Future Evolution of The Digital Fabrication Laboratories - Practical Application to Neàpolis

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***Abstract*—**There is a lack of existing platform that encourages the maker culture and innovation in Vilanova I La Geltrú. The paper reviews the study of the state of the art of Fabrication Laboratories to implement them on Neàpolis buildings in order to provide the mentioned platform. This concept is going to be implemented in the Neàpolis main building, the La Nau building from Neàpolis district and the sea container building. Firstly, a researched on the general information about Fabrication Laboratories were carried out. Subsequently, proposals for the designs and implementation of Fabrication Laboratories including a list of suitable machines were done for each of the building. Afterwards, the construction and installation processes needed was carefully analyzed. The overall cost estimations were calculated over the planning period. Initial studies and feedback from the agency suggest that our proposals could have a positive outcome on the future development of innovation and maker culture platform.

***Keywords*—**Designs, Fabrication Laboratories, Innovation, Maker Culture.

I. Introduction

THIS article contains information about the Neàpolis Fabrication Laboratories (Fab Lab) Project offered by the local innovation agency Neàpolis. The realization of the project has been done by a team of 4 international students participating in the European Project Semester (EPS) 2019 in cooperation with Neàpolis.

In the recent two years, Neàpolis has been working on two EPS projects. The first one is the sea container building project which provide a new coworking space besides the main building. The second one is the Neàpolis District which adapts several industrial buildings into a region called Neàpolis District. This year's EPS project focuses on applying the Fab Lab concept to Neàpolis.

The main problem in Vilanova I La Geltrú is that there is little to non-existing platform that encourage innovation. The project plays an important role in providing a platform for promoting the maker culture, innovative ideas and creative thinking skills. The main task of this project is to make proposals on implementing Fab Labs to Neàpolis buildings in order to achieved the mentioned platform.

The Fab Lab implementations will be carried out on the main Neàpolis building, the La Nau building from Neàpolis district and the sea container building. In order to achieve the task, a set of objectives were determined to grasp the idea of how the project will be carried out. The main objectives include studying Neàpolis in general, researching about Fab Labs, proposing the implementation of Fab Labs and explaining the advantages gained from this project. The specifications that must be taken into considerations include the general aspects, functions, size and space, designs and cost

Considering all the mentioned aspects, the project will satisfy the need of suitable platform for encouraging maker culture, innovative ideas and creative thinking skills. Furthermore, this project will also evaluate the future evolution of Fab Labs to further strengthen the positive outcomes.

Fig. 1: Neàpolis building

II. Information About Fab Labs

A. Fab Lab Definition

A Fab Lab is the educational outreach component of MIT's Center for Bits and Atoms (CBA), an extension of its research into digital fabrication and computation. [1] A Fab Lab is a technical prototyping platform for innovation and invention, providing stimulus for local entrepreneurship. A Fab Lab is also a platform for learning and innovation, a place to play, to create, to learn, to mentor and to invent. It is a digital workshop which can be used by the public to create and transform creative ideas into tangible prototypes. A FabLab comprises digitally controlled machines like laser cutter, CNC-router, 3D printer, vinyl cutter and electronics with the aim to make "almost anything".

B. Qualifications for a Fab Lab

First of all, a Fab Lab must have a public access for the users since it is about democratizing access to the tools for personal expression and invention. Therefore, when establishing a new Fab Lab, the Fab Lab must be open to the public for free or in-kind service for a certain amount of time every week. Moreover, a Fab Lab must also share a common set of tools and processes with other Fab Labs. All the labs should be able to share

knowledge, designs and collaborate across international borders since they are easily accessible. Besides that, it is essential that a Fab Lab has certain critical machines which include laser cutter, milling machine, vinyl cutter, wood routing machine and 3D printer and scanner. Furthermore, a Fab Lab must participate in the global Fab Lab network namely the Fab Foundation so that the new lab will be a part of a global, knowledge-sharing community. [2]

C. *Setting Up A Fab Lab*

Firstly, to set up a Fab Lab, one must identify a host and take ownership of the Fab Lab. Secondly, they have to identify the right champion to lead the Fab Lab. Thirdly, they need to finalize their partnership agreements which include Fab Foundation, MIT, local partners, funders and their service providers. Fourthly, they also need to secure their funding for this Fab Lab. Fifth on the list is they need to identify and prepare the location of the new Fab Lab. Next, they need to procure, install and commission the Fab Lab. Then, they have to train the trainers involved in terms of technical and management. Subsequently, they need to identify the project that they want to conduct so they can participate in global projects within the Fab community. Lastly, they will have to launch the Fab Lab. [3]

D. *Users of Fab Lab*

The Fab Lab Network is an open, creative community of fabricators, artists, scientists, engineers, educators, students, amateurs and professionals of all ages. From community-based labs to advanced research centers, Fab Labs share the goal of democratizing access to the tools for technical invention.

One of the most important users is the entrepreneur as they need a place to develop their ideas and a community to support their invention. Next is the artist or crafters as they can experiment with the tools in the fab lab so they could further improve the quality of their production.

In addition, university students are also important as they need to use the facilities in the lab in order to develop their project while influencing creativity and self-learning. Innovation companies are also involved as they require to develop a prototype model before finalizing with a final product, they could use the lab to develop it. Running a quality test in the lab would further improve their product. Educators such as teachers and lecturers can benefit from the global network by getting inspirations for educational contents involving creative ideas and innovations.

Moreover, the general public can also be involved as they could make things or learn new skills or make any products in the lab. Lastly, the government or cooperate employees play some role in the Fab Lab. They are the ones that will promote the Fab Lab in their local community and they could also be involved in sharing the profit gain from the Fab Lab.

Fig. 2: Fab Foundation logo

III. Designs of The Fab Labs

In order to implement the Fab Lab concepts into the three buildings, the Fab Labs should be blend in perfectly with the areas designated in each building and their intended users aimed towards to. The Fab Lab for Neàpolis building will be a space for research and will be aimed towards companies and university research groups. Next, the Fab Lab for the La Nau will be a Maker Space which will focus on academic schools, university students and the local neighborhood. Lastly, the sea container building Fab Lab will be a futuristic conceptual space for creation and university students with the aim towards university students and research groups. [4]

A. *Fab Lab for Neàpolis Building*

The dedicated space for Fab Lab in the main Neàpolis building is an open space on the second floor of the building near an elevator and a stair. The space was divided into two sections by the elevator. The divisions are made with glass partition walls which allows light to penetrate the surroundings for comfort purpose during work.

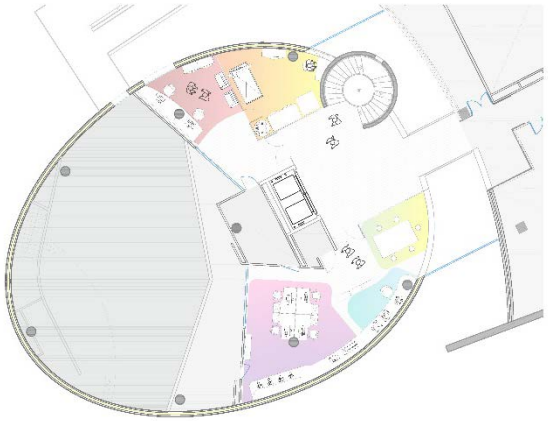

Fig. 3: Neàpolis Fab Lab layout

The section on the left wing of the building near the swirly stair was proposed for the shopBot space and the laser cutter area. On the other hand, the section on the right wing of the building was designed for the 3D printing area, electronics area and the central working space.

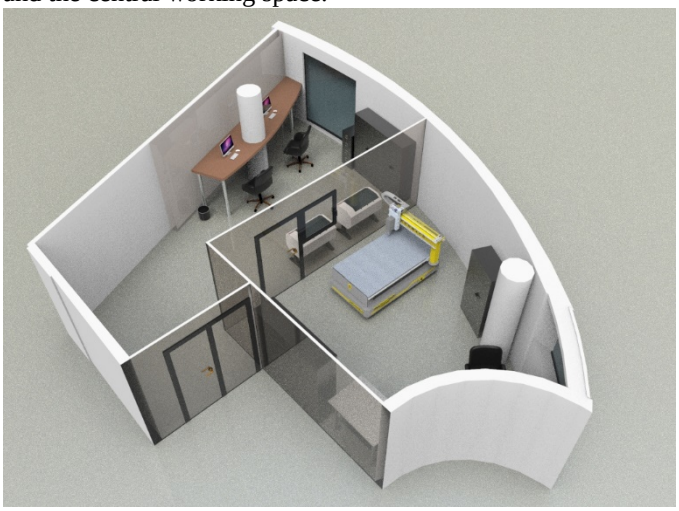

Fig. 4: 3D model of left wing Neàpolis Fab Lab

Fig. 5: 3D model of right wing Neàpolis Fab Lab

B. Fab Lab for La Nau Building from Neàpolis District

The Fab Lab that is going to be implemented in La Nau building will be located on the main entrance floor of the building. Since the main functionality of the lab is a Maker Space, this design will have the most complete ideal Fab Lab layout. The main feature of the space are the huge integrated areas and the glass walls surrounding the entrance resulting in a very modern and elegant appearance.

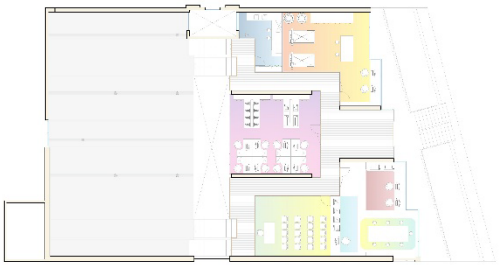

Fig 6: La Nau Fab Lab layout

The floor layout is divided by two corridors resulting in three separate spaces. The 3D printing area, laser area, working space and the conference learning space will be placed on the left side of the floor from the main entrance. The shopBot area and the molding and casting area will be located on the right side of the main entrance. The electronics area then will be designated to the center of the entrance floor.

Fig. 7: 3D model of La Nau Fab Lab

C. Fab Lab for Sea Container Building

The majority area of the whole sea container building will be designated for the Fab Lab implementation. Since the sea container building is still in a conceptual design state and have not yet been built, there is big room for improvement in terms of designs from the previous project. Therefore, the best possible layout design was made suitably for the sea container Fab Lab.

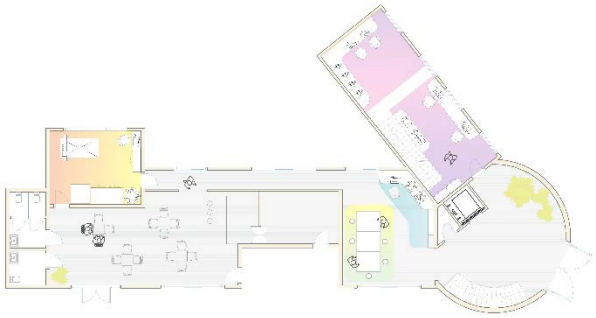

Fig. 8: Sea container Fab Lab layout on the ground floor

The sea container building consist of two floors with each floor has different layout and functions. The ground floor will be dedicated for exhibition space, shopBot space, 3D printing area, central working space, electronics area and cafeteria. The first floor will be specially designed for the exhibition space, laser cutting area, molding and casting area and learning space.

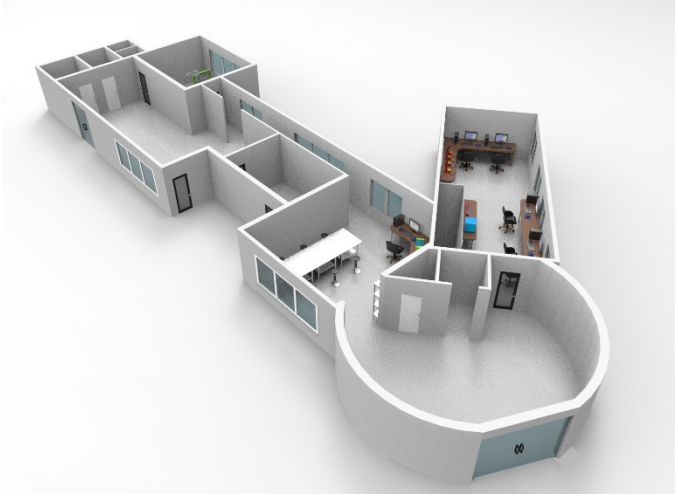

Fig. 9: 3D model of sea container Fab Lab on the ground floor

IV. Construction and Installation Process

In order to build a Fab Lab into the buildings, some construction and installation processes are necessary. This construction process includes the construction of new partition walls to create individual spaces and rooms for the lab. The Neàpolis and La Nau Fab Labs will require the construction of glass partition walls and plain brick partition walls, while the sea container Fab Lab will only need a plaster slab partition wall construction. Next, all the three buildings will need new electrical power outlets and LAN connector installation to accommodate the new machines incorporated in each building. Subsequently, the La Nau and sea container Fab Lab are the

only ones that require the installation of a wall mount range hood for the molding and casting area. Lastly, all the Fab Lab would need suitable set of furniture and setting up the machines for each dedicated area. The machines installation will vary depending on each type of machines. [5], [6]

V. Conclusion

As shown by the elaboration of the project, it is possible to implement the Fab Lab concepts to the Neàpolis buildings. However, it is also not as simple as it looks like in the paper. Many aspects must be taken into considerations when carrying out the tasks.

The advantage of this project includes providing a platform for promoting innovation in technology and entrepreneurship. Moreover, the hybridization concept could also be implemented along with the coworking and maker movement environment. This would also provide easy access to advance machines and digital fabrication to the general public. Furthermore, sharing and exporting of Fab Lab concepts can be done for the benefits of other people. Lastly, the study for the future of Neàpolis Fab Lab shows a promising success in promoting the maker movement and culturing innovative skills and ideas for the society.

Besides all the achieved tasks, there are still some small number of suggestions that are considered as optional but still holds significant values for this project. This includes running a professional analysis and providing a detailed fire proofing and evacuation plans.

It is clear that the team have achieved all of the main goals set out by Neàpolis. The outcome of the project should bring in some positive aspects for the team members, the supervisors, UPC, Neàpolis and Vilanova I La Geltrú in general. It is hoped that this project will be physically carried out in the future.

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