Deliverable 4.2

Roles and capabilities in open design-led distributed value creation settings

Yekta Bakırlıoğlu

September 2022

Abstract

This deliverable presents the outcomes of a survey aiming to reveal an initial understanding of how value-creation-for-self (i.e., responsible consumers, active users, prosumers/ makers/DIY-ers) and value-creation-for-others (i.e., local, regional, global/mass producers) stakeholders perceive their roles in open design-led distributed value creation settings of electrical household appliances. There were 166 respondents from Turkey, answering questions on their existing capabilities, their potential forms of participation and the capabilities they need or have access to at the design, production and post-use stages. The exploratory nature of the survey revealed key considerations regarding the potentials for and barriers against distributed value creation networks in general, and specifically for electrical household appliances.

This report constitutes Deliverable 4.2, for Work Package 4 of the DF-MOD project.

30/09/2022

For more information

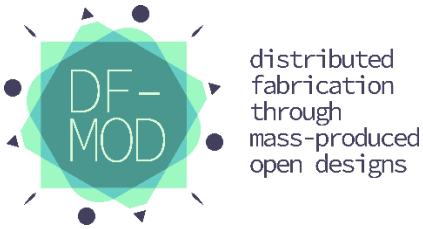
yektab@metu.edu.tr

Please refer to this publication as follows:

Yekta Bakırlıoğlu. (2022). Roles and capabilities in open design-led distributed value creation settings (Deliverable 4.2). Ankara: DF-MOD Project 120C213 – TÜBİTAK-H2020 MC-CoFund. DOI: 10.5281/zenodo.7128993

This publication is also available via dfmod-id.metu.edu.tr

This publication is part of the DF-MOD project funded by the TÜBİTAK-H2020 MC-CoFund under project no 120C213.



Contents

Lists of Figures and Tables

List of Figures

List of Tables

1. The purpose of D4.2

Work package 4 aims to develop an initial understanding of how value-creation-for-self (i.e., responsible consumers, active users, prosumers/ makers/DIY-ers) and value-creation-for-others (i.e., local, regional, global/mass producers) stakeholders would perceive their roles in open design-led distributed value creation settings. WP4 builds on the categorisation of stakeholders and the recognition of their hybrid roles in different value creation networks (e.g., one person can be a responsible consumer in one such network, a prosumer in another, and part of a regional producer in another). DF-MOD's focus on electrical household appliances frames the distributed value creation network this work package aims to explore. However, in line with the more exploratory nature of this work package, the researcher developed an inclusive survey that respondents can reflect such different roles and respond to questions accordingly.

Building on *deliverable 3.1 - Review of alternative business models for open design and distributed production,* the researcher initially developed a mapping of roles and corresponding knowledge, skills and capabilities for value-creation-for-self and value-creation-for-others stakeholders at design, production/fabrication and post-use stages. This mapping was presented in *deliverable 4.1 - Mapping of stakeholders' roles, capabilities and resources in distributed value creation networks.* This was a crucial step towards developing a detailed yet exploratory survey that can encompass the multitude of practices, forms of participation, the openness of knowledge and accessibility and necessity of resources.

The survey developed as part of this work package, titled *Roles in the Future of Distributed Production of Electrical Appliances [Elektrikli Ev Aletlerinin Dağıtılmış Üretimi Geleceğinde Alınabilecek Roller] (in Turkish),* had 166 valid respondents answering questions regarding their existing capabilities, potential forms of participation to design, production/fabrication and post-use practices, and the knowledge, resources and capabilities they have or need access to partake in such a distributed value creation network. The development of this survey and its implementation are presented in the following section.

2. Methodology

2.1. Mapping knowledge, skills and capabilities of stakeholders

Using the systematic literature review (deliverable 3.1), the author mapped knowledge, skills, and capabilities that enable participation according to the type of stakeholders and design, production, and post-use stages, and revised this mapping through the insights of five experts in sustainable design, codesign, design management, and design-led businesses. The following lines introduce this mapping in an attempt to formalize the required knowledge, skills, and capabilities to participate in distributed value creation networks at different stages. This mapping (deliverable 4.1) presents the knowledge, skills, and capabilities of stakeholders in open design-led distributed value creation networks categorized as (a) value-creation-for-self (i.e., responsible consumers, active users, DIY-ers, makers, prosumers) and (b) value-creation-for-others (i.e., local producers such as maker entrepreneurs and crafts-practitioners, regional producers and global/mass-producers), mapped according to various roles possibly adopted by them at different stages of (1) design, (2) production/fabrication and (3) post-use. The following sections are structured as (a) a table of the mapping for each stage, (b) an introduction of roles and corresponding skills, capabilities, and resources for value-creation-for-self stakeholders, and (c) an introduction of roles and corresponding skills, capabilities, and resources for value-creation-for-others stakeholders. It should be noted that the author does not propose a strict separation of design, fabrication/ production, and post-use stages; rather uses these stages for mapping skills, capabilities, and resources while acknowledging that these stages are intertwined in terms of both decision-making and collaboration, and their realization by any stakeholder of distributed value creation networks.

Table 1. Mapping of the roles and corresponding knowledge, skills, and capabilities at the 'design' stage

Design sub-categories	**Value creation for self**		**Value creation for others**	
	Roles	**Skills, capabilities, resources**	**Roles**	**Skills, capabilities, resources**
Design research	Participate in user research	○ Knowledge/training on design processes and methods ○ Design visualization (e.g., drawing) knowledge/training ○ Technical drawings of parts	Conduct user research	○ Design consultancy service (e.g., from a design consultancy firm) ○ In-house design team or department Networking events with other local and regional stakeholders ○ Open access to information on other local and regional manufacturers open to cooperation
Co-design processes	Facilitate co-design sessions		Facilitate co-design sessions	
	Participate co-design sessions		Participate co-design sessions	
Design detailing	Develop alternative part designs		Update designs based	

Design sub-categories	Value creation for self		Value creation for others	
	Roles	**Skills, capabilities, resources**	**Roles**	**Skills, capabilities, resources**
	Develop additional parts Change / adapt designs	○ 2D computer aided design knowledge/training ○ 2D computer aided design software ○ 3D computer aided design knowledge/training ○ 3D computer aided design software ○ Computer-aided design models of parts	on others' designs	○ Open access to knowledge and skills of other local and regional manufacturers regarding the design and production processes ○ Developing open-source licensing strategies suitable for enabling collaboration
Open design sharing	Openly share own designs		Openly share design knowledge	○ Horizontal management of licensing practices to be implemented ○ Open-source design platforms

Table 1 introduces various design stages such as design research, co-design processes, design detailing, and open design sharing to map the roles and capabilities of both types of stakeholders. For value-creation-for-self stakeholders, design research translates into participating in user research and requires no specific skills, capabilities, or resources. This is similar for participating in co-design sessions. However, the remainder of the roles involves a set of skills, capabilities, and resources applicable to all design sub-stages at varying levels. This set ranges from more general knowledge of design processes and methods to more skills-oriented knowledge of visualization, including hand drawing, and 2D and 3D CAD. For facilitating co-design sessions, this might involve knowledge and skills about facilitation and resources for developing generative tools; for developing or adapting parts, this might involve knowledge about ideation and detailing as well as visualization of ideas. Open design sharing involves proper documentation of designs in terms of communicating design decisions and sharing adaptable drawings/models for others' use. For any of these, access to appropriate software and openly shared designs is required.

For value-creation-for-others stakeholders, the roles vary. These stakeholders conduct user research, participate in or facilitate co-design sessions involving value-creation-for-self stakeholders, and update their own designs based on the designs of both stakeholder types. Beyond the design capacity in the form of in-house design teams or external design consultancy services, they also require information about other local and regional producers' intentions for cooperation and their skills and capabilities in design and production to formalize distributed value creation networks. Furthermore, as a barrier to overcome, novel open-source licensing strategies are required to enable such diffuse collaborations. This also affects openly sharing of design knowledge, as these licensing strategies should involve forms of horizontal management by all stakeholders and open-source design platforms enacting such management principles.

Table 2. Mapping of the roles and corresponding knowledge, skills, and capabilities at the 'production/fabrication' stage

Produce sub-categories	**Value creation for self**		**Value creation for others**	
	Roles	**Skills, capabilities, resources**	**Roles**	**Skills, capabilities, resources**
Assembling parts	Assemble a set of parts Combine different parts	○ Guides on assembling parts ○ Access to hand tools ○ Access to material resources	Openly share assembly information	
Producing / fabricating	Fabricate co-designed parts Fabricate additional parts Fabricate own/adapted designs	○ Knowledge/training on craft practices (e.g., glass, ceramics, leather, fabric, etc.) ○ Access to craft workshops and equipment (e.g., glass, ceramics, leather, fabric, etc.) ○ Access to workshop and production equipment ○ Production equipment use training ○ Files ready for digital fabrication ○ Access to digital fabrication equipment (e.g., 3D printer, laser cutter, CNC) ○ Digital fabrication training	Openly share production information Co-produce with local and regional producers	○ Standards for mechanical parts ○ Standards for electrical parts ○ Standards for designs ○ Logistics service between stakeholders in the distributed production network ○ Access to local material flows and supply chains information ○ Access to stakeholders providing production/fabrication services ○ Having a say in the management of the distributed production network ○ Quality control of production/fabrication outputs of different stakeholders

Table 2 identifies two largely defined production/fabrication stages, i.e., assembling parts and producing/fabricating. Whether assembling predefined parts or combining different parts designed for different purposes, value-creation-for-self stakeholders need access to guides on assembling parts, hand tools and material resources for assembly. As for fabricating co-designed parts, additional parts, their own designs or designs they have adapted, knowledge of craft practices, production equipment, and/or digital fabrication is necessary. In line with this, they might require access to relevant equipment (craft, production, and digital fabrication), which is still not immediately accessible to many value-creation-for-self stakeholders despite the global rise of coworking spaces providing these (e.g. craft ateliers, makerspaces, etc.). Finally, especially when using digital fabrication equipment, they might need access to digital files ready for digital fabrication, as these are different from CAD models and their preparation requires a different kind of knowledge (e.g., slicer software).

For value-creation-for-others stakeholders, other than them producing and assembling parts, assembly information should be shared with other stakeholders, not only as a means of enabling assembly by others but also to ensure that parts are assembled correctly for longer product lifetimes. For producing/fabricating, they openly share production/fabrication information in a way that enables repetition by value-creation-for-self and other local and regional producers and co-produce parts and products with

other producers operating locally or regionally. These require shared standards for electrical and mechanical parts and designs among value-creation-for-others stakeholders to enable interoperability of different parts designs, whether they are novel designs or adaptations of existing ones. It also requires additional services, such as logistics between stakeholders of distributed value creation network and quality control of production/fabrication outputs. Furthermore, they need to have access to information on local material flows and supply chains, as well as local and regional stakeholders that provide manufacturing-as-a-service (MaaS). Finally, they should be able to participate in the decision-making processes of such a distributed value creation network for the network's horizontal management.

Table 3. Mapping of the roles and corresponding knowledge, skills, and capabilities at the 'post-use' stage

Post-use sub-categories	**Value creation for self**		**Value creation for others**	
	Roles	**Skills, capabilities, resources**	**Roles**	**Skills, capabilities, resources**
Maintenance	Maintain parts and products	○ Access to repair manuals ○ Electrical and electronic parts (e.g., motor, key, circuit board, etc.) ○ Mechanical parts (e.g., blade, beater, fan, etc.) ○ Basic functional parts (e.g., pot, grill surface, etc.)		
Repair	Get parts & products repaired		Offer repair services	○ Repair service or authorized service network provided by my company
	Dis- & re-assemble products		Openly share repair knowledge	○ A repair platform where I can share repair information as open source
	Repair parts and products		Sell spare parts	○ A platform sales channel where I can sell spare parts or updated parts
Upgrading	Upgrade parts and products		Sell parts for upgrading	
Second hand	Sell/give away no longer used products	○ Reliable second-hand sales channels	Quality control of second-hand products	○ A sales channel where I can sell the refurbished products
	Acquire second hand products			
Shared use	Use products with others	○ People with whom I can collaboratively use the product	Facilitate shared use	
Small-scale recycling	Recycle parts to produce other parts	○ Access to shop floor recycling devices (e.g., Precious Plastics)	Collect & recycle parts to produce other parts	○ In-house recycling equipment and system
Proper disposal	Properly dispose of parts and products		Openly share waste management information	

The post-use stage involves maintenance, repair, upgrading, second-hand sale, shared user, small-scale recycling, and proper disposal of parts and products (Table 3). Properly addressing these stages are crucial especially in distributed value creation networks with potentially numerous stakeholders partaking in value creation processes, using different materials and production/fabrication methods for different parts. Value-creation-for-self stakeholders either carry out these stages themselves or get these

done by third-party individuals or businesses. For maintenance, repair, and upgrading, these stakeholders require access to manuals for these practices, as well as the availability of basic functional, mechanical, electrical, and electronic parts. They can acquire second-hand products or give away the products they no longer use, and for both, there need to be reliable channels facilitating the exchange process. For shared use, they need others who are also willing to use the products in a shared way. For small-scale recycling, they can recycle their parts and products to fabricate new parts; at which stage they require access to shop floor recycling equipment (e.g., Precious Plastics). Finally, if the above practices are not viable, they dispose of the product properly so that other stakeholders, including but not limited to other value-creation-for-self and value-creation-for-others stakeholders, can recapture their embedded value.

For repair and upgrading, value-creation-for-others stakeholders can offer repair services through their authorized service network, or openly share repair/upgrading knowledge and provide spare parts and parts for upgrading so that other stakeholders, both value-creation-for-self and for-others, can undertake these processes. For sharing repair/upgrading knowledge, these stakeholders might utilize open-source repair platforms (e.g., iFixit and Motorola collaboration). They might also require additional sales channels for providing parts (spare and/or upgraded), in case they do not have the necessary sales infrastructure in place. For reuse of secondhand products, they can take on their quality control and refurbish as required, for which they might also require additional sales channels. On the other hand, they can also facilitate the shared use of products, simply by leasing products rather than selling them. If these stakeholders have in-house recycling equipment and system, they can collect and recycle parts properly disposed of by value-creation-for-self to produce new parts. This opportunity emerges when they openly share waste management information detailed enough not only for open-loop recycling but also for their collection systems.

2.2. Developing an inclusive survey

The above mappings enabled the development of an inclusive survey that can be implemented for all types of stakeholders, as this study acknowledges the different roles stakeholders can take in a distributed production setting – both value-creation-for-self and value-creation-for-others – and these roles may not be mutually exclusive. The level of participation in diffuse value creation networks can also vary according to not only the existing capabilities of stakeholders but also their intentions. In an attempt to capture the dynamic nature of roles, the researcher opted for a logic-based questionnaire with two simple logic sequences that adapt to the questions according to responses. There are two main sets of questions (i.e. value-creation-for-self and value-creation-for-others) based on mapping of skills, knowledge and capabilities, and the participants were shown questions according to the roles they identified for themselves in the distributed production of electrical home appliances (Figure 1).

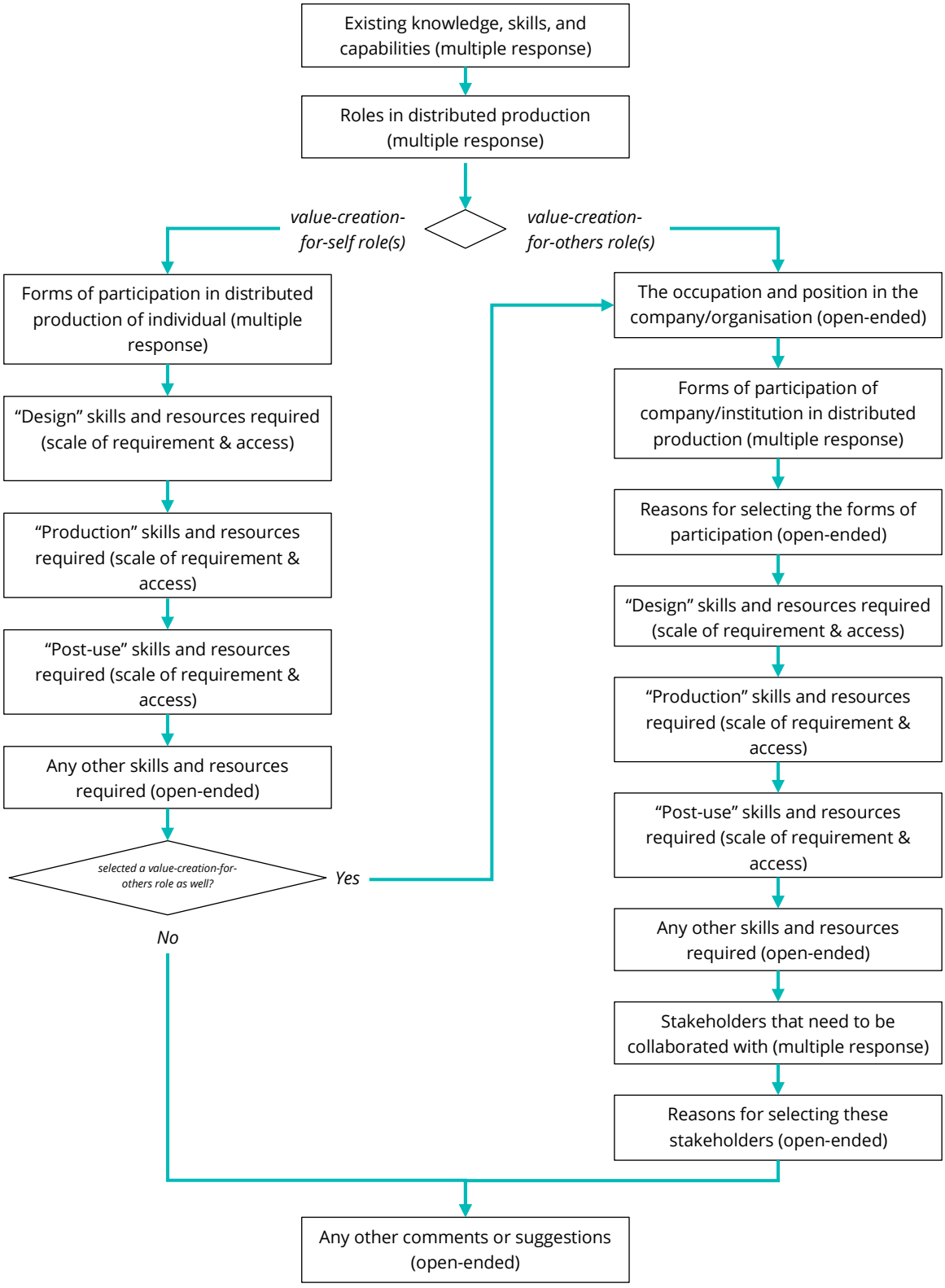


Figure 1. DF-MOD survey flowchart

As can be seen in Figure 1, three types of questions were used in this survey. Multiple response questions were utilised to present a wide breath of possible answers to

certain questions, which were derived from the systematic literature review (deliverable 3.1). These questions were related to:

- Participants' existing knowledge, skills, and capabilities in design, production/fabrication and post-use in general.
- Participants' own perception of the roles they might take in the distributed production of electrical household appliances – i.e. value creation for self (responsible consumer, active user, and/or prosumer/maker/DIY-er) and/or value creation for others (local, regional and/or global producer). *This was used to reveal or hide questions through a survey logic sequence.*
- Participants' perceived forms of individual participation in the distributed production of electrical household appliances as value-creation-for-self stakeholders.
- Participants' perceived forms of participation as an entity (e.g. their company, institution, etc.) in the distributed production of electrical household appliances as value-creation-for-others stakeholders.
- Participants' perception of the types of stakeholders their company/institution needs to collaborate with to partake in distributed value creation processes.

The choices under these questions were derived from the systematic literature review; however, there was always an 'other' option with free-text input in case there are options not covered in the question.

The second type of question was a scale specifically developed for this survey, and that aims to measure the perception of the 'necessity' and 'access' to specific knowledge, skills and resources to partake in distributed value creation processes. The scale was as presented in Table 4.

Table 4. Necessity-access scale for capabilities of stakeholders in identified knowledge, resources and skills items

Resource/skill/knowledge	**No access but not required**	**Has access but not required**	**No access but required**	**Has access but not enough**	**Has enough access**

This scale was developed in accordance with the stages of scale development for social research introduced by Boateng et al., 2018. The researcher conducted a systematic literature review (see deliverable 3.1) and confirmed that the domain does not have a scale measuring perception of access and necessity in an interrelated manner, in a way applicable to various forms of capabilities (i.e. knowledge, resources and skills) identified through the review of literature, and applicable to wide-ranging sets of capabilities of different value creation stakeholders operating at different scales (i.e. individual, local, regional and global) and with different capacities. An initial version of the scale along with the items measured was evaluated for validity with five experts on design management, design for sustainability, sustainable production and consumption, localisation, circular economy and the maker movement. These experts

evaluated the item pool for the representation of the domain of interest, the scale for the representation of necessity-access scenarios, and measuring perceptions of necessity and access comparatively using the scale (as introduced in the analysis section below). The items and scale were then pre-tested with seven participants to assess clarity and adequacy, which resulted in the addition of two sets of items for production/fabrication and post-use stages considering their thought processes and rewording of 11 items for further clarity. Before pretesting, the arrangement of the scale options was different (i.e. the first option was 'has access but not required', but the respondents indicated that the first one should be 'no access but not required' while considering the necessity of resources, skills and capabilities). This scale accounts for potential scenarios for accessibility of knowledge, skills and resources as well as if they are perceived as required by the participants. This scale was utilised for the items related to knowledge, skills and resources introduced in section 2.1. The survey was then administered with a sample explained in Section 2.3 (below). It should be noted that this survey was prepared and later administered in Turkish, and the current items used in this English report do not reflect the items worded in Turkish one-to-one. Thus, other researchers will need to go through the above-specified stages for administering this survey in other languages, including in English, and ensure the clarity and adequacy of items and the scale in their contexts and language. To aid this process, Appendix A includes the scale and the full list of items in Turkish, and English translations done by the researcher yet not validated.

Finally, the third type of question is open-ended questions, which aimed to get further details regarding the choices of the participants where necessary. The questions of the survey can be found in Appendix B.

2.3. Sampling and reaching participants

This survey utilizes the stakeholder categorisation introduced in deliverable 3.1, which consists of the following:

1. Value-creation-for-self stakeholders:
    a. Responsible consumer
    b. Active user
    c. Prosumer/maker/DIY-ers
2. Value-creation-for-others stakeholders:
    a. Local producer
    b. Regional producer
    c. Global / mass-producer

However, as can be seen in the flowchart of the survey, the participants can indicate more than one role for themselves. For example, a designer working in a global producer entity (i.e. a value-creation-for-others stakeholder) can also be an active user making additional parts to their products. Or, the participant can act as a responsible

consumer for a product they own, while making another product for themselves (i.e. a prosumer/ maker/DIY-er). This dynamic nature of the roles is further discussed in deliverable 3.1.

Purposive sampling was utilised for this survey to reach all types of stakeholders. For regional and global/mass-producers, the following lists were utilised to find email addresses and other modes of communication:

1. Electrical household appliances producers in Turkey, from the Union of Chambers and Commodity Exchanges of Turkey (TOBB) database
2. Electrical household appliances brands in the Turkish Houseware Association (ZUCDER) database
3. Individuals working in electrical household appliances producers from METU ID stakeholders list

In order to reach local producers and prosumers/makers/DIY-ers, the following were utilised:

1. Pop-Machina project İstanbul maker ecosystem stakeholders list
2. Dissemination of call for participation to Zemin İstanbul (makerspace) and Social Entrepreneurship Network [Sosyal Girişimcilik Ağı]
3. A field sweep in İstanbul (in the historical peninsula, Beşiktaş and Kağıthane) and Ankara (around the Ankara Castle region)

As a result, a total of 182 participants responded to the survey. 166 of these responses were found valid after the elimination of responses with unanswered questions, duplicates (one person filling in the survey twice), and contradictory answers (e.g. respondents specifying their role in a company/institution with unrelated professions or expertise such as a soldier, housewife, etc.). Table 5 shows the distribution of the participants according to their roles in a distributed production network of electrical household appliances.

Table 5. Distribution of respondents according to their roles in a distributed production network of electrical household appliances

	Responsible consumer	Active user	Prosumer/ maker/DIY-ers	Local producer	Regional producer	Global / mass-producer
Responsible consumer	96	57	39	27	19	18
Active user	57	88	37	26	21	14
Prosumer/ maker/DIY-ers	39	37	62	26	20	15
Local producer	27	26	26	45	26	17
Regional producer	19	21	20	26	32	17
Global / mass-producer	18	14	15	17	17	25

In terms of value-creation-for-self roles, 96 of the participants identified themselves as responsible consumers, 57 of which also identified as active users, and 39 of which as prosumer/maker/DIY-ers. 88 of the participants identified as active users, 37 of which also identified as prosumer/maker/DIY-ers. Finally, 62 participants identified as prosumer/maker/DIY-ers in total. While the higher number of people identifying as responsible consumers and/or active users is not surprising and within expectations, what is interesting about this data is that there are 17 prosumer/maker/DIY-ers that don't identify as being responsible consumers or active users.

In terms of value-creation-for-others roles, 45 participants identified their company/institution as local producers, 26 of which also identified as regional producers and 17 of which as global/mass-producers. 32 of the participants identified as regional producers, 17 of which also identified as global/mass-producers. Finally, 25 participants identified their company/institution as global/mass-producers. What is interesting about this data is, there are 8 global/mass-producers that do not target local and regional markets and claim to undertake production only for a global market.

Another interesting point emerging from this data is that while there are 62 participants identifying themselves as prosumer/maker/DIY-ers, only 26 of them perceive themselves as potential local producers in a distributed production network of electrical household appliances. This might be in relation to (a lack of) entrepreneurial skills or they might not see business value in becoming local producers. While they have the skills and capabilities to fabricate parts or products, they are not, and do not intend to become, value-creation-for-others stakeholders.

2.4. Analysis

The analysis of the data was done descriptively using MS Excel software for this deliverable. Due to the exploratory purpose of this survey and the hybrid roles of the respondents, inferential statistical analysis among resources, skills and knowledge was not carried out, since the data was collected with the assumption of changing roles of respondents in distributed value creation networks. This was supported by the highly overlapping roles selected by the respondents – more than half of the respondents (57%) selected more than one role.

The analysis was done in three stages. First, the data were analysed under two main categories of value-creation-for-self and value-creation-for-others. Then, competencies and gaps in existing skills, knowledge and capabilities were identified for different types of stakeholders under each category. This was done using percentages of each stakeholder type selecting and marking each skill, resource or capability, and enabling comparison among stakeholders. A similar percentage analysis was done according to forms of participation the respondents indicated in the distributed production of electrical household appliances, and collaborators as well, revealing similarities and differences between the types of stakeholders.

The third stage involves what kinds of skills, knowledge and resources are necessary to participate in distributed value creation networks, and which of these are accessible, using the scale presented in Table 4 (on page 8). Since there are two sets of items measured divided between value-creation-for-self and value-creation-for-others, these were analysed separately. The necessity-access scale was initially weighted as shown in Table 6, indicating certain levels of necessity. According to this data, the Cronbach's Alpha of 28 value-creation-for-self items was α= 0.943 overall, and for 8 'design' items it was α= 0.940, for 13 'production/fabrication' items it was α=0.912, and for 7 'post-use' items it was α=0.834. The internal reliability analysis for each subcategory item was also conducted and revealed that the removal of any value-creation-for-self items would reduce the reliability of the data collected, except for the 'post-use' item 'People for shared use' (α=0.841). However, this item was conceptually useful for the data analysis. The Cronbach's Alpha of 27 value-creation-for-others items was α=0.947, and for 11 'design' items it was α=0.886, for 11 'production/fabrication' items it was α=0.931, and for 5 'post-use' items it was α=0.817. The internal reliability analysis for each subcategory item was also conducted and revealed that the removal of any value-creation-for-others items would reduce the reliability of the data collected. These indicate that the scale items and collected data are reliable.

Table 6. The initial weighting of access and necessity scale options for reliability and correlation analysis.

Resource/skill/knowledge	**No access but not required**	**Has access but not required**	**No access but required**	**Has access but not enough**	**Has enough access**
Key functional parts (e.g., container, grill plates, etc.) for part replacement	-1	0	-2	1	2

The above weighting of scales indicated interesting correlations among different knowledge, resources and skills in participating design, production/fabrication and post-use stages in distributed value creation networks (the correlations tables are presented in Appendix C). The factor loading analysis of 28 value-creation-for-self items and 27 value-creation-for-others items separately revealed interesting results as well (discussed in Section 3), however, it also brought forward the importance of comparing levels of necessity and access for each item and for each stakeholder separately as well. Considering the number of items (28 items for value-creation-for-self and 27 items for value-creation-for-others stakeholders), it was important to analyse what skills, knowledge and resources were needed and accessible, how these change among different types of stakeholders were crucial to capture the context in terms of distributed value creation network. Thus, the research utilised the weighting presented in Table 4.

Table 7. Example of the access and necessity scale

Resource/skill/knowledge	**No access but not required**	**Has access but not required**	**No access but required**	**Has access but not enough**	**Has enough access**
Key functional parts (e.g., container, grill plates, etc.) for part replacement	Access score (*as*) = 0 Necessity score (*ns*) = 0	Access score (*as*) = 1 Necessity score (*ns*) = 0	Access score (*as*) = 0 Necessity score (*ns*) = 3	Access score (*as*) = 1 Necessity score (*ns*) = 2	Access score (*as*) = 2 Necessity score (*ns*) = 1

Each choice is given a weight for 'Access' and 'Necessity', as illustrated in the table. In terms of access, having no access is weighted as 0, having some access (regardless of necessity) is weighted as 1, and having enough access is weighted as 2. In terms of necessity, not required is weighted as 0, having enough access as 1, having some access that is not enough as 2, and having no access while it is required as 3. This scale produces two comparable measurements, namely *normalised access score* (*nas*) and *normalised necessity score* (*nns*) calculated as below:

$$normalised\ access\ score\ (nas) = \frac{\sum as}{2n} \times 100$$

$$normalised\ necessity\ score\ (nns) = \frac{\sum ns}{3n} \times 100$$

In the above formulas, the sum of access scores ($\sum as$) and the sum of necessity scores ($\sum ns$) are divided by the maximum possible access score ($2n$) and necessity score ($3n$) for each item and each stakeholder type. This enables the comparison of two differently weighted scores that their means (i.e., μas and μns) would not allow. This calculation was done in aid of analysing the differences among different resources, skills and knowledge for each stakeholder as well as to perceive the differences among different stakeholders for each resource, skill and knowledge. However, the distribution of answers may differ to produce similar scores, which is additionally analysed as part of the descriptive analysis of data.

3. Opportunities and limitations for distributed production in Turkey

This survey is comprehensive in terms of content and aimed to reveal relationships between required knowledge, skills and capabilities for different types of stakeholders and common opportunities and limitations for value-creation-for-self and value-creation-for-others stakeholders. Due to the purposive sampling of different participant groups and survey logic applied to reveal/hide questions according to participants' roles, the outcomes of this survey are exploratory in nature. However, the quantitative analysis of the data reveals the dynamic nature of these roles, the required knowledge, skills and capabilities for each role and if they have access to them, their perception of open design knowledge and collaborative intentions.

3.1. Existing skills, capabilities and resources

The chart in Figure 2 shows the perception of value-creation-for-self stakeholders (i.e. responsible consumers, active users, prosumers/makers/DIY-ers) regarding their own skills and capabilities. There is an expected lack of CAD skills and knowledge overall; however, this lack is especially surprising for prosumers/makers/DIY-ers (%32 with 3D CAD skills, and %42 with 2D CAD skills). However, these stakeholders said that they have crafts (%71) and material processing skills (%68), indicating that even though they do not possess CAD skills or digital fabrication capabilities (%27), they utilise other practices to fabricate parts and products – just not a digital fabrication. Furthermore, for all types of stakeholders, only around %40 indicated that they could access repair services, which is considerably low. Only around one-third of value creation-for-self stakeholders indicated that they sell their used products, and only around one-third of them indicated that they use products with others (i.e. shared use). Finally, only %34 of prosumers/makers/DIY-ers indicated that they openly share design knowledge, which is considerably low and indicates that design knowledge sharing is simply not preferred by these stakeholders.

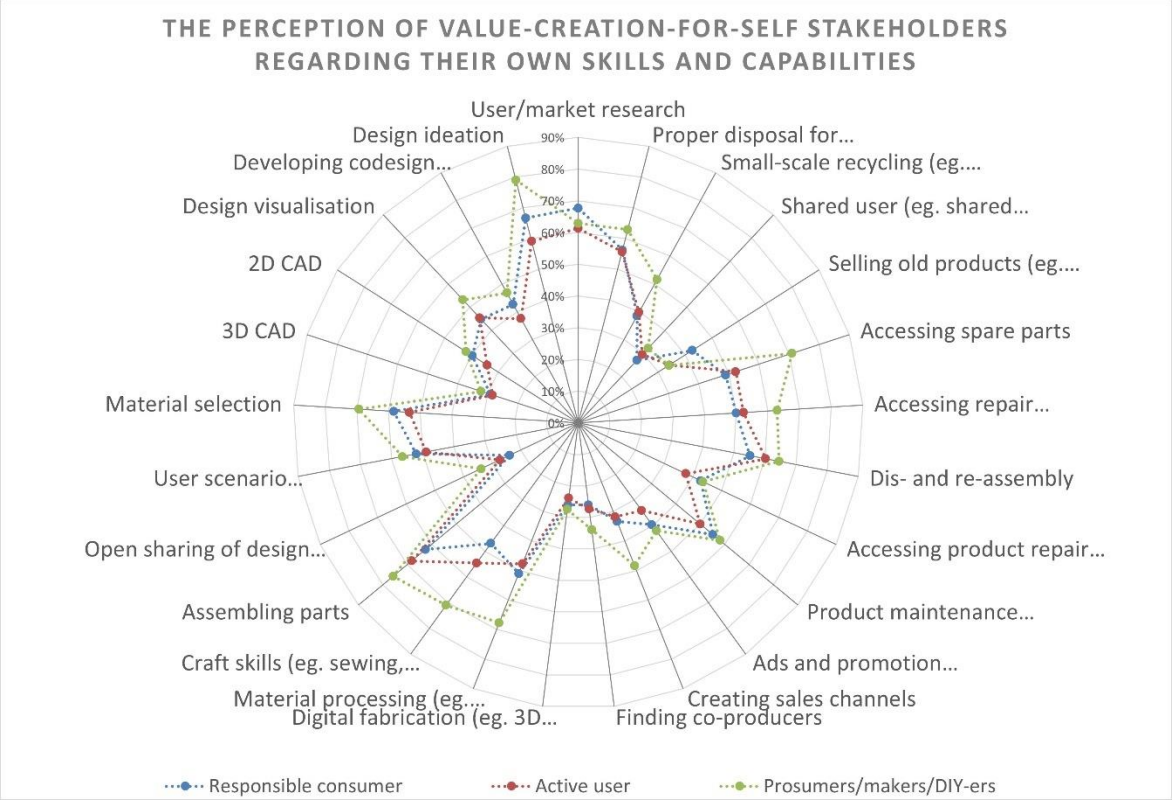


Figure 2. The perception of value-creation-for-self stakeholders regarding their own skills and capabilities

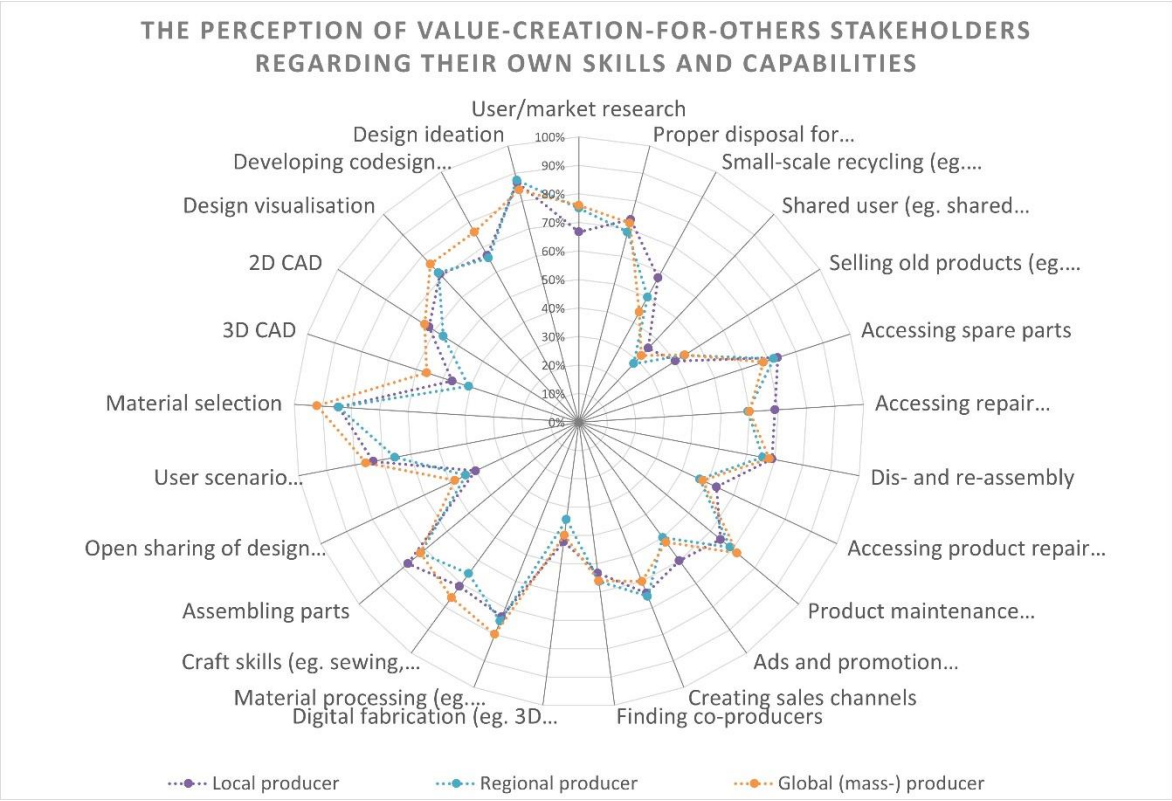


Figure 3. The perception of value-creation-for-others stakeholders regarding their own skills and capabilities

The perception of value-creation-for-others stakeholders (i.e. local, regional and global/mass producers) regarding their individual skills and capabilities are comparatively – and expectedly – higher compared to value-creation-for-self stakeholders on all fronts (Figure 3). These stakeholders engage in open design knowledge sharing more (around %45), which was unexpected and might indicate increased adoption of open innovation practices for these stakeholders. Local producers differentiate from others in terms of small-scale recycling practices (%58), most probably due to craftspeople participants of the survey. Interestingly, digital fabrication skills and capabilities are unexpectedly lower for all value-creation-for-others stakeholders as well (around %40). This might indicate that digital fabrication technologies have still not been disseminated much, and their opportunities are yet to be explored in Turkey. Around %40-45 of these stakeholders indicated that they sell their old products, however, this is about participants' personal behaviours rather than a company-level strategy.

3.2. Roles and Capabilities of value-creation-for-self stakeholders

When asked about the forms their participation can take in distributed production settings, the value-creation-for-self stakeholders (i.e., responsible consumers, active users, prosumers/makers/DIY-ers) were presented with a list of forms of participation introduced in *Section 2.1 - Mapping knowledge, skills and capabilities of stakeholders* in multiple response questions. The list was revised to be more explanatory and sometimes with examples to ensure proper communication of each item to the survey respondents. Table 8 presents the distribution of responses to this question, both in the number of respondents and in percentages.

Table 8. Value-creation-for-self stakeholders' perceptions of forms of participation in the distributed production of electrical household appliances

	Responsible consumer		**Active user**		**Prosumer/maker/DIY-er**	
	(out of 96)	*(%)*	*(out of 88)*	*(%)*	*(out of 62)*	*(%)*
Participating in user research and sharing my user experience	66	69%	60	68%	38	61%
Leaving positive or negative comments on the use of the product over the Internet	74	77%	62	70%	37	60%
Co-creating part and product ideas together with the design team	40	42%	36	41%	36	58%
Developing different part and product design alternatives	45	47%	43	49%	40	65%

	Responsible consumer		Active user		Prosumer/maker/DIY-er	
	(out of 96)	*(%)*	*(out of 88)*	*(%)*	*(out of 62)*	*(%)*
Designing additional parts (such as accessories) to the part and product designs that emerge at the end of the design process	33	34%	32	36%	34	55%
Altering designs according to my needs and preferences and creating new designs.	35	36%	36	41%	34	55%
Sharing my own designs open-source along with drawings, models, etc. files	21	22%	21	24%	23	37%
Assembling the designed and produced parts	36	38%	43	49%	30	48%
Assembling the designed and produced parts with different products and parts	24	25%	29	33%	26	42%
Producing additional parts (such as accessories)	26	27%	25	28%	30	48%
Producing the designed parts and products	27	28%	26	30%	27	44%
Producing my own adapted designs	30	31%	32	36%	35	56%
Maintaining the products I use (e.g. cleaning, filter replacement, etc.)	56	58%	47	53%	33	53%
Having the products repaired with repair services	44	46%	34	39%	24	39%
Repairing the products by myself	46	48%	51	58%	45	73%
Selling the products I use second-hand	38	40%	29	33%	19	31%
Sharing products with others	26	27%	27	31%	18	29%
Upgrading the products when my needs change	45	47%	43	49%	35	56%
Recycling the products I use	52	54%	49	56%	36	58%
Recycling the parts I have and using their materials (e.g. metal, glass, plastic) to produce other parts	37	39%	38	43%	39	63%

The results presented in Table 8 differ from the definitions of value-creation-for-self stakeholders derived from the literature review (see deliverable 3.1) in certain aspects, as presented below:

Result 1. Firstly, no form of participation was selected by all responsible consumers (RC), active users (AU), or prosumer/maker/DIY-ers (PMD). The highest score was 'leaving positive or negative comments on the use of the product over the Internet' selected by 77% of responsible consumers. This indicates that, while there are many forms of participating identified for each type of value-creation-for-self stakeholders, in reality, these stakeholders do not/would not

participate in distributed value creation networks of electrical household appliances in all the forms of participation.

Result 2. Open-source sharing of their own designs was considerably low for RC (22%), AU (24%) and PMD (%37), which is in line with the literature on open design. There can be many reasons for not sharing designs, including the amount of effort required to digitise design knowledge on physical parts, perceptions of their own designs (e.g. not good enough to share, too good to be openly shared), lack of a community to share them for, and so on.

Result 3. Regarding repair practices, 'having the products repaired with repair services' lowers from 46% of RC to 39% of AU and 39% of PMD. In turn, 'repairing the products by myself' rises from 48% of RC to 58% of AU and 73% of PMD. What is interesting is that 26% of RC, 25% of AU and 32% of PMD selected both options for repair. This means that 32% of RC, 28% of AU and 20% of PMD neither get their electrical household appliances repaired nor do they repair those products themselves.

Result 4. 'Selling the products I use second-hand' lowers from 40% of RC to 33% of AU and 31% of PMD. This might indicate various things, such as (a) AU and PMD use electrical household appliances until they are in no shape for second-hand use, (b) AU and PMD alter these products to a point that they do not look 'original' enough to be favoured in the second-hand market, or (c) AU and PMD alter these products according to their own needs and preferences that they would no longer respond to others' needs and preferences.

Result 5. Shared use of products is incredibly low for RC (27%), AU (31%) and PMD (29%), indicating that value-creation-for-self stakeholders mostly do not consider electrical household appliances for shared use practices. This might be due to (a) a lack of people they would consider using such products in a shared manner, (b) the perception of these products as personally owned and used, or (c) shared use is not adopted generally in Turkey.

Figure 4 shows the answers to questions regarding the perception of the 'necessity' and 'access' to specific knowledge, skills and resources to partake in distributed value creation processes for each stakeholder. The distribution of answers and necessity and access points are shown on top of each other for each stakeholder (i.e. responsible consumers, active users, and prosumer/maker/DIY-ers), and they are placed one under the other for ease of reading the data. The data described is highlighted in grey and numbered in parallel to the narrative below.

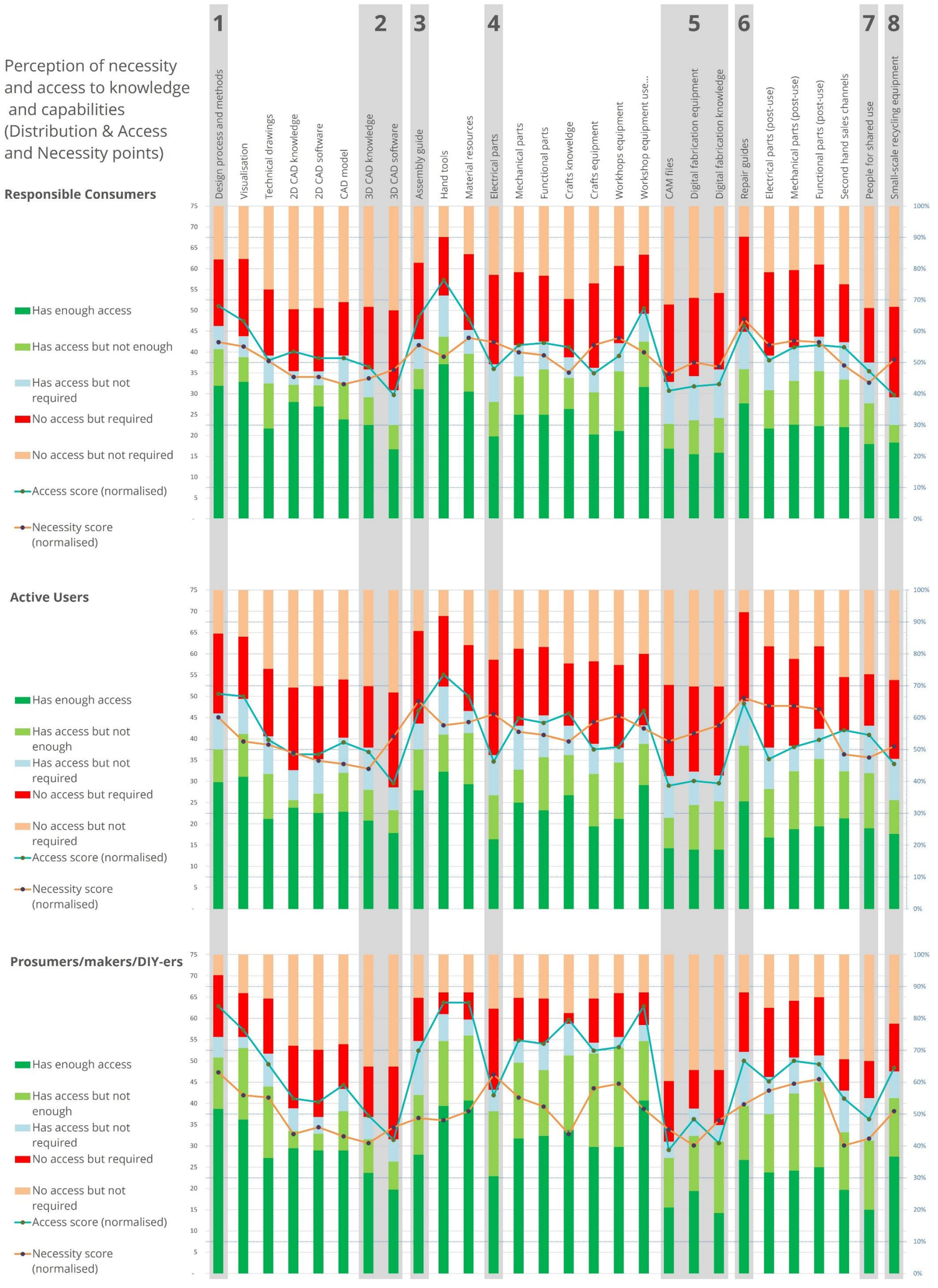


Figure 4. Perception of necessity and access to knowledge and capabilities for value-creation-for-self stakeholders (Distribution & Access and Necessity points)

Result 1. In terms of access to and necessity of knowledge on design processes and methods, prosumer/maker/DIY-ers (PMD) have higher 'access' to this knowledge compared to responsible consumers (RC) and active users (AU). This is an expected outcome, as PMD are engaging in the design and fabrication of things. What is interesting in this data is that, for all three types of stakeholders, *normalised necessity points* for knowledge of design processes and methods are very close (i.e. RC=42, AU=45, and PMD=47) and above average (i.e. average normalised necessity scores are RC=39, AU=42, and PMD=38). This indicates that *all* value-creation-for-self stakeholders find the knowledge of design processes and methods important and necessary for participating in distributed value creation networks (DVCN).,

Result 2. While more PMD – compared to AU – indicated that they have enough 3D CAD knowledge and access to 3D CAD software as expected, the *normalised necessity scores* for 3D CAD knowledge (i.e. AU=33 and PMD= 31) and 3D CAD software (i.e. AU=41 and PMD=34), and the *normalised access scores* for 3D CAD knowledge (AU=37 and PMD=37) and 3D CAD software (AU=30 and PMD=31) were too close. This might indicate that PMD are not necessarily deploying digital design and fabrication practices, where they create digital CAD models of their designs and might be utilising other skills and capabilities or directly design-through-fabrication. This is supported by Result 5 (below).

Result 3. The results about the 'assembly guides' were also interesting. The *normalised access scores* are RC=48, AU=47 and PMD=52. The scores of PMD and RC being close were interesting. However, the constitution of these scores differed for RC and PMD; %24 of RC indicated that they require assembly guides but don't have access to them, whereas only %13 of PMD indicated as such. On the other hand, %41 of RC indicated that they have enough access to assembly guides, compared to %37 of PMD. This analysis indicates that PMD, who design and fabricate their own parts and products, may not be requiring additional assembly guides to bring parts together.

Result 4. Access to electrical parts was indicated as required by all stakeholders (i.e. *normalised necessity scores* were above average and higher than *normalised access scores*). This is in contrast to material resources and the other types of parts (mechanical and functional) and indicates an overall inability to access electrical parts in general, although it is found necessary for participating in DVCN.

Result 5. The *normalised access scores* for CAM files, digital fabrication equipment, and digital fabrication knowledge were significantly lower than average for all value-creation-for-self stakeholders. For all cases, they were also lower than *normalised necessity scores* (which were also lower than average), except for PMD scores on digital fabrication equipment. This indicates an overall uninterest in digital fabrication; and that there are smaller groups of people

interested in digital fabrication but cannot access these knowledge and resources in Turkey. This is especially visible for PMD, as the scores for these stakeholders indicate that the people interested in digital fabrication do have access to digital fabrication equipment, but they find their access to CAM and digital fabrication knowledge lacking.

Result 6. At the post-use stage, *normalised access* and *necessity scores* for 'repair guides' present an interesting outcome. While the *normalised access scores* are very similar for all value-creation-for-self stakeholders (RC=46, AU=48, PMD=50), the *normalised necessity scores* differ (RC=48, AU=50, PMD=40), especially for PMD. This indicates that PMD may require repair guides *less* and supports the analysis in Result 3 for assembly guides.

Result 7. Shared use of products is an alternative business model component, also highlighted in *deliverable 3.1 - Review of alternative business models for open design and distributed production*. Finding and/or managing people for shared use is one of the resources highlighted in the survey; however, *normalised necessity scores* for all value-creation-for-self stakeholders are below average (RC=33, AU=36 and PMD=32). Furthermore, *normalised access scores* also remained below average except for active users (RC=35, AU=41 and PMD=36). This is an unexpected result since the researcher expected that access to people for shared use would be more for AU and PMD. %20 of PMD indicated that they have enough access to people for shared use, while %22 indicated that they have some access, but it is not enough. In that regard, the researcher surmises that shared use of products is not yet widely undertaken in Turkey, yet there are PMD who would be interested in shared use practices so long as they can find others interested.

Result 8. In terms of small-scale recycling equipment (e.g. Precious Plastics), *normalised necessity scores* were the same for all stakeholders (RC=38, AU=38, PMD=38), and *normalised access scores* were significantly lower, except for PMD (RC=30, AU=34, PMD=48). This data on access to small-scale recycling equipment is not surprising, however, it is interesting to see that all value-creation-for-self stakeholders attributed similar necessity to this equipment and indicates potential for adopting small-scale recycling practices at the individual scale.

While the above-mentioned results are drawn from the overall data, where participants could reflect their changing roles in a distributed value creation network (i.e. they could select more than one role), the researcher also analysed the data of participants who self-identified only with a single value-creation-for-self role (i.e. RC or AU or PMD), which yielded an interesting result regarding hand tools and material resources:

Result 9. For the participants who only identified as AU and not RC or PMD, there is a significant gap between *normalised access score* (*nas*=35) and *normalised necessity score* (*nns*=51) for hand tools. A similar gap is also observed for

material resources, for which *normalised access score* was *nas*=26 and *normalised necessity score* was *nns*=48. These indicate a sub-group of AUs that do not have enough access to necessary hand tools and material resources and requires further investigation.

The responses to items regarding the perception of the 'necessity' and 'access' to specific knowledge, skills and resources to partake in distributed value creation processes for each stakeholder were analysed using factor loading analysis, and revealed three dimensions. While the distribution of items among the three dimensions identified was mostly matching the conceptual categorisation of these items under design, production and post-use stages, as presented in Table 9, the order of importance revealed different foci.

Table 9. Factor loadings after Varimax rotation of value-creation-for-self items of necessary resources, skills and knowledge

Conceptual subcategory	Item	D1: Designing for digital fabrication	D2: Individualised post-use	D3: Secondary raw materials for individual fabrication
Design	2D CAD knowledge	0.916	0.122	0.103
Design	2D CAD software	0.909	0.126	0.072
Design	3D CAD knowledge	0.897	0.072	0.133
Design	3D CAD software	0.796	0.147	0.117
Design	CAD model	0.788	0.236	0.188
Design	Visualisation *	0.731	0.071	0.339
Design	Technical drawings	0.701	0.267	0.273
Design	Design process and methods *	0.584	0.233	0.415
Production/fabrication	Digital fabrication knowledge *	0.506	0.092	0.432
Post-use	Repair guides	0.213	0.793	0.056
Post-use	Functional parts (post-use)	0.185	0.791	0.050
Post-use	Electrical parts (post-use)	0.201	0.772	0.061
Post-use	Mechanical parts (post-use)	0.197	0.746	0.113
Production/fabrication	Electrical parts	0.059	0.680	0.256
Production/fabrication	Assembly guide	0.158	0.662	0.276
Production/fabrication	Material resources *	0.244	0.624	0.470
Production/fabrication	Mechanical parts *	0.154	0.619	0.427
Production/fabrication	Hand tools *	0.050	0.578	0.395
Production/fabrication	Functional parts *	0.330	0.508	0.449
Post-use	Second hand sales channels	-0.003	0.418	0.108
Post-use	People for shared use	-0.119	0.358	0.238
Production/fabrication	Crafts equipment	0.142	0.096	0.847
Production/fabrication	Crafts knowledge	0.271	0.119	0.777

Conceptual subcategory	Item	D1: Designing for digital fabrication	D2: Individualised post-use	D3: Secondary raw materials for individual fabrication
Production/fabrication	Workshop equipment *	0.387	0.260	0.642
Production/fabrication	Digital fabrication equipment *	0.316	0.157	0.591
Post-use	Small-scale recycling equipment *	0.058	0.367	0.584
Production/fabrication	Workshop equipment use knowledge *	0.381	0.356	0.569
Production/fabrication	CAM files	0.273	0.165	0.515

D1 - Designing for digital fabrication: The first dimension revealed was relevant to the design stage with all 'design' items, and an additional 'production/fabrication' item (i.e. digital fabrication knowledge). The reliability analysis for this dimension was α=0.935, and the removal of any item would reduce the reliability of the data. The ranking of items was an interesting outcome here, as CAD knowledge and software seem to affect this phase the highest, followed by 'Visualisation', 'Technical drawings', 'Design process and methods' and a production/fabrication item 'Digital fabrication knowledge'. This indicates the design process is mostly identified with its digital aspects and towards digital fabrication opportunities. This dimension for value-creation-for-self stakeholders is thus titled '*Designing for digital fabrication*' and is important to explore in future studies.

D2 - Individualised post-use: This dimension was impacted by all 'post-use' items, and additionally six production/fabrication dimensions related to resources. The reliability analysis for this dimension was α=0.903, and the removal of any item would reduce the reliability of the data. The order of importance indicates the importance of parts and components (electrical, mechanical, functional) in post-use processes. As the reader would notice, the parts were separately asked for production/fabrication and post-use stages, however, they are all significantly impacting this dimension, along with repair and assembly guides. These point towards an intention to adopt more individualised post-use processes by the value-creation-for-self stakeholders.

D3 – Secondary raw materials for individual fabrication: This dimension was highly impacted by all forms of fabrication (i.e. crafts, workshop, digital) items on the scale, and was also impacted by parts (i.e. functional, mechanical) and 'hand tools' items. The reliability analysis for this dimension was α=0.869, and the removal of any item would reduce the reliability of the data. The most impactful items were crafts equipment and knowledge. 'Small-scale recycling' – a 'post-use' item – was also highly affecting this dimension, confirming the result regarding the potential for adopting small-scale recycling and revealing that such recycling practices are perceived as part of the production/fabrication of parts and products at the individual scale.

3.3. Roles and Capabilities of value-creation-for-others stakeholders

When asked about the forms their participation can take in distributed production settings, the value-creation-for-others stakeholders (i.e., local, regional and global/mass producers) were presented with a list of forms of participation introduced in *Section 2.1 - Mapping knowledge, skills and capabilities of stakeholders* in multiple response questions. The list was revised to be more explanatory and sometimes with examples to ensure proper communication of each item to the survey respondents. Table 10 presents the distribution of responses to this question, both in the number of respondents and in percentages.

Table 10. Value-creation-for-others stakeholders' perceptions of forms of participation in the distributed production of electrical household appliances

	Local producers		**Regional producers**		**Global/mass producers**	
	(out of 45)	(%)	(out of 32)	(%)	(out of 25)	(%)
Obtaining information and opinions from other local and regional producers during the design process	30	67%	18	56%	13	52%
Obtaining information and opinions from active users and makers/prosumers during the design process	32	71%	24	75%	19	76%
Obtaining information and opinions from responsible consumers during design process	34	76%	21	66%	19	76%
Facilitating co-design process with other local and regional producers	28	62%	16	50%	13	52%
Facilitating co-design process with active users and makers/prosumers	34	76%	24	75%	19	76%
Facilitating co-design process with responsible consumers	35	78%	21	66%	17	68%
Updating your own product design based on parts designed and manufactured by active users and makers/prosumers	31	69%	20	63%	15	60%
Open-source sharing design information (e.g. drawing, CAD model, etc.) of the parts and products you produce	21	47%	14	44%	8	32%
Open-source sharing assembly/disassembly information (e.g. necessary tools, assembly parts, etc.) of the parts and products you produce	27	60%	17	53%	9	36%

	Local producers		Regional producers		Global/mass producers	
	(out of 45)	(%)	(out of 32)	(%)	(out of 25)	(%)
Open-source sharing production information (e.g. production method, material selection, supply chain, etc.) of the parts and products you produce	28	62%	18	56%	9	36%
Collaborating with other local and regional producers during production (e.g. some parts are produced by other producers, assembly takes place closer to consumption, etc.)	27	60%	16	50%	14	56%
Open-source sharing the repair processes of the parts and products you produce (e.g. fault detection, access to certain parts, etc.) publicly accessible	20	44%	13	41%	6	24%
Selling spare parts you produce as retail	12	27%	10	31%	7	28%
Refurbishing the parts and products you produce after use and selling them	22	49%	16	50%	12	48%
Selling parts with updated designs for upgrading	22	49%	17	53%	12	48%
Collecting and recycling the parts and products you produce	24	53%	16	50%	13	52%
Open-source sharing recycling information of the parts and products you produce (e.g. material conditions, local waste management information, etc.)	23	51%	14	44%	10	40%

The results presented in Table 10 yield interesting results regarding the differences among producers operating at different scales, sometimes matching and other times differing from the literature (see deliverable 3.1), as presented below:

Result 1. While all types of producers were similarly interested in obtaining information and opinions from AU and PMD, relatively more local producers (LP=67%) were interested in obtaining information and opinions from other local and regional producers (RP) during the design process. Also, relatively less RP (66%) was interested in obtaining information and opinions from RC, compared to LP (76%) and global/mass producers (GMP=76%).

Result 2. RP and GMP were more interested in facilitating co-design sessions with AU and PMD (RP=75%, GMP=%76) rather than RC (RP=66%, GMP=%68). Comparatively, more LP (%62) was interested in co-designing with RC. This was an interesting result that indicates an inclination to involve less RC and more AU and PMD into co-designing as the scale of production grows. This is in line with open innovation approaches, such as lead-user innovation, which

put emphasis on prosumers that design objects stemming from their own experiences and expert user opinions.

Result 3. GMP were not generally interested in sharing any knowledge/information about their design (32%), production (36%), assembly/disassembly (36%), and even repair (24%). While this indicates the prevalence of more traditional intellectual property rights (IPR) practices, the latter two were especially interesting as dis/assembly and repair information can be shared to outsource such practices while safeguarding the technological innovation behind the products.

Result 4. The above result is further explicated by the reluctance to supply spare parts in an accessible manner by all value-creation-for-others stakeholders (LP=27%, RP=31%, GMP=%28). The researcher believes this is highly relevant to electrical household appliances as a sector and hints at the focus on selling new products rather than offering opportunities for more widespread repair practices.

Result 5. In contrast to the situation with spare parts, nearly half of producers were interested in refurbishing old products for resale (LP=49%, RP=50%, GMP=48%), selling updated parts for upgrading (LP=49%, RP=53%, GMP=48%) and recycling parts and products they sell (LP=53%, RP=50%, GMP=52%). This was an interesting result affirming that producers of electrical household appliances perceive more (most probably economic) value in circular economy (CE) practices that they control, and hints at the fact they will probably not facilitate more widespread CE practices by external actors and value-creation-for-self stakeholders unless they are obliged to – further emphasising the importance of legislations like EU's Right-to-Repair.

Figure 5 shows the answers to questions regarding the perception of the 'necessity' and 'access' to specific knowledge, skills and resources to partake in distributed value creation processes for each stakeholder. The distribution of answers and necessity and access points are shown on top of each other for each value-creation-for-others stakeholder (i.e. local, regional, and global/mass producer), and they are placed one under the other for ease of reading the data. The data described is highlighted in grey and numbered in parallel to the narrative below.

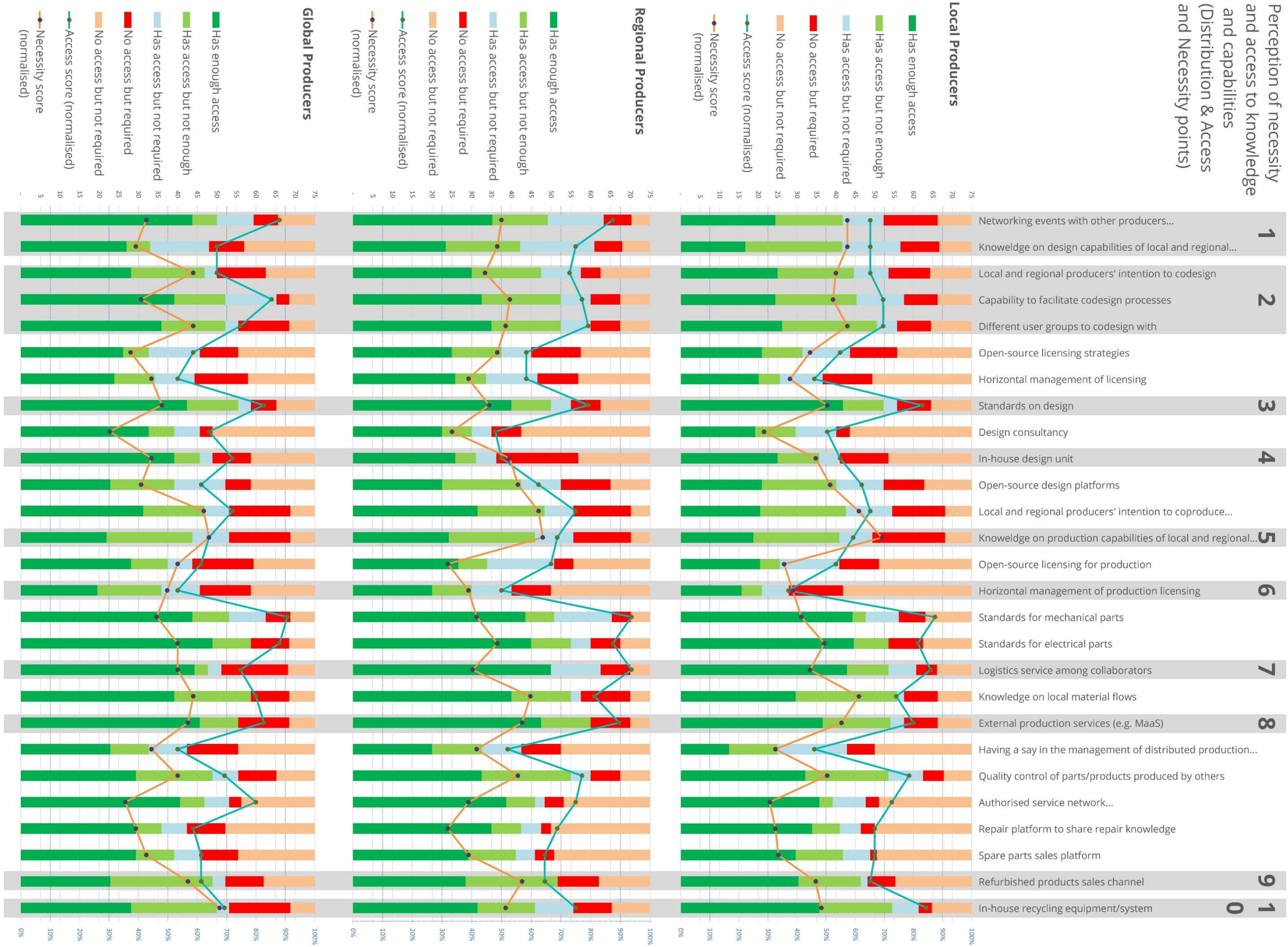


Figure 5. Perception of necessity and access to knowledge and capabilities for value-creation-for-others stakeholders (Distribution & Access and

Result 1. Regarding reaching to potential collaborators in distributed value creation networks through networking events, local producers (LP), regional producers (RP) and global/mass producers (GMP) all indicated that they have 'access' to such events. Similarly, all three indicated that they have knowledge on LPs' and RPs' design capabilities. This is also reflected in the normalised access and necessity scores, as for all stakeholders *normalised access scores* were higher than *normalised necessity scores*. However, for LPs, the gaps between *normalised access score* (*nas*=49) and *normalised necessity score* (*nns*=43) for networking events and for knowledge on LPs' and RPs' design capabilities were significantly smaller compared to RPs and GMPs. This indicates that LPs have *limited* knowledge on potential collaborators in distributed value creation networks and their responses indicate that they mostly need more access to both networking events and knowledge on other LPs' and RPs' design capabilities.

Result 2. Regarding the capability to facilitate codesign processes with other stakeholders, GMPs' *normalised access score* (*nas*=64) was significantly higher than *normalised necessity score* (*nns*=31). However, the gap shrank for knowledge of LPs' and RPs' intentions to codesign (*normalised access score*=50, *normalised necessity score*=44) and connecting with different groups (i.e. value-creation-for-self stakeholders) to codesign with (*normalised access score*=56, *normalised necessity score*=44). This is an interesting outcome in the sense that GMPs believe they have the capability to facilitate codesign process; however, they do not turn this into an equal capacity since they do not connect with potential collaborators. This can indicate that (a) GMPs do not adopt open innovation practices even though they have the capability, or (b) GMPs intend to adopt open innovation practices and increased their capability in this regard but cannot connect with LPs and RPs.

Result 3. Regarding standardisation of part, component and product designs, *normalised access scores* were significantly higher than *normalised necessity scores* for all stakeholders. Most of the stakeholders also indicated that they have enough access to knowledge of standards on designs (LP=%56, RP=%53, and GMP=%57). While it is not a surprising outcome for producers to be knowledgeable about different standards in the industry, it is also in tension with the literature calling for more plug-and-play solutions, standardisation and cross-compatibility of part and component designs in distributed production. Future studies should question if and how standardisation affects the capability to partake in distributed value creation networks more specifically, and separately for value-creation-for-self and value-creation-for-others stakeholders – since the latter may not regard further standardisation as crucial for partaking in distributed value creation networks.

Result 4. In terms of having an in-house design, *normalised necessity score* (*nns*=40) was higher than *normalised access score* (*nas*=38) for RP. This indicates that design capabilities are important for these stakeholders and they require dedicated a design unit actively participating in their operations. For LP, however, this was reversed (*normalised necessity score*=35, *normalised access score*=41). This may indicate that LP are either content with their existing design capabilities or do not emphasise the importance of design in their operations. The latter is supported by the percentage of respondents marking 'no access but not required' to the *in-house design unit* (%29) and *design consultancy* (%42). While it indicates an interesting point regarding the design processes of LP, it requires further investigation in future studies.

Result 5. Knowledge on production capabilities of local and regional producers surfaced as an issue for LP, as the *normalised necessity score* (*nns*=52) was significantly higher than *normalised access score* (*nas*= 44). While the *normalised necessity scores* of RP (*nns*=48) and GMP (*nns*=48) were also high and well above average, the *normalised access score* for GMP (*nas*=48) was matching and the *normalised access score* for RP (*nas*=52) was higher. This indicates that LP, at least in Turkey, were not aware of potential collaborators' production capabilities enough to form expansive distributed networks. This emerges as a barrier against the localisation of production, as well as distributed value creation.

Result 6. The *normalised access scores* for horizontal management practices of production licensing were significantly below the average for all value-creation-for-others stakeholders (LP=28, RP=38, GMP=40), but for different reasons. While there are more RP (%13) and GMP (%22) indicating that their participation in horizontal management is not enough, compared to LP (%7), there are significantly more LP (%44) indicating that such participation is not required, compared to RP (%33) and GMP (%22). This was an interesting result that might indicate either the lack of proper production licensing practices in LP or the production of original designs by LP in general. For the former, it might point to IPR issues stemming from unrecognised infringement. For the latter, however, it might indicate that LP do not bother with existing IPR mechanisms and prefer to operate outside it – rather than finding a more democratic way of managing the IPR. This might constitute immense barriers against distributed production practices since LP do not adopt a licensing practice that would enable them to participate in distributed value creation networks without the fear of hi-jacking of their designs by other stakeholders.

Result 7. The literature review on distributed production (see deliverable 3.1) revealed logistics as an important aspect of creating resilient value chains; however, more than half of LP (%57), RP (%67) and GMP (%59) indicated that they have

enough access to logistics services among collaborators during production. The researcher suspects this might be specific to Turkey with the rising accessibility of courier services and logistics becoming an integrated part of everyday life – especially during the pandemic period. However, this also hints at the reliability of existing logistics services which LP, RP and GMP found satisfactory.

Result 8. Regarding external production services (e.g. manufacturing-as-a-service), all value-creation-for-others stakeholders had significantly higher *normalised access scores* (LP=60, RP=67, GMP=62) compared to *normalised necessity scores* (LP=41, RP=43, GMP=43) – which are way above average *normalised necessity scores* for each stakeholder type. This indicates that all these stakeholders are utilising such services at certain levels and find external production services important for operations. This can be regarded as promising for distributed production at all scales (i.e. local, regional and global).

Result 9. The responses regarding accessibility and necessity of sales channels for refurbished products yielded interesting results as well. The *normalised necessity score* for LP (*nns*=35) was well below compared to RP (*nns*=43) and GMP (*nns*=43), whereas *normalised access scores* were similar (LP=49, RP=48, GMP=46) and above average for each stakeholder. This is also visible in the response distribution for refurbished product sales channels, where only %21 of LP responded 'has access but not enough responses' compared to %31 of RP and %35 of GMP. This indicates that there are existing sales channels for refurbished products utilised by all value-creation-for-others stakeholders, yet these channels are not as satisfactory for RP and GMP. This is an interesting outcome for further investigation, especially regarding the expectations of RP and GMP from refurbished product sales channels to reveal opportunities and barriers for refurbishment in general.

Result 10. In-house recycling accessibility yielded interesting results as well, *normalised access score* of LP (*nas*=63) was significantly greater than RP (*nas*=56) and GMP (*nas*=52). Furthermore, the *normalised necessity score* of GMP (*nns*=51) was significantly greater than LP (*nns*=36) and RP (*nns*=39). This data hints at various possibilities in terms of recycling operations for different stakeholders. For LP, the higher access score might indicate that they actively utilise the recycling of materials in their operations. LP consist of stakeholders that undertake craft production techniques and/or digital fabrication processes, and that produce things on lower volumes and/or on-demand. Hence, the higher recycling practices can be linked to these more flexible production/ fabrication practices enabling them to (re-)introduce materials to processes where possible. On the other hand, the higher necessity score of GMP is visible in the response distribution as %29 of GMP

indicated they don't have *enough* access to in-house recycling, and %21 indicated they have no access to in-house recycling practices, but they are required. This indicates an intention towards adopting in-house recycling practices for GMP, which is a promising outcome in terms of environmental sustainability.

While the above-mentioned results are drawn from the overall data, where participants could reflect their changing roles in a distributed value creation network (i.e., they could select more than one role), the researcher also analysed the data of participants who self-identified only with a single value-creation-for-others role (i.e. LP or RP or GMP) revealing the below result:

Result 11. For the participants who only identified with a single value-creation-for-others role (i.e. LP or RP or GMP), the *normalised necessity scores* for almost all collaboration-related knowledge and capabilities (at design, production and post-use stages) were higher than the *normalised access scores.* This indicates that there might be a correlation between operating at multiple scales (i.e. local, regional and/or global) and the potential for collaboration. While this result may not sound surprising to the reader, it might be worth investigating if this relation is causal for each stage (i.e., design, production and post-use).

The responses to items regarding the perception of the 'necessity' and 'access' to specific knowledge, skills and resources to partake in distributed value creation processes for each stakeholder were analysed using factor loading analysis, and revealed three dimensions. Unlike value-creation-for-self stakeholders, the distribution of items among the three dimensions identified was not matching the conceptual categorisation of these items under design, production and post-use. Rather the dimensions all included 'design' items (Table 11) indicating different ways of operation for different foci, namely *(De-)centralizing production, Codesigning post-use,* and *Open-source licensing & Collaborative production*.

Table 11. Factor loadings after Varimax rotation of value-creation-for-others items of necessary resources, skills and knowledge

Conceptual subcategory	Item	D1: (De-)centralizing production	D2: Codesigning post-use	D3: Open-source licensing & Collaborative production
Production / fabrication	Standards for electrical parts	0.835	0.074	0.214
Production / fabrication	Logistics service among collaborators	0.802	0.248	0.181
Production / fabrication	Standards for mechanical parts	0.800	0.187	0.240
Production / fabrication	Knowledge on local material flows *	0.733	0.085	0.391
Production / fabrication	External production services (e.g. MaaS) *	0.668	0.265	0.385

Conceptual subcategory	Item	D1: (De-)centralizing production	D2: Codesigning post-use	D3: Open-source licensing & Collaborative production
Design	Open-source design platforms	0.605	0.170	0.283
Design	In-house design unit	0.563	0.157	0.067
Production / fabrication	Quality control of parts/products produced by others *	0.558	0.468	0.260
Design	Standards on design *	0.445	0.410	0.133
Design	Networking events with other producers *	0.143	0.682	0.347
Design	Different user groups to codesign with *	0.516	0.679	-0.014
Design	Knowledge on design capabilities of local and regional producers *	0.379	0.640	0.171
Design	Capability to facilitate codesign processes *	0.485	0.638	0.072
Post-use	Refurbished products sales channel	0.129	0.614	0.243
Post-use	In-house recycling equipment/system	0.093	0.591	0.065
Post-use	Spare parts sales platform *	-0.031	0.571	0.466
Design	Local and regional producers' intention to codesign *	0.413	0.559	0.252
Post-use	Repair platform to share repair knowledge *	0.225	0.546	0.459
Post-use	Authorised service network *	0.168	0.520	0.420
Design	Design consultancy *	-0.055	0.466	0.448
Production / fabrication	Horizontal management of production licensing	0.278	0.056	0.824
Production / fabrication	Open-source licensing for production	0.286	0.144	0.814
Design	Horizontal management of licensing	0.186	0.223	0.688
Production / fabrication	Local and regional producers' intention to coproduce *	0.395	0.317	0.674
Production / fabrication	Having a say in the management of distributed production network	0.147	0.130	0.660
Production / fabrication	Knowledge on production capabilities of local and regional producers *	0.513	0.185	0.631
Design	Open-source licensing strategies *	0.329	0.254	0.448

D1 – (De-)centralizing production: This dimension is highly affected by the standardisation of designs and electrical and mechanical parts items, as well as 'logistics among stakeholders', 'external manufacturing services', 'open-source design platforms', 'quality control of parts/products produced by others', and finally, 'in-house design unit' items. The reliability analysis for this dimension was α=0.908, and the removal of any item would reduce the reliability of the data. These encapsulate the currently spreading open

innovation practices where certain stages of design and production are externalised whereas centralisation of designs through in-house design departments is present. This is a crucial tension revealed, where the producers show interest in opening up their design, innovation and production practices and decentralising certain aspects of these processes, yet they also find in-house design units necessary for such collaborative processes. This dimension reveals an area of research programme regarding which stages are perceived as capable to be opened and collaboratively enacted and which stages there emerge the need for centralising decision-making.

D2 – Codesigning post-use: This dimension is mainly affected by 'design' items relevant to codesigning with value-creation-for-self stakeholders as well as local and regional producers, and all 'post-use' items. The reliability analysis for this dimension was α=0.891, and the removal of any item would reduce the reliability of the data. This brings forward a significant relation between collaborative design processes on post-use processes, may it be repair, refurbishing, or recycling. It also reveals the importance of codesigning for the creation of post-use platforms (i.e., repair, spare parts, refurbished products), for which the producers might require capabilities of codesign facilitation and/or external design consultancy services. This points to an interesting potential change regarding the roles of design consultancy firms – and the design practice in general – where professional designers will increasingly need more collaboration skills, knowledge and capabilities to respond to the needs of producers to tackle more complex problems.

D3 – Open-source licensing & Collaborative production: The third dimension is related to diffused networks of distributed value creation managed through open-source design and production licensing and resultant practices of collaborative production. The reliability analysis for this dimension was α=0.887, and the removal of any item would reduce the reliability of the data. This dimension is affected by horizontal licensing practices as well as local and regional producers' intentions for collaborative production. This dimension demonstrates the potential of alternative open-source production and design licensing strategies and how these can be deployed for horizontal management of distributed value creation networks. This is in line with the initial exploratory goals of DF-MOD in terms of formalising distributed collaborative practices through alternative, open design-led businesses.

3.4. Collaborators of value-creation-for-others stakeholders

In the survey, the value-creation-for-others were also asked about other types of stakeholders they would need to collaborate with to carry out the roles they identified for themselves in distributed value creation networks. They were presented with a list of potential stakeholders loosely covering potential collaborators, as presented in the first column of Table 12. There was also an option for 'no need for collaboration' in the list.

Some results were in support of responses to previous questions, and others were interestingly diverged, as presented below:

Table 12. Potential collaborators in distributed value creation settings

	Local producers		**Regional producers**		**Global/mass producers**	
	(out of 45)	*(%)*	*(out of 32)*	*(%)*	*(out of 25)*	*(%)*
No need for collaboration	9	20%	6	13%	3	7%
Responsible consumers & active users	33	73%	23	51%	21	47%
Prosumers and makers	25	56%	19	42%	14	31%
Local producers (crafts persons, maker entrepreneurs, fab labs)	28	62%	19	42%	18	40%
Local repair persons	20	44%	16	36%	12	27%
Local waste management companies	12	27%	7	16%	8	18%
Regional producers	24	53%	17	38%	16	36%
Global/mass producers	18	40%	15	33%	15	33%
Logistics companies	26	58%	18	40%	14	31%
Local tradespeople and distributors	26	58%	18	40%	12	27%
Large stores and other sales channels	19	42%	15	33%	10	22%
Civil society organisations (e.g. Sectoral or professional associations)	14	31%	11	24%	11	24%
Policymakers (e.g. Chambers, unions, ministries, municipalities)	11	24%	7	16%	8	18%

Result 1. Although on the lower end, 20% of LP, 13% of RP and 7% GMP indicated that there was *no need for collaboration* with any other stakeholders. This result is actually promising and indicates that collaboration is regarded as important for the majority of value-creation-for-others stakeholders.

Result 2. LP put more emphasis on collaboration overall with all types of stakeholders, compared to RP and GMP, despite 20% of LP indicating that there is no need for collaboration. This indicates that while there are some LP who does not collaborate in practice, the remainder were actually more interested in collaboration with all other types of stakeholders. The reasons why some LP remain resistant to collaboration whereas the majority of LP are enthusiastic about it is worth further exploration, especially for distributed value creation networks.

Result 3. While RP and GMP mostly put emphasis on codesign processes with PMD (see section 3.3), it seems some of them do not regard PMD as collaborators. %42 of RP and 31% of GMP selected prosumers and makers as collaborators, as opposed to 75% of RP and 76% GMP indicated that they can facilitate co-design processes with active users and makers/prosumers. This indicates that although RP and GMP believe they have the capacity to facilitate co-design processes, they do not adopt codesigning as often in practice.

Result 4. Local waste management companies were generally considered as collaborators by all value-creation-for-others stakeholders (LP=27%, RP=16%, and GMP=18%). This might be in support of previous findings regarding accessibility and necessity of in-house recycling systems – for which GMP scored especially higher *normalised necessity score* (*nns*=51) – and indicate that recycling of parts and products might be perceived as a practice that needs to be done by the producers themselves, including the logistics of end-of-life parts and products.

Result 5. LP showed greater interest in collaborating with logistics companies and local tradespeople (58%) compared to RP and GMP, which is a reflection of existing distribution channels owned by, or in partnership with, RP and GMP. However, this emphasises the importance of logistics companies and local tradespeople for local producers and underlines the key role of these stakeholders in distributed value creation networks.

Result 6. Civil society organisations such as sectoral or professional associations, (LP=31%, RP=24% 11, and GMP=24%) and policymakers such as chambers, unions, ministries and municipalities (LP=24%, RP=16%, GMP=18%) scored comparatively low as potential collaborators. This brings to mind if this is about electrical household appliances or if this is true for other sectors as well.

4. Conclusion

This deliverable aims to explore the opportunities for and barriers against alternative ways of collaboration and doing business facilitated through mass-produced open design parts and products, which can enable the recapture of added value of parts and components within a circular economy through the active involvement of value-creation-for-self (i.e., responsible consumers, active users, prosumers/ makers/DIY-ers) and value-creation-for-others (i.e., local, regional, global/mass producers) stakeholders in their design, production and post-use within distributed value creation networks. The deliverable presents the results of a survey with 166 valid participants, conducted in Turkey. Considering the hybrid roles individuals can take in distributed value creation settings, the survey allowed respondents to select more than a single type of stakeholder. 96 of the respondents identified as responsible consumers, 88 as active users, 62 as prosumers/makers/DIY-ers, 45 as local producers, 32 as regional producers, and 25 as global/mass producers, with many overlaps.

4.1. Existing vs required capabilities

Value-creation-for-self stakeholders generally lack CAD skills and knowledge overall; however, this lack is especially surprising for prosumers/makers/DIY-ers. This is also affecting their forms of participation in design and fabrication processes of electrical household appliances, as they are not necessarily deploying digital design and fabrication practices. Rather, they tend to utilise crafts and material processing skills to fabricate parts and products – just not digital fabrication. This is an important consideration regarding prosumers and makers in Turkey, especially in facilitating their participation in distributed value creation networks.

There seems to be an overall uninterest in digital fabrication; and there are smaller groups of people interested in digital fabrication but cannot access the knowledge and resources in Turkey. This is especially visible for prosumers/makers/DIY-ers, who seem to have access to digital fabrication equipment, but find their access to CAM and digital fabrication knowledge lacking. *Designing for digital fabrication* emerged as a dimension, affected by 'design' items and the 'digital fabrication knowledge' item. Together these indicate an overall need to address the knowledge gap on digital fabrication, especially in Turkey and regarding electrical household appliances.

Regarding post-use processes of electrical household appliances in Turkey, only 40% of value-creation-for-self indicated that they could access repair services, which is considerably low. In turn, these stakeholders turn towards self-repair practices where possible. Nearly half of responsible consumers are interested in doing so in distributed value creation networks, and this rises up to three quarters of prosumers/makers/DIY-

ers who have comparatively more skills and resources. However, a considerable number of value-creation-for-self stakeholders indicated that they wouldn't get electrical household appliances repaired when broken or repair these themselves even in distributed value creation settings. This reveals the persistence of perceptions regarding the repair of this product group (Cooper, 2010), despite the recent rise of Right-to-Repair around the world in the past decade. Other alternative forms of consumption, such as shared use of products and using second-hand products do not seem to be favoured among value-creation-for-self stakeholders. However, there seems to be a sub-group of prosumers/makers/DIY-ers who would be interested in shared use so long as they can find others to do so, e.g. a community for shared use. These also explicate the *individualised post-use* dimension revealed through factor loading analysis.

An interesting outcome about recycling is that value-creation-for-self stakeholders attributed similar necessity to small-scale recycling equipment and indicates potential for adopting recycling practices at the individual scale. This is also reflected in the final dimension for value-creation-for-self stakeholders, *secondary raw materials for individual fabrication*, which was significantly affected by most 'production/fabrication' items along with 'small-scale recycling equipment'. This reveals an important future research and practice direction, especially individual recycling opportunities for individualised production/fabrication processes.

Regional and global/mass producers were more interested in design research and codesign practices with active users and prosumers/makers/DIY-ers rather than responsible consumers, indicating the adoption of open innovation practices similar to e.g. lead-user innovation (von Hippel, 2006). This was also revealed as a dimension '*(De-)centralizing production*' through factor loading analysis. Whereas local producers were also interested in engaging responsible consumers in codesigning, suggesting a more grassroots approach is being deployed. However, local producers also indicate that they cannot reach value-creation-for-self stakeholders as much as they would like and that their capabilities for facilitating co-design processes. Conversely, global/mass producers seem to be more capable of facilitating co-design processes, but their interest to deploy codesign practices is lower.

Most value-creation-for-others stakeholders indicated the use of external production services (e.g. manufacturing-as-a-service) at certain levels, indicating that this is normal practice for producers. The researcher suspects that for global/mass producers this might be not as localising as it sounds, and this externalisation of production can be in other regions or countries that collectively centralise some stages of production in certain geographies. However, for local and regional producers, higher accessibility to such services might be an indication of how they utilise mass-produced parts and components in their own production processes similar to what is suggested by distributed value creation networks. Additionally, value-creation-for-others stakeholders mostly indicated that they have enough access to logistics services among these stakeholders. This is in support of the expanding roles logistics companies can take in

the production/fabrication of parts and components locally and closer to where such parts are required (e.g., González-Varona et al., 2020; Pilz et al., 2020; Purvis et al., 2020).

In terms of post-use practices, the results revealed that value-creation-for-others stakeholders utilise existing sales channels for refurbished products, yet these channels are not as satisfactory for regional and global/mass producers. This was an interesting outcome highlighting a potential gap in the literature regarding the needs and expectations from 'refurbished' sales channels. On the other hand, comparatively more local producers seem to adopt recycling practices, and regional and global/mass producers indicate a necessity for in-house recycling facilities. The factor loading analysis indicated an interesting relation between codesigning and post-use practices, namely *codesigning post-use* as an important dimension. This dimension, along with the *individualised post-use* dimension for value-creation-for-self stakeholders, should be further explored especially in relation to revealing novel design, production/fabrication and post-use practices for all types of stakeholders.

4.2. Opening design knowledge and collaborative intentions

Only %34 of prosumers/makers/DIY-ers indicated that they have the capability to openly share design knowledge, which is considerably low. This was reflected in their forms of participation as well, for which only 37% of prosumers/makers/DIY-ers indicated 'open-source sharing of their own designs' as a practice. There can be many reasons for not sharing designs, including the amount of effort required to digitise design knowledge on physical parts, perceptions of their own designs (e.g. not good enough to share, too good to be openly shared), lack of a community to share them for, and so on (Bakırlıoğlu & Kohtala, 2019). However, this also signals that what is theoretically acknowledged regarding the creation of open design knowledge by prosumers/makers/DIY-ers is not enacted in real life as effectively, bringing forth questions regarding the potentials for truly distributed value creation networks. This remains the largest barrier against democratising and localising design, production and post-use through open design knowledge sharing.

The survey revealed that value-creation-for-others stakeholders engage in open design knowledge sharing more, which was unexpected and might indicate increased adoption of open innovation practices for these stakeholders. However, the level of openness is questionable as well – to what extent do these stakeholders open their designs and which parts do they keep closed? This was visible through the factor loading analysis as well, where two distinct dimensions emerged, namely *(de-)centralizing production* and *open-source licensing & collaborative production*. This is a crucial distinction, especially when thinking about alternative open design-led business models that would be able to economically sustain themselves. While it might be true that collaborative design and

production practices have become more widespread over the years, value-creation-for-others stakeholders still prefer to focus these collaboration practices to certain stages (e.g. codesigning) and certain stakeholders (e.g. prosumers), while not engaging other stakeholders and at other stages.

This might shed some light on why the value-creation-for-others stakeholders did not generally see much need for horizontal management of production licensing. It was visible that these stakeholders did not engage in horizontal management of production licensing but they were not interested in either. This was exceptionally clear for local producers, who either did not see value in novel IPR mechanisms to safeguard their designs while opening them or prefer to utilise traditional IPR mechanisms to ensure their exclusivity in producing their own designs. Either way presents barriers to the theorised resilience of distributed production and value creation, as such licensing depends on one-on-one, unique agreements that are different in each connection between two nodes of value creation rather than an encompassing code-of-conduct managing the whole value creation network.

4.3. Implications for future work

The outcomes of WP4 are important when analysing novel open design-led business models explored in the following work package 5, through which the participants will envision distributed value creation network settings that operate at various scales and value-creation-for-self and value-creation-for-others stakeholders can partake. The existing capabilities of stakeholders, their preferred forms of participation and the knowledge, skills and resources they need and/or have access to will inform the analysis and discussion on their applicability in real-world settings.

Additionally, there are many research directions emerging from the survey outcomes, some of which are being explored in literature and others are novel. For value-creation-for-self stakeholders, *designing for digital fabrication* is prominent and is widely being discussed especially in the literature related to the maker movement. *Secondary raw materials for individual fabrication* is also explored in recent research projects on self-sufficient cities and local circular economies, such as Pop-Machina; however, this area of focus is currently emerging with the novel, small-scale recycling technologies currently being developed and increasingly becoming accessible. *Individualised post-use* is also gaining more attention in literature, especially on repair practices through the Repair Manifesto, and successful projects such as the Repair Cafes and Restart project. This needs to be further explored following prominent work to include other possibly individualised post-use practices of reuse (e.g., the Use-to-Use project), refurbishing (e.g., Re-done appliances) and recycling (e.g., Precious Plastics). For value-creation-for-others stakeholders, there seems to be a divide between *(de-)centralised production* that is seemingly more focused on open innovation practices with more centralised tendencies of control at design and production stages and *open-source licensing & collaborative production* that focuses more on horizontal management of design and

production stages among distributed value creation stakeholders. While this tension is being explored in literature, how it will be overcome remains an open question hard to dismantle. However, there seems to be a novel area of research with regards to *codesigning post-use* – and in line with the *individualised post-use* focus of value-creation-for-self stakeholders – that puts more emphasis on value-creation-for-others stakeholders' inclination towards exploring alternatives for post-use practices along with other collaborators' involvement from the beginning.

References

Bakırlıoğlu, Y., & Kohtala, C. (2019). Framing Open Design through Theoretical Concepts and Practical Applications: A Systematic Literature Review. *Human-Computer Interaction*, *34*(5–6), 389–432. https://doi.org/10.1080/07370024.2019.1574225

Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best Practices for Developing and Validating Scales for Health, Social, and Behavioral Research: A Primer. *Frontiers in Public Health*, *6*, 149. https://doi.org/10.3389/FPUBH.2018.00149

Cooper, T. (2010). Longer Lasting Products: Alternatives To The Throwaway Society - Google Libros. In *GROWER*. Gower. https://books.google.com.co/books?hl=es&lr=&id=zq9t5dc-gGUC&oi=fnd&pg=PA39&dq=%22definition%22%22Psychological+Obsolescence%22&ots=YnzJNVAp1F&sig=3bPakZetH-PPwvttRVHEKbNuax4&redir_esc=y#v=onepage&q=Psychological%20Obsolescence&f=false

González-Varona, J. M., Poza, D., Acebes, F., Villafáñez, F., Pajares, J., & López-Paredes, A. (2020). New Business Models for Sustainable Spare Parts Logistics: A Case Study. *Sustainability*, *12*(8), 3071. https://doi.org/10.3390/SU12083071

Pilz, T. L., Nunes, B., Corrêa Maceno, M. M., Cleto, M. G., & Seleme, R. (2020). Systematic analysis of comparative studies between additive and conventional manufacturing focusing on the environmental performance of logistics operations. *Gestão & Produção*, *27*(3). https://doi.org/10.1590/0104-530X5289-20

Purvis, L., Lahy, A., Mason, R., & Wilson, M. (2020). Distributed manufacturing as an opportunity for service growth in logistics firms. *Supply Chain Management*, *26*(3), 307–322. https://doi.org/10.1108/SCM-03-2019-0096

von Hippel, E. (2006). *Democratizing Innovation*. The MIT Press PP - Cambridge. https://library.oapen.org/bitstream/id/49e8a8b0-842a-4fde-ae7a-b65aab127960/1003993.pdf

Appendix A – Necessity-Access scale and full list of items

Scale in Turkish	Scale in English (not validated)
Erişimim yok, gerek de yok	No access but not required
Erişimim var ama gerek yok	Has access but not required
Erişimim yok ama gerekli	No access but required
Erişimim var ama yetersiz	Has access but not enough
Yeterli erişimim var	Has enough access

Items in Turkish	Items in English (not validated)
Design stage (value-creation-for-self)	
Tasarım süreçleri ve yöntemleri hakkında bilgi/eğitim	Knowledge/training on design processes and methods
Tasarım görselleştirme (örn. çizim) bilgisi/eğitimi	Design visualization (e.g. drawing) knowledge/training
Parçaların teknik çizimleri	Technical drawings of parts
2 boyutlu bilgisayar destekli tasarım bilgisi/eğitimi	2D computer-aided design knowledge/training
2 boyutlu bilgisayar destekli tasarım programı/yazılımı	2D computer-aided design program/software
Parçaların bilgisayar destekli modelleri	Computer-aided models of parts
3 boyutlu bilgisayar destekli tasarım bilgisi/eğitimi	3D computer-aided design knowledge/training
3 boyutlu bilgisayar destekli tasarım yazılımı	3D computer-aided design software
Production/fabrication stage (value-creation-for-self)	
Parçaların nasıl bir araya getirildiğine dair kılavuz	A guide to how to put parts together
El aletleri	Hand tools
Malzeme kaynakları	Material resources
Elektrikli ve elektronik parçalar (örn. motor, tuş, devre kartı, vb.)	Electrical and electronic parts (e.g. motor, key, circuit board, etc.)
Mekanik parçalar (örn. bıçak, çırpıcı, fan, vb.)	Mechanical parts (e.g. knife, beater, fan, etc.)
Temel fonksiyonel parçalar (örn. kap, ızgara, vb.)	Basic functional parts (e.g. container, grill, etc.)
Zanaat pratikleri hakkında bilgi/eğitim (örn. cam, seramik, deri, kumaş, vb.)	Knowledge/training in craft practices (e.g. glass, ceramics, leather, fabric, etc.)
Zanaat atölyeleri ve ekipmanları (örn. cam, seramik, deri, kumaş, vb.)	Craft workshops and equipment (e.g. glass, ceramics, leather, fabric, etc.)
Atölye ve üretim ekipmanları (örn. ahşap, metal, vb.)	Workshop and production equipment (e.g. wood, metal, etc.)
Üretim ekipmanları kullanımı bilgisi/eğitimi	Knowledge/training on the use of production equipment
Dijital üretime hazır dosyalar	Digital production-ready files
Dijital üretim ekipmanları (3B yazıcı, lazer kesici, CNC gibi)	Digital production equipment (such as 3D printer, laser cutter, CNC)
Dijital üretim bilgisi/eğitimi	Digital production knowledge/training
Post-use stage (value-creation-for-self)	
Tamir kılavuzları	Repair manuals

Items in Turkish	Items in English (not validated)
Parça değişimi için elektrikli ve elektronik parçalar (örn. motor, tuş, devre kartı, vb.)	Electrical and electronic parts for parts replacement (e.g. motor, key, circuit board, etc.)
Parça değişimi için mekanik parçalar (örn. bıçak, çırpıcı, fan, vb.)	Mechanical parts for parts replacement (e.g. knife, beater, fan, etc.)
Parça değişimi için temel fonksiyonel parçalar (örn. kap, ızgara, vb.)	Basic functional parts for parts replacement (e.g. container, grid, etc.)
Güvenilir ikinci el satış kanallar	Reliable second-hand sales channels
Ürünleri ortaklaşa kullanabileceğim kişiler	People with whom I can use the products together
Atölye tipi geri dönüşüm cihazları (örn. Precious Plastics)	Workshop-type recycling equipment (eg. Precious Plastics)
Design stage (value-creation-for-others)	
Diğer yerel ve bölgesel paydaşlar ile tanışma [networking] etkinlikleri	Networking activities to meet other local and regional stakeholders
Diğer yerel ve bölgesel üreticilerin tasarım süreçlerine dair bilgi ve becerilerinin bilgisine açık erişim	Open access to knowledge of the knowledge and skills of other local and regional manufacturers on design processes
Diğer yerel ve bölgesel üreticilerin nasıl iş birliklerine açık olduklarının bilgisine açık erişim	Open access to information on how other local and regional producers are open to collaboration
Kullanıcı grupları ile beraber tasarım süreçleri yürütebilme	Ability to carry out design processes together with user groups
Beraber tasarım için farklı kullanıcı grupları	Different user groups to codesign with
İş birliğini imkanlı kılmaya uygun, açık kaynaklı lisanslama stratejilerinin geliştirilmesi	Development of open-source licensing strategies to enable collaboration
Uygulanacak lisanslama yollarının yatay denetimi	Horizontal control of applicable licensing strategies
Tasarıma dair standartlar	Standards on design
Tasarım hizmeti (örn. bir tasarım danışmanlık firmasından)	Design service (e.g. from a design consulting firm)
Şirket içi tasarım ekibi ya da departmanı	In-house design team or department
Açık kaynaklı tasarım platformları	Open source design platforms
Production/fabrication stage (value-creation-for-others)	
Diğer yerel ve bölgesel üreticilerin nasıl iş birliklerine açık olduklarının bilgisine açık erişim	Open access to information on how other local and regional producers are open to collaboration
Diğer yerel ve bölgesel üreticilerin üretim süreçlerine dair bilgi ve becerilerinin bilgisine açık erişim	Open access to knowledge of the knowledge and skills of other local and regional producers on production processes
İş birliğini imkanlı kılmaya uygun, açık kaynaklı lisanslama stratejilerinin geliştirilmesi	Development of open-source licensing strategies to enable collaboration
Uygulanacak lisanslama yollarının yatay denetimi	Horizontal control of applicable licensing paths
Mekanik parçalar için standartlar	Standards for mechanical parts
Elektrikli parçalar için standartlar	Standards for electrical parts
Üretim ağındaki paydaşlar arasında lojistik hizmeti	Logistics service between stakeholders in the production network
Farklı bölgelerdeki yerel malzeme akışları ve tedarik zincirlerinin bilgisine açık erişim	Open access to information on local material flows and supply chains in different regions
Üretim hizmetleri veren paydaşlara erişim	Access to stakeholders providing manufacturing services
Coğrafi olarak farklı yerlerde bulunan üreticilerden oluşan dağıtılmış üretim ağının yönetiminde söz sahibi olmak	To have a say in the management of a distributed production network consisting of producers located in geographically different locations
Farklı paydaşların üretim çıktılarının kalite kontrolünün yapılması	Quality control of production outputs of different stakeholders
Post-use stage (value-creation-for-self)	

Items in Turkish	**Items in English (not validated)**
Şirketim tarafından verilen tamir servisi veya yetkili servis ağı	Repair service or authorized service network provided by my company
Tamir bilgisini açık kaynak olarak paylaşabileceğim bir tamir platformu	A repair platform where I can share repair information open-source
edek parçaları veya güncellediğim parçaları satışa çıkarabileceğim bir platform satış kanalı	a platform sales channel where I can sell parts or parts that I have updated for sale
Yenilediğim (refurbished) ürünleri satışa çıkarabileceğim bir satış kanalı	A sales channel where I can sell the products I have renewed (renewed)
Şirketimde geri dönüşüm ekipmanları ve sistemi	In-house recycling equipment and system

Appendix B – DF-MOD Survey (in Turkish)

Bilgilendirme ve Araştırmaya Gönüllü Katılım Formu

Bu araştırma, ODTÜ Endüstriyel Tasarım Bölümü öğretim elemanlarından Dr. Öğr. Üyesi Yekta Bakırlıoğlu tarafından yürütülen AB Ufuk 2020 Marie Skłodowska-Curie ve TÜBİTAK ortak programı 2236 – CoCirculation2 programı tarafından desteklenen DF-MOD: Distributed Fabrication through Mass-produced Open Designs [Seri Üretim Açık Tasarımlar Yoluyla Dağıtılmış İmalat] projesi kapsamında yürütülen bir çalışmadır. Bu metin sizi araştırma koşulları hakkında bilgilendirmek için hazırlanmıştır.

Bu çalışmanın amacı, açık tasarımların seri üretiminin alternatif yerel işletmelerin oluşmasını kolaylaştırmak ve sürdürmek için sunabileceği imkanları keşfetmektir. Dağıtılmış üretim yaklaşımı ile seri üretim, yerel üretim ve kişisel üretimin nasıl bir araya gelebileceği ve yerelde tamir, yeniden kullanım ve yenileme gibi döngüsel ekonomi pratiklerini nasıl imkanlı kılabileceğini sorgulamaktadır. Proje ürün grubu olarak elektrikli ev aletlerine odaklanmaktadır. Bu anketin son kullanıcılar, türeticiler [prosumer], yapıcılar [maker] ve seri üretim aktörleri (firmalardaki tasarımcılar, mühendisler, yöneticiler gibi) tarafından cevaplandırılması beklenmektedir. Anket kapsamında, bu katılımcıların cevaplayacağı ortak soruların yanında, rollerine göre farklı sorular da bulunmaktadır. Hangi katılımcı grubunda olursanız olun, bu ankete katılım yaklaşık 15 dakika sürmektedir.

Bize Nasıl Yardımcı Olmanızı İsteyeceğiz? Sizlerden bu anket çalışması sırasında, bu gönüllü katılım formu ile üç soru grubu altında toplam 16 soruyu yanıtlamanızı istiyoruz.

Sizden Topladığımız Bilgileri Nasıl Kullanacağız? Araştırmaya katılımınız tamamen gönüllülük temelinde olmalıdır. Ankette, sizden ad/soyad ve iletişim bilgileri istenecektir, bu bilgiler sizleri araştırmanın sonraki aşaması olan ortak yaratım çalıştaylarına davet etmek amacıyla kullanılacaktır. Bu çalıştaylara katılım zorunlu değildir.Cevaplarınız tamamıyla gizli tutulacak, sadece araştırmacılar tarafından değerlendirilecektir. Katılımcılardan elde edilecek bilgiler toplu halde değerlendirilecek ve bilimsel yayımlarda kullanılacaktır. Sağladığınız veriler gönüllü katılım formlarında toplanan kimlik bilgileri ile eşleştirilmeyecektir.

Katılımınızla ilgili bilmeniz gerekenler: Katılım sırasında sorulardan ya da herhangi başka bir nedenden ötürü kendinizi rahatsız hissederseniz cevaplama işini yarıda bırakıp çıkmakta serbestsiniz. Bu aşamada, sayfa sonlarında bulunan 'Kaydet ve sonra devam et' seçeneği ile cevaplarınızı kaydedip daha sonra geri dönme şansınız olacaktır.

Eğer ankete katılmaktan vazgeçerseniz, anketi cevaplamayı bırakmanız yeterli olacaktır ve o zamana kadar cevapladığınız sorular silinecektir.

Araştırmayla ilgili daha fazla bilgi almak isterseniz: Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz.

Araştırma hakkında daha fazla bilgi almak için Endüstriyel Tasarım Bölümü öğretim üyelerinden Dr. Öğr. Üyesi Yekta Bakırlıoğlu (E-posta: yektab@metu.edu.tr) ile iletişim kurabilirsiniz.

İsminiz *

Ad Soyad

Cinsiyetiniz *

Kadın, Erkek, Diğer, Belirtmek istemiyorum

Yaş gurubunuzu belirtiniz *

18-24, 25-34, 35-44, 45-54, 55-64, 65 ve üstü

E-posta adresiniz *

Telefon Numarası (başında sıfır olmadan)

Bulunduğunuz ilçe ve il *

İlçe, İl

Lütfen aşağıdaki ifadeleri onaylayınız. *

Bu ankete gönüllü olarak katılıyorum ve istediğim zaman bu anket çalışmasından çekilebileceğimi biliyorum

Bu ankette verdiğim cevapların, kişisel bilgilerim ve şahsımla ilişkilendirilmeden akademik yayın ve diğer yayımlama kanallarında kullanabileceğini onaylıyorum

Bu anket kapsamında sağladığım iletişim bilgilerinin, araştırma ekibi tarafından DF-MOD araştırma projesinin amaçları çerçevesinde bilgilendirme amacıyla tarafıma ulaşmak, teyit almak ve araştırmanın süreçleri ve sonuçlarını tarafıma iletmek amacıyla kullanılacağını onaylıyorum.

Üretim becerileriniz ve imkanlarınız hakkında

Bu kısımda üretim becerileriniz ve imkanlarınız hakkında bilgi almayı amaçlıyoruz. Anketin sonraki kısımları ve cevaplamanız istenen sorular, bu kısımda verdiğiniz cevaplara göre belirlenecektir.

Aşağıdaki tasarım, üretim ve kullanım sonrası becerileri ve imkanlarından hangilerine sahip olduğunuzu düşünüyorsunuz?

(Birden fazla seçeneği işaretleyebilirsiniz.) *

- Kullanıcı ve piyasa araştırması
- Tasarım fikri üretme
- Beraber yaratım süreçleri kurgulama (örn. çalıştay)
- Tasarım görselleştirme (örn. çizim)
- 2B Bilgisayar destekli tasarım
- 3B Bilgisayar destekli tasarım
- Tasarım detaylandırma (malzeme seçimi)
- Tasarım detaylandırma (kullanım senaryosu geliştirme)
- Tasarım bilgisinin açık paylaşımı (örn. süreç dökümantasyonu, üretime dair teknik detayların paylaşımı) Üretilmiş parçaları bir araya getirme
- Zanaat becerileri (örn. dikiş, seramik, cam, vb)
- Malzeme işleme (örn. ahşap, metal , vb.)
- Dijital üretim (örn. 3B yazıcı, lazer kesici, CNC)
- Beraber imalat yapabilecek ortaklar bulma
- Satış kanalları yaratma
- Reklam ve promosyon becerileri
- Ürün bakımı (örn. temizlik, filtre değişimi)
- Ürün onarım servislerine erişim (örn. farklı tamircilere)
- Sökme-takma (bir ürünü parçalarına bölme ve bir araya getirme)
- Tamir bilgisine erişim (örn. tamir kılavuzları)
- Yedek parçalara erişim
- Eski ürünlerinizi satışa çıkarma (örn. internet üzerinden)
- Ürünlerin ortak kullanımı (örn. paylaşılan mutfak)
- Küçük ölçekli geri dönüşüm (örn. Precious Plastics)
- Ürünleri geri dönüşüme uygun bir şekilde atma
- *Diğer:*

Elektrikli ev aletlerinin ürün yaşam döngüsünde nasıl rol(ler) alabileceğinizi düşünüyorsunuz?

(Birden fazla seçeneği işaretleyebilirsiniz.) *

- **Bilinçli bir tüketici olarak:** Satın aldığım ürünlerin düzenli bakımını yaparak, bozulması halinde tamir ettirerek, değiştirmek istediğimde başkalarının kullanımı için satışa çıkararak/vererek
- **Aktif bir kullanıcı olarak:** Bilinçli tüketiciye ek olarak, belli parçaları kişiselleştirerek, beceri ve imkanlarımın yeteceği ölçüde kendim tamir ederek ve ihtiyaçlarıma göre yeni özellikler ekleyerek, başkaları ile ortak olarak kullanarak
- **Türetici (prosumer) veya yapıcı (maker) olarak:** Aktif kullanıcıya ek olarak, bazı parçaları kendim üreterek ve kendi ihtiyaç ve isteklerimi karşılayan yeni tasarımlar geliştirerek, tamir ve yükseltme (upgrading) süreçlerini kendim yaparak, parçaları aynı veya başka amaçlara yeniden kullanarak
- **Yerel bir üretici olarak:** Başkalarının kullanımı için ürünler ve parçalar (örn. kap, kapak, kulp, aksesuar, vb.) tasarlayıp üreterek ve bunları bulunduğum şehirde ve çevre illerde satışa çıkararak
- **Bölgesel bir üretici olarak:** Yerel üreticilerin ve türetici/ yapıcıların kullanımı için parçalar (örn. ürün gövdesi, fonksiyonel parçalar, kap, kapak, kulp, aksesuar, vb.), ve bilinçli tüketici ve aktif kullanıcılar için ürünler tasarlayıp üreterek ve bunları bulunduğum bölgede/ülkede satışa çıkararak
- **Küresel bir üretici olarak:** Yukarıdaki bütün paydaşların kullanımı için parçalar ve ürünler üreterek ve bunları ve dünya çapında satışa çıkararak

Bilinçli Tüketiciler, Aktif Kullanıcılar, Türeticiler ve Yapıcılar için sorular

Bir önceki kısımda, bilinçli tüketici, aktif kullanıcı, ya da türetici/yapıcı olarak rol alabileceğinizi belirttiniz. Aşağıdaki sorular, isteyen herkesin katılabileceği bir şekilde kurgulanmış elektrikli ev aletlerinin tasarımı ve üretimi süreçlerine ne şekillerde katılabileceğinizi veya katılmak isteyebileceğinizi sorgulamaktadır.

Elektrikli ev aletleri, küçük ev aletleri (çay makinesi, elektrikli ızgara, mikrodalga fırın, elektrikli süpürge, ütü, kişisel bakım aletleri, vb.), ev için elektrikli el aletleri (şarjlı tornavida, matkap, vb.) ve ev tipi soğutma ve hava temizleme çözümleri (vantilatör, hava temizleyici, fan, vb.) olabilir, ama bu liste ile kısıtlı değildir. *Son kullanıcıya yönelik elektronik ürünler (televizyon, bilgisayar, ses sistemi, vb.) ve beyaz eşyalar (buzdolabı, çamaşır makinesi, bulaşık makinesi, vb.) bu kapsama girmez*

Elektrikli ev aletlerinin tasarım ve üretimi aşamalarına nasıl katılım sağlayabileceğinizi düşünüyorsunuz? (Birden fazla seçeneği işaretleyebilirsiniz.) *

- Kullanıcı araştırmalarına katılarak ve **kullanım deneyimi paylaşarak**

- Internet üzerinden ürünün **kullanımına dair olumlu veya olumsuz yorumlar bırakarak**
- Tasarım süreci esansında tasarımı yapan grup ile **beraber parça ve ürün fikirleri üreterek** Tasarım süreci esnasında **farklı parça ve ürün tasarımı alternatifleri geliştirerek**
- Tasarım süreci sonunda çıkan parça ve ürün tasarımlarına **ek parçalar (aksesuar gibi) tasarlayarak**
- Tasarım süreci sonunda çıkan tasarımları **istek ve ihtiyaçlarıma göre değiştirip yeni tasarımlar yaparak**
- Kendi yaptığım tasarımları **açık kaynaklı bir şekilde paylaşarak** (çizim, model, vb. dosyalar ile beraber)
- Tasarım süreci sonunda çıkan ve üretilen **parçaları bir araya (montaj) getirere**k
- Tasarım süreci sonunda çıkan ve üretilen parçaları **farklı ürün ve parçalarla bir araya getirerek**
- Tasarım süreci sonunda çıkan parça ve ürün tasarımlarına **ek parçalar (aksesuar gibi) üreterek**
- Tasarım süreci sonunda çıkan**çıkan parça ve ürün tasarımlarını üreterek**
- **Kendi uyarladığım tasarımları üreterek**
- Kullandığım ürünlerin (örn. temizlik, filtre değişimi, vb.) **gerekli bakımını yaparak**
- Kullandığım ürünleri**tamir servisleri ile tamir ettirerek**
- Kullandığım ürünleri **kendim tamir ederek**
- Kullandığım ürünleri **ikinci el satışa çıkararak**
- Ürünleri başkalarıyla **ortak bir şekilde kullanarak**
- Kullandığım ürünleri ihtiyaçlarım değişince **güncellemek (upgrading)**
- Kullandığım ürünleri **geri dönüşüme uygun şekilde atarak**
- Elimdeki parçaları **geri dönüştürerek ve malzemelerini (örn. metal, cam, plastik) başka parçalar üretmek için kullanarak**

Yukarıda seçtiğiniz katılım şekilleri için hangi tasarım bilgilerine ve kaynaklarına erişiminiz var ya da olması gerektiğini düşünüyorsunuz?

(Her satır için uygun seçeneği işaretleyiniz.)

Erişimim yok, gerek de yok	Erişimim var ama gerek yok	Erişimim yok ama gerekli	Erişimim var ama yetersiz	Yeterli erişimim var

- Tasarım süreçleri ve yöntemleri hakkında bilgi/eğitim
- Tasarım görselleştirme (örn. çizim) bilgisi/eğitimi
- Parçaların teknik çizimleri
- 2 boyutlu bilgisayar destekli tasarım bilgisi/eğitimi

- 2 boyutlu bilgisayar destekli tasarım programı/yazılımı
- Parçaların bilgisayar destekli modelleri
- 3 boyutlu bilgisayar destekli tasarım bilgisi/eğitimi
- 3 boyutlu bilgisayar destekli tasarım yazılımı

Yukarıda seçtiğiniz katılım şekilleri için hangi üretim bilgilerine ve kaynaklarına erişiminiz var ya da olması gerektiğini düşünüyorsunuz?

(Her satır için uygun seçeneği işaretleyiniz.)

Erişimim yok, gerek de yok	Erişimim var ama gerek yok	Erişimim yok ama gerekli	Erişimim var ama yetersiz	Yeterli erişimim var

- Parçaların nasıl bir araya getirildiğine dair kılavuz
- El aletleri
- Malzeme kaynakları
- Elektrikli ve elektronik parçalar (örn. motor, tuş, devre kartı, vb.)
- Mekanik parçalar (örn. bıçak, çırpıcı, fan, vb.)
- Temel fonksiyonel parçalar (örn. kap, ızgara, vb.)
- Zanaat pratikleri hakkında bilgi/eğitim (örn. cam, seramik, deri, kumaş, vb.)
- Zanaat atölyeleri ve ekipmanları (örn. cam, seramik, deri, kumaş, vb.)
- Atölye ve üretim ekipmanları (örn. ahşap, metal, vb.)
- Üretim ekipmanları kullanımı bilgisi/eğitimi
- Dijital üretime hazır dosyalar
- Dijital üretim ekipmanları (3B yazıcı, lazer kesici, CNC gibi)
- Dijital üretim bilgisi/eğitimi

Yukarıda seçtiğiniz katılım şekilleri için kullanım sonrası süreçlere (bakım, tamir, yükseltme, yeniden kullanım gibi) dair hangi bilgi ve kaynaklara erişiminiz var ya da olması gerektiğini düşünüyorsunuz?

(Her satır için uygun seçeneği işaretleyiniz.)

Erişimim yok, gerek de yok	Erişimim var ama gerek yok	Erişimim yok ama gerekli	Erişimim var ama yetersiz	Yeterli erişimim var

- Tamir kılavuzları
- Parça değişimi için elektrikli ve elektronik parçalar (örn. motor, tuş, devre kartı, vb.)
- Parça değişimi için mekanik parçalar (örn. bıçak, çırpıcı, fan, vb.)
- Parça değişimi için temel fonksiyonel parçalar (örn. kap, ızgara, vb.)

- Güvenilir ikinci el satış kanallar
- Ürünleri ortaklaşa kullanabileceğim kişiler
- Atölye tipi geri dönüşüm cihazları (örn. Precious Plastics)

Yukarıda seçtiğiniz katılım şekilleri için başka hangi bilgi ve kaynaklara ihtiyacınız olduğunu düşünüyorsunuz?

Yerel, Bölgesel ya da Küresel Üreticiler için sorular

Bir önceki kısımda, yerel, bölgesel ya da küresel bir üretici olarak ya da böyle bir üretici firmada çalışarak rol alabileceğinizi belirttiniz. Aşağıdaki sorular, elektrikli ev aletlerinin tasarım bilgisinin herkesin erişimine açık bir şekilde paylaşılması ile gerçekleşebilecek, coğrafi olarak farklı yerlerde bulunan üreticilerin beraber üretim yaptığı alternatif bir dağıtılmış üretim senaryosunda elektrikli ev aletlerinin tasarımı ve üretimi süreçlerine ne şekillerde katılabileceğinizi veya katılmak isteyebileceğinizi sorgulamaktadır.

Elektrikli ev aletleri, küçük ev aletleri (çay makinesi, elektrikli ızgara, mikrodalga fırın, elektrikli süpürge, ütü, kişisel bakım aletleri, vb.), ev için elektrikli el aletleri (şarjlı tornavida, matkap, vb.) ve ev tipi soğutma ve hava temizleme çözümleri (vantilatör, hava temizleyici, fan, vb.) olabilir, ama bu liste ile kısıtlı değildir. Son kullanıcıya yönelik elektronik ürünler (televizyon, bilgisayar, ses sistemi, vb.) ve beyaz eşyalar (buzdolabı, çamaşır makinesi, bulaşık makinesi, vb.) bu kapsama girmez.

Mesleğinizi ve konumunuzu/pozisyonunuzu belirtir misiniz? *

Bu bilgi, verinin analizi sırasında kişisel bilgileriniz ile eşleştirilmeyecektir.

Elektrikli ev aletlerinin tasarım ve üretimi aşamalarında şirketinizin/kurumunuz nasıl roller alabileceğini düşünüyorsunuz?

(Birden fazla seçeneği işaretleyebilirsiniz.) *

- Tasarım süreçleri sırasında **diğer yerel ve bölgesel üreticilerden bilgi ve görüş alınması**
- Tasarım süreçleri sırasında **aktif kullanıcılar ve yapıcılar/türeticilerden bilgi ve görüş alınması**
- Tasarım süreçleri sırasında bilinçli tüketicilerden bilgi ve görüş alınması
- **Diğer yerel ve bölgesel üreticiler** ile beraber tasarım sürecinin yürütülmesi
- **Aktif kullanıcılar ve yapıcılar/türeticiler** ile beraber tasarım sürecinin yürütülmesi
- **Bilinçli tüketiciler** ile beraber tasarım sürecinin yürütülmesi

- **Aktif kullanıcılar ve yapıcılar/türeticiler** tarafından tasarlanan ve üretilen parçalara göre kendi ürün tasarımınızın güncellenmesi
- **Üretimini yaptığım parça ve ürünlerin tasarım** bilgilerini (örn. çizim, CAD modeli, vb.) herkesin erişimine açık şekilde paylaşarak
- **Üretimini yaptığım parça ve ürünlerin montaj/demontaj** bilgilerini (örn. gerekli araçlar, ara elemanlar, vb.) herkesin erişimine açık şekilde paylaşarak
- **Üretimini yaptığım parça ve ürünlerin üretim** bilgilerini (örn. üretim yöntemi, malzeme seçimi, tedarik zinciri, vb.) herkesin erişimine açık şekilde paylaşarak
- **Üretim sırasında diğer yerel ve bölgesel üreticilerle işbirliği** yaparak (örn. bazı parçaların başka üreticiler tarafından üretilmesi, montajın tüketime yakın yerlerde gerçekleşmesi, vb.)
- **Üretimini yaptığım parça ve ürünlerin tamir süreçlerini** (örn. arıza tespitinin yapılması, belli parçalar erişim, vb.) herkesin erişimine açık şekilde paylaşarak
- Üretimini yaptığım **yedek parçaları perakende olarak satışa çıkararak**
- Üretimini yaptığım parça ve ürünleri **kullanım sonrasında alıp yenileyerek (refurbish) satışa sunarak**
- Tasarımını güncellediğim parçaları **yükseltme (upgrading) amacıyla satışa çıkararak**
- Üretimini yaptığım parça ve ürünleri **toplayarak ve geri dönüştürerek**
- **Üretimini yaptığım parça ve ürünlerin geri dönüşüm bilgilerini** (örn. malzeme koşulları, yerel atık yönetimi bilgileri, vb.) açık kaynaklı olarak paylaşarak

Neden yukarıdaki seçenekleri seçtiğinizi kısaca açıklayabilir misiniz?

Yukarıda seçtiğiniz roller için hangi tasarım bilgilerine ve kaynaklarına erişiminiz var ya da olması gerektiğini düşünüyorsunuz?

(Her satır için uygun seçeneği işaretleyiniz.)

Erişimim yok, gerek de yok	Erişimim var ama gerek yok	Erişimim yok ama gerekli	Erişimim var ama yetersiz	Yeterli erişimim var

- Diğer yerel ve bölgesel paydaşlar ile tanışma [networking] etkinlikleri
- Diğer yerel ve bölgesel üreticilerin tasarım süreçlerine dair bilgi ve becerilerinin bilgisine açık erişim
- Diğer yerel ve bölgesel üreticilerin nasıl iş birliklerine açık olduklarının bilgisine açık erişim
- Kullanıcı grupları ile beraber tasarım süreçleri yürütebilme
- Beraber tasarım için farklı kullanıcı grupları

- İş birliğini imkanlı kılmaya uygun, açık kaynaklı lisanslama stratejilerinin geliştirilmesi
- Uygulanacak lisanslama yollarının yatay denetimi
- Tasarıma dair standartlar
- Tasarım hizmeti (örn. bir tasarım danışmanlık firmasından)
- Şirket içi tasarım ekibi ya da departmanı
- Açık kaynaklı tasarım platformları

Yukarıda seçtiğiniz roller için hangi üretim bilgi ve kaynaklarına erişiminiz var ya da olması gerektiğini düşünüyorsunuz?

(Her satır için uygun seçeneği işaretleyiniz.)

Erişimim yok, gerek de yok	Erişimim var ama gerek yok	Erişimim yok ama gerekli	Erişimim var ama yetersiz	Yeterli erişimim var

- Diğer yerel ve bölgesel üreticilerin nasıl iş birliklerine açık olduklarının bilgisine açık erişim
- Diğer yerel ve bölgesel üreticilerin üretim süreçlerine dair bilgi ve becerilerinin bilgisine açık erişim
- İş birliğini imkanlı kılmaya uygun, açık kaynaklı lisanslama stratejilerinin geliştirilmesi
- Uygulanacak lisanslama yollarının yatay denetimi
- Mekanik parçalar için standartlar
- Elektrikli parçalar için standartlar
- Üretim ağındaki paydaşlar arasında lojistik hizmeti
- Farklı bölgelerdeki yerel malzeme akışları ve tedarik zincirlerinin bilgisine açık erişim
- Üretim hizmetleri veren paydaşlara erişim
- Coğrafi olarak farklı yerlerde bulunan üreticilerden oluşan dağıtılmış üretim ağının yönetiminde söz sahibi olmak
- Farklı paydaşların üretim çıktılarının kalite kontrolünün yapılması

Yukarıda seçtiğiniz roller için kullanım sonrası süreçlere (bakım, tamir, yükseltme, yeniden kullanım gibi) dair hangi bilgi ve kaynaklara erişiminiz var ya da olması gerektiğini düşünüyorsunuz?

(Her satır için uygun seçeneği işaretleyiniz.)

Erişimim yok, gerek de yok	Erişimim var ama gerek yok	Erişimim yok ama gerekli	Erişimim var ama yetersiz	Yeterli erişimim var

- Şirketim tarafından verilen tamir servisi veya yetkili servis ağı
- Tamir bilgisini açık kaynak olarak paylaşabileceğim bir tamir platformu
- edek parçaları veya güncellediğim parçaları satışa çıkarabileceğim bir platform satış kanalı
- Yenilediğim (refurbished) ürünleri satışa çıkarabileceğim bir satış kanalı
- Geri dönüşüm ekipmanları ve sistemi

Yukarıda seçtiğiniz roller için başka hangi bilgi ve kaynaklara ihtiyacınız olduğunu düşünüyorsunuz?

Yukarıda seçtiğiniz rolleri gerçekleştirebilmek için hangi paydaşlarla işbirliği yapmanız gerektiğini düşünüyorsunuz?

(Birden fazla seçeneği işaretleyebilirsiniz.) *

- *Hiç kimse ile işbirliği yapmam(ız)a gerek yok*
- Bilinçli tüketiciler ve aktif kullanıcılar
- Türeticiler (prosumer) ve yapıcıları (maker)
- Yerel üreticiler (zanaatkarlar, yapıcılar, atölyeler)
- Yerel tamirciler
- Yerel atık yönetimi şirketleri
- Bölgesel üreticiler
- Küresel üreticiler
- Lojistik şirketleri
- Yerel esnaf ve bayiler
- Büyük mağazalar ve diğer satış kanalları
- Sivil Toplum Kuruluşları (örn. sektör dernekleri, meslek dernekleri, vb.)
- Politika üreticileri (örn. odalar, birlikler, bakanlıklar, belediyeler, vb.)

Yukarıdaki paydaşları neden seçtiğinizi kısaca açıklayabilir misiniz?

Appendix C – Correlation analysis tables

Table 13. Correlations among value-creation-for-self stakeholders' knowledge, resources and skills

		Design (α= 0.940)								Production / Fabrication (α=0.912)													Post-use (α=0.834)						
	Value-creation-for-self items α= 0.943	Design process and methods	Visualisation	Technical drawings	2D CAD knowledge	2D CAD software	CAD model	3D CAD knowledge	3D CAD software	Assembly guide	Hand tools	Material resources	Electrical parts	Mechanical parts	Functional parts	Crafts knoweldge	Crafts equipment	Workhops equipment	Workshop equipment use	CAM files	Digital fabrication equipment	Digital fabrication knowledge	Repair guides	Electrical parts (post-use)	Mechanical parts (post-use)	Functional parts (post-use)	Second hand sales channels	People for shared use	Small-scale recycling equipment
Design	Design process and methods	1.000	0.723	0.654	0.567	0.506	0.520	0.569	0.506	0.371	0.339	0.437	0.290	0.391	0.408	0.562	0.504	0.504	0.567	0.330	0.320	0.335	0.391	0.285	0.334	0.325	0.211	0.118	0.314
	Visualisation	0.723	1.000	0.703	0.700	0.665	0.585	0.643	0.515	0.197	0.167	0.406	0.168	0.275	0.374	0.450	0.396	0.513	0.441	0.345	0.339	0.447	0.188	0.248	0.242	0.250	0.173	0.142	0.305
	Technical drawings	0.654	0.703	1.000	0.668	0.629	0.604	0.576	0.570	0.319	0.317	0.444	0.203	0.416	0.515	0.452	0.312	0.573	0.614	0.267	0.289	0.386	0.359	0.366	0.373	0.337	0.131	0.072	0.323
	2D CAD knowledge	0.567	0.700	0.668	1.000	0.906	0.716	0.838	0.718	0.269	0.179	0.366	0.222	0.296	0.417	0.343	0.233	0.443	0.417	0.290	0.389	0.517	0.255	0.272	0.240	0.222	0.122	0.027	0.128
	2D CAD software	0.506	0.665	0.629	0.906	1.000	0.754	0.798	0.722	0.254	0.191	0.351	0.182	0.262	0.430	0.291	0.252	0.451	0.392	0.293	0.358	0.480	0.272	0.280	0.270	0.236	0.061	-0.033	0.133
	CAD model	0.520	0.585	0.604	0.716	0.754	1.000	0.737	0.653	0.363	0.310	0.468	0.284	0.384	0.521	0.377	0.248	0.436	0.489	0.344	0.424	0.510	0.338	0.306	0.326	0.277	0.038	0.027	0.255
	3D CAD knowledge	0.569	0.643	0.576	0.838	0.798	0.737	1.000	0.788	0.273	0.162	0.313	0.159	0.250	0.375	0.377	0.228	0.418	0.409	0.351	0.408	0.533	0.243	0.249	0.193	0.220	0.079	-0.008	0.169
	3D CAD software	0.506	0.515	0.570	0.718	0.722	0.653	0.788	1.000	0.220	0.187	0.315	0.230	0.246	0.350	0.343	0.277	0.403	0.405	0.281	0.319	0.412	0.277	0.282	0.275	0.244	0.131	-0.002	0.293
Production / Fabrication	Assembly guide	0.371	0.197	0.319	0.269	0.254	0.363	0.273	0.220	1.000	0.584	0.541	0.537	0.458	0.532	0.343	0.319	0.388	0.469	0.326	0.270	0.304	0.659	0.426	0.399	0.467	0.247	0.335	0.262
	Hand tools	0.339	0.167	0.317	0.179	0.191	0.310	0.162	0.187	0.584	1.000	0.647	0.517	0.648	0.551	0.423	0.341	0.355	0.452	0.192	0.294	0.082	0.373	0.376	0.386	0.340	0.153	0.177	0.315
	Material resources	0.437	0.406	0.444	0.366	0.351	0.468	0.313	0.315	0.541	0.647	1.000	0.579	0.647	0.605	0.478	0.433	0.530	0.551	0.328	0.482	0.343	0.510	0.510	0.560	0.487	0.195	0.232	0.514
	Electrical parts	0.290	0.168	0.203	0.222	0.182	0.284	0.159	0.230	0.537	0.517	0.579	1.000	0.728	0.557	0.234	0.287	0.294	0.314	0.210	0.317	0.191	0.447	0.539	0.371	0.392	0.229	0.233	0.353
	Mechanical parts	0.391	0.275	0.416	0.296	0.262	0.384	0.250	0.246	0.458	0.648	0.647	0.728	1.000	0.788	0.385	0.377	0.475	0.476	0.267	0.388	0.250	0.383	0.468	0.412	0.414	0.238	0.220	0.359
	Functional parts	0.408	0.374	0.515	0.417	0.430	0.521	0.375	0.350	0.532	0.551	0.605	0.557	0.788	1.000	0.453	0.426	0.555	0.527	0.347	0.399	0.350	0.397	0.391	0.373	0.426	0.134	0.129	0.367
	Crafts knoweldge	0.562	0.450	0.452	0.343	0.291	0.377	0.377	0.343	0.343	0.423	0.478	0.234	0.385	0.453	1.000	0.776	0.683	0.643	0.270	0.402	0.336	0.244	0.214	0.289	0.233	0.127	0.103	0.430
	Crafts equipment	0.504	0.396	0.312	0.233	0.252	0.248	0.228	0.277	0.319	0.341	0.433	0.287	0.377	0.426	0.776	1.000	0.679	0.578	0.352	0.425	0.345	0.180	0.233	0.276	0.211	0.106	0.113	0.519
	Workhops equipment	0.504	0.513	0.573	0.443	0.451	0.436	0.418	0.403	0.388	0.355	0.530	0.294	0.475	0.555	0.683	0.679	1.000	0.559	0.413	0.425	0.355	0.346	0.387	0.427	0.372	0.072	0.089	0.446
	Workshop equipment use knowledge	0.567	0.441	0.614	0.417	0.392	0.489	0.409	0.405	0.469	0.452	0.551	0.314	0.476	0.527	0.643	0.578	0.559	1.000	0.366	0.357	0.443	0.437	0.357	0.420	0.413	0.183	0.142	0.428
	CAM files	0.330	0.345	0.267	0.290	0.293	0.344	0.351	0.281	0.326	0.192	0.328	0.210	0.267	0.347	0.270	0.352	0.413	0.366	1.000	0.644	0.609	0.284	0.248	0.253	0.259	0.214	0.270	0.361
	Digital fabrication equipment	0.320	0.339	0.289	0.389	0.358	0.424	0.408	0.319	0.270	0.294	0.482	0.317	0.388	0.399	0.402	0.425	0.425	0.357	0.644	1.000	0.675	0.262	0.232	0.259	0.264	0.137	0.152	0.419
	Digital fabrication knowledge	0.335	0.447	0.386	0.517	0.480	0.510	0.533	0.412	0.304	0.082	0.343	0.191	0.250	0.350	0.336	0.345	0.355	0.443	0.609	0.675	1.000	0.301	0.195	0.245	0.221	0.111	0.257	0.314
Post-use	Repair guides	0.391	0.188	0.359	0.255	0.272	0.338	0.243	0.277	0.659	0.373	0.510	0.447	0.383	0.397	0.244	0.180	0.346	0.437	0.284	0.262	0.301	1.000	0.575	0.653	0.709	0.344	0.264	0.321
	Electrical parts (post-use)	0.285	0.248	0.366	0.272	0.280	0.306	0.249	0.282	0.426	0.376	0.510	0.539	0.468	0.391	0.214	0.233	0.387	0.357	0.248	0.232	0.195	0.575	1.000	0.662	0.694	0.239	0.216	0.416
	Mechanical parts (post-use)	0.334	0.242	0.373	0.240	0.270	0.326	0.193	0.275	0.399	0.386	0.560	0.371	0.412	0.373	0.289	0.276	0.427	0.420	0.253	0.259	0.245	0.653	0.662	1.000	0.755	0.254	0.160	0.395
	Functional parts (post-use)	0.325	0.250	0.337	0.222	0.236	0.277	0.220	0.244	0.467	0.340	0.487	0.392	0.414	0.426	0.233	0.211	0.372	0.413	0.259	0.264	0.221	0.709	0.694	0.755	1.000	0.279	0.160	0.375
	Second hand sales channels	0.211	0.173	0.131	0.122	0.061	0.038	0.079	0.131	0.247	0.153	0.195	0.229	0.238	0.134	0.127	0.106	0.072	0.183	0.214	0.137	0.111	0.344	0.239	0.254	0.279	1.000	0.548	0.286
	People for shared use	0.118	0.142	0.072	0.027	-0.033	0.027	-0.008	-0.002	0.335	0.177	0.232	0.233	0.220	0.129	0.103	0.113	0.089	0.142	0.270	0.152	0.257	0.264	0.216	0.160	0.160	0.548	1.000	0.339
	Small-scale recycling equipment	0.314	0.305	0.323	0.128	0.133	0.255	0.169	0.293	0.262	0.315	0.514	0.353	0.359	0.367	0.430	0.519	0.446	0.428	0.361	0.419	0.314	0.321	0.416	0.395	0.375	0.286	0.339	1.000

Table 14. Correlations among value-creation-for-others stakeholders' knowledge, resources and skills

		Design (α=0.886)											Production / Fabrication (α=0.931)											Post-use (α=0.817)				
	value-creation-for-others items α=0.947	Networking events with other producers	Knoweldge on design capabilities of local and	Local and regional producers' intention to	Capability to facilitate codesign processes	Different user groups to codesign with	Open-source licensing strategies	Horizontal management of licensing	Standards on design	Design consultancy	In-house design unit	Open-source design platforms	Local and regional producers' intention to	Knoweldge on production capabilities of local	Open-source licensing for production	Horizontal management of production	Standards for mechanical parts	Standards for electrical parts	Logistics service among collaborators	Knowledge on local material flows	External production services (e.g. MaaS)	Having a say in the management of distributed	Quality control of parts/products produced by others	Authorised service network	Repair platform to share repair knowledge	Spare parts sales platform	Refurbished products sales channel	In-house recycling equipment/system
Design	Networking events with other producers	1.000	0.623	0.542	0.590	0.613	0.369	0.416	0.271	0.482	0.160	0.285	0.519	0.448	0.450	0.343	0.298	0.267	0.338	0.311	0.389	0.390	0.489	0.457	0.378	0.461	0.394	0.252
	Knoweldge on design capabilities of local and regional producers	0.623	1.000	0.694	0.500	0.630	0.321	0.409	0.298	0.258	0.235	0.290	0.457	0.458	0.322	0.231	0.397	0.369	0.576	0.441	0.544	0.355	0.549	0.352	0.412	0.441	0.421	0.295
	Local and regional producers' intention to codesign	0.542	0.694	1.000	0.623	0.573	0.340	0.342	0.351	0.204	0.182	0.421	0.543	0.585	0.423	0.307	0.414	0.309	0.563	0.503	0.541	0.310	0.466	0.416	0.499	0.433	0.401	0.147
	Capability to facilitate codesign processes	0.590	0.500	0.623	1.000	0.760	0.460	0.249	0.489	0.355	0.354	0.513	0.444	0.374	0.329	0.343	0.468	0.364	0.462	0.399	0.500	0.258	0.593	0.319	0.427	0.223	0.435	0.285
	Different user groups to codesign with	0.613	0.630	0.573	0.760	1.000	0.418	0.353	0.531	0.314	0.466	0.443	0.456	0.359	0.299	0.221	0.415	0.381	0.515	0.366	0.543	0.169	0.578	0.347	0.361	0.189	0.369	0.350
	Open-source licensing strategies	0.369	0.321	0.340	0.460	0.418	1.000	0.648	0.367	0.296	0.393	0.488	0.426	0.478	0.470	0.516	0.279	0.319	0.391	0.346	0.267	0.265	0.406	0.205	0.382	0.196	0.242	0.288
	Horizontal management of licensing	0.416	0.409	0.342	0.249	0.353	0.648	1.000	0.328	0.403	0.279	0.382	0.496	0.447	0.509	0.650	0.295	0.301	0.226	0.402	0.458	0.506	0.411	0.350	0.407	0.304	0.310	0.178
	Standards on design	0.271	0.298	0.351	0.489	0.531	0.367	0.328	1.000	0.374	0.379	0.586	0.419	0.367	0.311	0.374	0.487	0.410	0.303	0.289	0.364	0.040	0.313	0.409	0.386	0.128	0.386	0.310
	Design consultancy	0.482	0.258	0.204	0.355	0.314	0.296	0.403	0.374	1.000	0.366	0.242	0.254	0.193	0.408	0.383	0.183	0.167	0.038	0.201	0.236	0.383	0.223	0.532	0.436	0.340	0.246	0.202
	In-house design unit	0.160	0.235	0.182	0.354	0.466	0.393	0.279	0.379	0.366	1.000	0.516	0.265	0.322	0.188	0.233	0.405	0.443	0.353	0.372	0.384	0.110	0.300	0.294	0.265	0.005	0.116	0.172
	Open-source design platforms	0.285	0.290	0.421	0.513	0.443	0.488	0.382	0.586	0.242	0.516	1.000	0.531	0.601	0.413	0.438	0.447	0.465	0.415	0.380	0.417	0.202	0.482	0.318	0.287	0.105	0.181	0.147
	Local and regional producers' intention to coproduce	0.519	0.457	0.543	0.444	0.456	0.426	0.496	0.419	0.254	0.265	0.531	1.000	0.879	0.778	0.638	0.457	0.396	0.507	0.507	0.614	0.431	0.555	0.499	0.555	0.477	0.364	0.300
Production / Fabrication	Knoweldge on production capabilities of local and regional producers	0.448	0.458	0.585	0.374	0.359	0.478	0.447	0.367	0.193	0.322	0.601	0.879	1.000	0.731	0.592	0.510	0.530	0.586	0.557	0.571	0.366	0.480	0.438	0.523	0.397	0.333	0.185
	Open-source licensing for production	0.450	0.322	0.423	0.329	0.299	0.470	0.509	0.311	0.408	0.188	0.413	0.778	0.731	1.000	0.764	0.433	0.396	0.455	0.509	0.479	0.505	0.397	0.415	0.513	0.385	0.303	0.195
	Horizontal management of production licensing	0.343	0.231	0.307	0.343	0.221	0.516	0.650	0.374	0.383	0.233	0.438	0.638	0.592	0.764	1.000	0.437	0.372	0.367	0.492	0.522	0.535	0.301	0.359	0.384	0.330	0.392	0.149
	Standards for mechanical parts	0.298	0.397	0.414	0.468	0.415	0.279	0.295	0.487	0.183	0.405	0.447	0.457	0.510	0.433	0.437	1.000	0.919	0.725	0.706	0.624	0.339	0.632	0.475	0.489	0.306	0.329	0.266
	Standards for electrical parts	0.267	0.369	0.309	0.364	0.381	0.319	0.301	0.410	0.167	0.443	0.465	0.396	0.530	0.396	0.372	0.919	1.000	0.726	0.698	0.606	0.250	0.591	0.416	0.440	0.221	0.217	0.169
	Logistics service among collaborators	0.338	0.576	0.563	0.462	0.515	0.391	0.226	0.303	0.038	0.353	0.415	0.507	0.586	0.455	0.367	0.725	0.726	1.000	0.788	0.712	0.275	0.580	0.263	0.426	0.353	0.362	0.341
	Knowledge on local material flows	0.311	0.441	0.503	0.399	0.366	0.346	0.402	0.289	0.201	0.372	0.380	0.507	0.557	0.509	0.492	0.706	0.698	0.788	1.000	0.751	0.476	0.514	0.241	0.343	0.329	0.351	0.184
	External production services (e.g. MaaS)	0.389	0.544	0.541	0.500	0.543	0.267	0.458	0.364	0.236	0.384	0.417	0.614	0.571	0.479	0.522	0.624	0.606	0.712	0.751	1.000	0.448	0.594	0.457	0.469	0.356	0.381	0.151
	Having a say in the management of distributed production network	0.390	0.355	0.310	0.258	0.169	0.265	0.506	0.040	0.383	0.110	0.202	0.431	0.366	0.505	0.535	0.339	0.250	0.275	0.476	0.448	1.000	0.515	0.275	0.282	0.330	0.238	0.129
	Quality control of parts/products produced by others	0.489	0.549	0.466	0.593	0.578	0.406	0.411	0.313	0.223	0.300	0.482	0.555	0.480	0.397	0.301	0.632	0.591	0.580	0.514	0.594	0.515	1.000	0.447	0.491	0.405	0.327	0.417
Post-use	Authorised service network	0.457	0.352	0.416	0.319	0.347	0.205	0.350	0.409	0.532	0.294	0.318	0.499	0.438	0.415	0.359	0.475	0.416	0.263	0.241	0.457	0.275	0.447	1.000	0.624	0.547	0.351	0.271
	Repair platform to share repair knowledge	0.378	0.412	0.499	0.427	0.361	0.382	0.407	0.386	0.436	0.265	0.287	0.555	0.523	0.513	0.384	0.489	0.440	0.426	0.343	0.469	0.282	0.491	0.624	1.000	0.658	0.444	0.378
	Spare parts sales platform	0.461	0.441	0.433	0.223	0.189	0.196	0.304	0.128	0.340	0.005	0.105	0.477	0.397	0.385	0.330	0.306	0.221	0.353	0.329	0.356	0.330	0.405	0.547	0.658	1.000	0.481	0.425
	Refurbished products sales channel	0.394	0.421	0.401	0.435	0.369	0.242	0.310	0.386	0.246	0.116	0.181	0.364	0.333	0.303	0.392	0.329	0.217	0.362	0.351	0.381	0.238	0.327	0.351	0.444	0.481	1.000	0.525
	In-house recycling equipment/system	0.252	0.295	0.147	0.285	0.350	0.288	0.178	0.310	0.202	0.172	0.147	0.300	0.185	0.195	0.149	0.266	0.169	0.341	0.184	0.151	0.129	0.417	0.271	0.378	0.425	0.525	1.000

DF-MOD

Distributed Fabrication
through Mass-Produced
Open Designs

Website: df-mod.id.metu.edu.tr

Instragram: @locallyfabricated

Twitter: @locallyfabric8ted