POLITECNICO
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Honors thesis

MASTER OF SCIENCE
IN
SUSTAINABLE ARCHITECTURE

abstract

://HACKING ARCHITECTURE

GUIDELINES AND APPLICATION SCENARIOS OF BIOHACK-TECH APPROACH

by
Fabio Sicilia

tutors
Roberto Giordano
Cesare Griffa

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Today, technological design involves more technical disciplines, therefore the architectural process has reached levels of complexity increasingly higher. A different approach, systemic and multidisciplinary can bring to the project a high added value. The traditional architect is destined to disappear, replaced by a new species evolved to professional programmers capable of knowing how to manage a complex information ever evolving. In short, a conductor who knows how to lead a team of professionals each with their own skills. This scenario is possible by adopting a change of mentality and not of technology, pursuing a different methodological approach to design: *biohack-tech approach*

MANIFESTO

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{
 .opensource
  open science: //democratization of ideas
}
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{
 .systemic Design
  change of mentality: //architecture 4.0
}
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{
 .biomimicry
  emulating nature: //The living Architecture
}
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{
 .digital fabrication
  from Bits to Atoms: //social innovation
}
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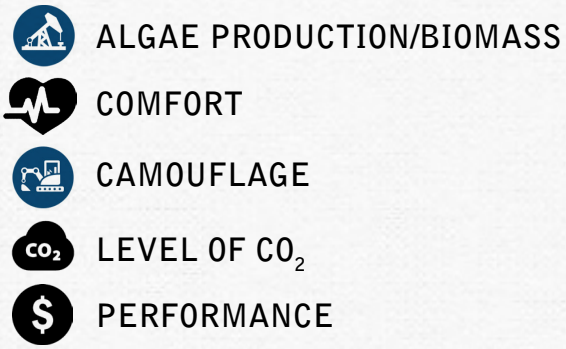
What makes it interesting biohack-tech approach, is how these four structures provide the technological action, referring to a process of thought as much material, proving the validity of the application of an action to a technological innovative methodological process. The four components constitute a connection process obtaining a machine, which has qualities absolutely different from the simple complex of its separate parts. Machine understood as dialectical structure of knowledge and description of the interweaving of systems that form the methodological approach.The biohack-tech approach gives designers the ability to overcome the limitations of a system architecture based, for example, on a linear economic model towards a circular system where a refusal of an industrial process becomes raw material for another. In fact, this design method was born out of that ethic subversive due to a hacker culture. The hacker culture in relation to the physical and biological in which he is placed characterizes this community and wider range of individuals we call bio-hackers, hence the term biohacking.

The problem, then, is not so much finding a solution to the environmental crisis, how to plot routes that consider the individual building not only as part of a city, a region or environment (design standard), but as in a digital system in which prevail the concepts of interdependence and exchange of feedback will continue, both in formal and compositional choices in the design process (design systemic).

The characters of the architecture will be its impermanence and transience. The architecture will live less. Each generation will have to build their homes and rebuild it every time you want to move to a different city. The architecture will live for short times since the main goal will be to protect the soil. Think of a "city" built to cope with a natural disaster, in search of a "genetic code of the territory" to guide the project and integrates with the context: structures designed to dissolve and degrade back into nature at the end of their use. And in this case, the microalgae could play a key role in the production of new materials. Architecture adaptable, mild and temporary that should not outlast its functionality for the man and always in harmony with nature. Microalgae, can transform the world of construction ottenedo new building materials, can save natural resources. Consequently microalgae could replace a whole series of obsolete materials generating a dematerialization which will produce a cost saving.
This system will generate new jobs in the field of renewable energy, ensuring a high standard of living for future generations.

Specifically, it developed a technology project of the building, alfie re//skin, according to the methodological approach biohack-tech, which has developed three different scenarios (industry, office, housing).

The requirements are associated with other indicators (performance) can judge the qualitative and quantitative depending on the nature and type of the same indicator. These indicators are expressed through a scale of 1 to 4 represented in the diagram on the next page. We analyze in detail what the requirements are selected:



CASE 1

Among the different scenarios that's what lends itself more to a cultivation of microalgae in front. The total willingness on the part of the customer to mask an industrial shed consequently affects on the ability to maximize the production of biomass without decreasing the internal comfort, as are local used mostly by machines

CASE 2

This scenario is positioned at an intermediate level, as there is more or less equal between requirements and performance. Only the will of the customer and the skill of the designer can increase the camouflage and consequently the performance of the system. In fact, in this scenario we have been removed more than 50% of growth chambers as the component is placed on a glass facade

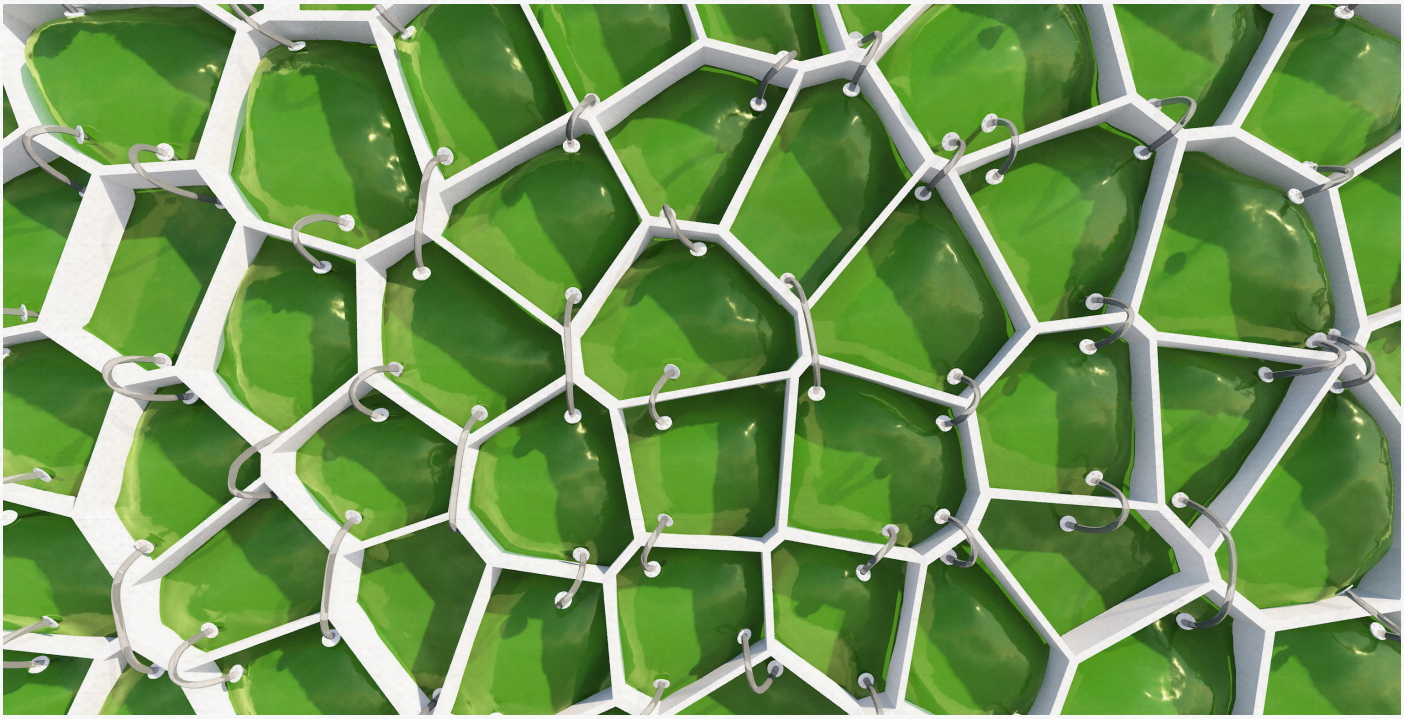
CASE 3

In this scenario, however, the need to obtain a high comfort / quality of indoor environments for people who will inhabit the local interior drastically affects on the final performance of the system. In fact, the production of biomass is at minimum levels. In this case, then you should place Alfie King // skin on a blank wall or with few openings to the outside

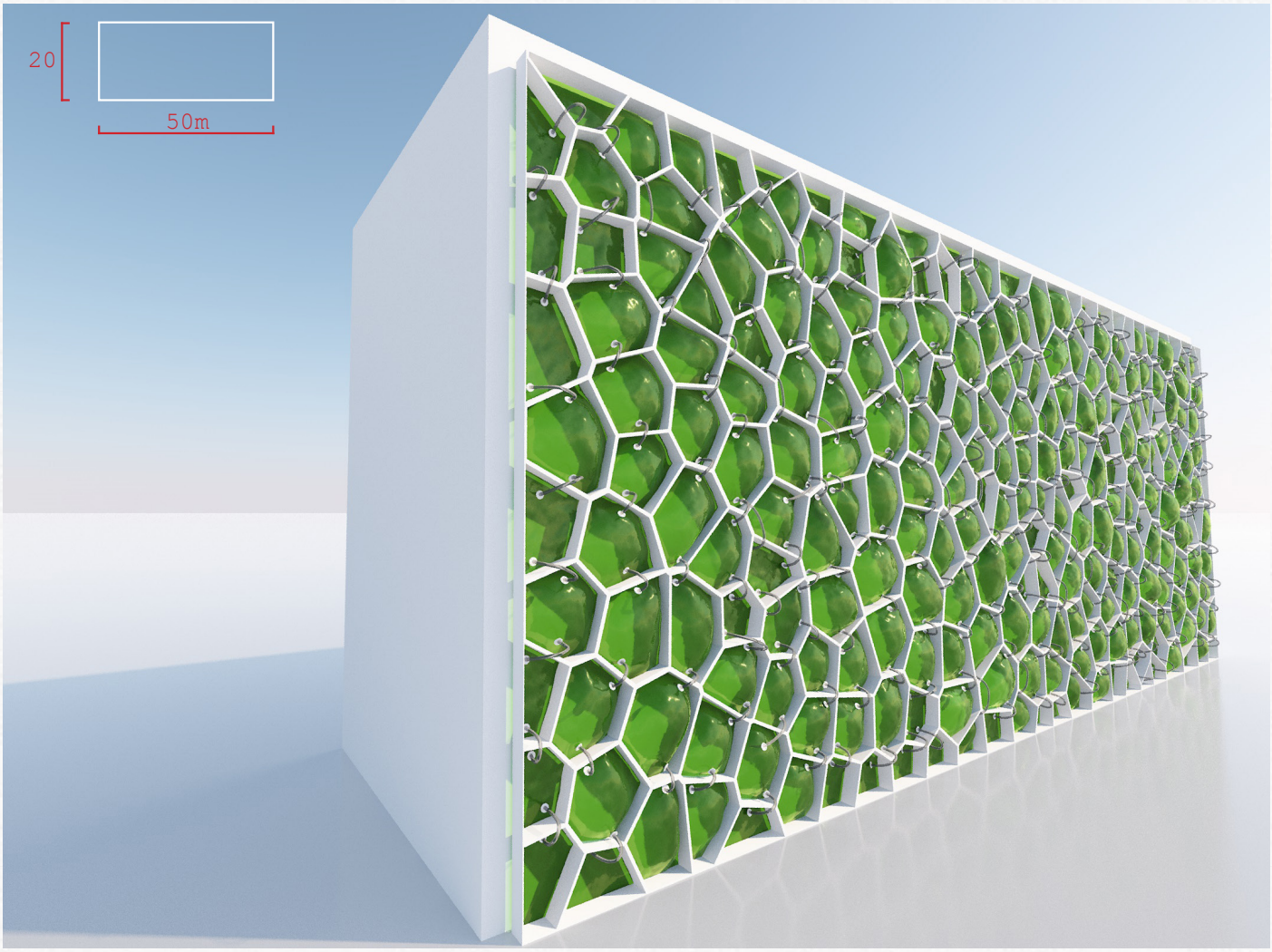
1. INDUSTRY	2. OFFICE	3. HOUSING
427.350 * €/year	**170.887** €/year	**60.690** €/year

*performance case 1: investment 1000-1500 €/m² - surface 1000 mq - recovery investment in 2-3 years

As can be seen from the table, the scenario 1 is the best solution for this type of activity. The ability to cultivate microalgae over large surface, without the problem of visual comfort is critical to the achievement of maximum profit. In these three scenarios it was adopted on market value equal to 40 to 50 €/kg which refers to a price aimed primarily at pharmaceutical and cosmetics, because in these areas the market is very active. This scenario is ideal, for example, on areas of Piedmont (Langhe and Roero), a UNESCO World Heritage Site. The objectives are to reduce the impact on the landscape of industrial buildings constructed for the production of wine, the setting of the CO_2 produced during fermentation of the grapes in wine-making and production of algal biomass as a profit-generating activities to cover the costs of installation in the shortest time and can generate a valuable source of income.
The system is composed of a natural photobioreactor for the cultivation of microalgae, posed on the external walls of the buildings. Microalgae are grown in transparent ETFE cushions which filter the gray water and collect rainwater building. At the end of the process the "clean" water is put back in the building as a blood of a living organism.



render alfie re//skin



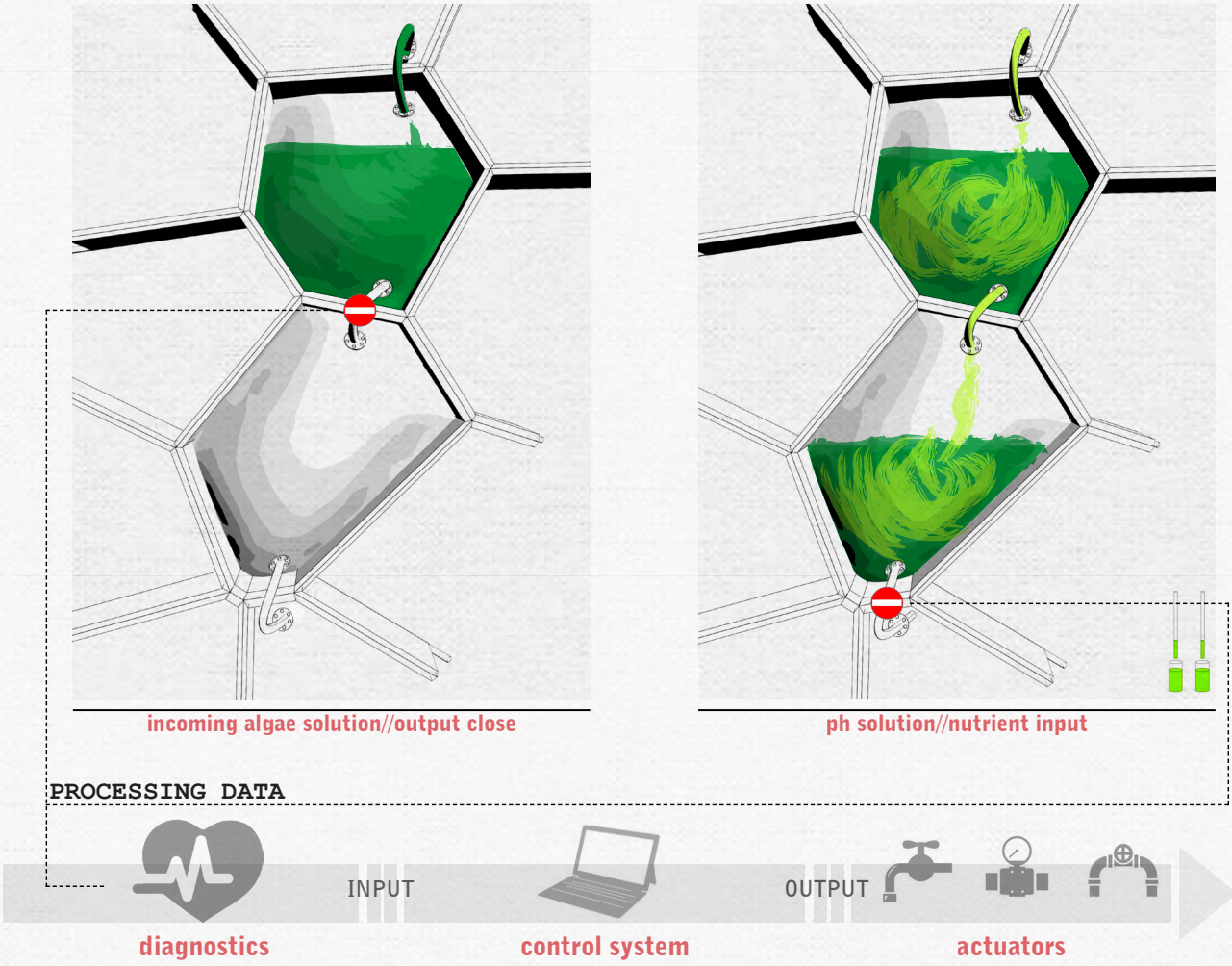
render case 1 (industry)

In addition to contributing to limit the waste of water, microalgae have been chosen for another important function, that of producing, with photosynthesis, a substantial amount of oxygen (are more efficient than tall plants), purifying the polluted air from CO_2.The results obtained have digitized the technological component alfie re//skin, through the use of special tools: // Rhino + Grasshopper, spreading the culture of open collaboration by bits to the atoms, that is, from the production of digital assets to that of material goods .

The house is transformed into a real factory that produces not only clean energy, but also the materials for its construction. Alfie re//skin is coordinated by a single control system (PLC) programmed to ensure optimum operation of the hydraulic pumps and mechanical properties, able to handle extreme situations that may occur in the event of climatic events extraordinary or accidental failures of parts of the component. The control system has to monitor, through hydraulic systemsand mechanical sensors, environmental conditions and the metabolic functions of organisms.
Like a nervous system it has to provide a range of feedback on the "state of health" of the system.There are a number of sensors in alfie re//skin and are:

- **T° air and water**
- **PH control / nitrate phosphate / EC in the solution algal**
- **CO_2 control**

These sensors send information to a computer connected to the hydraulic system which will manage the adjustment (open or closed) of algae solution. The fluid will now be redistributed in areas with radiation more favorable for cultivation. The self-tuning capability of the mechanical system of alfie re//skin joins the natural biological capacity of micro organisms present in the components forming a real living organism biotechnology. In the construction system it is also a screening structure able to improve the conditions for growth of microalgae in limit conditions.



nervous system

Overall, the biohack-tech approach has generated the living architecture in which natural organisms act as the backbone of a new stylistic // bio technology. Nature takes possession of passive technology, making it active. It was expanded vision of the building project, with the aim of optimizing the design of a technology component // wrapper dynamic adaptive. The result is a computational system that integrates elements of digital fabrication which are based on a concept of standardization, modularity and natural organisms. This new process between man and nature has generated the third pulse missing: the technological project of the building in the era of the digital revolution. The architecture is beginning to be seen as a compositional system due to an actual living organism.

FOR FURTHER INFORMATION

FABIO SICILIA
fbsicilia@gmail.com