The impact of sharing platforms on collaborative design development during emergencies: the case of COVID-19

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ABSTRACT

The COVID-19 outbreak resulted in an emergency of projects developed, shared and produced by makers, fablabs and open source enthusiasts. These projects are often released in design sharing platforms, e.g. Thingiverse, Github and Instructables under open source licenses. It is often argued that the release of such projects holds potential for enhancing collaboration, continuous development and design dissemination. These arguments have been subject of recent studies on the structure of maker/Open Design communities and sharing platforms. This study aims to contribute to the on-going debate on the potentialities of such communities. We adopt an explorative approach to (i) identify the influence of the COVID-19 outbreak on the activity volume of Thingiverse, the object of our study, (ii) analyze the designs metadata and its network patterns, and (iii) identify interaction patterns based on real-world localities. Based on our findings we comment on the importance of the maker/ Open Design communities to tackle critical situations and highlight the current limitations for a wider dissemination of open source designs. Our findings may contribute to build better tools for designers and enthusiasts of the maker/open culture as well as to studies on collaborative development.

Keywords: Design Remixes, Maker Movement, Open Design, Thingiverse

1. INTRODUCTION

The shortage of personal protective equipment (PPE), resulting from the health emergency caused by the COVID-19 outbreak, presents a high risk for healthcare workers. The high demand caused prices to double or even treble and let healthcare workers ill-equipped (WHO 2020). At the same time, workers from essential activities, such as groceries stores and pharmacies, also need PPE to prevent themselves from contamination. As a response to this situation, users started developing and releasing PPE designs with the aim to promote self-manufacturing of such equipment. These initiatives are linked to two recent trends in the design field, the maker movement and Open Design (OD).

The maker movement consists on a recent trend, driven by advances on personal/distributed fabrication technologies, and on information and communication technologies (ICTs). It encompasses do-it-yourselfers and high-tech enthusiasts (Gershenfeld 2012, 48) who usually share design models and experiences on online communities and/or forums. As for OD, it refers to a collaborative development process which outcomes are publicly shared for anyone to produce/use, study, modify and distribute them (Aitamurto,

Holland, and Hussain 2015; Boisseau, Omhover, and Bouchard 2018). Openness in OD is based on how collaborative/accessible is the development process, how robust and available are the outcomes (source documentation) and how replicable it is (Balka, Raasch, and Herstatt 2014; Bonvoisin and Mies 2018). In general, OD projects are developed/shared in two main types of online platforms. The first one is linked to intentional collaboration – which hosts projects maintained by active users responsible for revision, modification and contributions to the design development. A well-known example of this type of repository is *Github*. *Github* enables not only users to perform commits (revision/contribution) to project files but also provides a version control system. The second type refers to online repositories of designs which are not necessarily developed in collaboration processes. Examples of this case are the *Thingiverse, Tinkercad* and *Pinshape.* In this study, the term "*maker/OD communities*" is adopted to refer to the movements and communities involved in this process.

Recently, studies in Open Source Hardware and OD explored the structure of online communities by using both quantitative and qualitative approaches, such as interviews (Malinen et al. 2010; Ferdinand 2017) participant observations (Macul and Rozenfeld 2015) and data mining of online platforms, such as *Github* (Menichinelli 2017; Bonvoisin et al. 2018; Freire and Monteiro, 2020) and *Thingiverse* (Flath et al. 2017; Moilanen et al. 2015). The results help researchers to understand interactions between users, the influence and importance of actors, the activity volume (Menichinelli 2017), the quality of shared information and documentation and license choices (Moilanen et al. 2015).

This article contributes to the discussion by analyzing the COVID-19 content produced by users of a sharing platform and the possible impacts it has on enhancing collaboration, continuous development and design dissemination. We opted for the *Thingiverse* platform as our object of analysis. As mentioned, *Thingiverse* is a user-generated content repository for sharing designs. It is not oriented for active collaboration but it enables users to comment (making suggestions and reporting issues) and make derivative works when allowed by original creator. The adoption of *Thingiverse* as a repository for healthcare designs has been previously studied by Buehler et al., 2015, identifying the existence of 363 designs (out of 100.000). For the purposes of this article, we outline three questions to guide our study.

RQ1: How does a sharing platform hosted contributions and favoured creative interactions during the earlier COVID-19 crisis?

RQ2: Do online platforms contribute to design dissemination in different locations?

RQ3: Do creators take advantage of previous design releases to make improvements, changes and adaptations?

This article is structured as it follows: In the following section we present the tools we adopted to extract the design projects' data, analyze the design's network and map the geographical connections of users. The analysis and findings are introduced next. Thereafter, we discuss the results and its implications on practice and research. The limitations of this study are also presented in the discussion and conclusion section.

2. METHODS

Thingiverse was adopted in our study as our object of study. It is an online repository for sharing user-generated content. Users of the platform are encouraged to assign an

opensource license in order to allow others to copy, modify or reproduce any design (depending on the license type assigned). Once a design is shared on the platform, users are able to report makes, i.e. when they produce a specific design, develop derivatives (remixes) based on other designs, save designs (collect) or simply download the design files.

2.1. Data extraction

For the purposes of this study we developed six different scripts based on scrapy, a python module for extracting information from the site by parsing its web pages. Scripts were released under an OS license on an online repository (Freire 2020a). The first script was used to search for designs, hosted by *Thingiverse*, related to COVID-19 by using the keywords 'coronavirus' and 'COVID-19'. The search returned 4036 occurrences. Duplicated projects (n= 656) were removed, resulting in 3379 design projects related to COVID-19. The individual ID of each project was applied to other scripts (Figure 1) to collect the (i) Project Data, (ii) Ancestors Data, (iii) Makes Data, (iv) Derivatives/Remixes Data and (v) Creator Data.
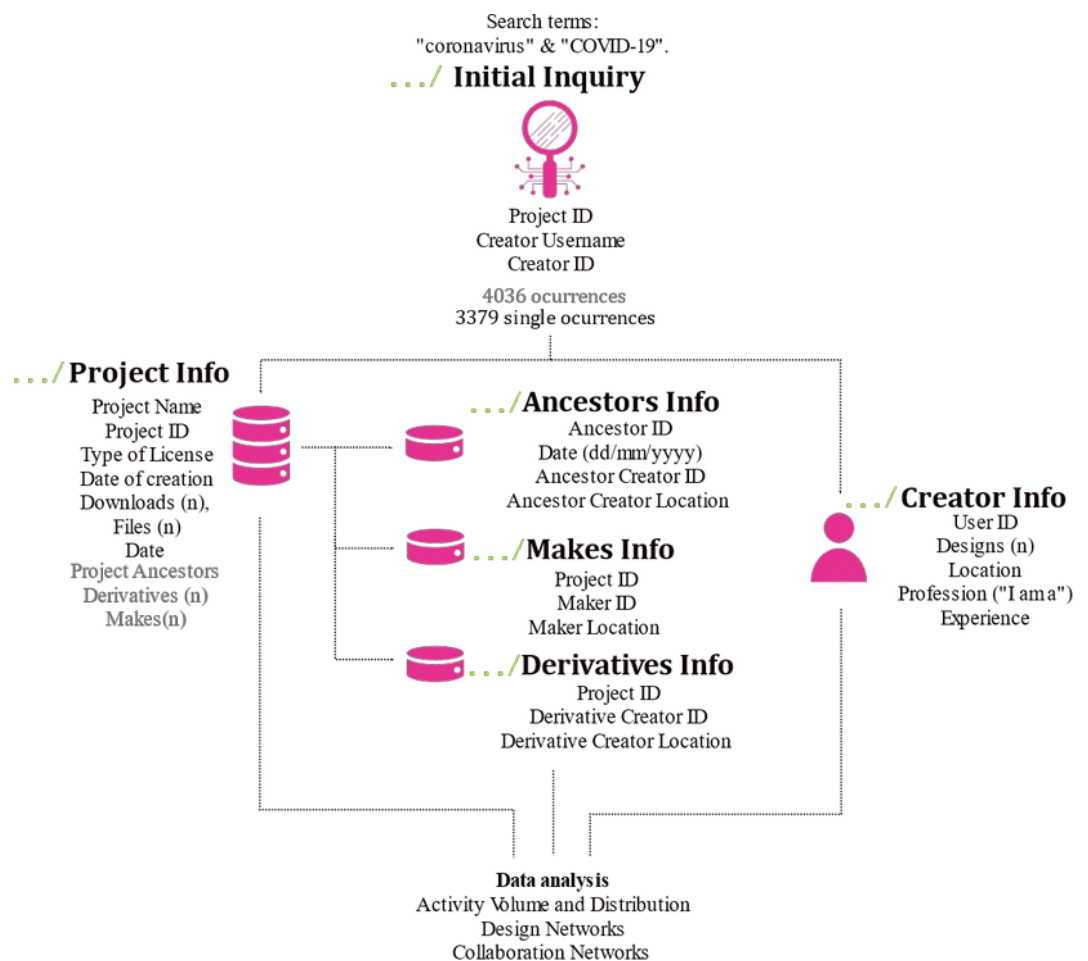

Figure 1 – Data mining process and information collected on *Thingiverse* from January, 1st to July, 1st

The data was used to analyze the activity volume for the periods ranging from January, 2020 to July, 2020 considering the original designs release, derivatives and makes. For each design, we identified the license types, the file types, the existence of derivatives, makes, number of downloads and related users. Finally, for each user we identified their location (country), profession and previous contributions to the sharing platform. It is important to note that while the data mining process enabled us to automatically organize the data, manual steps were conducted to check data consistency and refine the data. For example,

users' location data doesn't follow a pattern, i.e. it could provide either their full location (e.g. city, state and country) or a single information. In this case, manual work was performed to include only the country of residence.

The activity volume was calculated considering the designs (n=3.379) shared and the number of downloads they have (n=167.779) for the period ranging from January, 2020 - July, 2020. A running total calculation was performed to identify the activity volume distribution of the designs. We also measured for each design (i) the number of reported makes – when a user reproduces and reports it in the community, (ii) the number of derivatives *(remixes)* – when the design is combined or modified into a new version – (iii) the number of downloads, (iv) the number of likes and (v) comments. Finally, the designs were classified in terms of license types. For replicability purposes, the complete raw data is available at (Freire 2020b) including the scripts adopted in this study.

2.2. Network analysis

We adopted the Open Graph Viz Platform (Gephi[2]) for network visualization and network analysis (NA). First, we traced back the project ancestors, i.e. projects that were improved, combined or partially used to the development of the projects of our interest ("COVID-19" and "Coronavirus"). Up to four generations of antecessors were identified, and duplicate results were removed (1°=458, 2°=114, 3°= 28 and 4°= 22). These projects were added to the initial inquiry, resulting in 4001 projects. Following that, we structured the data based on the platform requirements, identifying antecessors projects as *source* and derivatives as *target,* their Ids and dates of creation. Force-Atlas2 layout algorithm was used to represent the network of the designs. The algorithm is force-directed, i.e. it uses attraction and repulsion forces acting between the bodies of a system, enabling some (but limited) inferences about the visual results. Projects unrelated to a *source* or a *target* were excluded from our analysis at this moment. We also calculated two topological indicators. First, the Degree Centrality (DC) was adopted to measure the influence of a node in a network based on the number of edges linked to it. Second, we adopted the *Modularity* measure (Blondel et al. 2008) to extract the different clusters of the given weighted network. It is based on the repetition of two iterative phases. The indicator assigns a different community to each node and evaluates the gain of modularity by changing the community each node belongs to. The analysis stops once the maximum modularity is achieved for each one of the nodes.

2.3. Geographical mapping

Mapping generation was performed in R. Based on the users' location data, we developed an origin-destination map to assess the relations between creators-remixers and creators-makers. As mentioned, locations were collected from the users' profile and adjusted to only include the user's country. Edges were color-weighted based on the number of connections and nodes (countries) weighted by the number of "Coronavirus/COVID-19" designs released.

3. RESULTS

3.1. Activity volume and characteristics

For the period considered for this study (Jan-Jul, 2020) we identified 3.379 designs shared in the *Thingiverse* platform. These designs were downloaded 167.779 times and have 3.299

remixes and 1929 makes reported. It is important to highlight that the number of remixes is influenced by *Customizer* designs, i.e. designs that can be easily customized directly on the website. For example, two designs - *"Parametric Surgical Mask Retainer"* (ID: 4192643) and *"Surgical Mask Strap Generator"* (ID: 4272985) – are responsible for 1.068 remixes (32,40% 3.299).

It is important to highlight that some designs are not exclusively related to PPE. It is possible to find, amongst them, knickknacks and *"fun"* objects. However, we did not exclude these of our analysis. The designs related to COVID-19 started being shared in January, 28th, but the first design dedicated to PPE was shared in February, 3rd named *"Coronavirus / Flu Reusable Emergency Respiratory Mask"* (ID: 4141338). A surge in designs, however, can be observed by the third week of March, varying from 14 uploads in March, 14th to 54 uploads in March, 21st (Figure 2). The designs released during this week are those who had more downloads for the whole period, over 45.000 downloads. Interestingly, both trends match the behavior identified in *GoogleTrends* for the term *"coronavirus"* (Figure 2.c). A peak is observed (n=104 designs) in April 9th and, from then, design uploads dropped continuously, possibly indicating a decrease in interest or a saturation of design options.
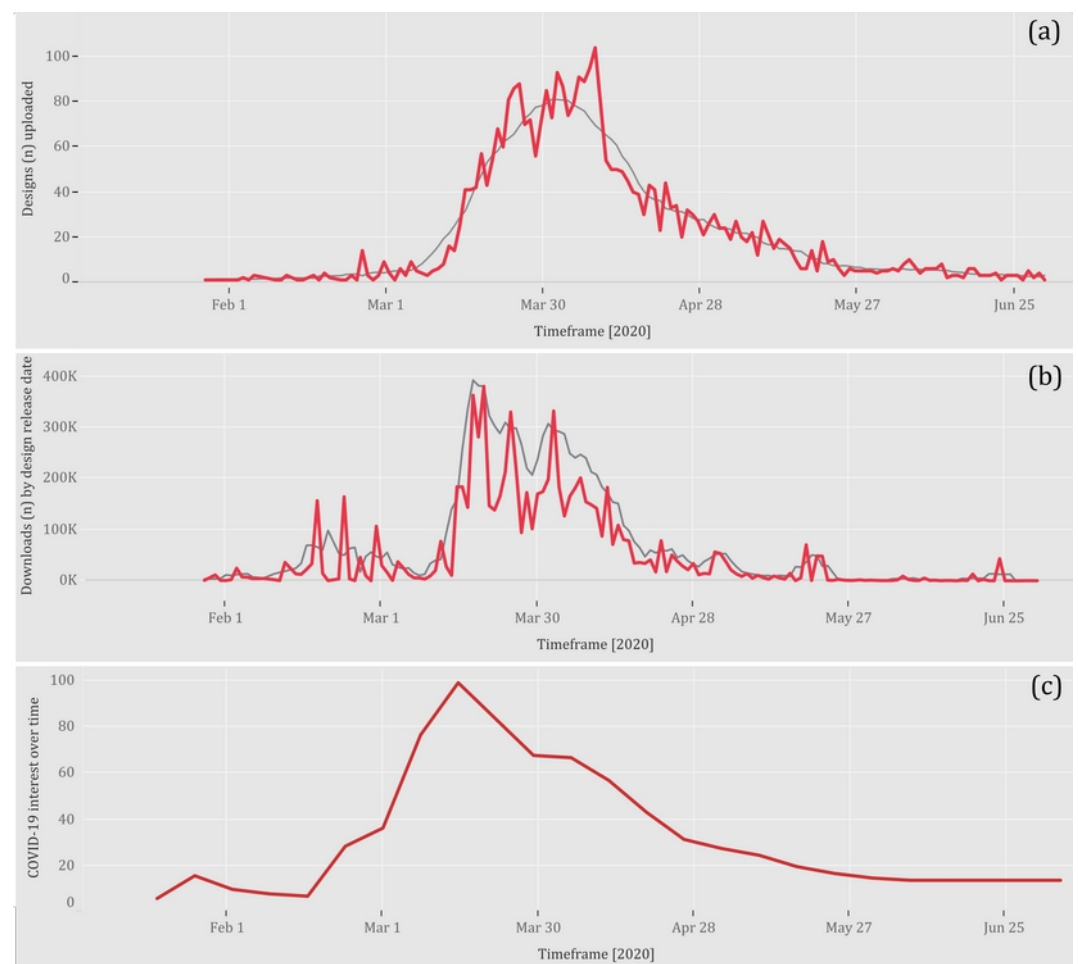

Figure 2 Activity volume (a), downloads by design uploaded (b) and *"Coronavirus"* user's interest over time based on *Google Trends* (c)

Despite the high number of designs, only a few are significant in terms of downloads, makes and derivatives. For instance, out of the 1.628.432 downloads, 100 designs are responsible for 782.100 downloads (48,02%) and 50 account for 613.836 downloads (37,7%). Regarding the 1929 makes reported, 1000 (51,80%) are linked to 52 designs. Finally, out of the 3287 remixes, 10 designs are responsible for 2500 (76,05%) remixes. We highlight however that a

high number of remixes are customizer remixes, a simple form of customizing that can be directly done on the website (Flath et al. 2017), e.g. changing the text included in a design. In Table 1, the descriptive statistics show the large difference of designs' importance. Considering the number of downloads, for example, it ranges from 0 to 12.160 with a SD of 2.036,67.

Table 1. Metrics for designs uploaded to *Thingiverse* (n=3376)

Metrics	Makes	Remixes	Collects	Likes	Comments	Downloads
Min	0	0	0	0	0	0
Max	190	891	12.160	9.587	742	47.742
Mean	0,57	0,974	49,71	38,37	2,87	483,35
Median	0	0	0	0	0	0
SD	4,36	20,67	288,60	226,51	16,55	2.036,67
SDERR	0,07	0,35	4,97	3,90	0,28	35,08

The data associated to the users indicates that 2647 users account for 35188 designs shared on the platform, including the 3379 designs related to COVID-19. The numbers of COVID-19 designs indicate that some users uploaded either more than one design object or more than one version of the same object, a remix. We also identified that 605 users (22,90%) had a single design shared on the platform, the one related to COVID-19, and other 340 users had two designs. A complete profile of users is presented in Table 2. The mean and median values possibly indicate certain degree of activity by the users prior to the COVID-19, although it also shows that few users concentrate the largest number of designs. For example, 50 users have 10196 designs shared (29,00% out of 35188).

Table 2. Metrics for users with COVID-19 designs uploaded to Thingiverse

Metrics	Users
N of designs	35188
N of designs related to COVID-19	3379
MEAN	13,30
MEDIAN	4
SD	38,95
SDERR	0,75

3.2. Network structure

The network structure of the designs highlights the relationships of original designs and derivatives (designs based on other designs). It includes only those designs that have a *"parent-child"* relationship, totalizing 1165 designs (nodes) and 1017 connections (edges) (Figure 3). The results indicate the existence of a large number of simple linear designs' evolution, when limited to two or three nodes (1→2→3 or 1→2). More diverse and complex relationships between remixes and original designs can be observed in larger clusters, defined based on the network's *Modularity.* For each cluster, we highlighted the design examples that correspond to it. The types of connections between nodes show that in a short period of time (February – July, 2020), users were able to develop a more complex structure of derivatives. Cluster "5", for example, is defined by 13 designs identified with their corresponding ids in Figure 4. If we consider the designs' connections independently, linear evolution can be observed in different situations, e.g.

(i)4235098→4238300→4284721 and (ii) 4235098→4261923. However, we can also note that the designs (iii) fork into 2 or more alternatives. Id 4264881, on the other hand, refers to a design resulting from a merging process (iv) of 4 other designs - 4243531, 4228123 and 4273350, which is also a merging result of other designs). Forks and merges represent the two classes of remixes identified in Flath (2017): *divergent* and *convergent*. *Divergent* remixes consist on a particular case when a design is the source for other designs and *convergent* refers to a design that is based on different sources. In Figure 5, for instance, the Id **4264881** is a convergent remix once it is based on Ids 4243531, 4273350 and 4228123. As for Id 4243531 it generates the diverging remixes with Ids 4305770, 4305798, **4264881** and 4273350. As we can note, a remix can be a result of both converging and diverging processes, e.g. Id **4264881.**
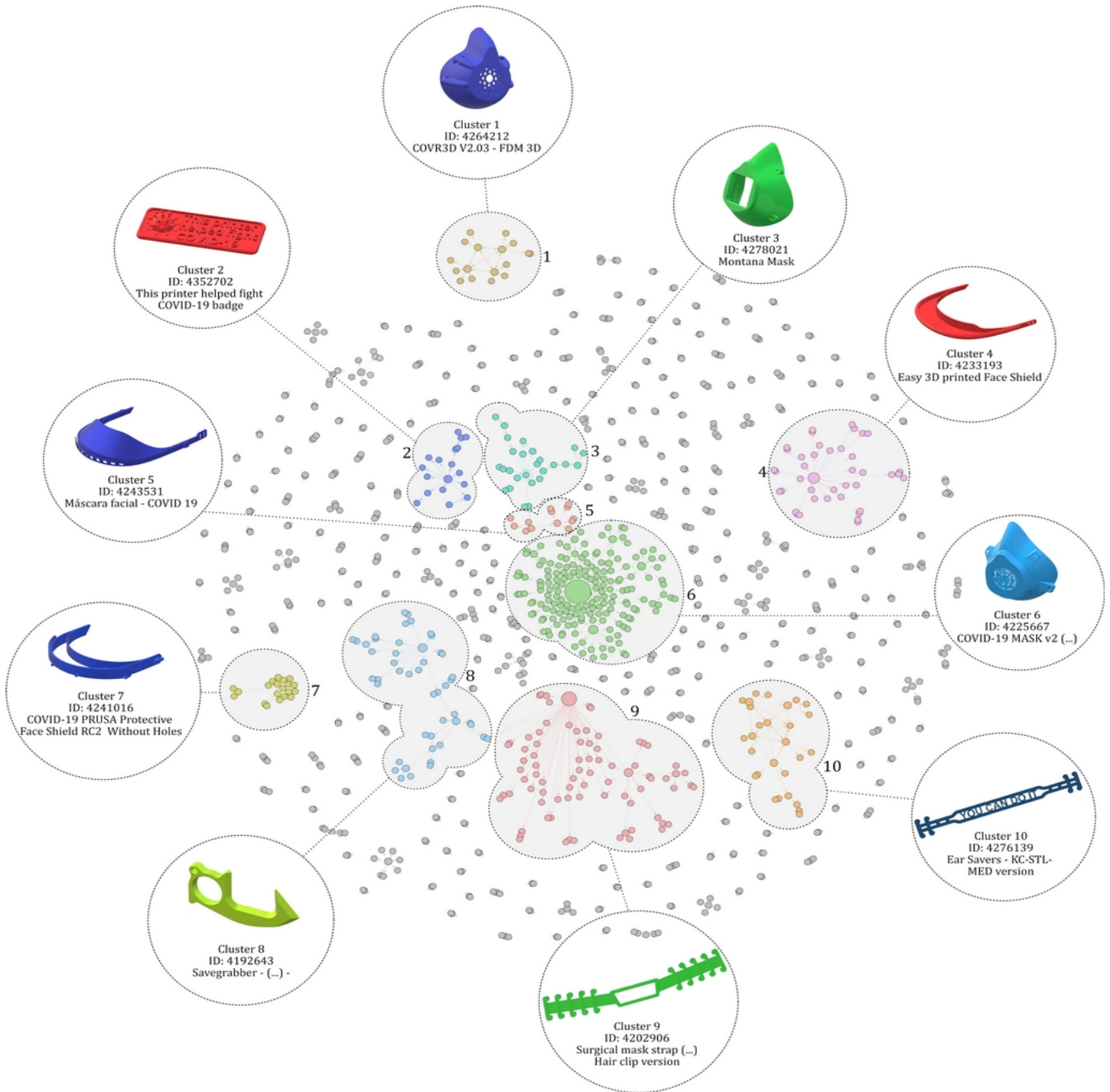

Figure 3 - Network structure of original designs and derivatives (remixes) developed and reported on *Thingiverse*
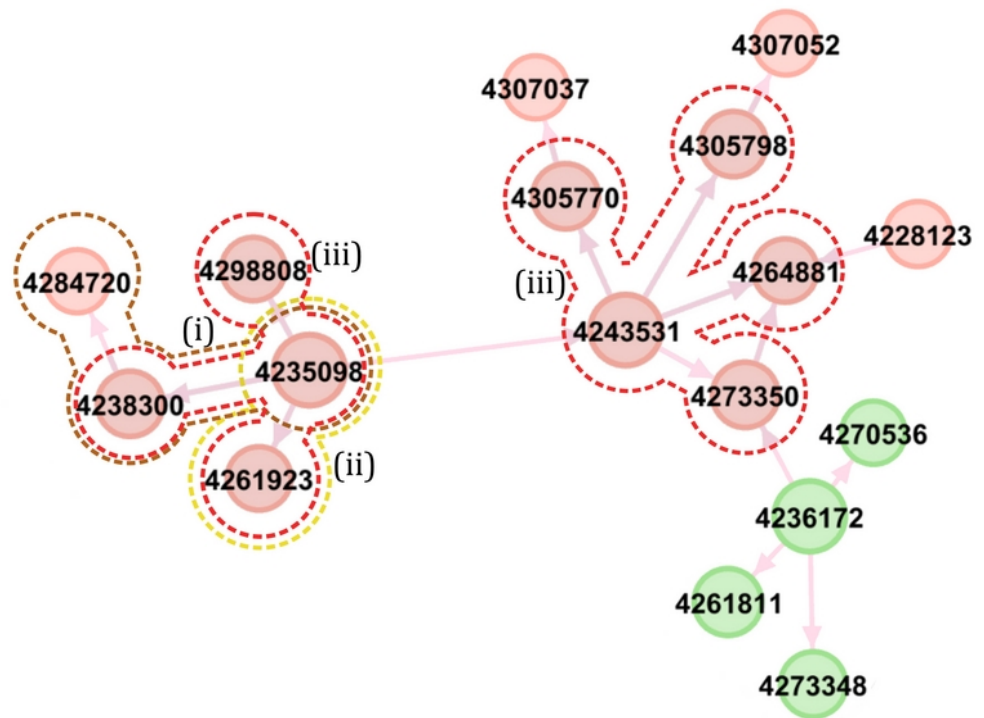
Figure 4 - Parent-child relationships between designs of Cluster 5 and part of Cluster 6

The clusters indicate the existence of 5 types of designs. The first one refers to respirator masks (clusters 1, 3 and 6). The designs include a large set of components including caps for filters and connectors. Non-PPE objects are limited to Cluster 2, which includes decorative designs, e.g. tridimensional representations of the coronavirus. The third type consists on face shields (clusters 4, 5 and 7) having a wide range of alternative designs. The fourth type (cluster 8) consists on- door openers/button pushers. Finally, the last type consists on surgical mask straps (clusters 9 and 10), of which some are highly customizable. It is important to mention that by choosing the 10 largest cluster, some types of designs may have been ignored, e.g. the "Emergency Ventilator (EV-02)" (Id: 4302479). However, a random check on designs indicates that the majority of design types is addressed by the clusters.

3.3. Geographical distribution of design creators, makers and remixers

Finally, the last aspect associated to the emergence of COVID-19 related designs refers to the real implications of the Maker Movement and OD on connecting users from different localities. For this purpose, we connected the original designs to its corresponding remixes and makes, based on users' locations (when available). Figure 6 illustrates these connections in two different maps: (a) Original→Remix (O→R) and (b) Original→Make (O→M).

We managed to identify 81 countries from which user's shared their designs. The results indicate, however, a high concentration of users in North America (Canada and USA) and in Europe (e.g. Germany, Spain and France). Out of the 1882 designs we managed to identify the user's location, these six countries account for 1224 of them (65%). This concentration is also reflected on the O→R and O→M connections identified (Table 3). It is worth mentioning the existence of a modest but diverse interaction system between users located in different countries, as observed by the number of distinct connections in O→ R (n= 192) and O→M

(n=257). The number of reported makes (with location details) is slightly higher than the number of derivatives but both have similar behaviors when comparing the statistics of both (MEAN, SD and SDERR). A valuable metric however is the number of connections generated by O→M, indicating a high potential for design dissemination.

Table 3: Metrics of geographical connections between original designers, remixers and makers

Metrics	Original→Derivatives	Original→Makes	Top 15 countries by number of designs (weighted by population) [a]	Top 15 countries by number of designs (absolute numbers)
N of connections	739	868		
N of distinct connections	192	257	Hong Kong	United States
MEAN	3,86	3,39	Spain	Spain
			Czech Republic	France
MEDIAN	1	1	Belgium	Italy
			France	Germany
SD	9,37	8,25	Austria	United Kingdom
			Italy	Canada
SDERR	0,70	0,51	Lithuania	Argentina
			Canada	Brazil
Frequency of connections (highest 10)	USA → USA (n=80) Spain → USA (n=71) Canada → USA (n=58) Spain → Spain (n=43) Germany → Germany (n=36) Canada → Spain (n=25) Spain → Portugal (n=22) Spain → Germany (n=16) France → France (n=15)	USA → USA (n=97) Spain → USA (n=70) Spain → Germany (n=39) USA → Germany (n=26) Spain → Spain (n=21) Germany → Germany (n=19) Canada → USA (n=13) USA → UK (n=13) Austria → Germany (n=12)	Luxembourg Australia Portugal Slovakia United States Slovenia	Australia Czech Republic Hong Kong Belgium Russia Mexico

[a.] Guernsey, Monaco and French Polynesia were excluded from the top 15 list given the small population size.
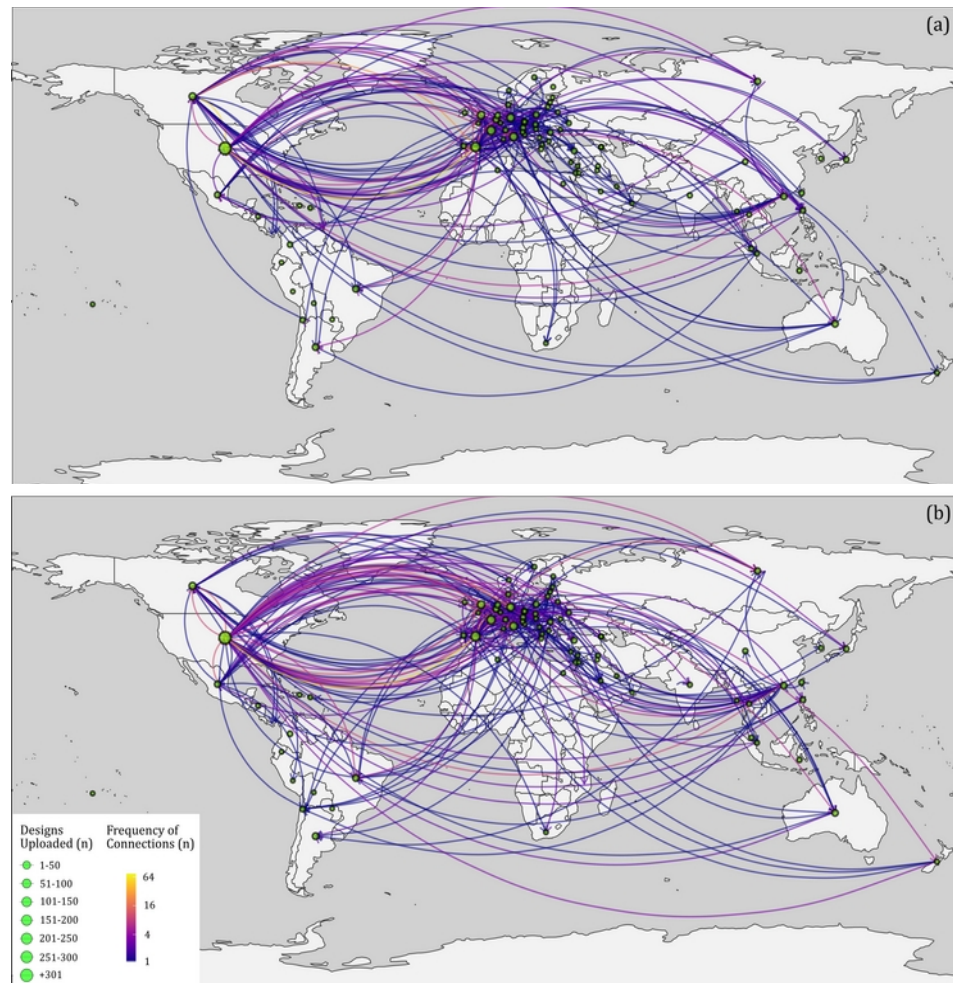
Figure 5 - Connections between users' locations considering (a) original design → make and (b) original design → remix

4. DISCUSSION

Understanding the functioning of maker/OD communities is of much importance to assess its potentialities to address real-world issues, its responsiveness and current hurdles. Researches on the structure of maker/OD repositories and their impacts are at an initial stage with some distinguished works (Bonvoisin et al. 2018; Flath et al. 2017; Freire and Monteiro 2020; Menichinelli 2017; Oehlberg, Willett, and Mackay 2015). We adopted an explorative approach and data mining techniques to shed light on the characteristics and potential impacts of the designs developed and shared during the COVID-19 outbreak. For that purpose, we retrieved the metadata from designs available on *Thingiverse* and analysed it based on the activity volume, the network structure of the designs and the geographical distribution of users. The discussion we present next is therefore limited to the object of our analysis, the available data and based on the few existing studies on the structure of maker/OD communities.

We explored the possible real impacts of maker/OD platforms on promoting design dissemination of COVID-19 related designs (RQ1). OD and distributed manufacturing are often put forward as a means for design democratization and dissemination (Haldrup et al. 2018). One of the motives is the possibility to have an object designed anywhere in the world and shared through online platforms (Fox 2014; Kostakis et al. 2015). However, it is also argued that limited access to resources, the lack of computer skills and functional literacy in languages usually adopted in such platforms, e.g. English, might configure a bottleneck for such dissemination (Fox 2014; Freire, Monteiro, and Ferreira 2018). As our results show, major contributions and interactions are performed by users located in North America and parts of Europe. One could argue that the geographical distribution of design creators, makers and remixers, and the volume of executed/remixed designs in developed countries were influenced by the fact that these locations were hit earlier by the COVID-19 pandemic. It is a plausible argument if we consider, for instance, the volume of activity in countries such as Spain, France, Germany and the USA which faced a high volume of COVID-19 cases earlier than other locations in the global south. Still, it is not possible to confirm this as the single cause for higher activity volume. The modest participation of countries located in Latin America and Africa, confirmed by the weighted number of contributions may also indicate a possible gap to the maker/OD culture and technological accessibility confirming previous studies (Fox, 2014). Nonetheless it shows that design collaboration/dissemination is in fact promoted by sharing platforms, as shown in Figure 6. It increases the chances of designs, oriented to tackle real-world issues (e.g. COVID-19), to be adopted in different locations (RQ2). In time, we emphasize that our dataset represents just a small portion of the data available on the platform, limiting a complete overview of users' locations. It is also dependent on self-reports of makes and remixes, which has two implications: The number of makes are greater than observed and not all remixes are correctly reported.

As for the results related to the activity volume, they indicate that the maker/OD communities are potentially motivated by the will to make a contribution to the society. It is clear that users provided a fast response to the outbreak, considering the design's volume increase in the third week of March — right after a surge on the number of COVID-19 cases, especially in Europe. The number of 605 users with single designs shared on the platform is also important. It comprehends 22,90% of the total number of users with designs related to COVID-19 and indicates a possible potential of critical events to motivate users to join and participate in maker/OD communities more actively. However, some other observations are

necessary. After the increase of designs, we can observe a continuous drop on the activity after its peak in late April. Here, we discuss three possibilities. Firstly, users' activity reflected the society's interest on the outbreak, following a similar pattern to the one given by Google Trends. Secondly, the designs reached a saturation stage where innovative remixes/adjustments are unlikely to happen. And thirdly, the platform community and structure limit the possibilities for different types of designs, especially those dependent on processes other than 3D-printing and laser cutting. It was expected that 3D-printing-oriented designs would count for the majority of the designs, since *Thingiverse* is owned by a 3D-printer company. However, as successful mechanical/electronic projects are also shared in the community, e.g. *"FoldaRap, the Folding Reprap"* (ID: 15877) and *"Omnidirectional Selfdriving Robot With Mecanum Wheels"* (ID: 3815005), an expected outcome that did not confirm was that the community had a potential to trigger such types of designs. But even when they exist, as we noted on the *"Emergency Ventilator (EV-02)"* (ID: 4302479), they did not promote continuous development nor reported makes.

Regarding the design aspects and network structure, which relate to RQ3, we explored the largest 10 clusters based on the *Modularity* calculation we performed. These clusters are linked to very clear categories of designs, indicating that *Modularity* is a viable measure to identify design patterns in maker/OD communities. The majority of the designs is strictly contained within its cluster, i.e. does not interact with other types of designs. This is not an unexpected result for two reasons. First, the object types are very different in terms of functionality, e.g. face shield and door opener. Second, this specific behavior was already identified in Flath et. al (2017) when investigating the remixing phenomenon in online communities. The authors identified that few designs establish connections outside its original categories. In our study, this was also confirmed. Almost none design was developed (remixed) based on designs released prior to the COVID-19 outbreak. On the other hand, the rapid proliferation of remixes during the 5 months we analysed do indicate that open repositories enable fast development of solutions because of the possibility to adapt and modify existing solutions. However, it also indicates some limitations to the degree of inventiveness, as adaptations rarely adopt solutions outside its own category (COVID-19). An example of design that incorporate references from previous designs is the *"DIY coronavirus (COVID-19) mask holder"* (ID:4234861) remixed after a bag clip (ID:330151). Finally, the forms of remixes described by other studies in remixes patterns of online platforms (Flath et al. 2017; Oehlberg, Willett, and Mackay 2015), e.g. *self-loop, convergent* and *divergent*, were also present. These patterns reflect an important aspect of creative problem-solving processes inducing, for instance, a greater number of ideas (Müller-Wienbergen et al. 2011). Our understanding is that, despite the short period of time, the system's network of COVID-19 related designs was able to reproduce the similar and more complex patterns observed in larger datasets.

The results may also indicate that, while there is an attempt in *Thingiverse* to promote design collaboration between its users, the degree and complexity of interactions is still poor when compared to platforms like *Github* and *Gitlab*, which have a more complete set of tools for collaboration. It should be put that this is not necessarily a downside, as the platform *(Thingiverse)* presents a friendlier interface to new users, including 3D visualization and easier access to images and files. The current characteristics of *Thingiverse* make it closer to a repository platform than a creator hub/collaborative platform. However, recent

improvements, such as including an online parametric modelling tool, are important steps to turn it a more complete environment for OD practices, for instance.

Finally, despite the limitations of our study, we highlight the valuable contribution of maker/OD communities to tackle the COVID-19 outbreak. The decentralized collaboration process plus the distributed manufacturing technologies potentially helped citizens (including workers from the healthcare sector) to obtain locally produced PPEs when faced the shortage of industrialized products. In practical terms, we expect this exploratory study to contribute to the debate on design democratization by highlighting its current limitations. In practical terms, the discussions will hopefully contribute to the development of more inclusive platforms for inexperienced users and non-English speakers.

5. CONCLUSION

In this study, we explored the characteristics and potential impacts of the designs developed and shared during the COVID-19 outbreak. For the purposes of this study we adopted the *Thingiverse* platform as our object of analysis. Based on the data, we illustrate the potential of maker/OD communities to provide fast-response to critical situations, develop improved versions of designs and build a network of collaboration. It also confirms its potential to design dissemination although it is still concentrated in North America-Europe. The limitations of this study are mainly related to the limited information available. For instance, we were not able to identify in which country users downloaded the designs. Aware that this is an important aspect of privacy, we relied on the information made publicly available by the users themselves.

The current limitations to promote continuous collaboration, observed in *Thingiverse*, are an important aspect that needs to be further explored. A deeper analysis/comparison with existing platforms, other than *Thingiverse,* and their corresponding tools, could provide significant insights about their effectiveness in fostering collaborative practices. In addition to that, it is crucial to understand the existing differences between maker/OD communities between the global north and global south, in terms of activity volume, and why these differences exist. Although studies indicate that language and access to technology are current hurdles to the democratization of maker/OD communities, these statements need to be confirmed with more robust data. We consider that the adoption of different research methods, including action research and participatory action research, may provide additional insights to confirm or reject these statements. Finally, future works may address the development of potential new platforms/tools prototypes aimed at maker/OD communities.

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