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RESEARCH ARTICLE

AUTONOMOUS PRODUCTION AS A VIABLE ALTERNATIVE TO LARGE-SCALE INDUSTRY

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ABSTRACT

Open source 3d printing technology, for some years, has been preparing to respond to the needs of society where autonomous manufacturers take on challenges that, until now, were reserved for large companies in the sector. Schools are formed in laboratories, taking on new challenges and opening up new scenarios and teaching methods. In this context, the world of architecture and home design is heading towards previously unexplored and novel terrain. This research work aims to explore through experimentation if production on demand is feasible in time, form and economy to greatly reduce the environmental impact of manufacturing. In short, the personal nature of autonomous production, in this context, adds to the possibility of reusing plastics such as PET, which are the cause of great global pollution. The objective is to investigate whether from now on the large industry will lose the character of exclusivity since the FabLab, the Makers are presented as the main protagonists of the near future due to their low environmental impact.

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INTRODUCTION

3D printing is the most recent technological advance of the last decades. Starting in the 1990s, it has progressed to become a benchmark in the field of manufacturing processes. Currently, each novelty in the architectural landscape is prototyped by manufacturing laboratories and not only, many of them are developed exclusively by them. Revolution 4.0 is an efficient response to the factor of change in the production and consumption model of a society in continuous evolution with a functioning capable of transforming our industries into a more efficient and effective model. The great sustainability of the climatic and environmental factor is not negligible. The incorporation of new technological systems, by changing the conventional industrial landscape, opens the door to new challenges. The current needs of our society oblige the productive sector, increasingly, to measure and limit the environmental impact in its manufacturing processes. However, our industries by size and regulations have enormous difficulty in updating their methods since the great challenge is to make it not only possible but also profitable. In the opposite corner, manufacturers or autonomous manufacturers live an idyllic situation in terms of sustainability but held back by economic profitability where large-scale industrial methods manage to reduce or limit costs to meet current demand at the expense of sustainability at reasonable prices.

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In this article, through the creation of prototypes, it is intended to study the economic viability of useful products for consumption that also have among their peculiarities the personalization and participation of the final consumer, an interesting argument for the more sophisticated public that sees a demand. growing. It is in this sense, our research is directed towards where advances in additive technology make it possible today to manufacture products with a wide variety of materials and finishes.

MATERIALS AND METHODS

The first step was to develop a practical action plan with the aim of experiencing the economic feasibility of autonomous manufacturing with the help of 3D printers. The objective was the elaboration of comparative tables between the material manufactured by the industry and the prototype manufactured (through the functional study, adaptation of the design to the manufacturing machine available). On the one hand, we had a cost study of the manufactured object and, on the other, we wanted to search the web for everything related to the manufacturing costs of objects in ABS or PLA. These, at present, are the most common materials for the manufacture of parts where the industry and autonomous manufacturers use them with different manufacturing processes. Our attention was focused on the everyday objects present in the house for residential use and more specifically a case study was carried out. After a study of the most common contents that exist in our homes, the choice was limited to those objects that do not exceed the maximum

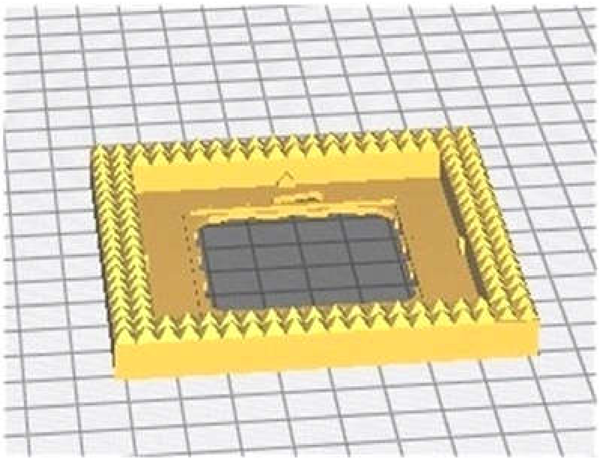

Figure 1. prototype

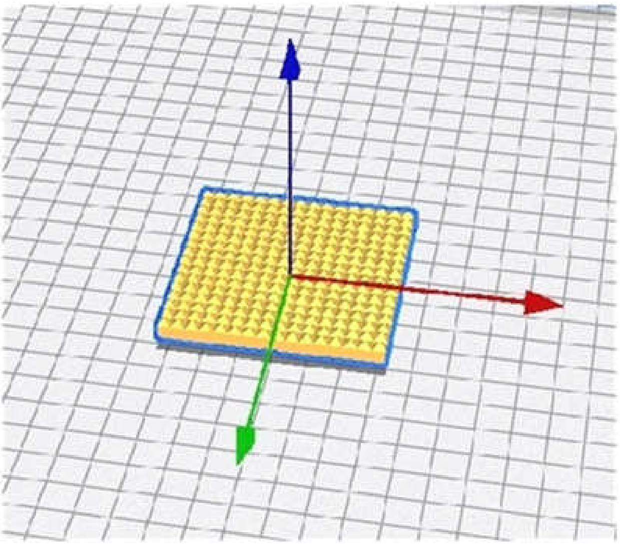

Figure 2. prototype

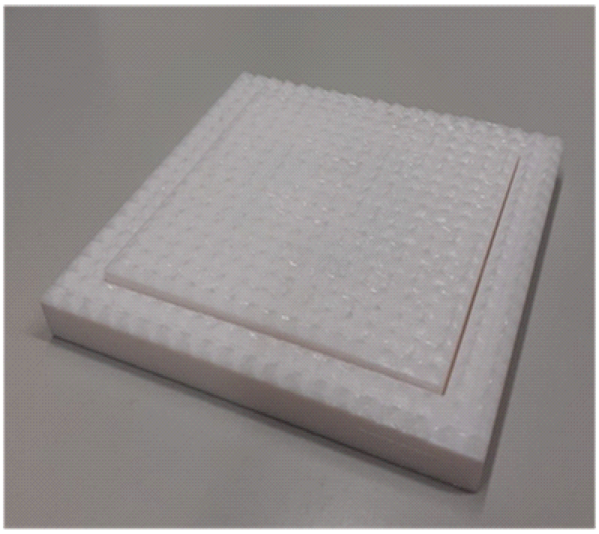

Figure 3. prototype

Brand	Model	Price White switch Frame	Price White switch key
Niessen	Arco	2,29 €	1,44 €
Simon	Simon 27	1,68 €	1,41 €
Jung	AS 500	1,45 €	0,97 €
Siemens	Delta Miro	1,75 €	2,18 €
Self-fabricated		0,53 €	0,47 €

manufacturing volume that we currently have. Our 3D printers have limited measurements. To this end, it was decided to prototype the frame and trim of a common electric push button on the market today. Adaptation to our study required not only cosmetic changes (figure 1 and 2), but also the introduction of important changes to obtain a functional prototype (figure 3). To carry out this project requires the use of a group of FDM 3D printers with a heated base, specifically the Prusa i3 MK3 3D has been used, which like many has the possibility of being assembled by the user, this solution makes it more accessible to the less economically gifted user. Some of these machines are made with 3D printed parts, a bit as a testament to the good quality of the parts made with additive printing. The print size is 25 x 21 x 21 cm, which is largely sufficient for the realization of the prototype. Among other peculiarities is the magnetic bed and the restart after power outage that allows us to carry out all kinds of extrusions without having to supervise the printing, a detail to take into account in this type of work since some pieces to be printed require a large number hours, which makes it difficult and complicated to justify the feasibility of the investigation. Finally, we firmly believe that the machinery chosen is the most suitable for the realization of the prototype (figure 3), being very versatile and with the functionality of being able to adjust the printing parameters in a very simple way. Prusa Slicer software will be used to print the prototypes, which will be in charge of filleting the 3D models. The Prusa Slicer, formerly known as Slic3rPE, is open source software from the same manufacturer as the printer, with a fairly simple and intuitive interface that allows not only setting the printing parameters, but also making small changes to the 3D model, repairing small Existing and undetected errors. The printing materials will be PLA for the prototypes under study, while the final models will be made of ABS, which is the same material used by the industry.

RESULTS

In the first place, a measurement of the pieces to be reproduced was carried out in order to make a modeling faithful to the original, but with a new and personalized design. The object designed in CAD was exported in open source software for study, analysis and reproduction. After 5 hours of printing, we got a PLA model to test. Subsequently, the trim and frame were nailed to the wall and after a reduced series of on and off we noticed that the support structures that were flanges on the back of the trim were not strong enough as they broke on the turn that was necessary to perform the on and off. Certainly, although ABS compared to PLA offers superior mechanical resistance, the problem lies in the reproduction system. Large scale industry replicated parts make their models in a single solution by melting the material. This manufacturing system is much more efficient since it reduces manufacturing times and lowers the cost of being a unique object, while models made with 3D printers need to be reinforced with the contribution of other materials, this type of manufacturing to be carried out in multiple phases is more expensive on a large scale. Unfortunately, 3D prints with the additive system are designed to create by adding layers of printing, and these offer poor performance against shear stresses. The prototype built by us needs to make corrections to make it useful and functional, so we decided to redesign the object by replacing the PLA tabs that were responsible for producing the rotation in the push button with metal tabs using nails. This cheap and easy-to-find material created the inconvenience of having to redesign the assembly by dividing them into more pieces and interrupting the manufacturing process of the unit. It is clear that for an autonomous manufacturer, having to intervene in more than one phase in the manufacturing process is not a big problem compared to the industrial system where automation is the basis of economic viability. Being able to participate in the creation of the model by making a unique object makes the model attractive to the most demanding user. After redesigning the set, the piece obtained was perfectly functional, so we went on to the phase of comparative analysis of the models. The final object was an ABS prototype with metal flanges and resin to obtain a unique set.

DISCUSION

Digital manufacturing turns out to be a good tool to manufacture new models, its field of action being the local one. This is undoubtedly their ideal territory, since they are a product developed to suit the consumer, while on a large scale, although autonomous manufacturing is economically viable, its commercialization would be unfeasible. Industries use advertising and complex systems to publicize their products, these add a cost that would be unfeasible for autonomous manufacturing. In this logic we imagine an alternative and artisanal market for the manufacture of objects where manufacturers can be a competitive variable in an existing market due to its strong connotation of exclusivity. It must also be said that industrial methods make products more durable because they are objects with equal tensional responses in all directions, while those printed with 3D tools are more vulnerable in the sense of the layers to be glued. The experience of the manufacturer will play a fundamental role in the durability of the object.

Conclusión

- Autonomous manufacturing is profitable for both producer and consumer if developed locally (figure 4).
- Its exclusivity makes it an affordable product for a range of consumers with design savvy and a desire for diversity, while large-scale consumption is more limited to the standard population, where large industry still boasts reliability compared to a product. little tested and with the risk of inferior durability in the short and long term.
- There is a great difference between the final product and the solution depending on whether it is solved with 3D printers or with industrial manufacturing in favor of the latter.

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