

Trends in digital manufacturing laboratories over time during the SARS-CoV-2 pandemic. Study of small-scale private laboratories in Mexico

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Abstract

This study analyses the points of interest, doubts, manufactured projects, obtained from more than 200 small-scale manufacturing laboratories throughout the year 2020 using netnographic techniques, through non-participatory observation of the interactions in participation groups in the social networks where the different laboratories interact and provide feedback internally.

The participations of the members were collected from January 2020 to December 2020, subsequently performing a categorization in chronological order where the interactions are divided according to their nature, which may or may not be related to COVID 2019, Materials, Equipment, Doubts about processes, Available Projects, Regulations, Courses, Project Results and Collaboration with Institutions, among others. After having this information, quarterly trend maps have been generated that allow us to study the behavior of these laboratories.

Finally, these quarterly maps are contrasted with the various milestones in the development of the epidemic in search of causal relationships between its evolution and the behavior of the manufacturing laboratories.

Keywords

COVID-19, FabLab, 3D printing, 3D models, personal protective equipment

1 Introduction

In December 2019 in the Wuhan region of China, the first case of the first global human pandemic of Coronavirus was presented, caused by the SarCov-2 virus, and known today as Covid 19, this respiratory tract infection manifests itself in different ways, being able to take the most serious cases to the death, or in case of recovery it leaves severe consequences to the health (El Zowalaty, et al.2020). However, it has another way of manifesting itself and that is to be asymptomatic, that is, a person can appear to be healthy and therefore continue their daily life, while carrying the virus and becoming an agent of contagion. This duality between the possible death by contagion and the carrier who does not know what it is, gave special characteristics to the disease in the minds of the population, causing distrust and the duty to treat everyone as “possible infectious agents”.

This process in Mexico generated various reactions, from panic purchases, confinement, defiance of health authorities, misinformation, to social anger. On the other hand, health authorities have been widely criticized in their handling of the pandemic for not keeping accurate and verified records of confirmed cases by not performing clinical verification tests on all possible cases, and instead performing statistical sampling (Ibarra-Nava, et al. 2020). In addition to this, official channels offered vague information and sometimes tending to popular beliefs, all of these having repercussions on the “belief model” of society (San Pedro, et al. 2003).

As the rate of cases increased, sanitary measures were changing and in the "National Healthy Distance Day" decreed in March 2020 (Galeano, et al. 2021), it was decided to close all non-essential establishments and the population was asked to stay in their homes unless it was essential leave. Along with these restrictions, the cases of patients registered in hospitals, as well as the news of deaths grew exponentially (Suarez, et al. 2020) , in the digital media you could see photographs of the full care rooms and with a great shortage of personal protective equipment for the workers of the health, lack of respirators in patient hospitals, and even news of full crematoriums, posing a very dark stage.

Along with this, popular theories of health care questioned the treatments and even the existence of the disease, generating a series of beliefs and parallel explanations that promoted poor care in some sectors of the population, contributing to a certain extent to the increase in cases (Ortiz,2021). It is in this heterogeneous, chaotic, and uncertain environment that the efforts of the community of creators in Mexico and the world offered their support in different ways, some replicating models obtained in forums, others developing proposals for medical equipment or personal protection, some more investigating and some more from the academy or local associations seeking to support the population in the best possible way.

From those initial months of the pandemic, circumstances have changed, today there is more information about the virus, the population has changed its behaviour, the constant use of Personal Protective Equipment has permeated society in general, and even vaccines have been developed to treat the disease, as conditions change it is understandable that the efforts and activities of Makers in Mexico have also changed

2 Research Methodology

To carry out this research, the keywords were used: Digital Manufacturing, Makers, FabLab, 3D Printing and FDM, words that allowed finding specialized groups on these topics within the social networks of public participation such as Facebook [™], Instagram [™] and Tweeter [™]

63 groups were obtained then selected according to the following criteria:

- Have more than 10,000 members
- Members are mainly Mexican
- Show activity at least once every 2 days

After carrying out this screening, it is discovered that only four groups in the social network Facebook[™] will meet the requirements, so they were used as case study

The participants in these groups add up to 126,320 and although there is no doubt that several of the members belonging to these groups may be repeated and belong to more than one at a time, what is important for the case study is the publications and responses published, so when these interactions are collected, the duplicated post were discarded.

All the publications and comments published in these 4 groups between January 1st and December 31th 2020, were collected obtaining a total of 1035 new publications, of which an average of 2.7 interactions per new publication was also obtained, generating a total of 3829 interactions to analyze.

These publications were transcribed, ordered, and evaluated in terms of their content and subject matter, discarding commercial publications or with primarily offensive content, after this work the information was grouped into 9 categories, keeping the date on which, the original publication was made and grouping these data by quarter. The categories used are:

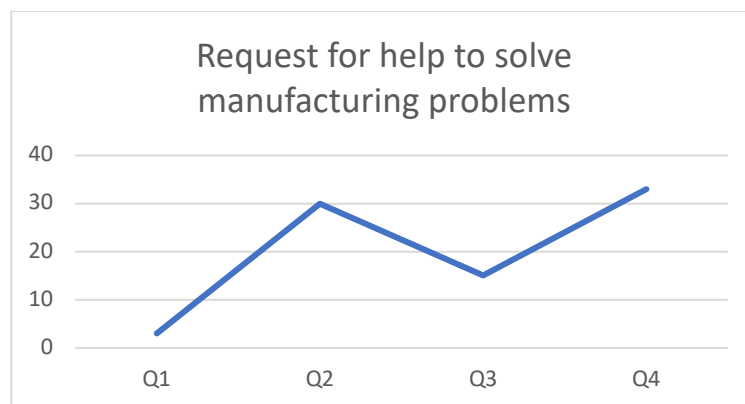
- Request for help to solve manufacturing problems
- Request for advice on surface finishes
- Requests to create 3D models
- Requests to share 3D models

- Sale of consumables
- Offer and request for courses on manufacturing
- Job applications and offers
- Help selecting manufacturing equipment
- Specific topics about Covid

3 Findings and discussion

Request for help to solve manufacturing problems.

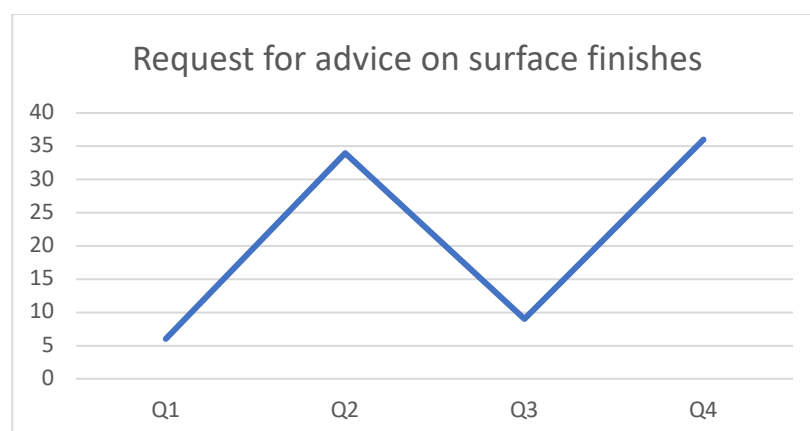
In this section, the publications in which members request help to solve common problems in 3D printing, such as slicer profiles, temperature problems, adhesion to the work surface, delamination, or filament rupture were grouped. The study shows 81 publications of this type, the fourth quarter of the year in which the most presence was had with a 41% incidence. (Graph 1)



Graph 1. Chronological progression of publications in the category: Request for help to solve manufacturing problems

Request for advice on surface finishes.

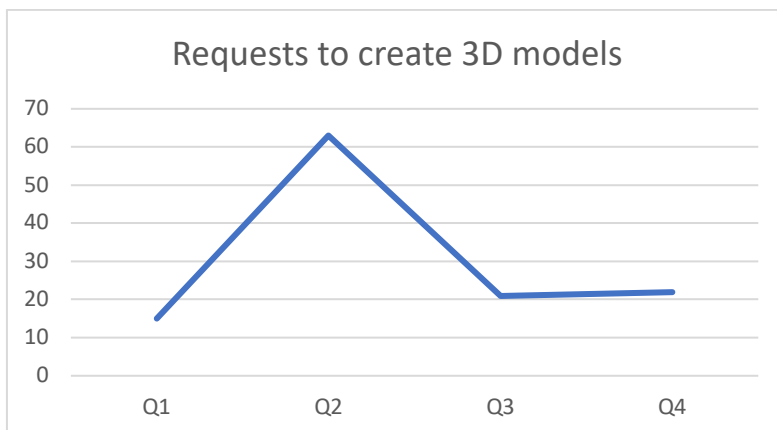
That were grouped in this category are those in which advice is requested to paralyze the pieces, close the pores, paint, stamp, join, or perforate elements manufactured by digital means. 85 publications of this type were found, of which 42% occurred in the fourth quarter, corresponding to what happened in the category of manufacturing problems. (Graph 2)



Graph 2. Chronological progression of publications in the category: Request for advice on surface finishes

Requests to create 3D models

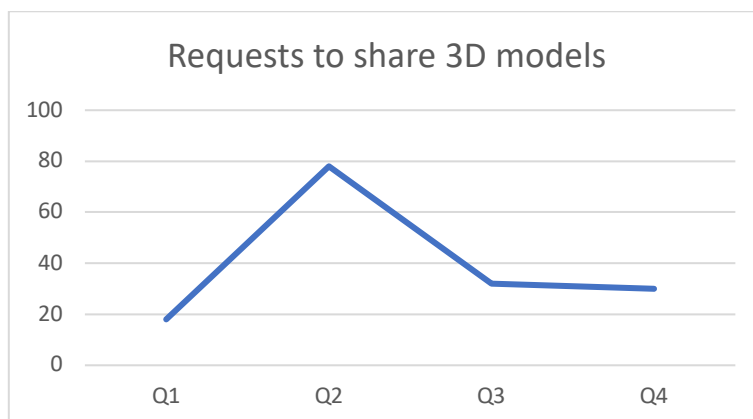
This category includes requests made by group members for professionals or other amateurs to create original models, replicas, or reverse engineering of existing objects. 121 original publications of this type were obtained, the second quarter being the most important, covering 52% of all cases. (Graph 3)



Graph 3. Chronological progression of publications in the category: Requests to create 3D models

Requests to share 3D models

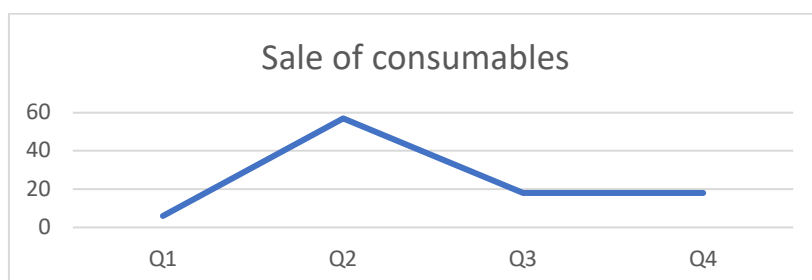
In this category are grouped publications in which members request to share with them a file or three-dimensional ready-to-print model created by a third party. It should be noted that for the purposes of this study, no discrimination was made between those models that can be sold or those granted free of charge. There are 158 publications of this type, the second quarter have been the most active with 49% participation. (Graph 4)



Graph 4. Chronological progression of publications in the category: Requests to share 3D models

Sale of consumables

The publications in this category include those in which suppliers are requested or material is offered for sale such as filaments, photocurable resins, laminated plastics, or even spare parts for manufacturing machinery. 99 publications of this type were found, of which 58% occurred in the second quarter of the year. (Graph 5)



Graph 5. Chronological progression of publications in the category: Sale of consumables

Offer and request for academic courses on manufacturing

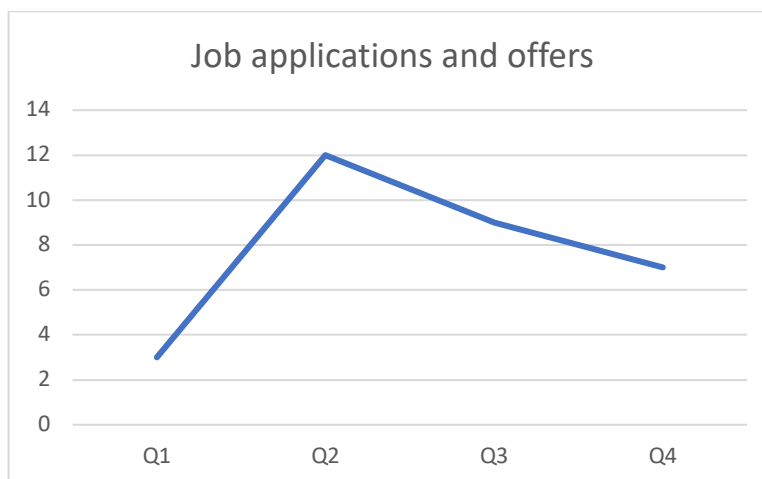
The category were the publications in which synchronous or asynchronous courses are requested or offered on topics of 3D modelling, three-dimensional printing, or basic electronics. There were 45 publications of this type throughout the study, with 40% of these publications in the second quarter. (Graph 6)



Graph 6. Chronological progression of publications in the category: Offer and request for academic courses on manufacturing

Job applications and offers

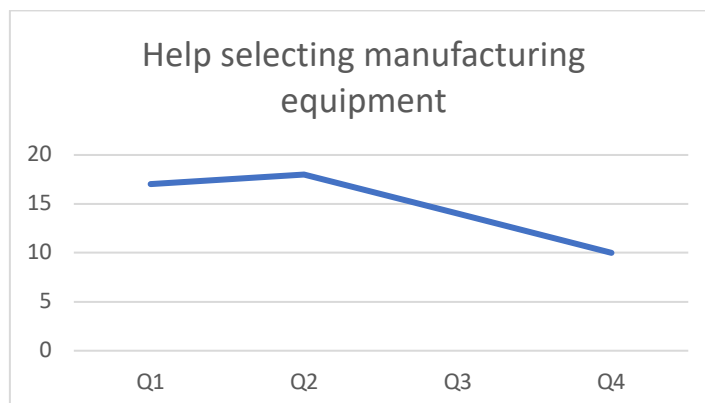
In this category were added those publications in which the members of the group offered their professional services or requested those of any of them. There are 31 publications of this type, of which the second quarter presents 39% (Graph 7)



Graph 7. Chronological progression of publications in the category: Job applications and offers

Help selecting manufacturing equipment

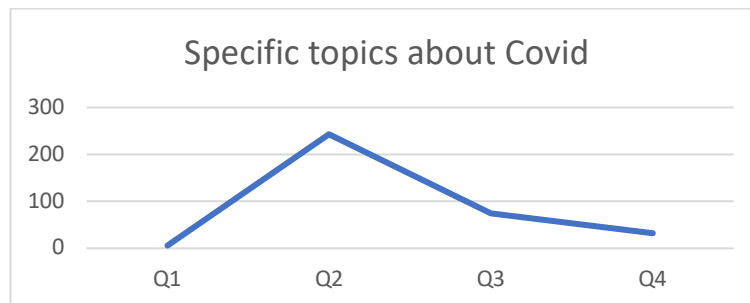
In this category, all those requests for support to the members of the groups were grouped to decide between two or more models of machinery to buy according to the previous experience of the members of the group. There are 59 publications of this type in the study, of which 30% occur in the second quarter of the year (Graph 8)



Graph 8. Chronological progression of publications in the category: Help selecting manufacturing equipment

Specific topics about Covid

This is the largest category in which all those publications related to covid-19 are grouped, among which there is development of ideas, manufacturing of products, sale of specialized supplies, called for participation and resolution of projects, among others. As it is the largest category, it is subsequently analysed in the busiest quarter. Within the study there are 356 publications of this type, mainly concentrated in the quarter from May to June with 68% of the total (Graph 9)



Graph 9. Chronological progression of publications in the category: Specific topics about Covid

In the area of specific Covid issues, we can see that the second quarter is the most important and that the participation in the groups is several times higher in this area than in any of the others, so an in-depth analysis is done by dividing the issues monthly. allows us to have an overview of the concerns and contributions of the makers during the critical period that goes from March to May 2020.

During the month of March, the most repeated topics in the forums were related to the manufacture of automatic respirators, valves for respirators, requesting volunteers and design groups to address the problem, emergency medical supplies, and donations of equipment. doing an analysis crossing the situation of the country at that time in which the news marked the insufficiency of for these respirators in hospitals and the day of healthy distance was decreed in which people had to stay in their homes it is understandable that in The best faith of the manufacturing groups if it wanted to address this problem by proposing solutions that ranged from the use of modified traditional medical devices such as ambu resuscitator, to the creation of devices, fish tank type air pumps will be used, however in a short time it was discovered These devices could not only be inefficient, but several of them put the health of patients at risk of permanent damage.

In the month of April, the topics changed, being the main ones: personal protective equipment, the supports for face shields, the manufacture of 3D printed facemasks, accessories to cover commercial facemasks, the concern about the porosity of polylactic acid as a material for manufacture of personal protection accessories and the search for filaments with antiviral properties. During this month, the strategy change to the use of facemask and personal protective equipment for people who had to go out to work or carry out their work, keeping the campaign at a safe distance, however, equipment such as facemask and plastic masks were very scarce and, in many cases, expensive. I no time the massive manufacture of facemask, together with the domestic manufacture allowed the reduction of the cost of these, which is reflected during the month of May, in which the most addressed issues were adapters for facemasks, children's decorations for masks and the production of filters for household masks.

Making a cross matrix between the specific issues of covid-19 and the publications seeking support for the creation and distribution of models, a strong correlation can be seen, with requests to share models being higher at this time, facemask and supports for masks as well as of personal protective equipment that could be replicated and, where appropriate, donated by the manufacturing laboratories, also showing that many of these were not dedicated to the creation of new projects but to the replication and distribution of existing models. This replication in large volume led to a temporary shortage of the material and filaments, as can be seen, were highly consumed during the second quarter, gradually recovering from the third quarter.

The sharp drop in issues related to COVID-19 in the third quarter reflects the changing circumstances in the overall development of the pandemic and the vision of the workshops involved in the follow-up forum. By June 2020, the availability of facemasks, as well as the hospital demand, were well stabilized, at least

at a perceptual level, so the sense of urgency and the call to action that this corresponds decreased in the groups studied, which throughout of those generated a dynamic of participation in the so-called “new normality”, gradually changing the interests of the participants towards issues such as economic recovery and activation, social participation of digital manufacturing spaces and leisure, the latter being that presented a further increase throughout the fourth quarter.

This change to the new normal modifies the behavior of these groups, increasing the interest in training on subjects as 3D modeling, digital and electronic manufacturing, while at the same time, according to the comments of the fourth quarter, several of the laboratories that were founded during the pandemic due to the need and desire to support medical problems through 3D printing, today seek the reproduction of figures and leisure elements pursuing the economic sustainability of the equipment purchased throughout 2020.

As can be seen, the small manufacturing laboratories attended to the extent of their possibilities and strengths the crisis experienced during the pandemic, even expanding the number of these spaces with the intention of supporting according to the figures of the sites to which they were made. Before the pandemic, there were a total of 72,000 members, however at the end of the study in addition to 126,320 participants, which implies a growth of almost 76% in one year, that is, by the end of 2020 In Mexico there was a greater number of people, institutions, and laboratories with digital manufacturing capabilities that before the pandemic, who are now looking for how to use these technologies.

It is also important to note that most of these groups the primary technology is the manufacturing by arrangement of filament also known as FDM with 74.5% of the shares, being followed by resin printing known as SLA with 25.5%.

While in training, problem solving, and seeking opinions on different technologies, more than 94% prefer to consult informal media such as online videos or live broadcasts before formal courses offered by institutions according to comments Much of this preference is given by the permanent accessibility to the content, the ease of search and even by the personality and way of explaining of the creators of this. This information could help us to improve and understand the potential and the limitations that institutionalized spaces present in the face of popular demand in areas such as the one studied and the characteristics of the millennial Zeta and Alpha generations, who are largely the users of these technologies.

This is a Work in Progress, for which there are no final conclusions, it is expected to continue in the process until the moment in which the World Health Organization declares the disease generated by SARS-CoV2 as endemic at a global level.

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