

Sustainable design surfaces for an industrial boiler

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Abstract

This study introduces a new perspective to an industrial system for biomass heating boiler water - such as firewood, forest residues, biogas, biodiesel - which remains the power source with a greater contribution to the primary consumer. The design of a boiler product is a complex and difficult process with technical requirements and a tight development cycle, involving several entities and producers. The technical knowledge requirement of the product and the spatial and social issues combined with the complexity and contradiction that characterize liquid modernity (Bauman, 2000) increases the difficulty setting of a product as an industrial boiler.

However, the energy advantage can be integrated into the architectural construction of a new and sustainable way. The energy and the communication can transpose a new cultural revolution that, increasingly, is imposed in spaces and buildings, facades or through a complete perspective of the architectural space. Today, there is the opportunity to have a third revolution. We miss the distributive and distributive energy communication, to reach a new economic model and collaboration in society, where each person has a responsibility to create its own energy. One of the aspects to be taken into account in the design of the boiler is the physical dimension. When the boiler is consisting of several modules may limit its versatility to buildings, thus ignoring the spatial values. The limitations and disadvantages will have to be

rethought in order to obtain improvements and virtues, which constitute a communication processing between the product and persons. To support this thesis the authors presents the progress, the methodology and the results of the research project “Plug & Heat”, developed in partnership with the Ventil company (Aveiro), in which is present the importance of developing an engaging structure of the boiler, capable of protecting, respecting the concept of space: with the respective cultural value and their social habits. It is expected to prove that, in the circumstances in which this product system is installed as the industrial sector, there is an introduction of new communication settings for an interaction, not only in the environment in which it operates, but also by whom will enjoy. Through this analysis, it is intended that, through a relationship between the area of knowledge (the Academia), industry (company Ventil) and design, there is an identity reinforcement and a prevalence both in functional capacity and the pragmatic industrial sector requires either a close link between product and citizen, culture and space, highlighting the value of design semantics.

Keywords

Product system, Epidermis vs Material, Comfort vs Interaction, Energy vs Communication, Industry.

Introduction

Globalization and population growth have forced rethinking strategies for energy consumption. Raw materials depletion and land occupation by society keep increasing, along with the dependence on secondary energy sources. Taking into consideration that “(...) all human activities generate environmental impacts to a greater or lesser extent, notably energy-related activities, indus-

tries, agriculture and transportation” (INE, 2009, p.19), sustainable consciousness must evolve and with it the daily consumption of massified sectors. The new approaches to energy are based on sustainability and socio-economic policies. The emphasis on sustainability as economic development factor answers concerns about future generations. The concept of sustainability establishes an alternative to traditional models of development based on secondary energy, which represent a worn-out

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consumption philosophy. Secondary energy is used due to easy implementation and acquisition, in contrast to primary energy, more expensive in immediate monetary terms but in energy terms more lucrative in the long-term. A social modernization in a multidimensional perspective involving economics, ecology and politics is the starting point for sustainable development.

The design of spaces or equipment involving these concerns is an important step, although sometimes resulting in problems concerning the context of insertion. In this research, the development of a biomass hot water heating boiler underlines the difficulty to apply apparatuses in context, considering the spatial implantation of buildings and the important economic factor attached to that application. Subsequently, the impact of energy in economy and buildings constitutes a design opportunity to create new scenarios to experience this category of equipment. As a projectual approach it will allow addressing different levels of interaction between the individual and the product, considering a person's life that has become a paid-for experience (Rifkin, 2001) instead of a collection of paid-for products; adding communication value and identity to the product.

Research Process

Aims

This paper intends to reveal that communication and energy are part of the construction. As argued by Palma (2011, p.70), “today we have the opportunity to go beyond previous paradigms, to launch a third industrial revolution, to switch from distributive communication to distributed energy, reaching a new collaborative economic model of society, where everyone has the responsibility to create their own energy.”; Following Robert Venturi's thinking (2005), nowadays architectural dimension should focus on designing surfaces as membranes able to articulate complexities, translating into thinking the skin of the product/boiler as a system of patterns (Alexander, 1977) in an enveloping macro-system.

Related Work

Today, products must be interpreted, assuming liquid modernity (Bauman, 2005) as a part of the process. There are some projects that transform constraints into opportunities, such as the

Lullaby Factory by Studio Weave (2012). This project is an intervention carried out in 2012 at the Great Ormond Street Pediatric Hospital which turned a negative circumstance into a better condition. A new building was built in front of the Hospital, with a small hallway, an alley in between the two buildings. Facing a problematic surface design, the façade of the new building was conceived and designed as an open space, giving priority to a future spatial restructuring. It is important to underline that the Hospital was to be demolished in fifteen years, thus the large windows overlooking piping, draining tubes and vital connections installed on the outside of the Hospital.

The surface product system was intended to provide a magical place with a peaceful disrupting atmosphere, totally unconventional, taking advantage of this structure. Holding the patients as main concern, the development of the surface system created an extremely complex ‘steampunk’ landscape with an industrial allure, using consecutive musical instruments.

On the one hand, the instruments' physical shape was designed to solve aesthetic problems in a surface. On the other hand, the immaterial part of the musical instruments – sounds, melody – was solved in relationship with the building's façade. The project was complete with the intervention from the sound artist Jessica Curry, a reference in composing original soundtracks for videogames.

As explained by Studio Weave, “Jessica Curry has composed a brand new lullaby especially for the project, which children can engage with



Figure 1 – Detail of Lullaby Factory by Studio Weave
Source: www.studioweave.com (accessed 17.02.2015)

through listening pipes next to the canteen or from the wards by tuning into a special radio station”². The project was extremely ingenious in a social design and inclusive design perspective. Studio Weave solved a problem answering with simple thinking for a complex application, turning disadvantages of the façade into benefits for the project, studying hypothetical forms and deciding to add value in the perspective of hospital users.

The success of the intervention was due to a partnership between two distinct areas in their materialization, but complementary when the most important factor to consider is people who use the space. Beyond a physical approach, it is a social, cultural, human approach.

Participants and method

The system of patterns of a water-heating boiler is a pilot project that relates the design school with an industry of water heating boiler. Investigation in design, according to Roberto Verganti (2008), is a research conducted around specific reading instruments such as “those studying innovation processes promoted by enterprises in collaboration with designers and the world of creativity” (Verganti *apud* Soares, 2012, p.225). Masters Studies in Integrated Design differ from other Masters due to the approach it allows students in developing and building their thesis, since case by case the distance from real enterprise situations is shortened, involving added value and shared knowledge and experience between the teaching institution and the entrepreneurial world. Some industries, such as Ventil, are facing adaptation problems concerning their product-boilers, since now meeting new challenges, often facing spatial restraints causing standard models not to fit.

Thus, Ventil proposed a design collaboration and action through the Master Degree in Integrated Design. This pilot research was carried out in different stages. A first stage took place between Ventil and 3 designers, targeting the system of patterns of the water heating boiler skin. A second stage targeted the design of the system of patterns, and also the outdoor implantation of the new water heating boiler. The other partner

is an Agricultural College working in a former monastery whose historical values are visible everywhere, outside and inside. The monastery building and premises had its largest renovation during the intervention by the Portuguese architect Fernando Távora, keeping the strong historical value of the building and the sustainability of the surrounding environment, consciously embracing a contemporary approach, namely offering a new breath to timelessness, reaching a high-level of creative consciousness (Gomes, 1993), whereas each space composing the building is historical.

In this research, the project was developed in the principle that the equipment-boiler should be installed outdoors, requiring a sleeve casing, an architectural structure to solve weathering issues, highlighting a connection between product-space-people in the urban space. It is through structure and skin that communication between elements takes place.

Material and appropriation

The structure is mainly in metal, factory built on the Ventil plant, since metal is also the main material employed to produce boilers. Hence, the choice and application of the material was

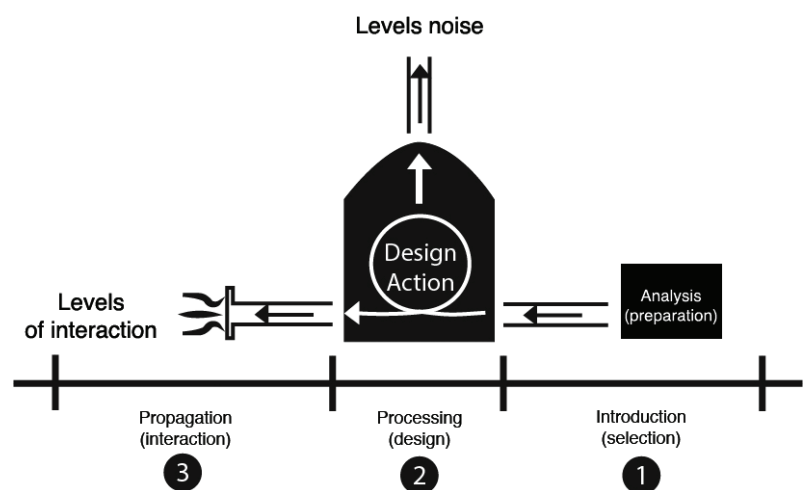


Figure 2 – Mental Map

Source: authors' material

determinant for the project. In the exceptional event of other materials, their characteristics will be established through networking with other companies. All the inner part sections will be determined by metallic girders, with structural

² <http://www.studioweave.com/projects/detail/lullaby-factory>. Accessed 18.09.2014

columns forming a skeleton standing on a concrete mount. One of the wider sides of the parallelepiped structure includes two folding doors with standard fitting system, while the opposite side and ceiling are composed of plates attached to the columns. The entire structure is in metal. The top framing secures acrylic plates, allowing sunlight during the day and performing as a light box during the night.

Technology and performance

The industrial boiler is an assembly of different modules. The process begins with biomass placed in the silo, remaining there for as long as necessary until the end of use. At the bottom of the silo there is a feeds crew axle transporting the material to the feeding feeds crew, connected to the boiler module, where burning and energy production takes place. The originated gases pass through the internal pipes and heat the water. Gases are then directed to the multicyclone, where pollutants particulate from the remaining air are filtered and cleaned. Clean steam from this process follows to the butterfly valve, which directs it to the chimney thus ending the process with steam expelled onto the atmosphere. Ventil products are manufactured with a strict quality control in all processes. Welds are performed by qualified workers and the final coating of paint is periodically tested to ensure corrosion resistance. The equipment is also subject to periodic testing to ensure the correct operation. The boiler to burn forest biomass has a three pass smoke-tube design with integrated flame tubes. The flame tubes were developed for the exclusive combustion of wood chipper, sawdust, wood shavings, pellets and other biomass-derived fuels. The combustion is also optimized, ensuring total compliance with existing restrictions regarding environmental emissions. The technical characteristics of biomass boilers performance are directly determined by the fuel characteristics, particularly rated thermal input, fuel consumption and system performance. Situations such as excessive moist on the biomass may cause a lower performance in energy production. After purchased, the system only requires periodic maintenance in some of the modules. Verification of the correct operation of the equipment and surpluses cleaning are some examples of such maintenance operations.

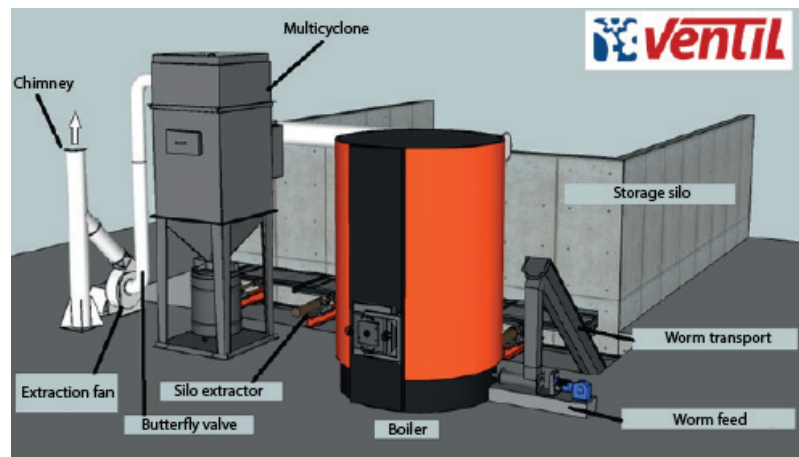


Figure 3 – Industrial boiler modules

Source: Ventil

Findings

Advantages of the process

The acknowledgment of the potential of the material. In the case of boilers production, the raw material to apply to the architectural structure is the one usually employed by the company Ventil: metal, namely, iron and steel, characterized by flexibility in their application. Their properties may be an asset for product design.

The market for biomass boilers is limited to indoors application, invariably with a metal coating to allow fast production and assembly, with minimum insulation requirements. Setting this material outdoors carries new implications in the introduction of this type of energy in the target market. The use of metal as the surrounding boiler structure coating enhances the relationship between the low production cost and the good behavior of the material in response to weather conditions, with zinc finish or paint.

The potential of increasing the use of this material by other industries promotes cross-fertilization (Cappellieri, 2006) and opportunities for other potential companies and the industrial sector.

A project with a different application than the one Ventil is used to doing may constitute an opportunity for the company to transform, pointing and revealing new applications for their products, recognizing the market demands have to be followed by sustainable energy demands targeting the future and the social impact of applying such products.

Disadvantages of the process

The lack of communication between some of the actors hindered the development of research. At Ventil, the need for a successive follow-up was identified as a slow process. The company is a reference in the market of industrial boilers, and every available time would chiefly be dedicated to internal issues such as foreign expansion. There wasn't enough time to answer all questions being posed, at the pace demanded by the project. However, management members volunteered to show the entire plant and didn't obstruct any direct relationship with the plant workers.

Market competition in the boilers sector is mainly an international issue, since sustainable energy policies and their application have a much greater impact in the North European market. This impact spins-off to the rest of Europe stemming from these countries, with a stable long-standing tradition in this sort of products, namely for cultural reasons related to the use of their own natural resources. There is little competition at a national level because the relationship with secondary energies is still very strong.

The pilot study

The project was developed in two different ways. On one hand, the process was adjusted to technology. On the other hand, the process was driven by design innovation, considering design research into new languages (Verganti, 2001) and design action focused on creating new markets. The development of the project was founded on abductive reasoning (Cross, 2006), linking the company, the Academia and other entrepreneurs. It is based on design's ability to convey cultural values (Chiapponi, 1999) to a given space. The architectural form is that of a parallelepiped. One of the sides is the main cause for the rest of the volumetric form. That side is composed of triangular profiles applied to a plate, with spacing between them, occupying the whole area of the sidebar. This solution is the result of the study carried out at the level of relationship with people. The chosen path was illusion and its application to shared social spaces, such as for instance with graffiti. Depending on the point of view regarding that side of the parallelepiped, three different images are viewed: one image seen from a corner side perspective, another image seen from the opposite side and a third image when facing the object. When passing in

front of the structure at a considerable distance it is possible to perceive the image configuration. Image formation and deconstructing is possible to see due to the triangular side profiles, which will mark each side with a part of the picture. Spacing between triangles was calculated to allow the application of the third image, visible when facing the side. The opposite side comprises a folding door, allowing access to the boiler storage and access to the technical area. The door follows the same triangular shapes of the opposite side in full harmony. The top sections are slightly inclined creating a lighting effect during the night, illuminating the surrounding area and becoming a reference point for those attending school.

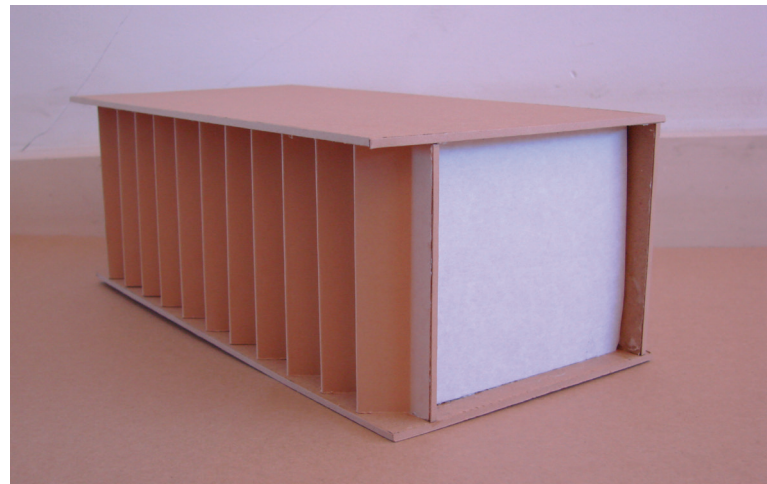


Figure 4 – Mockup of the structure

Source: authors' material

Conclusion

The findings from this study support that circumstances define a market that requires industrial products with innovative configurations to interact with their own environment and with people. It is therefore intended to explore new settings for product integration through design, meeting requirements of meanings and integration onto the space shared with individuals. The boiler sector reveals some gaps in the field of communication, and therefore this research profited from the problems of an industrial product, fulfilling its practical role as a machine, transforming problems into project opportunities and identity value. This approach allowed building bridges onto companies from different areas, such as Ventil Company. It is also through communication and connection between trades,

research and education that a visionary result is expected. It is expected from design teaching to be a determining factor for the answer to and solution of different problems related to products developed by industry, in a eventually paradigmatic approach. This research also highlights important issues for design teaching, especially concerning bridging the gap between students and the business world. Having the opportunity to deal with an ambitious project like this one reflects mature teaching and vision towards a better understanding of the world. The future of society is also shaped by environmental decisions, and by the importance of individual responsibility towards a sustainable world. This notion is now creating values in human relationships, in everyday activities, decisions and commitments, and in the business world. This way, design will serve as a liaison vehicle, an instrument for a better world.

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