count on César García Sáez, the author of the study '(Casi) Todo por hacer' and co-founder of MakeSpace Madrid, as coordinator of the FabLab spaces in the project, and on Susanna Tesconi as the head of pedagogic design. The project was run thanks to the collaboration of FEPA, (a federation of associations that work with and offer solutions to young people who are or have been in care, to encourage their emancipation), and of BJ-Adaptaciones, a specialised design, development and implementation company offering a personalised technological solution for persons with disabilities or social problems, and the FabLab spaces in each city.

The network of FabLabs and makerspaces which gave training regularly includes the following spaces: MakeSpace (Madrid), FabLab Sevilla, FabLab Valencia, Space Open (Bilbao), Tinkerers Lab Castelldefels, SokoTech and Ateneu de Fabricació Ciutat Meridiana (in Barcelona), FabLab León, and with complementary training under other related programmes, such as the TecnoLab programme, with TecnoLab La Rueca and Asociación Cultural La Kalle (both from Madrid) and Yamakers, with the Fundació Friends (Barcelona).

Figure 59.Training for trainers in Maker Space Madrid

5.2.2. From where does it receive aid?

Fundación Orange is the promoter of the project in which fablabs and makerspaces from Madrid, Seville, Bilbao, Valencia, Barcelona, Castelldefels and León have collaborated with the programme. Between 2016 and 2019, three editions have been run each year: Spring Breakers, Summer Breakers and Autumn Breakers. The Foundation believes in technology as a tool and as an opportunity to improve peoples' lives. It therefore runs projects in the field of digital education, with special emphasis on groups at risk of exclusion. Furthermore, Fundación Orange strongly backs the use of digital solutions to improve the quality of life of people with autism and it is committed to a task which, using technological tools, brings culture and leisure to people with sight or hearing disabilities.

5.2.3. Star product or service

'Breakers, make yourself a new world' is a programme that brings digital creation and the "maker" culture to young vulnerable persons. The programme is educational and is an innovative field, preparing young participants to develop creative initiatives and ideas that make a positive contribution to their process of independence and emancipation. The methodological innovation is based on:

- Following the practice-theory-practice dynamic, in which, through the elaboration of a designed milieu, theoretical content is generated through reflective practice.
- Hybridisation/exchange between the different profile of participants (social educator, maker, designer, scientist-trainer, etc.).

The social trainer figure close to young people

- Harmonisation/use of the human and material resources of the spaces.
- Pedagogic evaluation/reflective practice as the backbone of the activity.
- Documentation of training processes, content and designs as an evaluation tool and a resource for the replication of the programme.

5.2.4. Technologies and sources of innovation

Digital innovation: The training takes place in makerspaces and FabLabs, spaces for collaborative work with long experience in the field of making and digital manufacture. These places receive the young Breakers and guide them on their learning journey and their discovery of the maker world. To achieve this, the learning takes place by acquiring skills in 2-D/3-D design techniques and digital manufacturing technologies such as 3-D printing, laser cutting machines and electronic prototyping, together with other transversal and social skills such as teamwork, improvement in communication, negotiation and motivation.

Learning process guided by the trainers

5.2.5. Usual working process

The methodology of the programme takes its inspiration from the maker movement. Breakers take advantage of the opportunities offered by maker philosophy to learn not only technical, but also social and personal skills that could become very significant to improve their independence and achieve emancipation. Making, as a set of physical and training tools, has the potential to transform educational practices related to the creative use of technology, but its potential is nil if its implementation does not go hand in hand with educational action that is compatible with its philosophy.

Maker Ed methodology (as it has become known) is based, firstly, on the Design-Based Research (DBR) paradigm and, secondly, on skill-based training. DBR is a systematic, flexible focus whose end purpose is to improve educational practice through the reiterative analysis of the design of programmes and their implementation. DBR also takes into account a wide set of processes and contexts, in order to capture all of the complexity of an intervention and improve it over several design cycles, in order to produce a prototype that can be adapted to different contexts.

Skill-based training has many points of contact with the maker movement's learning model. The acquisition of skills, in the sense of complex, integrated, multi- and trans-disciplinary knowledge that can be transferred from one context to another, allows decisions to be made and complex solutions found, which is what usually occurs in making and in educational making practices.

Breakers Closure Workshop in FabLab Oceanonaranja

5.2.6. Type of public or user

Participants in Breaker training are young people of between 16 and 25 years of age in a situation of vulnerability, or who are experiencing complex realities and have little opportunity to access this type of technology.

5.2.7. Recognition and awards

2017. Fundación Orange's Breakers won the Jury's Prize at the I Make 4 My City International Challenge, a competition that brings young people into contact with digital manufacturing and innovation, offering them the opportunity to create digital solutions as a contribution to the cities of the future: (*http://www.fundacionorange.es/reto-imake4mycity-sport-for-all/)*

2017. The Foundation received the Gadget Prize for social impact through ICT: (*http://www.fundacionorange.es/premio-gadget-2017/)*

2018. A group of Breakers were finalists in the I Make 4 My City International Challenge 2018-2019, participating in the presentation of projects in Paris: (*http://www.fundacionorange.es/international-challenge-imake4mycity/)*

5.3. Labfab Université de Rennes 1

Name of fablab or makerspace:		*Labfab Université de Rennes 1 – UR1 Fablab – CAMP OSV*			
Foundation year	*2013*	Address	*Université de Rennes 1 Campus de Beaulieu - Bât. 11D 263, Av. Général Leclerc CS 74205*		
Country					
France		C.P.	*35042*	City:	*Rennes cedex*

Web	*https://labfab.univ-rennes1.fr/*	Mail	*valerie.guichon@univ-rennes1.fr*	Nº Workers	*3*

Instagram	Facebook	Twitter
		@LabFab_UR1

The fablab of the University of Rennes 1 is based on MIT standards. It has the particularity to welcome users from very different backgrounds as students of technology, art, economics, law, chemistry, urban planning etc.. It was probably one of the first french university fablab to open up to the general public and outside actors.

The specificity of the fablab UR1 is that the structure was defined in relation to an ambition project of development and prototyping of an open source vehicle (*Camp OSV project*).

Prototype of Open Source Vehicle

5.3.1. Origin

A series of meetings between researchers from the University of Rennes 1, the University of Rennes 2 (art) and the European School of Arts in Brittany has enabled to unseal leads for collaboration on artistic and technological creation projects.

Following this, the fablab of the University of Rennes 1 was founded in 2013 by Valérie Guichon with a vision of open innovation and a place for multidisciplinary sharing.

The fablab is quickly structured around an ambitious project of development and prototyping of open source vehicles.

The fablab visions are oriented around MIT standards, free and open source culture, sharing and openness to diverse audiences included citizens and industries from different sectors. The objective is to develop tools to facilitate and transmit knowledge on creation and prototyping subjects.

Subsequently, the metropolis and the fablabs began a project of structuring and pooling local collaborative spaces, which today represents a network of several local fablabs called "Labfab".

5.3.2. From where does it receive aid?

The fablab of the University of Rennes 1 is mainly financed by public institutions wishing to support the structuring of the territory's fablabs and the main project (Camp OSV). Among these financial institutions we find :

- The University of Rennes 1
- The metropolis of Rennes
- The Brittany region
- Europe

More recently, private companies have invested in the fablab through the provision of human resources to design and prototype vehicles on the basis of the Camp OSV Project.

5.3.3. Star product or service

The main service of the fablab is the training and more particularly the training of the students of the different fields of the university thanks to the multiple free resources available. Practical work and hackathons are organized in order to teach design, prototyping, industrialization, regulation, law, economics and more.

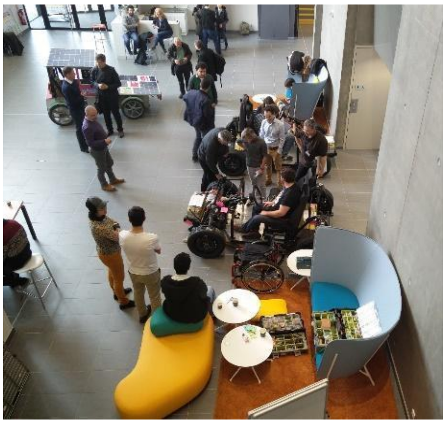


Figure 60. Hackathon on Camp OSV and mobility Project

5.3.4. Technologies and sources of innovation

The fablab extends to the whole university. As a result, it pools all the conventional fablab prototyping equipment (MIT-based) as well as larger equipment from the university and its research laboratories.

So you can find :

- 3D Printer
- Computer
- Cutting machine
- Electronical systems (arduino,…)
- And co-design methods or techniques such as:
    - Brainstorming
    - Design Thinking
    - Rapid prototyping

Some examples of projects and technologies treated:

- Development of an open source modeling software (CAD / CadRacks) for complex objects
- Open source vehicle prototyping (CAMP OSV - BMS, IoT, chassis modeling, engine control)
- Communication and connected object technologies for the building industry (both technical, chemical, health and social aspects)
- Robot prototyping
- Connected glass

5.3.5. Usual working process

The daily activities of the fablab are these:

- Reception of the actors involved in the projects under construction
- The organization of hackathon which allows all the actors of the same project to get together 2 to 3 times a year
- Setting up internships to document or work on specific topics
- Support for innovation and prototyping
- Support for setting up a service, product or start-up
- Search for funding for the fablab and its projects
- Organisation of conference as a tool to support the prototyping : *conférence internationale sur le Libre*

UR1 Fablab's projects systematically stem from a need identified by the general public.

When this project is initiated in the fablab, a working group is set up with users with various profiles, fields and skills.

5.3.6. Type of public or user

The fablab users are:

- Students
- Teachers and researchers
- Companies / industrialists

- Citizens
- Autoentrepreneurs (Graduate jobseeker in the transitional phase of job search or in the process of creating his company)
- Associations (personal assistance, handicap, environment, organic agriculture among others)

5.3.7. Recognition and awards

A media support and a rising interest from the companies exists, but not specifical prices.

5.4. Atelier FabLab Kamp-Lintfort

Name of fablab or makerspace:		*FabLab Kamp-Lintfort*			
Foundation year	*2015*	Address	*Rhine-Waal University of Applied Sciences Faculty of Communication and Environment*		
Country			*Friedrich-Heinrich-Allee 25*		
Germany		C.P.	*47475*	City:	*Kamp-Lintfort*

Web	*https://fablab.hochschule-rhein-waal.de*	Mail	*fablab@hochschule-rhein-waal.de*	Nº Workers	*4-5*

Instagram	Facebook	Twitter
www.instagram.com/fablabkamplintfort	*https://de-de.facebook.com/fablabkamplintfort*	

This ultramodern workshop puts state of the art fabrication technology at the fingertips of schools, students, entrepreneurs and businesses from around the region. The FabLab Kamp-Lintfort offers over 600 m² (6,400 ft²) of both space and machinery to make ideas into reality.

5.4.1. Origin

The idea of the FabLab came up in 2013, when Dr. Martin Kreyman from the University of Applied Sciences in Kamp Lintfort took part in a training session of the German education initiative zdi (future by innovation). There, the trainer mentioned the idea of FabLabs in a coffee break. zdi is an initiative of the state of North Rhine-Westfalia to mobilise, empower and foster children for STEM (science, technology, engineering, mathematics).

Figure 61. FabLab Kamp Lintfort

Soon after, he visited the fablab in Barcelona (Fab Lab Barcelona) and took part in Fab Academy courses where he immediately was infected by the enthusiasm and compassion of all participants. By this time he knew that a FabLab needs to be created in Kamp Lintfort. At a status briefing together with partners at zdi, the idea for a FabLab concept was further developed resulting in an application for EFRE fonds (European fonds for regional development). In 2014 the school lab in Kamp Lintfort was initiated using EFRE fonds, also supported by the Rhine Waal University of Applied Sciences in Kamp Lintfort. 2015 was the official start of the FabLab Kamp Lintfort.

Applying to a regional EFRE call in the state of North Rhine-Westfalia started the initiative of the 3D Competence Center Lower Rhine (*www.3dzentrum-niederrhein.de*). The project started in 2017 and the Rhine-Waal University of Applied Sciences teams up with partners at University of Applied Sciences Ruhr West and at the RWTH Aachen University.

5.4.2. From where does it receive aid?

The FabLab Kamp Lintfort is financed by the EU and the state of North Rhine-Westfalia through the EFRE program and funding from the Rhine-Waal University of Applied Sciences.

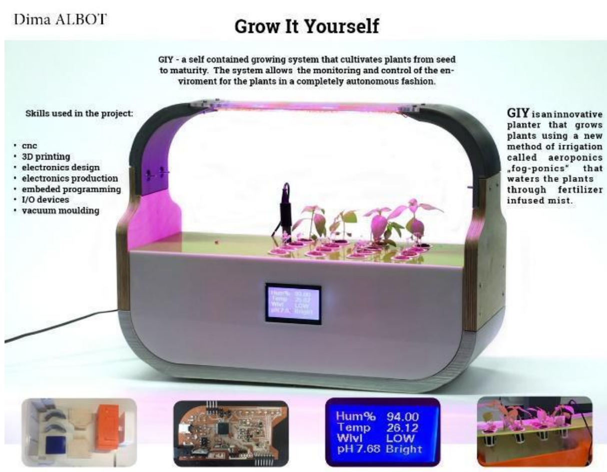
The FabLab Kamp-Lintfort is a common facility operated by the zdi center Kamp Lintfort (*https://www.zdi-kamp-lintfort.de/*) and the Faculty of Communication and Environment at the Rhine Waal University of Applied Science.

5.4.3. Star product or service

The FabLab Kamp Lintfort is a reference model to initialise school fab labs. The program *www.schoolfablab.de* is a network of schools, setting up their own fablab. About 15 schools are currently opening their own fablabs so that the initiative is by size quite unique in the world, exceeding the size of *www.schoolfablab.com*. The schools have access to funding via the German governmental program Digitalpakt.

Also, a Green FabLab is inaugurated in July 2020 as part of the FabLab Kamp Lintfort, which is setting a focus not only on digital manufacturing but with an emphasis on environmental questions.

The FabLab Kamp Lintfort was the first fab lab in Germany offering Fab Academy, a five month intensive training program deduced from successful courses Center for Bits and Atoms (CBA) at the Massachusetts Institute of Technology (MIT).



Fabacademy project

5.4.4. Technologies and sources of innovation

The FabLab Kamp Lintfort offers a variety of technologies:

- 3D printing (up to 1m³)
- 3D scanning
- Laser cutting
- CNC milling
- Vacuum press
- Wood working

- Metal processing
- Electronics workshop

Via the fabacademy also skills in design thinking, rapid prototyping etc. are taughtto students, smes and other interested participants. Moreover, the fablab offers consultancy for smes in product development and the use of state of the art digital manufacturing tools/machines.

FabLab Kamp Lintfort, interior lower floor

5.4.5. Usual working process

The FabLab has a weekly plan. From 8-12 the fab lab is usually used for internal courses and training in the framework of the university's curriculum.

Figure 62. Workshop with students

From 14-17, the fab lab is open for students. This can include mentored work but also free work on own projects.

In addition, the fab lab offers several dedicated workshop programs for schools.

Every two weeks, there is an open afternoon, where after a security introduction and an introduction into the techniques and machines, everyone can use the fab lab for their own project.

5.4.6. Type of public or user

- Students on a daily basis
- Every day at least one group of school kids
- Teachers
- Open lab for everyone (school kids, employees from smes, retired people, etc.)

5.4.7. Recognition and awards

- Employees won the Best Idea Cup (Innovation and funding initiative of Lower Rhine región).

Awarded as “Pilot and demonstration facility” (i4.0 test space) within the project 4kmu (project funded by the federal ministry of education and research) *https://i4kmu.de/*

6. Overview of Technical Activities in iPRODUCE

This section presents the overview of each of the work packages in iPRODUCE for the M1-M6, including a precise definition of what will be used from benchmarking document, an indication of the envisaged state, and progress (where applicable) by iPRODUCE

6.1. WP2: iPRODUCE Business Challenge Definition for Social Manufacturing in Consumer Goods Sectors

This work package focus on the:

- Reassert the project vision and user scenarios, benchmarking it and aligning it with micro-factory and collaborative production models and technologies as well as providing the overall requirements, KPIs, and a trust policy framework depicting the envisioned iPRODUCE solution.
- Identification and analyse our stakeholders' perceptions, intentions, needs, drivers and barriers with regards to their involvement and active engagement in user innovation and social manufacturing.
- Production a detail mapping of co-creation/ OI methods, tools and practices with respect to the proposed social manufacturing framework and the corresponding stakeholder needs.
- Collection of the high-level consumer goods industry sector scenarios, Use Cases, and KPIs to address specific co-design, co-production, OI challenges and to define the generic KPIs to measure the improvements after applying iPRODUCE.
- Integration of the above into a holistic visionary social manufacturing/ collaborative production reference model and further update/ improved throughout the project duration.

6.1.1. T2.1: Users and stakeholders Requirements, Perspectives (gender preferences will also be analysed) and Motivation

This task aims to analyse stakeholders' (general public, makers and manufacturers) perceptions, intentions, needs, drivers and barriers with regards to their involvement in user innovation, collaborative manufacturing and co-creation schemes.

During the period of January – February 2020, the involved consortium partners performed a thorough literature research, analysing the state of play around the topics of user innovation, social manufacturing, and maker movement. Retrieved insights lead to the formation and development of the T2.1 questionnaire. The survey (questionnaire) was translated in the 6 pilot languages (ES. DE, DK, GR, FR, IT) by the 28th of February. The survey was administered online through the, GDPR compliant, EU survey platform and was officially *published* on the 6th of March. Consortium also distributed a guideline with indicative strategies for promoting the survey in local communities with a target to capture 150 responses per pilot case. Apart from reaching their sampling target, pilot teams were advised to coordinate efforts on capturing responses from all 3 major stakeholder groups. The online survey has been extensively broadcasted in social media accounts, including the project's and partners' twitter profiles. Only a few days after the survey's launch (March 6, 2020), the COVID-19 pandemic took hold over the EU and all iPRODUCE maker communities and Fablabs, the **driving**

force of each pilot team and the main **lever for collecting responses**. Understanding that the lack of acquisition of a statistically representative sample would impact the quality of the survey analysis and aiming to safeguard the validity of the Task's outcomes, WR suggested a 3-month extension in delivering D2.1 (new deadline: September 2020, M9).

The results from the benchmarking document and specifically its conclusions regarding the Future and the Economic and Social Demand for the Most Significant Activites and the 7.1 about Technology will be considered to the D2.1 and correlated with its results.

6.1.2. T2.2: Benchmarking Makers Approaches and Value Adding Potential in Consumer Goods Manufacturers

This task deals with a comprehensive and up-to-date investigation of existing state-of-the-art methodologies, architectures, technologies, and solutions supporting the collaborative production/ social manufacturing philosophy which establishes the success-factors of Fablab and makers approaches as a goal for manufacturing companies/ SMEs in the consumer goods sector.

During the period of January – June 2020, the involved consortium partners performed initially a Benchmarking questionnaire on English and then translated it in the 6 pilot languages. The survey was administered online at the *www.survio.com* on May targeting six successful Fablabs of each pilot country as the best paradigm, following GDPR compliance. The online survey has been extensively broadcasted in social media accounts, including the project's and partners' twitter profiles. Also, interviews with makerspaces and Fablabs which achieved successful cases of business models were performed. To guaranty the quality of the survey analysis and aiming to safeguard the validity of the Task's outcomes, due to the COVID-19 caused delays, a 1-month extension in delivering D2.3 (new deadline: July 2020, M9) was decided.

6.1.3. T2.3: Mapping and Assessment of Co-creation and Open Innovation Methods, Tools and Practices

The aim of this task is to create a knowledge base of practices, methods and tools to ground and provide the most relevant resources to be applied to the upcoming activities in iPRODUCE. The report D2.4 was delivered on time within June and presents the literature review, definitions and assessment of Co-creation, Co-Production and Open Innovation tools, while including the definitions of Design Thinking and generative design, more specifically how these approaches can be explored towards open innovation and social manufacturing. Furthermore, this report gives an overview of current materials lifecycle management approaches carried out by iPRODUCE partners. The initial chapters of the report present definitions of the key concepts of co-creation, co-production and open innovation, followed by the definition of approaches and methods, such as Design Thinking, based on a thorough literature review as well as an assessment of the most popular and useful tools among makers and related creative communities. In order to complement and improve the review, we devised a small questionnaire with the intent to gather the practitioners' perspective of the concepts and tools encountered during the review. The questionnaire gathered responses primarily from the project partners and a few other international labs and makers that assist in framing and expanding the concepts used in the project description and their related tool list. This approach has created a wider and more consistent practice perspective of the terms, which can better assist with the project process and the cMDFs developments. The following chapters cover the methods and tools converging the literature review with the questionnaire results. The tools are introduced and discussed, including how they have impacted projects' processes and outcomes. The discussion is complemented with an assessment of how the methods and tools are applied in regards to distinct project phases. The tools are presented with their descriptions, purposes and links to digital resources and are listed according to the assessment of their popularity, from the most to the least used and known. The report also covers the assessment of hardware and software tools used by iPRODUCE partners as well as an initial assessment of approaches towards lifecycle management from within iPRODUCE partnering labs. The final chapters give examples of which types of tools and methods can be applied in the context of the project upcoming tasks and activities, towards optimising and devising new approaches for social manufacturing and urban production.

In sum, the submitted D2.4 report analyses over 100 co-creation and co-production tools and resources as well as communication platforms used across projects for various purposes identified throughout a thorough literature review and desk research. The tools cover all aspects of co-creation project phases: team building, research, ideation, development, assessment and evaluation and validation. The types of tools and resources are assessed on how they impact co-creation processes and they are listed in tables based on an assessment of their popularity (indicating which were the ones most used and known among makers). The final part of this report indicates how a range of these tools can be applied throughout many of the iPRODUCE activities, helping identify those most valuable for social manufacturing and how they can be adapted or further developed to support and strengthen the iPRODUCE platform towards creative approaches to local and on-demand urban production.

6.1.4. T2.4: Defining the Local Collaborative MDFs, Use-Cases, Innovation Challenges and KPIs

This task initiates the establishment of the local cMDFs, while provides the identification and general definition of the different Use Cases that will be used as validation scenarios of the iPRODUCE project.

Within the first six months the cMDFs have defined the use cases that suit best to their infrastructures and services.

- Spanish cMDF: physical products design and co-production will be introduced for the furniture domain
- German cMDF: use cases relevant to design, training and rapid prototyping of electronic devices, focusing on emerging IoT applications for Industrial Environments and/or Smart Cities context based on 3D printed PCBs
- Italian cMDF: use cases relevant to product development/enhancement in the microelectronics consumer sector
- France cMDF: physical products co-creation and co-design in the mobility and automotive sectors
- Danish cMDFs: customer-oriented consumer-goods manufacturing like co-created social event sites, customized bespoke furniture for housing or office purposes etc
- Greek cMDFs: physical products design and co-production will be introduced for medical domain like orthopaedic equipment, face shields etc.

The results of the D2.3 will play a significant role in its progress. Results about the current state of the business model and technology through the 7.1 regarding the validation of the initial research hypothesis and Technology, will be taken into account respectively.

6.1.5. T2.5: Social Manufacturing Reference Model and Framework Evolution

The objective of this task is to align iPRODUCE as much as possible with existing manufacturing reference models facilitating the interoperability with other compliant platforms. In this task the involved consortium partners fuse and synthesise the outputs from T2.1-T2.4 to enrich and strengthen the iPRODUCE's vision on how social manufacturing can work in the consumer goods sectors.

The benchmarking document will play a significant role in the configuration of the D2.6. Useful results for the elaboration of the reference manufacturing model will be derived mainly from 2.1.1 The trend towards digital manufacturing, 4.1.1 Organisational model, 4.2.3 Channels of transmission, 4.3 Collaboration and Funding, and 4.7 Technology.

The best paradigms of emerging spaces will be also considered appropriately to enrich the aspects related to the iPRODUCE architecture based on the defined use cases of the local cMDFs concept and ecosystems structure and OI approach, and identifying potential gaps in the above models and suggesting improvements to reinforce them.

6.2. WP3: Establishment of Local Collaborative Manufacturing Demonstration Facilities

The objective of the WP3 is to define the Operational Model for cMDFs'Federations, the toolset and workflow simulation and improvement through digitalisation of technological and manufacturing cMDFs capacity and assessment.

The current progress as described below will be enhanced by the results and conclusions of the D2.3. Significant knowledge gained through the different digital creation and manufacturing spaces that found in European models of fablabs, makerspaces and hackerspaces, will envisage a better understanding of the business model, values, strategies, conditions for access and the adaptation of these spaces, as well as their business potential correlated also with industry 4.0., in order to facilitate a means of intervening with the different agents in the system in the near future.

6.2.1. T3.1: Lean Operational Models for Local cMDFs and their Federation

This task is focused on the development of a Lean Operational Model which can lead the transformation of both Local cMDFs and their Federation.

The Operational Model will consider both the scenario defined by each Local cMDFs and the integration of each facility in the overall Federation; the latter factor will be critical to properly pursue the integration purposes on which iPRODUCE is built. The involved consortium partners will give rise to an Implementation Roadmap, focused on the application of the main principles of Lean Models (i.e.Just-In-Time, Stability, Quality, Continuous Improvement, Policy Deployment and Future Design) to the holistic vision of the Federation.

CMDFs could take as a reference the positive aspects of the SWOT to consider their strategic vision, consolidate the model and complement it with the same available tools to the entire 'Federation' of CMDFs.

6.2.2. T3.2: Mapping and Reinforcing the Manufacturing Capacity of the CMDFs

This task aims at creating a repertory of the existing manufacturing capacity and reinforcing it where machine or technology is lacking to enter the iPRODUCE platform.

We have recognized from the benchmarking study the technology and equipment that have been used, as well as the real production capacity both in terms of machine and resources, to have an accurate view of the manufacturing capacities to be further benchmarked in T3.2.

6.2.3. T3.3: Setup the Network of local cMDFs

In this task the involved partners start to set up a network of local individual contributors (designers, producers, engineers, …) in a collaborative way.

The study has obtained several conclusions, which highlight those elements oriented to innovation like the participation of citizens, clients and users in the processes, which together with the benefits and possibilities of the studied spaces, outline the CMDF model of the net, as well as the "real" network.

6.2.4. T3.4: Digital Fablab Kit and Production Workflow and Simulation

The iPRODUCE Digital Fablab Kit aims at digitizing repetitive educational tasks and make digital technology solutions easily available in the cMDFs.

Based on the benchmarking of the use of IT Tools, the involved consortium partners have contributed towards the definition of a coherent approach for this task, combining the training needs with a Sw optimisation of their business processes..

6.3. WP4: iPRODUCE Core Services and Digital Platform for Social Manufacturing

This work package focuses on the development of the iPRODUCE platform architecture that will illustrate the different technology components and their interplay; as well as the data sharing functionalities and security and privacy aspects. The work package also delivers some of the key technology components in the iPRODUCE platform.

6.3.1. T4.1: Architecture and Design of the Open Innovation Platform

One of the highlighted aspects by the benchmarking study is how the relationships between users and the service provider are established. Through this way of operating, defined strengths and weaknesses of the spaces, it will be possible to detail and document the desired architecture for the platform.

The involved consortium software developers have already filled out the architectural component's specification template and present the methodology used to achieve and document the architecture that has been defined as a result of three main steps namely, technology exploration, bottom-up and top-down within the first three months that has started this task. In particular, the overall on-going architecture is carefully reviewed by taking into account inputs from the technical work packages (i.e., WP2, WP3) and the defined use cases (UCs) from T2.4.

6.3.2. T4.2: Knowledge Extraction and Data Sharing

The knowledge extraction and knowledge sharing task aims at establishing common grounds for the exchange of data in the iPRODUCE platform through the adoption of shared data models, semantic descriptions and annotations. Since the task starts at M10 of the project, at this early stage the task partners have developed the functional and non-functional specifications of the technology solutions to be developed in this task. The specifications are being used in the design of the iPRODUCE platform architecture (in T4.1). Based on the agreements from relevant partners, on the specifications of the knowledge extraction and data sharing solution, the technical developments will start with the initiation of the task later this year.

6.3.3. T4.3: Open Innovation Marketplace for Consumer Goods Manufacturing

This task is responsible for developing a digital multi-sided marketplace for the iPRODUCE platform with APIs for services provision and integration of added-value tools, including other components with which the marketplace will have to interact with. At present the functional and non-functional specifications of the marketplace have been developed to provide input towards the architecture design activities (in T4.1). These specifications will be validated through user consultations, before the technical activities start to develop the two iterative versions of the marketplace during the project duration.

6.3.4. T4.4: Lead User Identification, Matchmaking and Agile Network Creation

This task provides an integrated set of tools that can assist iPRODUCE users to identify lead innovators as well as potential partners and product/service offerings in the iPRODUCE ecosystem. The task will develop two integrated tools that provide matchmaking and agile network creation functionalities. The integrated toolset will be offered to the user through an intuitive GUI. The GUI will allow the users to search for products, services or potential partners (based on capabilities, skillets etc) in the iPRODUCE ecosystem. Building on the results of the matchmaking functionality, the agile network creation tool will apply machine learning and team formation algorithms to compose teams (of potential partners) that can jointly address the specific search criteria. Since the task starts at M10 of the project, at this early stage the functional and technical specifications of the technology solutions have been developed. These specifications are used in the design of the overall iPRODUCE platform architecture. The architecture design will help in further clarifying the functional aspects and dependencies between different tools. Based on this ground work, the technical developments in this task will start at the planned time (M10) later in the year.

6.3.5. T4.5: iPRODUCE Training Toolkit on Co-Creation

This task delivers a training toolkit that equips the different stakeholders in the iPRODUCE ecosystem with necessary techniques on co-creation, design thinking and use of innovative technology solutions. The task plans to organise workshops to provide support on the testing, prototyping and evaluation of the co-creation activities.

D2.3 will reinforce the needs for the implementation of open innovation co-creations tools, which are the most useful to promote the idea of social manufacturing which will allow the development of the iPRODUCE platform arquitecture.

As the task starts at a later stage in the project (M10) when the project outcomes start to become visible, the ongoing activities are focused on identifying the relevant formats and mediums for the training workshops.

6.4. WP5: Customer-Driven Production and Co-Creation Enabling Tools

The objectives of this Work Package are related to the development of technical and methodological tools to facilitate the collaborative production engineering and the involvement of the customers along with all phases of product development (inception, process deployment, manufacturing, end of life, etc.) through co-creation processes.

In the productive case, the experience of the spaces with digital manufacturing technology has generated flows that better respond to the expected model of CMDF. In the collaborative case, the experience to transfer the studied models (user profile, work formats, etc.) to more systematized schemes is a need that should be depthly developed.

This is one of the critical points and the project should be further developed and provide novelty in this flieds. The study highlights the relationship that should be established between users and companies is almost new, even its innovative spirit that surrounds this spaces.

6.4.1. T5.1: Assistive and Collaborative Designing Methods and Tools

In this task, existing methods and tools for collaborative design processes widespread in Europe and in the world will be deepened in order to define and assess the iPRODUCE methods for the assistive and collaborative Design.

The type of tools that are expected, both associated with co-design and production, are related to the format of this type of space (FabLabs, Makerspaces and alike) and the ways the provider and the users act.

For example, as regards 3D printing, the diffusion of commercially 3D printer kits has inspired the early collaborative designs mitigating the issues related to the part sourcing and also creating a commercial interest in developing clear assembly instructions.

The commercial success of maker-oriented digital fabrication machines based on low-cost printer usability and accessibility has favoured the release of plug-and-play 3D printer models instead of build-it-yourself kits.

In this way, the personal fabrication market has become a serious contender for machine development, alongside the previously dominating industrial fabrication markets.

Currently, results essential to participate in related networks for the use of 3D printing, as confirmed by the responses to our Benchmarking questionnaire. The development of specific learning methods and tools that take place by acquiring skills in 2D/3D design techniques and digital manufacturing technologies such as 3D printing, laser cutting machines and electronic prototyping, together with other transversal and social skills such as teamwork, improvement in communication, negotiation and motivation is very important.

Taking into account the received responses, it will be important to pay attention to space management techniques and technological empowerment with the aims to improve the participation of people to the fablabs and maker spaces work and to facilitate the use of the technologies required to develop ideas and projects through specific learning processes.

6.4.2. T5.2 Generative design platform

Generative design uses cloud computing and artificial intelligence to accelerate design exploration.

The study has also confirmed that the initial generative design proposal will be one of the outstanding elements for all types of users, mainly those who stand out the most: designers, inventors and students.

The study also suggests social functionalities are needed and will allow making a step forward compared to the currently most popular tools such as Autodesk on Amazon Web Services (AWS) which interface with existing social media but do not provide an effective user collaboration dedicated platform.

These features will allow designers and engineers to use the platform to quickly generate a set of high-performance design options based on their specific constraints (like materials, weight, or manufacturing methods) and share observations, feedback and opinions. Furthermore, the cloud allows for rapid exploration of thousands of possible solutions in the design space allowing the engineers to consider and judge between the different options that best meet their needs.

6.4.3. T5.3 Collaborative VR/AR-based real time social manufacturing space (human interaction of MMCs)

In Task 5.3, the iPRODUCE VR/AR-based collaborative framework will provide to various stakeholders the possibility to collaborate, also at distance, for designing new products in a VR/AR environment, where each user will be able to make changes and share them at real-time to all involved parties.

This implies the need to use a variety of smart devices such as smartphones, tablets and smart helmets providing further information and knowledge to the workforce (e.g. practical information relevant to design).

In order to apply this, process-oriented technical and web-based training approaches have to be developed for the learning environment at the workplace, as well as a personalised lifelong and autonomous learning system tailored to the needs of the individual.

6.4.4. T5.4 Usable & Agile Data Analytics and Visualisation Suite

The Collaborative manufacturing approach allows the optimization of the use of shared resources, coordinating the usage of production machinery virtualising them through cloud services and managing them centrally. It is, therefore, possible to use resources, such as machines and software, on-demand, according to the needs and focusing the activities and the products to be developed also on the user feedback from social networks, surveys and advanced techniques such as sentiment analysis.

The Data analytics and visualization suite will provide all the technologies needed to make these types of analytics. In particular, this tool will be able to use data from the heterogeneous data sources identified in the study (e.g. social networks, direct user interaction, open data sources) as well as the new to be developed (marketplace, edge processing TPUs, etc.) and to offer a flexible, scalable and user-friendly toolset to perform adaptive AI-based algorithms to provide product, process, market and consumer insight.

The benchmarking questionnaire has shown how collaboration networks are spreading in Europe. In this context, advanced collaboration platforms such as the Opis platform that will be developed in iPRODUCE, managed in the cloud, can facilitate the interaction between different teams that can then share information related to the projects, solving all aspects related to technical and commercial feasibility exploiting the "data-driven nature" of the cloud.

Agile data analytics and visualization tool will therefore also enable management based on the paradigm of big data analytics allowing the celebration of all the flows related to the creation of a product in a single continuity solution. Digital support, in addition to making many processes more efficient, in fact, allows us to better follow the feedback from potential users and make new business easier. Using algorithms associated with data science and Artificial Intelligence, it is possible to cross-product and customer data to monitor the production and sales pipelines, also using forecasting techniques.

6.4.5. T5.5 Lifecycle Management, Recycling, Repurposing and Reusing

In this task, the techniques to reuse and reduce waste present in the State of the Art will be investigated in order to define the iPRODUCE approaches for Lifecycle Management, Recycling, Repurposing and Reusing.

The ecosystem structure implicitly identified in D2.3, opens the door to a complete Life Cycle Analysis Stream which will be deployed in this tasl: project mapping of local industries, raw material analysis, prospective value chains in order to value the project waste by reselling them, etc..

Furthermore, cMDFs managers will be trained about Lifecycle Management to allow them to consider recycling ideas and to produce with the best choice of material also exploiting the Opis platform to provide e-learning features.

6.4.6. T5.6 Collaborative Testing and Training

This task will deal essentially the organization of sessions for the testing of the products and the training about how these products are developed. To do this, the cMDFs will use agile methods assessing and developing the techniques defined in task T5.1.

As reported in the information from emerging spaces, making particular reference to the fabCafè in Barcelona, the creation of spaces to test ideas and see how they could be used (Assembly Container) can be very important for iPRODUCE cMDFs.

In particular, following the usual working process defined for the Barcelona fabCafè also in iPRODUCE the collaborative testing and training sessions will be based on the design of workshop formats, combining innovative elements from hackathons, science slams or product fairs.

In particular, it will execute public co-creation, prototyping, brainstorming or idea evaluation events in order to open the fablab scene to a broader public and to endorse communication between producer and consumer of a product. The collaboration sessions will feature user-centred design techniques for learning how to develop close to user needs and rapid prototyping sessions for iterative evaluation.

6.5. WP6: Social Media-Enriched Engagement Strategies for Makers and Consumer Communities

This work package focuses on defining the methodologies that will drive the engagement of makers and consumers for the establishment of the local ecosystems and MMCs communities as well as enhancing the community spirit and the participatory design processes of the project.

6.5.1. T6.1: Ecosystem Establishment and Engagement

Task 6.1 aims at mobilising the multi-stakeholder communities in the targeted areas around our local CMDFs. This task will provide methodologies for stimulating and managing the engagement, mainly, of maker and consumers communities but also of other relevant stakeholders (e.g. local business and industry communities).

The study shows that the spaces value the professional and business experience, so it is not strange to be able to draw a future scenario of interaction with manufacturers even with associations or groups of entrepreneurs with innovative initiative.

The use of common resources for the maker or fablabs spaces, to communicate with their users, and the arrangement in their spaces of areas where to carry out these actions, have allowed us to know from the study that it is not difficult to interact with users, propose training activities or pilot respect to CMDFs in order to obtain an initial commitment from typical consumers.

Since the task starts at M11 of the project, there has been no such activity in this task at the time of submitting this deliverable. Once this task kicks-off the initial activities will focus on identifying lead users in the iPRODUCE ecosystem that can help in building a collaborative manufacturing vision and driving the relevant communities towards realising this vision.

6.5.2. T6.2: Mobile App for Social Media-Enabled Consumers & Makers Feedback

There is an increasing amount of evidence indicating that using social media in product innovation can lead to leads to better product ideas, better requirements' identification, faster time to market, lower costs, etc. Task 6.2 aims to develop a mobile app for obtaining Voice of Customer feedback through which we can actively solicit input about new ideas, stress test existing ideas, etc., and passively obtain insights for recurring problems, needs and preferences, etc.

Social media is used and frequented by all of the spaces in Spain, Greece and France, while the Danish are those who least use social media (71.4%). E-mail is used above all in Spanish and French spaces, and least in Greece (66.6%). Denmark is the most regular user of communication by mobile phone (85.7%) while Germany uses it least. However, German spaces make significant use of databases to contact with their users, while Denmark is the country which most organises these functions internally (71.4%).

Since the task starts at M11 of the project, there has been no such activity in this task at the time of submitting this deliverable.

6.5.3. T6.3: Ambassador Programme for Early Adopters

One of the ways to activate and verify that the participatory design will work with users will be to search for early adopters, based on profiles that already normally intervene in this type of space, as the study indicates. With this CMDF pilot we will be able to attract other user communities interested in participating in the design and manufacture of consumer goods.

Directly in line with our stakeholder engagement strategies for each pilot site as well as with our market research activities (Task 2.1), the iPRODUCE Ambassador Programme for Early Adopters will be designed with a view to identify early adopters of our MMCs communities' concept and products and encourage and incentivize for becoming our ambassadors. The iPRODUCE Ambassador program will be launched in M18.

6.5.4. T6.4: Open Competitions on Consumer Products Innovation Challenges

The concept of building Open Competitions is to:

- To engage iPRODUCE stakeholders in the identification and definition of challenges
- To attract different stakeholders and engage these in Open competitions
- Organize at least two online competitions and one hackathon

The type of competitions to be deployed will be associated with the phase of development of the project and the various challenges will be faced. The competitions can be of different nature: Online Challenges, Bootcamps, Hackathons and side events (of international one).

Some challenges previously used in the domain are:

"2017. Fundación Orange's Breakers won the Jury's Prize at the I Make 4 My City International Challenge, a competition that brings young people into contact with digital manufacturing and innovation, offering them the opportunity to create digital solutions as a contribution to the cities of the future:

http://www.fundacionorange.es/reto-imake4mycity-sport-for-all/"

"2018. A group of Breakers were finalists in the I Make 4 My City International Challenge 2018-2019, participating in the presentation of projects in Paris:

http://www.fundacionorange.es/international-challenge-imake4mycity/"

This task and the open competition on consumer products innovation challenges kicks off from M16 of the project.

6.6. WP7: iPRODUCE Sharing Economy Business Models and Execution

Many of the forms that the iPRODUCE project conceptually incorporates are already commonly processes used in fablabs and makerspaces. In the study we have highlighted who the stakeholders are, the existing community approaches, the relevant policies, the technological solutions in place and other factors that influence the promotion and adoption of the social manufacturing framework and platform that is pursued.

This work package focuses on the development of novel business models and IPR management strategies that can promote multi-stakeholder interactions as well as the uptake of the iPRODUCE outcomes in business contexts. The tasks in this work package perform the market analysis to identify the markets that are addressed in iPRODUCE, followed by the development of relevant business models that can promote the commercialisation aspects of iPRODUCE platform and associated offerings. A parallel activity focuses on IPR management to ensure that the interests of different stakeholders are preserved in the social manufacturing activities.

6.6.1. T7.1: Analysis of Market Trends and Practices in Collaboration

This task provides an overview of the market trends and practices dealing with collaborative production across Europe and internationally. The activities in this task start with a thorough review of best co-creation practices and case-studies within the industry, regarding consumer driven customisation and prosumerism.

Many of the elements that the iPRODUCE project conceptually incorporates are already common processes used in fablabs and makerspaces. In the study we have highlighted who the stakeholders are, the existing community approaches, the relevant policies, the technological solutions in place and other factors that influence the promotion and adoption of the social manufacturing framework and platform that is pursued.

This task will base on the identified elements and go further the commonly used processes, relevant stakeholders, existing community approaches, relevant policies, suitable technology solutions and other factors that influence on the promotion and adoption of the social manufacturing framework and platform developed in the iPRODUCE project.

The task started recently (at M7) with the initiation of studies on the above aspects, which will be shared with the project partners through the task duration. This participatory approach will improve the uptake and adoption of iPRODUCE outcomes and development of a common agreement on the target markets and relevant practices.

6.6.2. T7.2: Business Models and Case Development for iPRODUCE CMDFs

This task builds on the market analysis (from T7.1) to develop cases and business models that can help the cMDFs to focus on consumer driven design and production strategies and to promote the project outcomes in business contexts.

As an starting point the benchmarking study has shown that the model of work and interactions with users is sufficiently innovative and responds to a trend marked by the open and collaborative nature of its activities. We understand that this connection between its members will facilitate the introduction of the CMDFs of these elements and co-design practice

The business modelling activity will be performed using established techniques such as the use of Business Model Canvas that is used to gain insight into the value proposition, infrastructure, customers, and finances. This task starts at a later stage in the project (M13) after the initial market analysis is available from T7.1.

6.6.3. T7.3 IPR and Transaction Management Strategies and Automation

The D2.3 benchmarking study shows that the management of intellectual property rights and the limits of the different actors, especially when theres is industrial and / or commercial exploitation of a result, is one of the highlighted aspects that must be necessary to specify and clarify. This situation does not occur in the spaces studied, so we are faced with a situation that will have to be resolved.

This task develops the intellectual property management strategies and transaction management rules to assist in the operations and dynamics of the collaborative and social manufacturing activities. Owing to the specific (collaborative) nature of social manufacturing activities, open and incentive based IPR management strategies will be considered in this task to prevent any bottlenecks that may derail co-creation activities. The use of technology solutions is also envisioned in this task e.g. a visual authoring tool is being considered to provide a simple and comprehensive interface to define and examine the terms of Ricardian Contracts for simple, but yet important, design thinking/ co-creation processes. Since the task starts at a later stage in the project (M10), the initial work focusing on the study of relevant techniques and tools that can be adopted/implemented when this task formally starts.

6.7. WP8: iPRODUCE Integrated Social Manufacturing Space

To plan the CMDFs, the state of the art has provided essential information regarding the technologies (software and hardware) available in these spaces, services, clients and agents involved in each makerspace or fablab, their needs and requirements and how the communication with clients and users is. These factors will be taken into account and used to foresee the way in which each CMDF will integrate the tools proposed in iPRODUCE, the interconnection network of each center and the training of the local ecosystem.

This WP deals with

- To integrate and interconnect iPRODUCE technological and operational infrastructure and tools and establish operational readiness on behalf of the project consortium (before the pilot demonstrations start)
- To deliver OpIS by integrating the core services of the digital platform, the co-creation enabling tools, the training toolkit, the social engagement app and the IPR & transactions management automation framework.
- To configure the local instances of OpIS on the basis of each cMDF characteristics and interconnect them to establish the federated network.
- To plan and execute thorough testing of the integrated solution, while familiarizing/ training users with the operation of the overall solution.

Therefore, the D2.3 since determines all the necessary information about the technologies (software and hardware) available in these spaces, services, clients and agents involved in each business, their needs and requirements, examining also and how communication with clients and users takes place, and the technical and human resources at their disposal will be taken into account and used to envisage on how the OpIS will integrate the iPRODUCE software toolkits.

6.7.1. Operational Integration and Acceptance Testing of iPRODUCE Platform

The aim of this task is to integrate all various IT modules developed within iPRODUCE project, into a unified, interoperable and efficient iPRODUCE framework that will take the form of OPiS. This framework, during this task, will encompass the design and development of a diverse set of technologies with different specifications, requirements and developing methodologies, at each individual Task.

The Benchmarking study has provided essential information regarding the technologies (software and hardware) available in these spaces -including cMDFs-, the services, the clients and the agents involved in each makerspace or fablab, their needs and requirements and how the communication with clients and users is. These factors will be taken into account and used to foresee the way in which each CMDF will integrate the tools proposed in iPRODUCE, the interconnection network of each center and the training of the local ecosystem.

6.7.2. Installation of Local Hubs and Interconnection of cMDFs

T8.2 task will configure and install instances of the OpIS into the local cMDFs taken into consideration that the latter comprise of locally dispersed physical space and production facilities. The successful execution of this task will require the close collaboration between the technology providers with the relevant local hubs (of the cMDFs).

6.7.3. Collaborative Testing and Training of Local Communities

This task will be responsible for developing a detailed plan and methodology for testing the iPRODUCE framework at local communities' level. Partners will take into account all the services and functionalities provided by iPRODUCE, which will be tested according to the developed methodology. All the iPRODUCE use-cases related to local communities will be thoroughly tested in this task. Furthermore, T8.3 will provide all the necessary training services for local ecosystems and communities.

6.8. WP9: Validation, Demonstration & Evaluation of the iPRODUCE Social Manufacturing Space

WP9 is focused on the validation, demonstration, and evaluation of the iPRODUCE social manufacturing space and how to apply it to the different cMDFs from each of the different countries, reporting later the results of the analysis. It focuses on the definition and implementation of the evaluation framework for the validation and demonstration of the iPRODUCE solution in the six cMDF, each of them with a series of defined use cases. In particular, the evaluation methodology and the corresponding plan and metrics will be defined with the aims to validate core horizontal functionalities and co-creation tools of OpIS platform and offer the iPRODUCE co-creation (support & coaching) services to the MMC teams. These MMC teams are the key stakeholders whose needs will be addressed in each of the corresponding cMDFs through the validation of the different OpIS technologies..

In addition, WP9 will demonstrate the value of the federated network of local ecosystems and cMDFs, evaluating the results of the pilots and assessing the impact of iPRODUCE Social Manufacturing Framework into the innovation performance of local innovation ecosystems. The iPRODUCE

Evaluation Framework provides the procedures to be followed in order to gather the evaluation data throughout the project in the scope of the Social Manufacturing Space

6.8.1. T9.1 Validation, Demonstration and Evaluation Methodology, Plan and Metrics

This task will deal with defining the evaluation methodology for the validation of the different technologies with the Digital Open Innovation Space for Social Manufacturing (OpIS) offerings at the six project established cMDFs , along with the respective time / action plan. In particular, the practices for use cases analysis will be investigated to plan verification and validation of the Opls platform identifying tools and instruments for User Engagement in the validation process with the aim to facilitate user acceptance of the products.

For this aspect, the most cited models in literature for the evaluation of user satisfaction and user acceptance will be investigated. In particular, the Technology Acceptance Model (TAM) developed by Davis[13] will be deepened.

The benchmarking study information provides indicators to previously determine the evaluation of the preliminary validation activities of the CMDF model (from the user profiles, the type of project ... to the types of service or the technology used in each case). This validation will be carried out by each local pilot (the study has identified different situations by country that can facilitate this data) and the pilot work model with users will serve as a guide to provide information throughout the experiences while the tools are tested..

6.8.2. T9.2 Validation of the Digital Platform and Co-creation Tools

This is the task where the application of the methodology and therefore, the evaluation of all the different OpIS tools occur. Creative techniques for the resolution of problems related to the usability of the iPRODUCE platform at a technical level will be adopted to identify the aspects related to the management, understanding of the process and method of realization and the validation of all the functionalities expected by the platform.

Therefore, the relevance of the applied co-creation methodologies, the usefulness of each tool, as well as the value that the iPRODUCE framework brings to each CMDF and to the local ecosystem in general will be evaluated.

Once defined indicators and evaluation methodologies following the basis of the experiences detected, there will be no major influence of the conclusions of the study in tasks 9.3, 9.4 9.5 and 9.6.

6.8.3. T9.3 iPRODUCE innovation services to MMCs

This task main goal is to enable the application of the iPRODUCE pilots while guaranteeing that the necessary conditions are established with the MMCs for an effective result of the demonstrations. T9.3 will deal with the realisation of the Use cases for the OpIS platform validation in the six cMDFs environments confirming that the necessary conditions and maturity are established within the MMC

[13] Davis, F. D. (1993). User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. International journal of man-machine studies, 38(3), 475-487.

communities for a successful outcome of the demonstrations. To this end, coaching and support services will be provided to the teams that will work on the OI missions/challenges under the pilots.

6.8.4. T9.4 Realisation of Local CMDF Pilots and Open Innovation Missions

T9.4 will implement the iPRODUCE pilots. The MMC communities will work under 'controlled' conditions on consumer product innovation related challenges. Each local cMDF will run individually the iPRODUCE platform. Business model validation preliminary activities will also be performed per pilot. Users will be requested to provide feedback (as OI missions will advance) on the overall user experience while testing the tools, the relevance of the co-creation methodologies applied, on the usefulness of each tool, as well as on the value provided by the iPRODUCE framework to each OI mission and the local ecosystem overall.

6.8.5. T9.5 Demonstration of the Federated Network of CMDFs and Business Model Validation

T9.5 will focus on the validation of the federated solution of iPRODUCE (that is the network of local cMDFs) by using the following tools: knowledge extraction, resource and knowledge sharing, security and privacy mechanisms, data/ service interoperability, marketplace (requests and offers, product listings, cMDs profiles).

The business model, values, strategies, access conditions and the adaptation of the spaces, as well as their business potential will be deepened in order to validate the whole intervention methodology of the iPRODUCE project.

6.8.6. T9.6 Pilots Evaluation and Socio-economic Assessment

T9.6 will process and analyze all the feedback collected by pilots and iPRODUCE main users. The evaluation will concern: the performance/validity of the project's Social Manufacturing Framework; the operational effectiveness of local DMCs; the performance of the individual OI missions/teams; the performance of each OpIS method, tool, service and platform in general; user satisfaction paying special emphasis in the UX, creation of perceived value, perceived feasibility of the proposed framework; evaluation of training material and activities. iPRODUCE's agile analysis toolkit will also provide data inputs for the evaluation process, as well as relevant visual analyzes.

7. Main Outcomes of the Study

7.1. Regarding the Current Situation

7.1.1. Organisational model

As a conclusion, the configuration of the organisations on which these spaces depend is very diverse, although the majority operate as small and medium-sized enterprises, followed by those which are dependent on professional or business associations, and those which are managed by or have personnel from universities. There is also a significant number which are NGOs or come under the umbrella of not-for-profit associations or foundations.

Their presence in networks, especially international networks, is very significant, and these networks are related above all with digital manufacture, especially with 3-D printing systems and DIY culture.

Promoted or created mainly over the last decade, the organisations are very young. As most are companies, they are fully involved in commercial activity, though a significant number have yet to become active.

7.1.2. Values and Strategies

To summarise the section on values and strategies, the results show the following:

The spaces have core values, such as technological empowerment (in 86.3% of the cases), since the purpose is that the persons participating in or visiting these spaces can have access to and learn the technology required to develop ideas and projects. In line with this, other values are self-learning, found in 68.1% of the spaces, and open hardware-design, in 65%.

Other complementary values found in the spaces are digital inclusion, which enhances empowerment and the self-learning process, in 70.4% of the spaces. Other important values are urban innovation (in almost 60%) and the circular economy (in 56.8%).

These values are conveyed through different channels, but the most important overall is the organisation of workshops and courses, which are run in 81.8% of European spaces. This is followed by transmission through collaborative management and the (maker) manner in which participants work in the spaces, and through the promotion of free technological support.

The in-person working model in the spaces is practically universal, as can be seen all over Europe. Even so, online experience is now very widespread, and both modes are combined in 75% of the spaces. Only 22.7% have exclusively in-person activities without any online experiences (we understand that this was also the case before the effects of the pandemic).

Some spaces have restrictions on access (34.09%), while others have no access conditions (22.73%). Among the spaces where this is found, 29.5% are public spaces with high attendance capacity.

Of the European spaces, 45.4% consider that they are fully adapted and prepared to attend to their public. However, 43.1% believe that although they offer services, they are not fully prepared technologically and organisationally to attend fully to their users.

The scope of action or influence is normally municipal (68.1%) or regional (61.3%). A significant percentage declares that they have relationships with Europe (36.3%) and, in over 34% of the cases, internationally.

The most frequent activities undertaken in European spaces, according to users, are professional or business projects related to prototype construction (a ratio of 2.98), followed by personal initiatives or projects, with a ratio of 2.70 of the activities recorded.

These spaces are most used by designers (68.1%), followed by 'inventors' (63.6% with enterprising and ingenious persons without specific or defined qualifications), and students (61.3%).

With respect to the type of project undertaken in European fablabs and makerspaces, the most frequent are related to product and object design (70.4%), followed by electronics (59%), and training of both children/young people and of adults (both with 56.8%).

7.1.3. Collaboration and Funding

To conclude this point, the European spaces surveyed work for different types of organisation, with 84.09% collaborating with (non-educational) public institutions and, at 75% each, with companies and individual persons. It is, therefore, a business model that works extensively and habitually with companies, and also with individual users, either as professionals, students or enthusiasts. There is an effective, ongoing relationship with the different local, regional, national and European institutions.

From the results obtained, to define the model of European spaces, we believe that it is relevant that half of the spaces surveyed do not receive any kind of support and rely, above all, on their own resources. As they belong to networks, 54.4% of European spaces do recognise that they are subcontracted or participate as partners and they receive or have received support from public institutions.

Therefore, the four pillars on which the business of these spaces usually rests (as shown by at least 43.1% of the sample), are: the performance of projects with public funding, income generated from prototyping services, R&D services for companies and running different training activities.

Finally, the results with respect to investments are clear, with almost all of the spaces devoting their profits to the maintenance of the space and of their technology, in 93.1% of the cases, and the acquisition of machinery or technology (86.3%).

7.1.4. Internal composition

To conclude in this area, according to the data obtained, we can say that most of the spaces (54.5%) have teams of between one and ten persons, as if they were micro-SMEs, and 31.8% of the total are organisations with less than 50 workers, (considered in Europe to be an SME). They are small structures defined as micro-enterprises or small enterprises. The decision-making teams usually consist of two or three persons (the survey shows that in 68.1% of cases, decisions are taken by one to five persons). The gender divide is clearly visible in European spaces in general, and the presence of women in these organisations amounts to 28.4%, on average, among all the spaces.

The members of these teams are, in 61.5% of cases, university graduates, they are adults (52.4%), and the most highly developed soft skills are creativity (88.6%) and teamwork (72.7%). The teams have training in fields related to innovation (75%), where the members (43.1%) receive initial training or informal guidance (in 40.9% of the spaces).

7.1.5. Communication

With respect to communication, we have seen that perhaps one of the most significant weaknesses found in this study is that many spaces do not have a single person dedicated to communication (47%) and if they do, most are not specialised (25%). Even so, communication resources are available, especially by means of digital tools (used by 65.9%)

European spaces usually update their information and document their work monthly (29.5%) or weekly (20.4%), and the same occurs with the frequency with which they update their website (22.7% and 20.4%, respectively).

Their presence in the media is mainly through interviews (79.5%), and news or current affairs reports in both the written and digital press (63.6%).

To conclude this section, the usual resources for communication with users of the spaces are social networks (90.9%) and e-mail (88.6%).

7.1.6. Technology

In view of the results of the survey overall, it can be said that European spaces, taken together, have the following characteristics:

The most widely used software is 2-D and 3-D design programs (84.5%), whose results can then be used with digital machinery. Thanks to manufacturing software (72.2%), which prepares these files, plus the machine programs, it is possible to develop whatever elements and prototypes we wish. This technology is available in all of the European spaces.

Thirdly, and no less importantly, there is the software to programme and develop electromechanical and computer applications, which is often decisive if the space is clearly oriented or specialised in these fields. This software is found in 57.6% of the spaces.

Finally, the most commonly used software is open or commercial programs, such as those for data processing or administration, or for making presentations. Their use is below average, though data processing software is still significant (used in 45.3% of makerspaces).

As regards hardware and technical equipment, three-dimensional printing systems are the most common technology, at 85%, and many spaces (68.3%) have more than two 3-D printers.

The next most widely-used technology in the spaces is laser cutting and engraving equipment, which is found in 76% of the total. This is followed by medium or large CNC milling machines, found in 67.2% of the spaces, with small milling machines in 64.7%. Closely following are 3-D scanning systems, installed in 63.5% of the spaces in Europe.

The next most common equipment in European makerspaces and fablabs are electronic devices, in a total of 60.4% of spaces, and vinyl cutters and plotters which are to be found in 55.9% of the spaces.

These are followed by sewing and embroidering machines, found in 52.5% of the spaces. Some of them could be said to be the most important of the main non-digital items of equipment. The next in the list are virtual and augmented reality devices, which are used in half of the European spaces, with 51.7% having these systems.

Other items of equipment are used in fewer organisations, such as traditional printing plotters, which are found in 45.7% of the spaces, and thermoforming systems, in 44.4% of the makerspaces surveyed.

Trailing far behind these systems are CNC metal cutting devices, which are used in 19.4% of the cases. These are systems which can be more costly, requiring greater space, and metal is not a priority material. To these digital metal cutting systems, we must add metrology devices, which scored lowest of all, with 18.5%, perhaps for reasons of cost or functions which cannot be undertaken in these spaces, unless they are more specialised.

By country, the features are broadly as follows:

For software, France matches the pattern and the ratios found at the European level.

It is in second or third place with respect to the use of lasers in its spaces, but this is not the case with medium and large CNC milling systems, where the country is below average, in last place (43% below the European average, with 67.2%). Together with Spain, it is the country in which all of the spaces have 3-D printers, and in contrast, with respect to thermoforming systems, it is in last place, with only 14% of the spaces equipped with this technology. It is also significant that it is the country with the second fewest virtual reality or augmented reality devices, after Germany, although it is the country with the second highest number of devices per space (43%). With respect to complementary equipment, France is above the European average, especially in electronic resources.

According to the survey, Greece is close to the European average for software, except in programming. It should be highlighted that, in general terms, it is the country with the greatest deficit of resources in its spaces, and has no CNC metal cutting equipment or any kind of metrology devices. It is true, though, that these are not the types of equipment that are used mostly in Europe as a whole, but the results with respect to 3-D printing (where 77% do not have any equipment at all), sewing or embroidering machines (only 17% have this type of equipment), and even electronic devices (67% do not have these resources), are below average. There is a greater number of virtual reality and augmented reality devices, where the country is close to the European average. Half of the spaces surveyed have one or two lasers. The situation is similar with regard to both medium-large and small milling machines. Although they lack machinery, the Greek spaces have basic electronic equipment in most of their facilities.

In Germany, the spaces are equipped with software, especially design software, though the levels are similar to the European average, except for presentations, which are very widely used in German spaces (83.3%). As regards machinery, it is notable that all of the spaces are equipped with lasers and it is the only country that can make this claim in the entire survey. It is also notable that half of them have two lasers. A similar situation is seen with respect to the number of medium or large milling machines, which are installed in all of the spaces, and it is also the only country in Europe where this is so. Regarding 3-D printing, it is notable that all of the spaces surveyed have more than two printers on their premises (83%, above the European rate of 68.3%). Half of the spaces have thermoforming equipment, and 17% have two. Together with Greece, it is the country with fewest 3-D scanning systems. Of the German spaces, 67% have more than two sewing or embroidering machines, and it is the country with most VR/AR resources in Europe, 83% of its spaces being equipped with these systems (and 50% of them have more than two devices). They are also in a leading position with respect to mechanical tools and materials in all of their spaces, enabling them to undertake any work.

Denmark, with France and Spain, returns the best data for the implementation of software, coming above the European average in all cases, especially in 2-D and 3-D design. There is a high percentage of data software use with respect to the European average, at 85.7% (the same level as manufacturing software). It is the country with fewest cutting-engraving lasers (possessed by only 43% of the spaces), in comparison with other cases such as Germany and Spain, and it is also the country which least uses small milling machines (in less than 43% of the spaces). In contrast, the figures are better for medium-large milling machines (though still behind Germany and Spain, with 71%). In the case of 3-D printing, it is the second country for the use of these systems, with more than two being used in 72% of the spaces. It is striking that it is the country with most sewing or embroidery machines in Europe (86%, compared with a European average of 52.5%). With respect to electronic devices and virtual reality equipment, though, there is a significant technological deficit, and in the case of the latter, it is used in only 14% of cases. In contrast, together with Spain, it has the best equipped facilities in mechanical, electronic and painting resources.

Italy is more predisposed to programming software (71.4%), together with Spain. Also with Spain, it is the second country in the number of lasers in the spaces (57%) and, with France and after Germany, with two lasers, found in 29% of Italian spaces. However, together with Greece, 43% of the spaces still lack a medium or large milling machine and 29% do not have 3-D printers, while 14% of the spaces have a CNC metal cutting system (spaces with more than two of these systems also score 14%). After Spain, it is the country with the second highest number of small milling machines and, with France, it has the fewest vinyl cutters. More than two plotter printing systems are found in 28% of the spaces, and a significant number of spaces have one (43%) or more (28%) 3-D scanners. Together with Denmark, there is an above average number of spaces with sewing or embroidering machines (57%). There are more than two electronic devices in 29% of the spaces and also more than two virtual or augmented reality devices in 57% of the sample.

Finally, Spain has 2-D or 3-D design software in all of its spaces, as well as manufacturing software (more than the rest of the countries), and a very high number of makerspaces that use programming software (90.9%, also more than the rest of the countries). It has the highest percentage of presentation software use (some distance above the rest, with 63.6%). There are a considerable number of lasers, since 73% have at least one laser, and in only 9% of the sample there were none (only Germany exceeds these figures among all of the countries with at least one laser in each space). The same situation is repeated with milling machines (70% of spaces have one, and there are 88 medium or large milling machines in the country); only Germany has more. The number of spaces with more than two 3-D printers is relevant, as it suggests that there is backing for this type of technology. However, as in Greece, there is no CNC metal cutting system. With respect to the number of small milling machines, the percentage is the highest in Europe (73% of spaces have at least one), and thermoforming systems can be found in 46% of the spaces (which means that there are 54 of these systems in the spaces surveyed, an average which is only surpassed by Denmark). The number of 3-D scanning systems with respect to Europe should be noted (there were 112 in 11 spaces, representing 82% of the country), electronic devices (only 9% do not have them), and in the number of virtual or augmented reality systems (37% still do not have this equipment), a figure exceeded only in Germany. Lastly, the spaces have shown little interest for metrology equipment, with only 9% of the spaces having these systems available

7.2. Regarding future and economic and social demand for the most significant activities.

We should note that the study has been affected by the COVID19 pandemic and, in many cases, there is a before and after situation regarding the expectations that might be held of these spaces in the future, in terms of both the economic (business) and the social impact. In this section of the conclusions, we shall attempt to define the keys that may help us to understand the future of most of these spaces:

Prototyping and co-working are two of the services which have formed a significant part of the service portfolio. They will continue to add value to these spaces, and the spaces will continue to offer the services to entrepreneurs, as stated by Nuria Robles, the director of FabLab León, when referring to a transfrontier cooperation programme between León and Beira Interior (Portugal), under the Interreg V A (POCTEP) Programme - 2014-2020:

"We have also participated in ideas competitions here, promoted in León, financed by European Interreg funds, with Portugal, selecting six entrepreneurs, of whom three had been working with the fablab; they reached the final, and that is our experience."

With respect to training and other transfer activities, there is an important reflection to be made on in-person training, which is sometimes offered in combination with online training. In this case, all of the organisations are examining, if they have not already done so, how best to organise secure access, in order to work with the machinery and participate in the activities. In-person activity still gives meaning to these spaces, which promote the use of materials and components and also their transformation using different devices, and this is mainly thanks to the collaborative working methodology, promoting the "Do it Together" philosophy. Another positive aspect is that, during the adaptation period, these spaces can be digitally prepared so as to improve the attention given to the user, as they are not sufficiently prepared in this respect. In the well-grounded words of César García, one of the founder members of Makespace Madrid and an outstanding international figure in the field:

"We must see within one year ***how to organise in-person activities****. There are some things which are not optimal, there's nothing in common between an organised room for 'teamwork' where we meet and the possibilities of places with little collaboration. But it is true that at Makespace we are seeing the* ***digitalisation of aspects of the space*** *(membership, hire of machinery, task planning…). We must facilitate these processes for organising, invoicing, etc…, which are operations that make the process profitable both today and tomorrow."*

With respect to the digital gender divide, women, young women and children are also called on to take a more prominent role in the future. Women are definitively called on to become directors and to hold responsibility in technological companies and, therefore, to become the future.

The focus groups agreed that one of the key future tendencies would be the specialisation of the spaces, which is essential. This thematic or sectoral specialisation (either through architecture, design, modelling, textiles or entrepreneurship, among others), as was also stated by César García, will depend on the areas of influence of the spaces (in the cities, depending on the local business sectors, etc.), and all of the makerspaces and fablabs will have to be differentiated. Many of the participants in the focus groups were also of the opinion that the training must offer "niche (specialised) content, such as bio-inspiration, programming courses for the creation of ventilators, etc". With respect to how the spaces are designed today, the training must evolve, because low-cost content (advertised on social media) or high-level content (master's, technical or university studies) are not competitive due to the high demand.

Another of the positive aspects of most of the spaces is that, overall, and as a network, they should be able to take advantage of the visibility that these spaces have had, with the development of different PPE items during the difficult moments of the pandemic. In this regard, Delia, Director of FabLab Cuenca, who has long experience of digital manufacturing in Northern Ireland, spoke of the repercussion of the work of all of the organisations worldwide, and specifically of theirs, which had had an important role in the region of Castilla-La Mancha:

"We have been very closely involved with the pandemic, through the Coronavirus Maker citizens' activities, an initiative which, with a lot of hard work, we have led locally".

The same as been seen in other countries, where the involvement of these spaces gave important support to the communities and other volunteers involved in different actions, as Salim Deeb, co-founder of MakerSpace Bonn, explained to us:

"We started Maker gegen Corona (makers against corona) and connected with a much wider national and international community. We made lots of new contacts. Several Communities joined together. We got help from bike enthusiasts and our local critical mass group who offered to distribute face masks, shields and other equipment by bike in town."

Juan Carlos Cano, one of the coordinators of Asociación Xtreme, who works in rural areas of south-west Spain, asserts that there are other questions that we should address, such as micro-lab strategies in small, local contexts, where there are not enough maker or inventor communities:

"(…) there are small spaces where it seems that everything is lost so we have to try to find opportunities, and we have set up 15 ***mini-laboratories*** *already. With this Coronavirus situation, these small towns have seen how they had small factories and with Covid, micro-local activity has reawakened, and they realise that with an Arduino and a printer, they can do a lot, in a small space, in a room in the Town Hall… That's the way they're going."*

Furthermore, the presence of an itinerant platform (such as a mobile fablab) with a philosophy like the maker and fablab spaces, could be a future or complementary answer to the in-person format, if we think of the existing demand. Another solution which has not been attempted, but which has been proposed, and in this case it is being trialled by Juan Carlos Pérez, the Manager of FabLab Sevilla, which is part of the School of Architecture of the University of Seville, is the loan of machinery and devices, just as in a library, so that people can use them for a time in their houses.

While harbouring a certain hope, the spaces are also relatively concerned about the effects of lockdown and the type of model they might be able to achieve, in order to find an appropriate balance of resources and attention to the user. In this regard, Nuria Robles underlines that:

"For us, in-person activities are important, it is the magic of 'hands-on', where people practice together, share. I don't see a promising future for this, unless it is in a co-working space where we can guarantee a hygienic space for all of the team. The situation is worrying."

But, however, in the middle of this situation, new scenarios appear which had not been seen before, and as the CEO of Fab the Fab, and also the person responsible for the FabLab at the Francisco de Vitoria University, Fabricio Santos, says:

"We realised that during the pandemic, we had not found any direct clients, but we had received consultations from Mexico, Colombia, the United Kingdom… they asked us what we could do… And we realised that we could work in anything from the field of bio-printing to concrete extrusion. I think that there are some misunderstandings, because a maker is not just a person with a printer, but we've got the visibility that we needed."

In this regard, one of our partners in iPRODUCE, MakerSpace Bonn, which has been part of the world maker movement which has addressed the effect of the pandemic, believes that this distributed way of working has allowed us to 'combat' the PPE supply problem efficiently, which in a way certifies the effectiveness of the response of these spaces and justifies the support that they should receive from the administration:

"We realized that local rapid prototyping and rapid production capabilities will be needed and fostered financially by official institutions. It was quite obvious that the global supply chain can break down easily and goods need to be made available locally."

One way or another, and on the basis of the SWOT analysis by Lena and García (2016) mentioned in the first chapter of this study, we have completed the analysis by adding and removing aspects that have not been highlighted or detected in our study, and which are shown in the grey zone of each field. The rest of the aspects have basically been extracted from the conclusions described and which give a picture of the current status of European spaces. With these aspects, any new space (such as the CMDFs in the iPRODUCE project) or existing space can or will be able to improve its strategic skills, evaluate its current situation and redesign its business model:

STRENGTHS	WEAKNESSES
Allow access to the Open culture. Bring technology to young people. Generate a technology-centred community. Facilitate access to digital creation and production. Collaborate with multiple groups and associations. Form part of different networks, especially international networks. Run several joint programmes with other organisations. Bring the Maker world into their area of influence. Offer a space for creation.	Obtaining the necessary funding. Improvement or acquisition of machinery. Constructing an appropriate ecosystem. Expanding the space available in the facilities. Economic sustainability. Documenting projects adequately. Maintaining the Open culture. Attracting more users and increasing participation. Generating an adequate business model.
Significant presence on social media. Access to 2-D and 3-D software. Frequent media appearances. Teams made up of highly-qualified technology graduates. Decision-making does not obstruct the activity. The prototyping services work well. They have their own funding resources. Work with companies and professionals. Designers are the main clients. Business models with mature persons. Very active organisations.	Lack of persons dedicated to communication. Little metal-cutting technology. No strategic investments made. Not specialising or seeking new training niches. Dependency on public funding in many cases. Belief that the spaces are not sufficiently prepared. Making online and in-person activities compatible. Processes not digitalised. Lack of (non-technological) tools to facilitate

Fairly specialised users.	innovation.
THREATS	**OPPORTUNITIES**
Lack of a sustainable business model. Geographical location or poor access. Lack of innovation culture. Funding and sustainability difficulties. Lack of appropriate space. Lack of new ideas. Poor comprehension of the FabLab or Makerspace concept. Loss of support from the institutions. Supplies and specific products. Lack of connection with other spaces. Lack of infrastructure for projects. Lack of the necessary personnel.	Location close to universities. Collaboration with multiple organisations. Collaboration with other bodies to spread the Maker culture. Location in a company incubator. High capacity of the teams and projects. Great innovative ideas (source of innovation). Highly versatile (thanks to multi-disciplinary work). Being the first in the area of influence. Taking advantage of the visibility of the Maker movement (as a result of Covid). Being part of an institution with numerous users.
Dependence of investments on salaries, rent, maintenance and acquisition of new machinery. Dependence of projects on public funds. Dependence on the same training programme. Failure to take advantage in the future of the current relationship with the students. Organisational difficulties in attending to users. Very young business models. Lack of specialisation (in a specific area or sector). Not being open to other future possibilities. Not maximising the adaptation of their facilities.	3-D printing as a step towards additive manufacturing (industry 4.0). Small, well-equipped production centres. Increasing availability of VR equipment. Equipped with electronic devices. Teams that enhance creativity. Small units allow greater flexibility. Contribution of know-how to R&D services. In contact with the institutions. Increasing number of in-person activities in different disciplines. Innovative model despite recent creation. The spaces have different types of business model. Continue strengthening and taking advantage of their network relationships.

Table 3. iPRODUCE Benchmarking Study SWOT

7.3. On the validation of the initial research hypothesis

Together, the spaces surveyed enable an exchange of knowledge, since they apply "Do It with Others" (Lallement, 2015; Morel & Le Roux, 2016) or "Do it Together" between disciplines and users, promoting collaboration and teamwork. However, the CMDFs can be distinguished (increasing their value), including connection and co-design with consumers, and all that entails.

Their collaborative working methodology in a way enables and validates these meetings between makers, manufacturers and consumers, either because work is already being done with companies, and they are the main client, and in a more specific sense, work is being done with users, who intervene by making or constructing their objects with skills they had learned or which they acquired in these spaces.

The spaces surveyed have shown us that both makerspaces and fablabs are valid reference points which, as reinforced, strategically-positioned business models, could become local, accessible drivers of co-design initiatives and they could be a source of innovation in a collaborative environment that is attractive to the different agents involved in the process under study (consumers or users, makers and manufacturers at different levels). These initiatives allow the development of consumer products to be widened and complemented and, furthermore, they also allow the introduction of one or more production models oriented towards open innovation, leading to the development of new proposals with a highly circular content, which is today essential.

The survey and its results have shown us the answers that can be provided by the social and productive philosophy that surrounds the European fablab and makerspace models, and this information will allow regional CMDFs and the network as a whole to identify the ideal model to introduce into companies, with the value chain or cycle that is necessary for optimal operation with SMEs producing consumer goods.

We have seen that some spaces lack the resources available to the industry, but they are used to working for companies. The companies, in turn, do not have the 'laboratory' resources of the spaces that are necessary to prototype and validate their products. Their situation, with respect to the possibility of prototyping, can be strengthened by the CMDFs, which can provide companies with a model of collaboration with the makers and co-design with potential users.

In addition to prototyping or laboratory technologies, we have observed that physical prototypes are not the only response that can be provided in the development of a product. The use of technologies such as Virtual or Augmented Reality are widely used in these spaces, and the presence of future users is not out of context, at least in the case of those who learn the technologies for their benefit.

Finally, the work done with the experts (in two focus groups) has provided many more details which allow us to conclude that the research into CMDFs makes even more sense if we are to achieve these new objectives, both through the necessary specialisation and the collaborative approach of the different agents who are expected to participate.

8. Conclusions

There are new opportunities (niches) of innovation and approaches to the business and professional sector can be generated around the new technologies and specifically in the activities of the spaces of creation and digital manufacture that we have studied, This synergy could allow, in the case of consumer goods companies, to have a partner whom to get closer with to the consumer to validate proposals or recognize their needs, to develop a new product or service possibilities by introducing technology, or to facilitate and improve the design and product development processes, co-designing with professionals, makers and/or users.

The objective of this study will allow us to validate the methodology of the intervention of the iPRODUCE project, aimed at the future implementation of CMDFs, based on the knowledge obtained from the sector and from the spaces of digital creation and manufacturing, around the existing models of FabLabs in Europe, makerspaces or hackerspaces, which allow the project partnership to justify the new opportunities for connection between the maker activity and companies (of consumer products), generated by the sustained growth of these spaces and their potential development. For this purpose, it has been interested in knowing the business model, its values, strategies, the conditions of access and adaptation of these spaces, as well as their potential as a business.

From the sampling and the results obtained, we have obtained answers from the productive and social philosophy that involves the European fablab or makerspace models, and with this information we can allow the regional CMDFs and the network, to see which is the appropriate model to be introduced in the companies or the cycle of values for the best operation of the small and medium companies of consumer products. These would be the most important points:

1. Apart from prototyping or laboratory technologies, we have observed that not only physical prototypes can provide us with information during the product development, but also the use of technologies such as Virtual or Augmented Reality that are being implemented to a great extent in these spaces, and that presence of future users is not out of context either, at least in the case of those who learn the technologies for their benefit.
2. The third aspect of the research to highlight is that the European spaces, have more than a common organizational model, several ways of interpreting and organizing themselves, and this undoubtedly influences their decision making. If we had to think about the most common decision model, the sample carried out has valued that the number of people making decisions in the teams that manage or coordinate them, is between one or five people (47.7% is normally between two or three people). It is true that these are young organizations, formed by a big number of adult people, and have had very little development, since these organizations originated mostly between 2013 and 2017. Therefore, we understand that with shared decision-making, and within young organizations mostly, the possibilities of improvement, openness and future transformation can help them in their internal processes and in the attention to their users.
3. The technological empowerment of its users or the digital inclusion of citizens are the values that stimulate this type of spaces. These values, among others, are transmitted in different ways, but the one that stands out the most is the organization of workshops and courses throughout Europe. In the case of collaboration, there are many initiatives that revolve around open design or hardware, open source or open data. Their collaborative way of working

favours and validates in some way, that these meetings between makers, manufacturers and consumers could take place, either because they already work with companies and we can see that they are the main client, and they work with users, even in a more specific sense, that intervene making or building their things with a certain skill that they have learned or acquire in these spaces.

4. The fifth aspect that determines their possibilities around co-creation, is that we talk about collaborative models, which reach in digital tools their widest stage, but also where values such as inclusion and citizen participation predominate. Regarding this, the spaces defend the presentiality, even if they have been awaiting the effects of the Covid-19. Many of the spaces are already planning to be a platform combined with online training activities. In this case, the online activities are being programmed in all the organizations, how to better organize security access, to work with the machines and participate in the activities. This presentiality continues to be the meaning of these spaces, which promote the manipulation of materials, components and transformation with different types of devices, mainly because they work in a collaborative way and promote "Do it Together". Even so, it is highlighted that the online experience is already very widespread, and both are combined in 75%. The spaces sampled allow the exchange of knowledge, as they practice the "Do It with Others" or "Do it Together" between disciplines and users, promoting teamwork and collaboration. However, the CMDFs can be distinguished (expanding their value), including all that means the connection and co-design with consumers.
5. To further confirm the influence on their environment, as a sixth point, we have been able to know that the radius of action or influence that spaces normally have is of a municipal nature, as they were thought to be able to intervene by neighborhoods, allowing a greater possibility of access to different social and professional agents, giving rise to that technological empowerment (allowing for a greater sense of ownership) and social inclusion (which facilitate or can facilitate the participation of different groups or possible voices, can address inequalities, etc.)
6. Even so, the activities that are carried out more in the European spaces, according to the user, are the professional or business projects on construction of prototypes (a ratio of 2.98 over 4).
7. The seventh most notable aspect is that designers are the professionals who most frequent these spaces in Europe. This detail confirms in some way that design can become an interlocutor to support the community, collective or group of users who meet or can meet in these spaces. In general there is a solid and formed preparation of the groups that prefigure these workshops or laboratories, which are composed of staff with university studies. An essential element to further understand and strengthen this idea, is that in the conducted study appears as a result, that the most developed soft skills are creativity and teamwork. In their training field, the sampling indicates that these teams are mainly trained in subjects related to innovation (reaching 75% of the cases). The iPRODUCE project aims to stimulate the tools of collaborative innovation from the spaces it aims to create. It would be convenient to set up a series of instruments tailored to the productive sectors of consumer goods, with which we intend to work.
8. The spaces sampled have shown us that there is a valid reference in the makespaces and fablabs, which as a business model strengthened and strategically positioned, could become a closer and more accessible driver to create co-design initiatives and be a source of

innovation, in a collaborative environment that attracts the different agents involved in the process studied (consumers or users, makers and manufacturers of different levels). These initiatives that are promoted will allow to extend and complement the development of consumer products and to introduce one or several productive models oriented towards open innovation, provoking the development of new proposals with a high circular content, necessary nowadays.

9. We have seen that some spaces suffer from sufficient resources as those of the industry but are used to carrying out work for the companies and these in turn, do not have 'laboratory' resources to prototype and validate their products as the spaces sampled have. Their position, around the possibilities of making prototypes, can be extended with the CMDFs to provide companies with a collaborative model with makers and co-designing with potential users.
10. Finally, the work with the experts (through two focus groups) and the analysis of cases, have been able to provide us with some more details, which allow us to reaffirm that research on CMDFs has more sense to achieve these new objectives, because of the necessary specialization and because of the collaborative approach of the different agents that are intended to participate.

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Annexes

Benchmarking questionnaire

***Dear participant**, welcome to our survey/questionnaire!*

The survey lasts about 5 minutes. There are no right or wrong answers, this is about your views. All data is anonymized, and your privacy is guaranteed.

Thank you for helping us gather relevant information!

What is the iPRODUCE project?

iPRODUCE is an EU-funded Horizon 2020 project which aims to promote collaborative manufacturing between makers, consumers and manufacturing Small Medium Enterprises (SMEs). The objectives of iPRODUCE are threefold:

(1) Bring Manufacturers, Makers and Consumer communities (MMCs) closer at the local level; (2) Engage these communities into joint co-creation challenges for the manufacturing of new consumer products and the introduction of novel engineering and production (eco) systems; (3) Provide practices, methods and tools that both makers and manufacturing companies (specifically SMEs) are utilizing;

With this survey we aim at collecting information regarding people's, makers' and manufacturers' perceptions, opinions and needs regarding the maker movement, collaborative manufacturing and co-creation schemes between individual makers, consumers and manufacturing enterprises.

+++

1. ORGANISATION ACTIVITY

1.1. Which of these definitions describes better your organization?

- Professional or business association/ federation
- User community or informal group (e.g. P2P initiatives)
- Cooperative or social enterprise
- Non-governmental organization (NGO)
- University research group or center
- Public institution
- Technology Centre
- Small-Medium Enterprises
- Large Company
- Start-up
- Vocational training

- Non-higher education centre

1.2. Participation in organization's networks

- National network project
- Local or regional network project
- International network project

1.3. Themes of the networks in which you participate

- Design
- Hardware/electronics
- 3D printing
- Do-It-Yourself (DIY)
- Other digital manufacturing resources (not 3D printing)
- Trading platforms (products)
- Collaborative networks (creation and production)
- Institutional networks
- Business networks
- Others

1.4. Year your organization was founded

1.5. Current status of the organization

- Active: commercially active
- No commercial activity
- Pending

2. VALUES AND STRATEGIES

2.1. The organization supports the following values:

- Technological empowerment
- Technology Observatory
- Self-learning and digital education
- Open data
- Hacktivism
- Open Hardware / Design
- Open Software

2.2. The organization shares other values not mentioned above:

- Urban Innovation
- Digital Inclusion
- Circular Economy
- Creative Commons
- Activist Design
- Other, please specify

2.3. Which actions transmit the indicated values through?

- Media
- Open access cultural content

- Management of the physical space
- Service Provider
- Management of community networks
- Organization of workshops and courses
- Organization of specific events
- Development of research projects
- Manufacturing with open hardware
- Development with open software
- Free technology support
- Development of social innovation projects
- Others (please specify)

2.4. How does the organization carry out its activities?

- Online only (virtually)
- Offline only (physically)
- Online and offline

2.5. What kind of place do you use to do it offline?

- Private open
- Private Restricted
- Public
- Leased

2.6. Are the facilities adapted for your purposes?

- Yes, totally
- Partially or in process
- At a starting point
- Not adapted

2.7. Where are the areas for the activities you carried out?

- Neighbourhood-District
- Within your town/City
- Regional/provincial/County
- State/Country
- European
- International/ Global

2.8. Type of product usually developed

- Fixing things (Bricolage)
- Build prototypes (professional)
- Working on models and mock-ups (hobby)
- Personal initiative
- Others

2.9. Users profiles

- Student
- Inventor
- Designer
- Architect

- Electronic Engineer or technician
- Informatic Engineer or technician
- Mechatronic Engineer or technician
- Mechanical Engineers or technician
- Technology Teacher
- Researcher
- Artist

2.10. Project profile

- Mechanical accuracy
- Product design
- Architecture
- Merchandising or communication
- Software development or programming
- Robotics projects
- Electronics projects
- Training projects for children and young people
- Adult education projects
- Other

3. PARTNERSHIPS AND FUNDING

3.1. What type of entities does the organization collaborate with?

- Public (non-educational) institutions
- Private companies (non-educational)
- Professional and business associations
- Neighbourhood Associations
- NGOs
- Educational Centres
- Non-formal groups
- Individuals

3.2. What kind of entities does your organization receive grants, financial assistance, money from?

- Private for profit: Venture capital, Private equity, Business angels, …
- Private Non-Profit
- Public institutions: Universities, Public corporations…
- Self-financing
- No income (Venture capital, Private equity, Business angels, Foundations, etc)

3.3. Main activities for the financing of your organization

- Direct public funding
- Private sponsorships
- Associated fees
- Grants by competitive call
- Parties and recreational events
- Crowdfunding
- Training activities
- Donations

- Financial support from the organization you belong to
- Advertising
- Specialized events (not training)
- Own merchandising
- Informal contributions from people in the organization (not quotas)
- Rent of spaces
- Machine rental
- Punctual rental of space
- Prototyping services
- R&D Services

3.4. What is the money usually invested in?

- Maintenance of space and technology
- To pay for the activities: transport, accommodation, materials, etc.
- Investment in advertising and dissemination
- Payroll payments, fees to collaborators
- Acquisition of machinery or technology
- Materials and Consumables Complaint
- Volunteer expenses
- Training

4. INTERNAL INFRASTRUCTURE

4.1. How many people are involved in the organization on a regular basis?

4.2. How many people are involved within the organization to make a decision?

4.3. If you could set an average, what would you say about them?

- Level of education
- Gender
- Age range

4.4. How many are employed? If you could set an average, what would you say about them?

- Level of education
- Gender
- Age range

4.5. Technology skills. If you could set an average, what would you say about them?

- Yes
- No
- Partially

4.6. Soft skills training

- Creativity
- Teamwork
- Management and organization
- Communication
- Documentation
- Others, please specify

4.7. Other training aspects

- Economy and administration
- Innovation
- Quality
- Environment
- Marketing
- Safety and Occupational Risks
- Marketing
- IPR

4.8. Do you make users complete any training to become part of the organization?

- Basic enabling training is required
- We provide introductory training
- We carry out continuous training
- We carry out informal training for accompaniment
- No training required

5. COMMUNICATION AND TOOLS

5.1. We have people dedicated to communication

- Yes, professional subcontractors
- Yes, professional associates
- Yes, associates but not professionals
- No

5.2. Does your organization have resources to communicate and disseminate its activities?

- Yes
  - personal
  - digital tools
  - budget
- No

5.3. Does your organization regularly report the developed projects?

- Daily
- Weekly
- Monthly
- Quarterly
- Half-yearly
- Yearly
- Never

5.4. Whom does your organization regularly report the developed projects?

5.5 Has your organization been in the media?

- Interviews
- Debates or discussions
- Current news

- Press release Advertisement
- Others

5.6. Do you update your website?

- Daily
- Weekly
- Monthly
- Quarterly
- Half-yearly
- Yearly
- Never

5.7. (types of) Communication tools (internal and external)

- Regular mobile phone contact
- Social networking
- Email address
- Contact for events
- Internal organization
- File sharing and storage
- Web management
- Video blogging
- Streaming stuff

6. TECHNOLOGY

6.1. Software (free or commercial)

- 3D-2D Design
- Programming
- Manufacturing
- Data
- Administration
- Presentations
- Other (please indicate)

6.2. Digital devices (number and technology)

- Laser (<90, 90/100, >100)
- Medium large milling machine (3, 4, 5 axes or robot)
- 3D printing (FFF, SLS, SLA or other)
- Metal cutting machine (oxyfuel, plasma, laser)
- Small milling machine
- Vinyl Plotter
- Print plotter (b/w, color)
- 3D Scanner
- Sewing or embroidery machines
- PCB and other electronics production machines
- Metrology equipment (CMM, tomography, etc.)
- AV/VR equipment (Glasses and Virtual or Augmented Reality)

6.3. Other important devices (mechanical, electronic)
Machinery
Tool

THANK YOU
Thank you for taking part in this survey and contributing to our understanding of what people think about makerspaces and collaborative manufacturing between individual makers and manufacturer enterprises.
Your input will help us a great deal to identify key elements and perceptions that should be considered during the implementation of our project.
Do you have any questions or comments? You can contact us at info@iPRODUCE-project.eu.

Informed consent
This privacy policy details information collection practices related to your personal data and other related information and the limited manner in which the iPRODUCE project will use and disclose the information provided to us when you responded to the survey.
By participating in the survey, you voluntarily consent to the collection and use of your information by iPRODUCE as set forth in this privacy policy. If you have any questions concerning this privacy policy or our data collection practises you may contact us at info@iPRODUCE-project.eu. *We reserve the right to change this privacy policy at any time and inform all participants about the updates. The collected data will be only used for the purpose of the iPRODUCE project, funded under the European Union Horizon 2020 programme. The lawfulness of the processing of personal data is determined pursuant to Article 6 of the EU's General Data Protection Regulation (GDPR). With respect to personal data, the processing of personal data is based on consent.*

Expert Panel Script

EXPERTS ONLINE MEETING: DIGITAL MANUFACTURING SPACES TUESDAY, 30 JUNE 11:00-12:30

1. ABOUT THE CURRENT SITUATION

The time of the Benchmarking study has coincided in an exceptional and surprising way with the Pandemic. Many maker spaces have had to close due to the health alert and many have not been able to carry out their normal operation, and the few which have continued carrying out facial protections or other elements that have facilitated the activities of health sanitary personal and other professional profiles. They were on the front line, alongside the local maker communities. We would like to reflect on what was happening at the time you were living, just before the Pandemic, the current moment, after this situation of health crisis, the current economic and social crisis that is being announced.

- **How was the situation before Covid-19 in your space?**

Opening hours 5-6 times a week, often > 20 visitors.

- **How is the situation now, once the Pandemic (seems to have) reduced its effects?**

After full physical lookdown, we are slowly starting by opening 2 times a week again with strict limitations on people and the requirement of prior registration (mail/discord)

• What do you think is the situation that the spaces are currently experiencing based on your knowledge or your intuition?

Massive loss of traction with regard to visitors and impact

• What changed for you (and your community) when the country shut down?

MSB:

Change to 100% online interaction. This in some ways worked out better than anticipated. Some members were involved heavily in the Covid-19 activities, others withdrew.

Community:
Starting Maker gegen Corona (makers against corona) and connecting with a much wider nationwide and international community. Lots of new contacts.

Several communities joined together. We got help from bike enthusiasts and our local critical mass group who offered distributing face masks, shields and other equipment by bike throughout town.

• What were the biggest challenges you faced?

Losing the traction as most of our plans and co-operations had to be put on hold.

• How did you come up with solutions for the newly introduced problems?

Makerbusiness as usual:-) Looking for the problems and finding solutions. The most massive bottleneck were masks, so we started sewing them and having local businesses sew them for us. Same with faceshields, etc.

• How did you communicate with your members?

Discord (chat) and Google Hangouts for video conferencing

• How did the shut down affect the social aspects of your fablab?

2. ABOUT THE FUTURE

The influence of the Covid-19, the closure or slowdown of your normal daily activities, would influence the future, as in other areas of the economy and society ...

• How do you see the next future of your space?

We will slowly try to reopen with a strict limit on visitors and hygienic rules in place. We especially need a restart with our co-operations.

• How do you see the future of fablabs, makerspaces or hackerspaces?

It was visible that Makerspaces and their rapid prototyping capabilities can be a big help during these times of crisis as we were able to produce needed equipment faster than any traditional businesses. This has to be communicated to administrative partners, also with regard to have this funded.

• Do you think you will need new tools, methods or technologies to face these challenges?

We identified machines that would have helped us very much in producing the needed equipment. With regard to tools, we did ok.

• **Was there something you learned during the pandemic?**

Too much to name:-) Topics varied from logistics to mass production and injection molding.

One other finding: the school and education system in Germany is not up to the challenges that remote learning poses.

• **Is there anything you want to keep for the future that was introduced by the pandemic?**

We might use video conferencing/streaming during physically hosted workshops and meetings to allow remote people joining in.

We will improve on networking with different parts of the local community like bike activists, etc.

MakerVsVirus

3.ABOUT THE ECONOMIC AND SOCIAL DEMAND OF YOUR MOST SIGNIFICANT ACTIVITIES

Many spaces have based their activity on the rental of technology or spaces, and also on training (children or adults) or technological empowerment (of devices). Others depend on public or private organizations, which support the financing part of their activities.

• **Are these still the most common or demanded services until the pandemic arrived?**

Training, community, workshops, education and access to machines and equipment are still widely demanded. We cannot say if there is a noticeable shift in the relevance of any of these topics, yet.

• **Have you detected any other type of services other than the usual ones that you have been offering?**

• **Are you still maintaining the same type of audience as before the pandemic?**

We expanded (bike community), etc.

• **Do you think that iPRODUCE could help you to relocate or re-think the future in a medium and long term?**

We realized that local rapid prototyping and rapid production capabilities will be needed and fostered financially by official institutions. It was quite obvious that the global supply chain can break down easily and goods need to be made available locally.

The meeting will be as follow:

We already know the institution which will take part in the meeting so we will not make a profile introduction of the institution, just that everyone will need to identify themselves, due to the internal switch of peoplerepresenting each institution.

We have defined three big blocks, 25 minutes each aprox.

We would like to talk about these three points and afterwards in case we still have time we could talk about everything you would like to share with the rest of the participants. We are in very similar initiatives and could enrich us as a collective.

Thank you very much for taking part as experts in this meeting. We hope the results will satisfy you.

Success stories

FABLAB MODEL

Please do not write in the grey cells

Why do you think your maker space is different to the rest of them? What does make it special? (answer two or three lines sentence)
By example, it is an coworking space, where to train and rent digital and analogical technology.

Name of fablab or makerspace:					
Foundation year		Adress			
Country					
		C.P.		City:	

Web		Mail		Nº Workers	

Instagram	Facebook	Twitter

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1. How did you found it, who were the founders and what is the story of the beginning? (*Max 200 words)*
Describe the history of the organization, about why you did found this makerspace

2. Did you get financial help or investment from any private or public institution? In case yes, from who and why (*Max100 words)*
Describe if there are some organization behind or if the space is private or public

3. Which one is your "Star service" Describe it (*150 - 250 palabras)*

Describe which are the services you offer in you makerspace (training, material sale, digital production technology rental, etc

4. Which one are the technologies you manage in your place ? Any innovation? *100 - 150 words*
Describe which are the technologies the makersspace offers, and if there is any initiative, product or non technological service.

5. How is the daily procedure with the different users? (*200 - 250 words)*
Describe the process you use with the main users: ● *activities with students* ● *joung university students developing prototypes* ● *digital technological rental* ● *designers, makers and so on designing or developing a project* ● *space rental* ● *etc*

6. ¿Quién es el público o cliente habitual que acude a vuestro espacio?Who are the regular/usual user of your place? (*15 -75 words)*
Define them

7. ¿Algún reconocimiento o premio obtenido? Did you or your makerspace get a a prize or award regarding its activities, initiatives, projects or so on? *15 - 75 words*

Please add three or four pictures of your place and work			
File 1 jpg:	*name.jpg*	Footer text:	*3D printing area*
File 2 jpg:		Footer text:	
File 3 jpg:		Footer text:	
File 4 jpg:		Footer text:	

Please send the information to *do@oceanonaranja.com* with the attached pictures and files you find important

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