Principal Academic Tutor

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External Institution

Barilla Group S.p.A.

Team Members

Fabio Giulietto [Team Controller and Communication Coordinator]
Chemical Engineering, Politecnico di Torino
Sara Bazzano [Financial Controller]
Industrial Production and Innovation Technology Engineering, Politecnico di Torino
Fabrizio Carvelli
Management Engineering, Politecnico di Torino
Dustin Dopsa
Biomedical Engineering, Politecnico di Milano
Marco Marni
Energy Engineering, Politecnico di Milano
Martina Merlo
Architectural Design, Politecnico di Milano
Ludovico Pincini
Communication Design, Politecnico di Milano

Tasks and skills

Fabio Giulietto: Master of Science Chemical Engineering and Sustainable Processes. Scenarios definition, data analysis of the questionnaire outcome, business idea development of the hotspot, technical experiments planning. Team controller: activities scheduling. Communication coordinator: presentation of the recurring outcomes to Barilla Group.
Sara Bazzano (Industrial Production and Innovation Technology Engineer): team financial controller, scenarios analysis and rollout of the restaurant scenario with data analysis of the questionnaire outcome and business model development, use cases creation in the hotspot scenario
Fabrizio Carvelli: Master of Science management engineering student of Politecnico di Torino. Main tasks included the data analysis of the outcome of the questionnaire outcome,

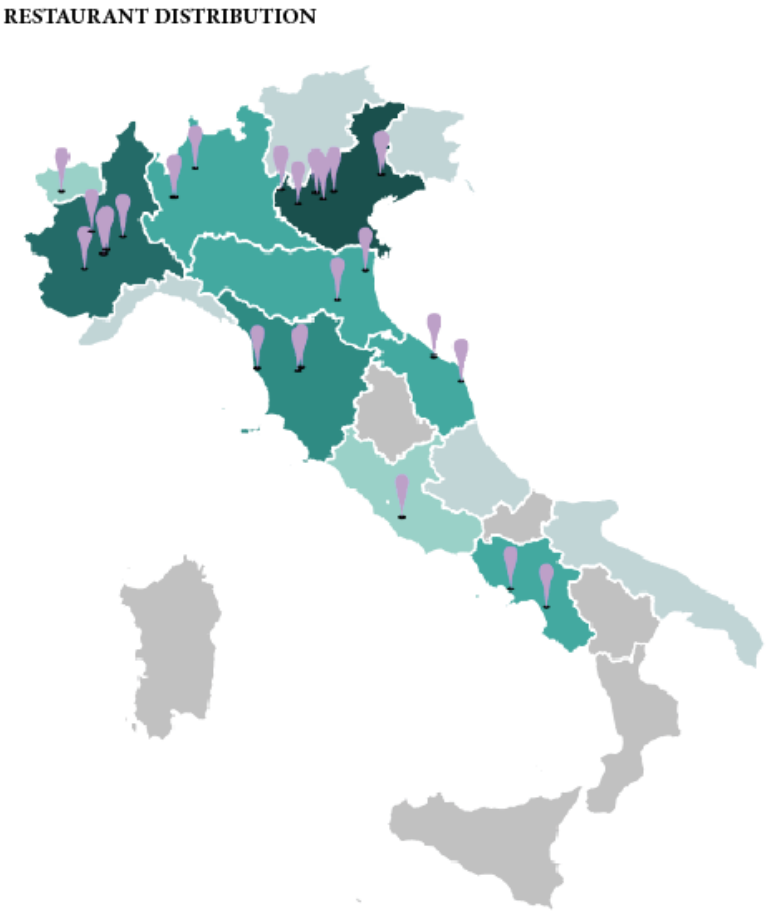
definition of the hypothesis and development of the model used for determining the price of the 3D printer in both the scenarios analysed, definition of the use cases for the hotspot scenario.
Dustin Dopsa: Master of Science biomedical engineering student of Politecnico di Milano, Bachelor of Engineering in biomedical engineering at Ryerson University in Toronto, Canada. Main tasks included the pasta cooking experiment, business models and strategies, cooking techniques and additional writing.
Marco Marni (Energy engineer): scenarios analysis, design of the questionnaire directed to Michelin Guide restaurants chefs and results analysis, pasta cooking experiment, investigation of the actors involved in the supermarket hotspot scenario
Martina Merlo Master of Science in Architectural Design student at Politecnico di Milano, Bachelor of Arts in Architecture and Visual Studies at the University of Pennsylvania in Philadelphia. Main tasks included testing subject for pasta cooking experiment, architectural design of the supermarket hotspot and packaging design, hotspot renderings, additional help with the use cases of the hotspot scenario, and additional writing for the final report.
Ludovico Pincini (Communication designer): scenarios analysis, printer requirements matrix and typologies, pasta cooking experiment, supermarket hotspot and packaging design, renderings of hotspot and past boxes, graphic design of final report and presentation

Keywords

3D printing, pasta, food innovation, business strategy

Abstract

3D food printing integrates the technology and techniques of 3D printing and additive manufacturing, together with gastronomy. Alongside Dutch research institution TNO (The Netherlands Organization for Applied Scientific Research), the Italian pasta goliath, Barilla S.p.A., has developed a prototype 3D printer dedicated to the food market. Although the possibilities for this type of novel device are quite vast, the two preferred and selected scenarios focused on for this project were an in-store hotspot and restaurant with in-house 3D food printer. A set of pasta experiments, questionnaires and interviews of Michelin-starred restaurants, hotspot design and business model were devised for the report and assignment.



Understanding the problem

3D food printing has the combined ability to control taste, nutritional input, corresponding shape and design. The use of 3D printing as a new approach to cuisine has the ability to revolutionize food production and food business, but effective plans and scenarios for using 3D printing in the food industry have not yet been fully developed. The goal of the FoodMade4U project was to further understand where and how this technology could be applied, to make it applicable for a large, multinational pasta company. Upon launch of the project, there were no concrete requirements provided due to the multiple directions possible for the technology, and the company involved in the project (Barilla S.p.A.) had not decided on a specified direction, either. However, Barilla shared their interests and current endeavours to forge a path for pasta and biscuits in the 3D food printing marketplace. Accordingly, the possibilities and objectives were extensive; understanding the appropriate goals was difficult. It was our task to develop a focus in aspects of their ventures that we found interesting and produce valuable results and feedback. It was essential to understand and consider the user, this was done with an analysis of the potential users of the 3D printer, and the imaginable products. Thus defining use scenarios, where different food items are printed, their use contexts, and particular users. It was also necessary to obtain an understanding of the strategies for accessing markets for the technology, in order to assess future markets. To do so, understanding the most important stakeholders of the project, was essential. Of the use scenarios ultimately selected for the project, the most important stakeholders were Barilla, TNO, the grocery retailer, chefs and restaurants, and the end

user. Combining all stakeholders and their respective expectations for each scenario, it was possible to create a list of needs and requirements for the resulting hotspot and restaurant proposals, encompassing a comprehensive understanding of the project.

Exploring the opportunities

The first step after having identified the stakeholders was to perform a brainstorming, with the objective of finding the possible scenarios in which the 3D food printer could have potentially been employed.

The 3D pasta printer could be placed in a *restaurant* (Scenario 1), serving as aid to the chef and having the objective of automating the production of fresh pasta, allowing the chef to dedicate himself to other duties. The 3D printer could also be of help to a *catering* (Scenario 2) service, giving the possibility to produce fresh pasta anywhere the service operates, without having to pre-cook the pasta and warm it up once arrived at destination, guaranteeing a higher product quality. Another use case could be the production of food in *luxury retails* (Scenario 3), where it would not only be possible to produce 3D printed pasta, but also any other kind of food, i.e. chocolate, vegetables, and so on, allowing the personalization of the shapes and improving the value creation of food. It could also be possible to find the 3D printer in an attractive position, such as a supermarket or a mall, under the shape of a *hotspot* (Scenario 4), where customers could buy pasta or order it online and then pick it up while grocery shopping. Thinking of a more customer-oriented approach, a *family* (Scenario 5) could use a smaller and adapted 3D food printer at home, having the possibility to cook fresh pasta in an automated way and with a specific pasta design, for example to make it more appealing for kids. Another purpose could be to install bigger sizes of 3D food printers in *canteens* (Scenario 6), i.e. hospitals, prisons, schools and allow the personalization of nutritional values within the dishes. The same principle can be extended to *small crews* scenarios (Scenario 7), such as astronauts on a space shuttle and crew in a cargo ship, or *bigger crews* (Scenario 8), such as soldiers in a military base. Finally, the concept of 3D pasta printer could potentially also be used in the *industry* (Scenario 9) by creating plants of fresh pasta production with additive manufacturing productions.

Of course, all the scenarios listed above would require specific characteristics, in terms of size of the printer, production capacity, design, configuration, allowing for example the incorporation of a cooking unit, or the development of a multiple nozzle.

From the analysis of all these scenarios, we came to the conclusion that the restaurant scenario and the hotspot scenario were the ones worth developing with particular attention in order to find the most appropriate solution to our problem.

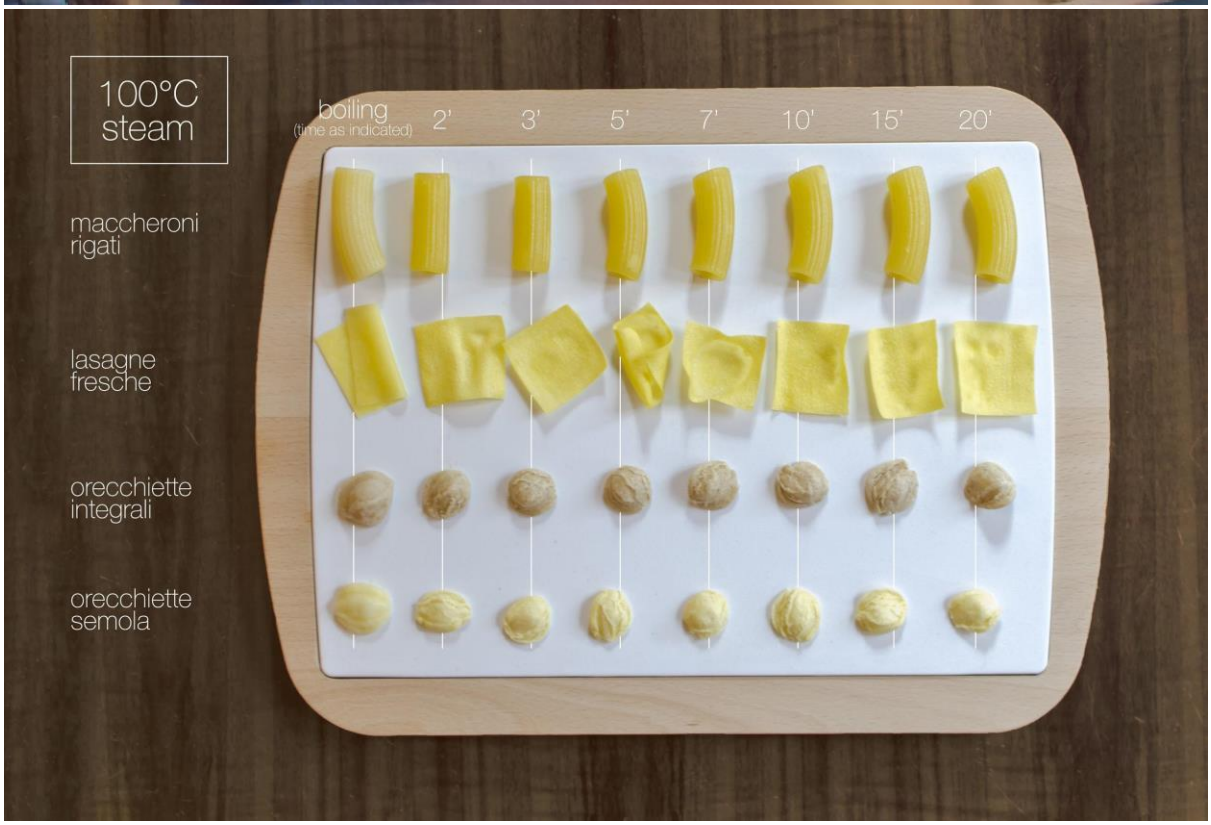
Generating a solution

Our solutions have been developed following three main directions:

- The evaluation of an eventual integration with the existing 3D printer of a cooking device for the printed pasta
- The investigation of the possible implementation of the restaurants scenario
- The design of a supermarket hotspot equipped with a 3D pasta printer

As regards the cooking device, a set of experiments have been carried out in order to perform a comparison of the resulting pasta quality cooked with a steamer and with the traditional boiling. The requirement at the bottom of this evaluation was the production of cooked pasta that had to be edible and provided with a certain level of quality. The results of

the experiments have been such that they do not support the implementation of an integrated cooking device.



In the restaurants scenario analysis, starting from the defined target restaurant obtained from the questionnaire data, some economic evaluation have been performed to assess the drivers that could allow the actual implementation of this scenario. Where actual data from

the questionnaire, Barilla or other sources were missing, all the economic analysis have been based on plausible and conservative assumptions to obtain results which are as accurate as possible.

First of all, an estimation of the Net Present Value of an eventual restaurant investment in a 3D pasta printer have been carried out to determine the willingness to pay for this device.
After that, the competitive environment for this type of device has been investigated in order to assess a credible value for the price of the 3D pasta printer. Together with that the possibility of leasing the printers by Barilla to the restaurants has been examined as a promising option and a final monthly fee has been calculated.
Finally the volume of pasta 3D printed in the restaurants has also been taken into consideration to assess on the one hand the feasibility of the production of the necessary pasta in a plausible time within a restaurant and on the other hand the overall amount of refills production required to Barilla.

Concerning the supermarket hotspot design, we started with the definition of two types of customers, pre-order and on-demand, and the consequent design of their customer journeys. Then all the different actors involved in the hotspot operation and in the supply chain have been considered with the definition of all the duties and tasks. After that, a deeper look into the hotspot required functionalities has been effectuated and this has brought to the actual physical design of the hotspot.

Finally, we performed an analysis to understand the economic sustainability of the installation of the supermarket hotspots for Barilla. To do this, an evaluation of the volume of pasta sold by Barilla in hypermarkets where the hotspot may be installed and the calculation of the necessary price at which one kilogram of 3D printed pasta would need to be sold have been done.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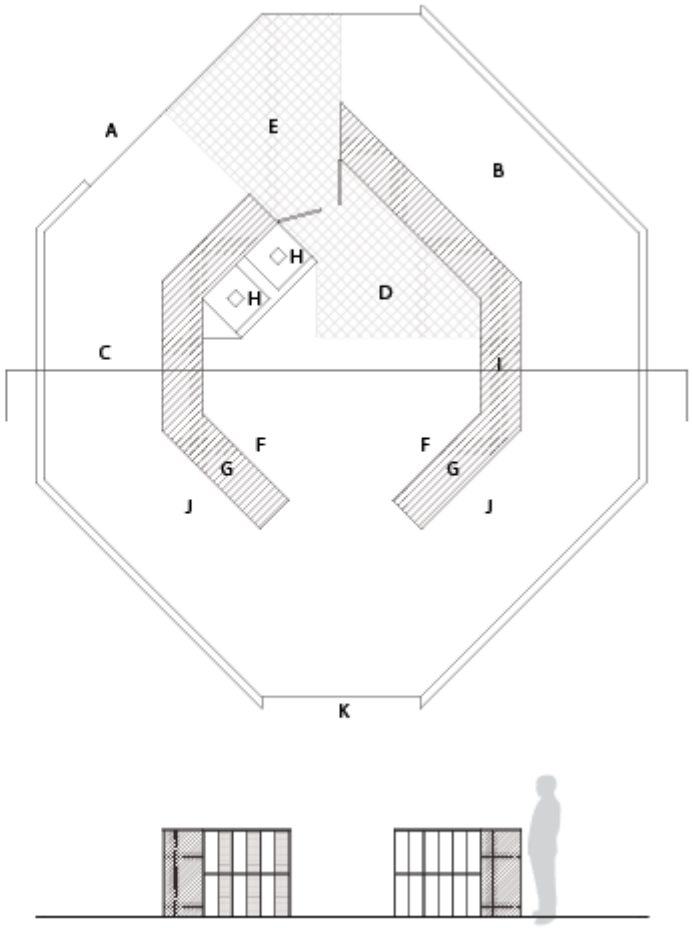
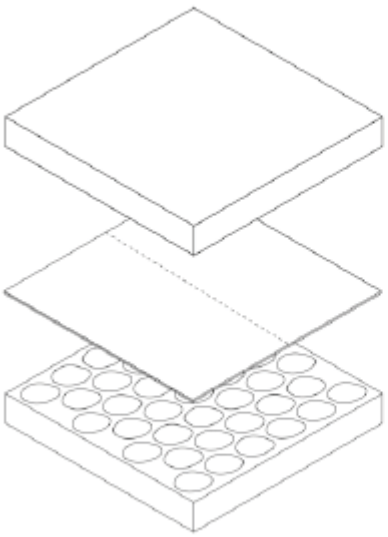
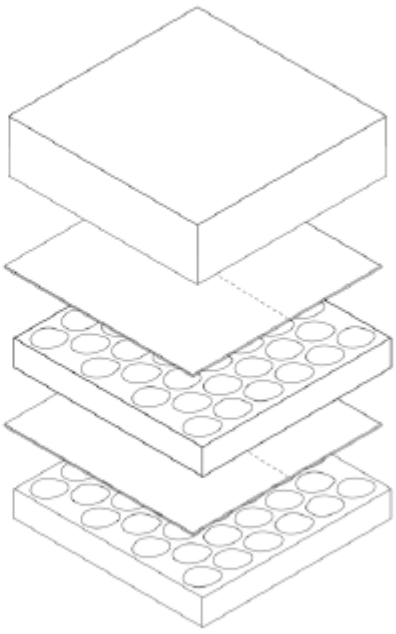
Entrances	A
On-demand	B
Pre-Order	C
Restricted	D
Access to Storage	E
Shelving	F
Countertops	G
Printers	H
Cashier	I
Pickup	J
Exit	K



One layer packaging



Two or more layer packaging

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3D shapes with a purpose