



# Design with and by Marginalized People in Humanitarian Makerspaces

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There is a growing demand for humanitarian aid around the world as the number of displaced people has reached an unprecedented level. At the same time, the number of community-based design and fabrication makerspaces has been growing exponentially. Recently the humanitarian sector has become interested in how these spaces can help marginalized populations, including migrants, refugees, and asylum seekers. However, there have been few efforts to document what types of design projects marginalized populations develop in these spaces. More broadly, knowledge on design with and by marginalized people remains underdeveloped. This study responds to this gap in knowledge, by analyzing cases from three makerspaces that support migrants, refugees, and asylum seekers in Greece. Ethnographic studies are conducted of twenty-three design projects emerging from these spaces. These projects are analyzed using the framework of Max-Neef's fundamental needs to show how they simultaneously address functional and non-functional needs. For researchers, this study contributes to knowledge on design with and by marginalized people. For practitioners, this study helps to document the impact of humanitarian makerspaces by showing how design projects emerging from these spaces can address the needs of marginalized people.

**Keywords** – Humanitarian Design, Makerspaces, Marginalized People, Co-design, User-driven Design.

**Relevance to Design Practice** – This study contributes to knowledge on design with and by marginalized people. It provides insights relevant for the organization of humanitarian makerspaces.

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## Introduction

In 2015 an unprecedented number of displaced people arrived in Europe, with many people fleeing conflict in Syria, Iraq, Afghanistan, and South Sudan (Triandafyllidou, 2018). Since then, general alarm about the *refugee crisis* has continued to escalate, despite recent decreases in immigration. Many European countries have refused to accept migrants, refugees, and asylum seekers (MRAs), leaving people stranded in political limbo (Nimführ & Sesay, 2019). Even when MRAs are accepted, they are often confined to camps and ghettos. MRAs struggle to integrate with local populations and contribute to their new communities (Betts et al., 2017).

In contrast to populist views that MRAs are a threat to society, people are beginning to recognize the potential economic and social contribution of MRAs (Betts et al., 2017; Holmes & Castañeda, 2016). Humanitarian organizations have started looking for ways to position MRAs as agents of change, rather than as powerless victims (Easton-Calabria, 2015; Ekren, 2017; Long, 2001). Following this, there has been a turn in refugee studies towards theories on grassroots, frugal, and bottom-up innovation (Betts et al., 2015; Bloom & Faulkner, 2016). These shifting narratives emphasize the creative potential of people living in resource-constrained environments (Prabhu, 2017) as well as the ability of marginalized people to develop appropriate solutions for themselves (Smith et al., 2013).

Alongside this, makerspaces are emerging as new sites for bottom-up design and fabrication (Smith, 2017). These makerspaces (also known as FabLabs, Hackerspaces, or Techshops) are typically community-based fabrication workshops that enable people to *make almost anything* (Gershenfeld, 2012). They provide access to a range of digital tools (e.g., 3D printing), non-digital and craft tools, whilst promoting knowledge exchange and collaboration (Prendeville et al., 2017; Smith & Light, 2016). Globally, the number of makerspaces is growing exponentially (Gershenfeld et al., 2017) and in recent years, several makerspaces have been set up with the specific purpose of supporting MRAs. As these makerspaces are set up with a specific humanitarian agenda, we distinguish them from other types of makerspaces and refer to them in this study as *humanitarian makerspaces*.

Despite the emergence of humanitarian makerspaces, there remains limited research that documents the design projects emerging from these spaces. Of the few studies on this

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phenomenon (Corsini & Moultrie, 2018, 2020), they have tended to focus on how humanitarian makerspaces are organized. Much less is known about what types of design projects people develop in these spaces, and the potential value of these design projects. This paper addresses this gap in knowledge by addressing the following research questions: (1) What are the types of design projects developed in humanitarian makerspaces by marginalized people? (2) How do these design projects satisfy the needs of marginalized people? For clarity, this study does not intend to compare humanitarian makerspaces with makerspaces more broadly (i.e., in non-crisis settings). Rather, it focuses specifically on the role makerspaces play in the humanitarian context.

This article is structured as follows. First, we begin by describing what is already known about design with and by marginalized people. We also introduce Max-Neef's theory of fundamental needs as a key framework for this study. Second, we explain how data was collected on design projects developed at three humanitarian makerspaces in Greece. Third, we describe various design projects and analyze how they satisfy the needs of marginalized people. Finally, we discuss the main findings, thus contributing to knowledge on design with and by marginalized people.

## Design for, with, and by Marginalized People

The concept of using design to support the social and human development of marginalized populations is discussed using a variety of names such as *humanitarian engineering*, *community development engineering*, *design for development*, *design at the base of the pyramid*, *frugal innovations*, *bottom-up innovations*, *grassroots innovations*, etc. (e.g., Donaldson, 2009; Gupta et al.,

2015; Jagtap et al., 2013; Margolin, 2007; Radjou et al., 2012). The social-cultural and many other characteristics of marginalized societies are noticeably different from those of non-marginalized societies (Aranda-Jan et al., 2016). Therefore, solutions designed for marginalized societies ought to address unique requirements and circumstances in these societies (Jagtap, 2020). However, designers typically lack experience of living in these societies, and they are unfamiliar with the living conditions and needs of marginalized people (Jagtap et al., 2014). Solutions which are designed outside the context of marginalized societies are often not fully adopted, and their intended impact is unfulfilled (e.g., Dodson et al., 2012; Murcott, 2007; Nieuwsma, 2004; Thomas, 2006).

As a result, interest has shifted in recent years away from designing for marginalized people, to designing with marginalized people, in which affected stakeholders are actively involved in the design process. Several researchers argue that such collaborative design is fundamental for the social and human development of marginalized communities (Aranda-Jan et al., 2016; Jagtap, 2019a). It can enhance the design capability of marginalized people, by enabling them to contribute towards design activities, whilst supporting their project ownership (Jagtap, 2019b). On the other hand, co-designing solutions with marginalized people offer several benefits for designers. Specifically, it supports designers in understanding the local context, and in gleaning insights into the needs, aspirations, and life circumstances of marginalized communities (e.g., Sethia, 2005).

Whilst these co-design strategies are flourishing, user-driven design is also gaining attention. Whereas *design for* favors externally driven solutions and *design with* seeks to involve the participation of both designers and users, *design by* goes a step further to position the user as the lead designer and project instigator. This user-driven design approach is closely related to grassroots and bottom-up innovation which places emphasis on the ability of affected actors to develop their own solutions (Bergman et al., 2010; Smith et al., 2013). It also follows growing calls from the design community to recognize the potential contributions of non-expert designers. In *Design, When Everybody Designs*, Manzini (2015) highlights the role of *diffuse designers*, i.e., non-formally trained designers who are active in shaping the world around them through everyday practice.

However, as compared to non-marginalized societies, research on co-design and user-driven design in marginalized societies has been given limited attention. Among few studies, Thomas (2006) reports on a participatory approach employed in designing an aid to reduce the physical burden of washerwomen. Likewise, Nieuwsma and Riley (2010) elaborate on co-design workshops employed in designing a renewable energy system; Ssozi-Mugarura et al. (2017) present a participatorily developed ICT solution; Ambole et al. (2016) document the participatory design of a sanitation intervention in South Africa; and Hussain et al. (2012) describe co-design activities used to design a prosthetic device for children in Cambodia. However, it is reported that the perspectives of marginalized people are often not given adequate attention in the literature (Hirmer & Guthrie, 2016). Some

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researchers have criticized the lack of available examples of design projects within marginalized communities (Kolk et al., 2014). Hirmer and Cruickshank (2014) also identify that understanding the user-perceived value of design is key to improving the success of interventions in marginalized communities. To address these concerns, this research pays particular attention to the perspectives of marginalized people, and need fulfilment is used as a proxy to understand the user-perceived value of design projects.

### Max Neef's Fundamental Needs

In this study, Max-Neef's (1992) model of fundamental needs is used as a lens through which to analyze user projects.

Although Maslow's (1954) hierarchy is perhaps the most famous theory on human need, Max Neef's model has received greater acclaim in recent years within the field of social development. Whilst Maslow's hierarchy asserts that there are different stages to need fulfilment, Max Neef puts forward the idea that needs must be simultaneously satisfied in order to create personal fulfilment. Maslow's model supposes that needs of belonging, self-esteem and love, to self-actualization and transcendence cannot be addressed until basic physiological needs and safety are met. However, several studies have contradicted this model as it has been found that many people in resource-constrained environments actually choose to fulfil higher-level needs at the expense of lower-level needs (Subrahmanyam & Gomez-Arias, 2008).

Max-Neef presents a similar taxonomy of needs to Maslow (see Table 1) and also introduces the important concept of *satisfiers*, that is objects or actions by which needs are satisfied. Whereas singular satisfiers produce satisfaction in just one category of need, synergetic satisfiers fulfil multiple needs. In the following section, we explain how Max-Neef's needs are used to help evaluate design projects at humanitarian makerspaces.

**Table 1. Max-Neef's (1992) model of fundamental needs.**

Need	Description
<b>Subsistence</b>	health, food, shelter, work
<b>Protection</b>	being cared for, having choice and autonomy
<b>Affection</b>	being respected, loved, having fun, friends
<b>Understanding</b>	thinking, curiosity, investigating, learning
<b>Participation</b>	duties, responsibilities, work, collaboration, opinions
<b>Idleness</b>	imagination, fun, games, dreaming
<b>Creation</b>	boldness, invention, designing, building
<b>Identity</b>	belonging, esteem, self-knowledge, religion, values
<b>Freedom</b>	autonomy, passion, equality, choice, exploration, awareness

## Method

### Data Collection

An ethnographic method was adopted in order to document design projects emerging from three humanitarian makerspaces based in Greece, including ConstrACT Lab, AstroLab, and Habibi Works. Ethnographic studies originated from the field of social anthropology but have more recently been used in design research to study design artefacts from the point of view of the key actors involved (Bergman et al., 2010; Smith et al., 2013). They seek to illuminate the context of this study, and the meaning associated with products, according to their users. Given the desire to give a voice to the perspectives of marginalized people, it was decided that this approach was well-suited to the underlying agenda of the study.

Prior to visiting the makerspaces, key sources such as photos and videos of design projects which were published on social media (Facebook, Instagram, YouTube) were reviewed. These sources helped to build up a picture of the types of design projects being developed at the selected makerspaces. The first author travelled to Greece in November-December 2018 to visit the three humanitarian makerspaces. The researcher mainly acted as a participant-observer, with care taken to make their presence as unintrusive as much as possible. For example, during a visit to ConstrACT Lab, the researcher assisted users with their projects. The researcher observed users developing projects at the makerspaces, took photographs (with permission from users), and also kept a detailed field diary that was updated at the end of each day. This field diary included observations as well as reflections from informal conversations with MRAs.

In addition, semi-structured interviews were conducted with twenty-three MRAs at the makerspaces, with each interview lasting between ten to thirty minutes. These interviews were purposefully designed to be brief and conversational to not expose MRAs to research fatigue, where marginalized groups feel *over-researched* (Clark, 2008). Only fully anonymized data was recorded by the interviewer. The interviews were all recorded with the participants' consent, with the exception of four interviews, as the beneficiaries did not want to be recorded. In these cases, detailed note taking was used instead, and *power quotes* were documented (Pratt, 2008). During the interviews, some questions were asked to establish the beneficiary's background and aspirations. The beneficiary was also asked to describe a project that they had worked on in the makerspace. They were prompted to what motivated the design project and what impact it had on their life. Separate interviews were also conducted with employees at the humanitarian makerspaces to enrich findings from the beneficiary interviews. These semi-structured interviews aimed to identify whether there were any other types of design projects developed at the makerspace not covered in the interviews, and how these projects were perceived to satisfy the needs of MRAs. They also helped to build up a contextual understanding of the design projects. Table 2 provides a summary of all the data sources used.

**Table 2. Overview of data sources used in the study.**

Data		Role in analysis
Research field diary		21 pages of field notes Key source to analyze design projects
Semi-structured interviews (face-to-face interviews, between 10 minutes–30 minutes)	One-to-one interviews with beneficiaries at AstroLab	4 interviews
	One-to-one interviews with beneficiaries at ConstrACT Lab	7 interviews
	One-to-one interviews with beneficiaries at Habibi Works	12 interviews
	One-to-one interviews with employees at AstroLab	3 interviews
	One-to-one interviews with employee at ConstrACT Lab	1 interviews
	One-to-one interviews with employees at Habibi Works	7 interviews
Archive (55 items)	AstroLab's material, including captures of AstroLab's website (2019), Testimonials I-IV on YouTube (2018), Xenios on Youtube (2018), photo posts on Facebook (2016- 2019), AstroLab presentation (2018), AstroLab photo album (2018), AstroLab Annual Report 2018)	18 sources
	ConstrACT Lab's material, including TDH blog (2018), primer on TDH fab labs (2018), posts on Facebook (2018-2019),	10 sources
	Habibi work's material, including captures of Habibi Work's website (2019), videos on YouTube (2017- 2019), Photo posts on Facebook (2016-2019), and Instagram (2016-2019)	24 sources
	Media on small businesses in Katsikas Camp, including Rob Blake's website (2019), Instagram accounts (yahyabarber49; cafe_yasmin_60) (2018-2019)	3 sources

## Data Analysis

All the interviews were transcribed verbatim and stored in MAXQDA for analysis. To begin with, each of the design projects was analyzed using the following categories: makerspace (i.e., Astro Lab, ConstrACT Lab, or Habibi Works); project type (e.g., furniture, clothing, etc.), tools used (e.g., 3D printing, woodwork tools), project beneficiary; maker demographics (e.g., age, gender, individual, or group). Each project was initially labelled as either *design with* (i.e., emerging from a collaboration between MRAs and employees at the makerspace) or *design by* (i.e., initiated and developed by MRAs at the makerspace). In addition, it was noted whether the projects were *product-oriented* (i.e., tangible artefacts) or *use-oriented* (i.e., tangible artefacts developed for the purpose of delivering a service). Appendix Table 1 provides a detailed overview of the projects.

Once this had been completed, Max Neef's fundamental needs (protection; affection; understanding; participation; idleness; creation; identity; freedom) were used to create a code hierarchy within MAXQDA and to analyze the interview transcripts and field notes using line by line coding (Saldaña, 2015). Based on the weighting and frequency of coded segments, a score from 0-3 was assigned to each category of Max-Neef's needs for the twenty-three design projects. A score of 3 indicated that the need was strongly addressed by the design project; 2 indicated that the need was moderately addressed by the design project; 1 indicated that the need was weakly addressed by the design project; 0 indicated that the need was not addressed at all

by the design project. The following section will present three vignettes of user projects, followed by more detailed findings from the complete data set.

## Results

### Vignettes of User Projects

#### User Project #4

This project is an example of a product-oriented clothing project to design a jumper (See Figure 1). The project was initiated by Augustin, an MRA who had initially visited ConstrACT Lab while attending language classes in the same building. He was looking for inexpensive, warm clothing when he realized that there were resources available to make his own clothing at the lab. He found a UNHCR blanket that had been donated and left in the space and upcycled this into a hoodie.

Augustin explained that as well as being able to meet his own needs for warm and comfortable clothing (*subsistence*), he felt pride at being able to make something for himself (*identity*). His mother had been a tailor, and so he was familiar with sewing, although he had no experience of sewing anything himself. This experience of designing and making a jumper (*creation*) allowed him to develop new tailoring skills (*understanding*) in an area that he felt comfortable.

Moreover, making the hoodie allowed Augustin to explore a new passion (*freedom*) and build his self-esteem. Instead of seeing himself as a passive recipient of aid, he became active and





Figure 1. Upcycled jumper.

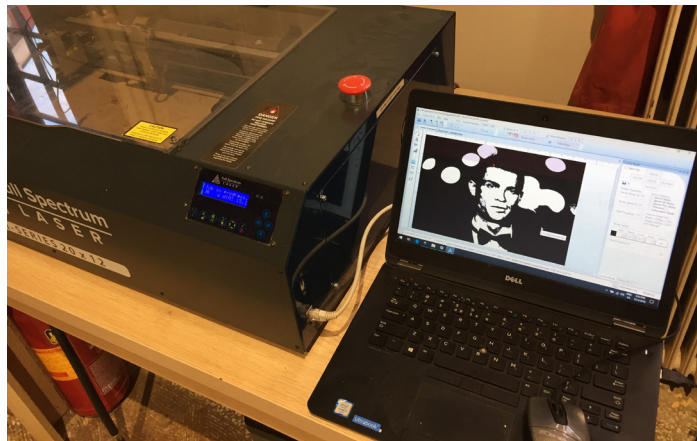


Figure 2. Digital artwork.

confident in his ability to shape his own experiences. This renewed sense of *identity* was highlighted by Augustin’s description of himself as a designer: “It’s a passion, it’s not a job, for my job I have another idea what I want to do. But I have my own passion to sew my own clothes, to be my own model. For me, I feel good when I wear clothes that I sew myself. I’m the designer, and I think it will cost me very low. It’s not expensive when you do something yourself. When you sew your own jacket, it’s not the same price as Gucci and Zara. I don’t have money to buy those clothes. The most important is to cover my body against cold and snow.”

### User Project #6

This project is an example of a non-functional digital art project designed by an MRA for a Greek friend (See Figure 2).

Mohammed is a 12-year-old who visits ConstrACT lab almost every day with his brother, whilst his parents attend language classes in the same building. At the lab, he produces a variety of creative, personal items. Whilst visiting the lab one day, Mohammed worked on a gift for his friend at school (*creation*). He was using digital design software to manipulate an image of Ronaldo (his favourite football player) so that it could be laser cut

onto a piece of wood (*understanding*). Mohammed was confident using the tools and resources, however when he was unsure he would seek help from some of the older boys in the lab. In this way, the digital artwork inspired collaboration and allowed Mohammed to move flexibly between the roles of learner, maker and even teacher (*participation*).

The project also satisfied Mohammed’s need for *affection* in two ways. First, Mohammed built relationships with people at ConstrACT Lab during the making process. When he finished his work, he would show his peers work with pride. Second, the gift allowed Mohammed to express his friendship with another boy at school. Furthermore, it enabled him to participate in the ritual of giving presents at Christmas time, allowing him to feel part of Greek society (*participation*). Finally, the project satisfied his need to express himself (*freedom*) and to develop his manifold identity as a football fan, a maker, and a friend (*identity*).

### User Project #13

Café Yasmin is an example of a use-oriented infrastructure project that was developed collaboratively between MRAs and employees at Habibi Works (see Figure 3).

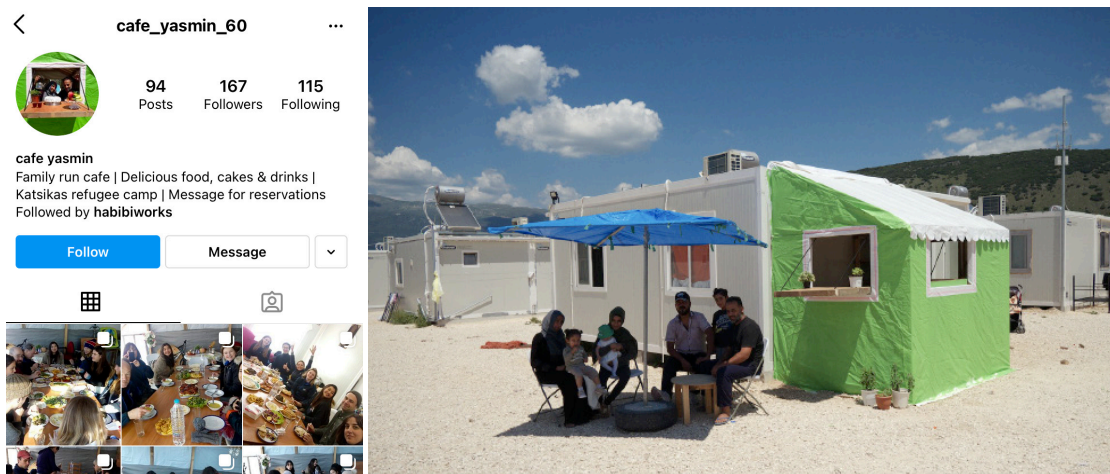


Figure 3. Café Yasmin Instagram (left) and Café Yasmin in Katsikas Camp (right). With permission from Rob Blake.

The project began when Rob Blake, a volunteer at Habibi Works started working with people living in Katsikas camp to develop ideas for community-led businesses. Yasmin approached Rob with the idea of setting up a small café. Using some of the woodwork tools available in Habibi Works, they worked together to make some furniture and built a wooden extension to Yasmin's container to set up a shelter for the café (*creation*).

As well as providing an income for Yasmin (*subsistence*) the café gave Yasmin and her family a new sense of purpose. It provided entertainment from the extreme boredom that people face in the camp (*idleness*). It also fulfilled Yasmin's need for participation in society as she contributes to and cares for the camp, through her business.

The café itself creates a social space in the camp, which brings people together (*affection*) in a safe space (*protection*). Instead of being provided with food, people have the opportunity to choose what they eat at the café, a small expression of freedom. Eating a shared cultural (Arab) food together also reinforces a sense of community and identity.

For Yasmin, building the café and creating a new business has been a learning curve and an opportunity to develop many new skills (*understanding*). She has even used social media to promote the café to people living outside the camp. As a result, the café is a unique space in that it fosters inclusion, bringing together people from inside and outside the camp (*affection*).

### Findings from the Complete Data Set

Table 3 offers an overview of the twenty-three user projects included in the study, and Appendix Table 1 provides an extended summary of these projects. The results show that the majority of projects ( $n = 7$ ) focused on the design of non-functional items, such as digital artwork or jewellery; other projects focused on the design of furniture ( $n = 5$ ), clothing ( $n = 4$ ), homeware ( $n = 4$ ), and infrastructure ( $n = 3$ ), including basic construction projects.

On the whole, most projects tended to be product-oriented ( $n = 20$ ), i.e., users designed products that could be directly used by themselves or others. For instance, *project 1* involved the design of a necklace and *project 4* involved the fabrication of a

**Table 3. Overview of the design projects.**

#	Project description	Project type	Makerspace
1	"Allah" necklace pendant	Non-functional	ConstrACT Lab
2	Branded vinyl stickers for trainers	Clothing	ConstrACT Lab
3	Digital art work	Non-functional	ConstrACT Lab
4	Jumper from an upcycled UNHCR blanket	Clothing	ConstrACT Lab
5	Laser cut Arabic poetry	Non-functional	ConstrACT Lab
6	Laser cut image of Neymar	Non-functional	ConstrACT Lab
7	Wooden table for container	Furniture	ConstrACT Lab
8	Art work for skateboard	Homeware	Habibi Works
9	BBQ grill	Homeware	Habibi Works
10	Beauty salon in Habibi Works	Infrastructure	Habibi Works
11	Bicycle shed at Habibi Works	Infrastructure	Habibi Works
12	Bracelet	Non-functional	Habibi Works
13	Café Yasmin	Infrastructure	Habibi Works
14	Curtains for accommodation at Katsikas camp	Furniture	Habibi Works
15	Decorative box	Non-functional	Habibi Works
16	Fixing jeans	Clothing	Habibi Works
17	Skirts	Clothing	Habibi Works
18	Wooden laptop rest	Furniture	Habibi Works
19	Wooden table	Furniture	Habibi Works
20	Engraved wooden coasters	Homeware	AstroLab
21	Framed engraved art work	Non-functional	AstroLab
22	Table for accommodation in Eleonas Camp	Furniture	AstroLab
23	Xenios branded t-shirts, coasters, bags, mugs	Homeware	AstroLab

jumper. Only a handful of projects were use-oriented ( $n = 3$ ), i.e., their value was created through their use as part of a service. For example, *project 13* included the fabrication of a simple wooden structure for creating a shop in the Katsikas refugee camp.

The design projects included some projects that were designed by MRAs ( $n = 16$ ) and some projects that were designed collaboratively by MRAs and employees at the makerspaces ( $n = 7$ ). In the majority of projects, the users designed for themselves ( $n = 17$ ), with a handful of projects designed for others ( $n = 7$ ), including for other MRAs and local populations. Roughly half of the projects ( $n = 10$ ) used digital fabrication tools (such as 3D printers and laser cutters), with the remaining projects using non-digital tools (such as sewing machines, hand tools and welding machines).

Table 4 shows the weighting of need fulfilment for each project. Every project in the study addressed at least six of Max-Neef's needs. 100% of projects at least partially addressed the needs of identity, creation, and idleness; 96% addressed freedom and understanding; 61% addressed subsistence; 57% addressed affection; 39% addressed protection.

Figure 4 compares the average Max-Neef's need fulfilment scores for different types of project (Clothing; Furniture; Homeware; Infrastructure and Non-functional); group and solo projects; design with and by projects; use- and results-oriented projects; digital and non-digital projects; and projects by makerspace (AstroLab, ConstrACT, & Habibi Works).

Overall, it shows that projects fulfil multiple needs simultaneously, irrespective of project type (Figure 4a). Figure 4b suggests that group projects result in slightly higher scores for participation, affection and understanding, compared with solo projects. In addition, design-with projects score highly for participation, understanding and affection, although design-by projects score more highly for subsistence and identity (see Figure 4c). This is perhaps not surprising as it is well known that collaborative projects can strengthen relationships and support skill development (Björgvinsson et al., 2010). Yet the findings tentatively suggest that solo projects afford greater freedom for individuals to explore their identity and personal subsistence needs.

**Table 4. The weighting of Max-Neef's need fulfilment for each project.**

	Subsistence	Protection	Affection	Understanding	Participation	Idleness	Creation	Identity	Freedom
Project 1	0	1	0	3	2	3	2	3	3
Project 2	3	0	0	2	1	1	3	3	2
Project 3	1	0	2	3	1	1	2	3	3
Project 4	3	0	0	1	1	1	1	2	2
Project 5	0	2	0	2	1	1	3	1	3
Project 6	0	0	3	1	1	2	1	3	2
Project 7	3	0	1	1	1	1	2	2	3
Project 8	0	0	2	2	1	1	3	3	3
Project 9	3	2	2	2	1	3	1	2	3
Project 10	0	2	3	2	3	3	2	3	2
Project 11	0	0	3	2	2	2	3	3	3
Project 12	0	0	3	1	1	3	1	2	2
Project 13	3	2	3	2	2	2	3	3	3
Project 14	3	3	2	2	1	1	1	3	3
Project 15	0	0	3	3	2	2	1	1	1
Project 16	3	2	1	3	1	2	0	3	2
Project 17	1	1	2	1	2	2	3	0	1
Project 18	3	0	2	1	1	2	3	3	2
Project 19	3	2	0	1	2	2	2	3	2
Project 20	0	0	3	3	2	2	2	1	1
Project 21	2	0	2	2	2	2	1	1	0
Project 22	3	0	0	2	2	1	2	2	3
Project 23	1	0	3	3	3	2	1	2	2

Max-Neef Fulfillment:



**Figure 4. The radar chart of Max-Neef’s fulfillment analysis result by (a) project type; (b) makerspace; (c) digital/non-digital; (d) group/solo; (e) design by/with; (f) use-/results-oriented.**

It is also of note that there is little difference in scores between digital and non-digital projects (Figure 4d), apart from the fact that digital projects score slightly higher for understanding, whereas non-digital projects score more highly for subsistence, protection, and freedom. This could be explained by the fact that digital projects result in greater reported learning and skill development; however, non-digital tools enable a broader range of product outcomes (including clothing, furniture, homeware, and infrastructure).

Finally, it is found that use-oriented projects tend to score more highly across all needs (with the exception of subsistence) compared with product-oriented projects (see Figure 4e). Although there was only a handful ( $n = 3$ ) of use-oriented projects in the study which may limit the strength of this finding, the result provides initial evidence that use-oriented projects should be encouraged within humanitarian makerspaces.



## Discussion

In light of the increasing appetite for innovation in the humanitarian sector, a number of makerspaces have been set up to specifically support marginalized and crisis-affected populations (Corsini & Moultrie, 2018, 2020). However, there has been little attention paid to what types of design projects marginalized people develop in these spaces, and how these projects might address their needs. Earlier work has also called for more examples of design projects within marginalized communities (Kolk et al., 2014). This study has addressed this gap by documenting the design projects emerging from humanitarian makerspaces.

### What Are the Types of Design Projects Developed at Humanitarian Makerspaces by Marginalized People?

Our findings identify the different types of design projects that humanitarian makerspaces give rise to. In this study, projects ranged from items of clothing, furniture, homeware, infrastructure, and non-functional items. It was found that MRAs develop projects for themselves, for others and for commercial purposes. In earlier work, Jagtap and Larsson (2018) identified that resource-poor people could adopt the role of either consumer, producer or co-designer in design projects. Our study has shown that these roles often overlap, and that *design with* and *design by* marginalized people are both valuable and complementary design approaches. The findings revealed that whilst *design with* projects scored highly for participation, understanding and affection, *design by* projects scored more highly for subsistence and identity. It is therefore recommended that humanitarian makerspaces should seek to nurture both *design with* and *by* marginalized people to maximize opportunities for their need fulfilment.

In terms of technology, we find that people use a variety of digital, non-digital and craft tools. Although much of the discussion around makerspaces has been driven by the interest in digital technologies and digital fabrication tools (e.g., 3D printing), our findings underline that non-digital tools (e.g., sewing machines, lathes) are just as popular among users. This underlines the need for a blended digital and non-digital environment. It also steers the conversation away from what technologies should go in makerspaces, to what an enabling environment for these technologies might look like (Niaros et al., 2017). This supports calls by Taha et al. (2011) for *creative capacity building* in which workshops are held with the community to determine what technologies are appropriate for the context, and how they can be adapted to the needs of the community. They also specifically criticize a one-size-fits-all makerspace model.

Finally, whilst most projects tended to be product-oriented, the tentative finding that use-oriented projects (e.g., Example 13 - Café Yasmin shown in Figure 3) result in greater need fulfilment make the case for *infrastructuring*. Björgvinsson et al. (2012) coined this term to describe the transition from designing pre-defined outcomes to developing long term, open-ended solutions. To this extent, design does not end with the creation

of a product but is an ongoing process of relationship building between different actors. Café Yasmin is an example of a long-term and open-ended solution that has continued to evolve beyond when the café was first built. As new people have visited the Café, the menu and entertainment have changed, and the space has fostered new relationships between MRAs and employees at NGOs based in Katsikas. For the design research community, this finding highlights the need for design methods to support *infrastructuring* among marginalized communities to advance long-term, holistic impact.

### How do These Design Projects Satisfy the Needs of Marginalized People?

First and foremost, the findings provide evidence that makerspaces do make a difference in the humanitarian context. Specifically, they show that design projects developed at humanitarian makerspaces can satisfy multiple needs of marginalized people. Second, the findings underline the importance of a multi-faceted approach to addressing needs that extends beyond basic subsistence needs. Although many design projects are initially motivated by subsistence needs (e.g., shelter, comfort, and money), the results show that marginalized people derive value from a holistic fulfilment of their needs. Moreover, some design projects do not address the need for subsistence at all, instead addressing *intangible needs such as affection, idleness, and identity*.

In the past, the aid sector has been criticized for not acknowledging users' perceived values (Hirmer & Guthrie, 2016) and for failing to sufficiently address intangible needs (Santos et al., 2013). Our study has underlined that marginalized people are motivated to address their own intangible needs when given an opportunity. It has shown that there are particular opportunities for humanitarian makerspaces to help reinforce positive identities and to foster a sense of belonging. This is especially valuable in the refugee context as many MRAs experience poor mental health and low self-esteem (Abbott, 2016; Anagnostopoulos et al., 2016) and also face negative representations in the media that portray them as being underserving or incapable (Holmes & Castañeda, 2016; Rettberg & Gajjala, 2016). The findings suggest that design projects created at humanitarian makerspaces might help to counter these discourses, by shifting how MRAs see themselves. For instance, several MRAs spoke about how using the makerspace made them feel self-reliant and empowered to achieve their goals:

Here if you bring some clothes for people to sew for you, they will say 'no, you have to do it by yourself'...they will teach you the technical know-how for you to do it yourself... You will feel good, you will not beg people 'please do this or that.' It makes someone strong... If you don't know how to do anything, even if this country accepts you, you will be a liability to them... But if you are versatile, you can do anything. (Interview 16)

I was searching for a table, a proper one that I liked I couldn't find. So, I thought to myself why not go to the fab lab and do it myself? It makes you feel independent. (Interview 12)

Whilst this paper has primarily focused on the design outcomes of marginalized people as opposed to the design process, Hussain (2010) explains that design outcomes and process are intrinsically related as *an empowering process results in empowering outcomes*. This study thus supports previous work which highlights the potential for empowering marginalized people through design (Hussain et al., 2012; Björgvinsson et al., 2012).

### Potential Limitations of Design in Humanitarian Makerspaces and Recommendations for Further Research

Our findings have largely reflected the positive impacts that humanitarian makerspaces can have by enabling design with and by marginalized people. But what are the potential limitations of design with and by marginalized people, specifically in humanitarian makerspaces?

In the literature, several authors warn about the dangers of tokenism when involving marginalized people in design projects (Hart, 1992; Hussain, 2010). Others have pointed out that there is an opportunity cost to participating in design projects, which can limit the extent to which marginalized people are able to participate (Corsini et al., 2019). It is notable that among the user projects documented in this study, only four were developed by women, with two projects involving mixed groups, and the remaining seventeen developed by men. Several researchers have already reported on a gender bias in maker culture which tends to exclude women and non-binary individuals (Costanza-Chock, 2020; Lewis, 2015; Maric, 2018). For instance, Lewis (2015) finds that despite the rhetoric that makerspaces are open to all, women avoided them because they were perceived to be too male-dominated. In the refugee context, there may also be other reasons why women are less likely to design in humanitarian makerspaces, which deserve further attention. Future studies might consider how humanitarian makerspaces might accommodate older groups, which according to Karunakara and Stevenson (2012) are often neglected by aid sector care.

There also remain question marks around how the efforts of design with and by marginalized people might be scaled up in the humanitarian context. To take the earlier example of user project #4 to make a jumper, makerspaces are clearly not a solution for making jumpers for *all* MRAs—there are clearly more efficient ways to manufacture and supply warm clothing at scale. Rather, it seems that humanitarian makerspaces could help marginalized people to access items that might be overlooked by the aid sector. For example, one of the projects in this study was a set of curtains made by a woman for her accommodation in Katsikas camp; she was frustrated that her accommodation had not been fitted with curtains which were limiting her privacy and personal freedom (see Appendix Example 14). Previous work has identified that makerspaces could potentially contribute to the supply of humanitarian items when supply chains fail (James, 2017; Corsini et al., 2020; Corsini & Moultrie, 2021) where decentralized small, local sites are engaged in production, often supported by digital systems and networks, can be a powerful tool in humanitarian aid. Field Ready uses distributed manufacturing to produce essential

non-food items locally where they are needed during humanitarian responses. Such supplies can be available to communities in need and to relief workers more quickly, more cheaply than alternatives, and provide appropriate solutions to problems, often engaging local people in designing and making necessary items, and supporting economic development. Scaling up this requires local production capabilities (skills, tools, and information such as designs. This study complements these findings by showing that humanitarian makerspaces can enable the provision of appropriate items where there are gaps in knowledge about user needs.

A valuable elaboration to this study would be to explore the collaborative design processes that take place in humanitarian makerspaces. In an attempt to clarify what collaborative design is (and is not), Wang and Oygur (2010) set out that collaborative design must bring together distinct knowledge domains to construct shared viewpoints, via iterative processing and knowledge brokerage; in sum, this should result in new, demonstrable outcomes. Drain et al. (2018) define three types of outcomes as solutions, insights (e.g., challenges, community knowledge) and empowerment (e.g., creative capacity, social inclusion). As stated earlier, this study has primarily focused on the design projects (i.e., solutions) emerging from humanitarian makerspaces. However, future studies might consider the dimensions of insights or empowerment as areas for study; or consider how knowledge is brokered, and shared viewpoints are constructed through iterative development. In other work, Frauenberger et al. (2015) present four lenses for studying participatory design: outcomes, stakeholders, values, and epistemology. Whilst our research has concentrated on documenting user perceptions of their design projects, further studies might investigate what values drive the process, how they are reflected in decisions, what kinds of knowledge and constructed and shared, what the nature of participation is, and how it varies throughout the design process. As the authors reflect on the largely positive findings of this study, they consider that such future research might help to shed a light on the possible tensions and darker sides of design in humanitarian makerspaces.

### Conclusion

As the *refugee crisis* in Europe becomes increasingly protracted, organizations have started looking for more long-term solutions. There are a small but growing number of humanitarian makerspaces specifically aimed at supporting migrants, refugees and asylum seekers (MRAs).

This study has helped to shed a light on design in humanitarian makerspaces. It provides a useful illustration of design with and by marginalized people, and encourages researchers to further this line of enquiry. Methodologically, our study showcases the value of studying design projects, as a way of giving a voice to marginalized people. The findings suggest that co-design and user-driven design in humanitarian makerspaces can play a role in helping marginalized people to address their needs.

Whilst this study advances knowledge on the emerging phenomenon of humanitarian makerspaces, we acknowledge some limitations of our work. First, we have only focused on

three makerspaces in Greece during a limited time. We encourage other authors to conduct studies in other European countries such as Germany and the Netherlands. Second, we would welcome long-term studies on the same. Our study only provides a *snapshot* of the user projects from the beneficiary perspective. We recognize the importance of longitudinal studies to evaluate the impact of these projects over time. Third, our study of humanitarian makerspaces is limited to migrants, refugees, and asylum seekers. Whilst the authors speculate that such makerspaces might also offer substantial benefits in other low-resource settings (e.g., rural areas, low-income regions, etc.), it would be necessary to further explore the role of humanitarian makerspaces in other contexts.

Finally, our study has focused primarily on design projects at an individual level. It would be interesting to further investigate the impacts of design with and by marginalized people at a broader community level. In addition, we believe that further investigation into the design processes, management and structure of humanitarian makerspaces is needed to complement this study. A fruitful avenue for research could include developing simple and easy-to-use design methodologies to support design by marginalized people in makerspaces. Whilst there are scarce attempts to develop such methodologies to support design by marginalized people (e.g., Hernández Girón et al., 2004), they are not aimed at design practices in a makerspace. Since design is a social and cultural process, with a close association between design practices and the context in which they are undertaken (Bucciarelli, 1994; Konda et al., 1992) there is a need for design processes and methods specifically tailored to the needs of marginalized people to support their design activities in a given makerspace context. Such design methods could themselves be co-designed with marginalized people to enhance their adoption and use.

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## Author Contributions

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## Appendix A: Detailed Summary of Design Projects

#	Project description	Project type	Makerspace	Maker	Age	Gender	Beneficiary	Tools used	Digital tools?	Product- or use-oriented?	Design with or by?
1	"Allah" necklace pendant	Non-functional	ConstrACT Lab	Solo	20	Male	Maker	CAD, 3D printing	✓	Product	Design by
2	Branded vinyl stickers for trainers	Clothing	ConstrACT Lab	Solo	19	Male	Maker	CAD, Vinyl cutter	✓	Product	Design by
3	Digital art work	Non-functional	ConstrACT Lab	Solo	40	Male	Maker	CAD, laser cutter	✓	Product	Design by
4	Jumper from an upcycled UNHCR blanket	Clothing	ConstrACT Lab	Solo	35	Male	Maker	Sewing machine	✗	Product	Design by
5	Laser cut Arabic poetry	Non-functional	ConstrACT Lab	Solo	12	Male	Maker	CAD, laser cutter	✓	Product	Design by
6	Laser cut image of Neymar for a school friend	Non-functional	ConstrACT Lab	Solo	14	Male	Friend	CAD, Laser cutter	✓	Product	Design by
7	Wooden table for container	Furniture	ConstrACT Lab	Solo	30	Male	Maker	Handsaw, drill, etc.	✗	Product	Design by
8	Art work for skateboard	Non-functional	Habibi Works	Solo	18	Male	Maker	CAD, Laser cutter	✓	Product	Design by
9	BBQ grill	Homeware	Habibi Works	Solo	38	Male	Maker	Handsaw, welding tools	✗	Product	Design by
10	Beauty salon in Habibi Works	Infrastructure	Habibi Works	Group	40 (average)	Female	MRA community	None	✗	Use	Design with
11	Bicycle shed at Habibi Works	Infrastructure	Habibi Works	Group	20 (average)	Male	MRA community	Handsaw, drill, etc.	✗	Use	Design with
12	Bracelet	Non-functional	Habibi Works	Solo	18	Male	Maker	Textiles	✗	Product	Design by
13	Café Yasmin, a café selling food in Katsikas camp	Infrastructure	Habibi Works	Group	40 (average)	Mixed	MRAs, NGO staff at Katsikas camp	Handsaw, drill, etc.	✗	Use	Design with
14	Curtains for container at Katsikas camp	Homeware	Habibi Works	Solo	54	Female	Maker	Sewing machine	✗	Product	Design by
15	Decorative box	Non-functional	Habibi Works	Solo	18	Female	Maker	CAD, Laser cutter	✓	Product	Design by
16	Fixing jeans	Clothing	Habibi Works	Solo	38	Male	Maker	Sewing machine	✗	Product	Design by
17	Skirts	Clothing	Habibi Works	Solo	60	Female	Maker	Sewing machine	✗	Product	Design by
18	Wooden laptop rest	Furniture	Habibi Works	Solo	40	Male	Maker	Handsaw, drill, etc.	✗	Product	Design by
19	Wooden table	Furniture	Habibi Works	Solo	40	Male	Maker	Handsaw, drill, etc.	✗	Product	Design by
20	Engraved wooden coasters	Homeware	AstroLab	Group	25 (average)	Male	Makers	CAD, laser cutting	✓	Product	Design with
21	Framed engraved art work	Non-functional	AstroLab	Group	34 (average)	Male	Local contractor	CAD, laser cutting	✓	Product	Design with
22	Table for container in Eleonas Camp	Furniture	AstroLab	Solo	25	Male	Maker	Handsaw, drill, etc.	✗	Product	Design with
23	Xenios branded t-shirts, coasters, bags, mugs	Homeware	AstroLab	Group	25	Mixed	Local population in Athens	CAD, Silk screen printing	✓	Product	Design with

## Appendix B: Additional Vignettes of User Projects

Image	Project description
	<p><b>User project #14:</b> At Habibi Works, several women were observed making curtains for their containers in the Katsikas camp. The majority of women living in the camp are Muslim and wear headscarves in public to cover their hair. However, none of the containers in Katsikas camp had been provided with curtains. People found living without private shelter was both undignified and uncomfortable. Without privacy some women were wearing their headscarves twenty-four hours a day. Curtains satisfied people's need for private shelter (<i>subsistence</i>), providing security (<i>protection</i>), religious freedom (<i>identity</i>), and dignity (<i>freedom</i>). Making the curtains was not only a creative activity that involved selecting fabric and decorating them (<i>creation</i>), but it was also a social activity, that involved sharing knowledge and building friendships (<i>affection</i>). The process of making the curtains also satisfied the need for participation, as it gave rise to spontaneous help and advice being exchanged between people in the space.</p>
	<p><b>User project #23:</b> During a training course on 2D/3D design, AstroLab invited MRAs and local Greek people to collaborate to create a set of images that combined their own cultures (<i>participation</i>). In doing so, people were forced out of their 'ethnic ghettos' and started to develop relationships with people from different ethnic backgrounds (<i>affection</i>). The project helped to establish set of shared values whilst also reaffirming people's own cultural identities (<i>identity</i>). It also satisfied the need to pursue creativity and have fun (<i>idleness</i>). The images that were created were developed into a visual brand, Xenios. These images were then silk-screen printed onto a range of products for sale, including t-shirts, mugs, coasters and bags (<i>creation</i>). Producing these items satisfied the need for <i>understanding</i>, as people learnt and applied new skills. The ambition for the project was that Xenios could operate as a social enterprise, which sold products made by the beneficiaries at AstroLab. This would provide beneficiaries with an income, satisfying their need for <i>subsistence</i>. Although some products were sold at a charity event in Athens, the project stalled after it struggled to find the funds to launch the brand.</p>
	<p><b>User project #2:</b> Adeel is a fashionable 20-year-old who visits ConstrACT Lab regularly to make things and meet with friends. Among several projects, Adeel was particularly proud of his project to repair his trainers. After learning how to use several of the machines in the lab (<i>understanding</i>), he realized that he could use the vinyl cutter to repair his trainers (<i>subsistence</i>). He printed stickers that could be carefully placed to fix the sole of his shoe, which was peeling off. Adeel decided that he could disguise this fix by printing Nike and Adidas branded stickers. In doing so, he was able to customize his trainers according to his style (<i>creation</i>) and reinforce his identity as a someone who is fashionable and confident. Adeel also expressed pride at the ingenuity of his fix to transform a damaged trainer into high-status footwear (<i>identity</i>). Having limited economic means, the ability to customize his footwear and choose for himself how he dressed was empowering (<i>freedom</i>). Furthermore, the user-project gave Adeel a sense of purpose during his free time (<i>idleness</i>). Physically engaging with the resources at the lab (<i>participation</i>) helped him to stay active and created a sense of personal accomplishment.</p>
	<p><b>User project #10:</b> Amal is a beautician who works at beauty salon, providing grooming and hair styling for women. Her work satisfies the need for protection through caring for others. In the salon, she builds friendships with other women and fulfils her own need for affection, as she is respected and appreciated. Before she left Iran, Amal used to own a beauty salon and so working at the beauty salon in Habibi Works reaffirms her identity as a beautician. It creates a sense of normality and continuity from her previous life. In providing this service, she keeps busy (<i>idleness</i>), practices her own beauty skills (<i>understanding</i>), and is able to participate in the community (<i>participation</i>). For Amal, creating new styles according to people's requests (<i>creation</i>) is highly rewarding because of the joy she can bring to others. The beauty salon itself satisfies the need for freedom, by providing the community with the freedom to express themselves and to choose their personal style.</p>