BIONIC DESIGN, AS AN INNOVATION TOOL IN PEDAGOGIC PROCESS

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ABSTRACT
The role of this paper is to define an industrial product process developed through the use of Bionic design and considers the designer role. The purpose is to reach a new level of knowledge and to implement a method able to innovate the product process development in education field. Beyond the tools and process employed it's important to underline the new "project approach" furnished by Bionic: a new way to draw near to the project in a mutable market reality as nowadays. The approaches to investigate the various sources of knowledge in Bionic are different. These start from the intuitive creativeness to the systematic research, from the formal research to the solutions by analogy. The paper focuses on the analogy with Nature as one of the tools that can be used for generating new ideas. The use of the analogy can be defined the basic principle on which Bionic is found. The Bio analogy (analogy with Nature) is founded upon the ability of the designer to observe. Because Bionic – Bio analogies does not only pay attention to shapes design, but it also takes care of the mechanical and morphological characteristics. The performed analysis wants to highlight how Bionic design represents a new learning process to become a designer, because, through analogies with Nature, offers a pragmatic and interdisciplinary approach and the designer experiments the characteristic transfer of Nature in the design project.

Keywords: Bionics, design, Products, Analogies.

1 CREATIVITY

It is possible to define creativity as the ability and the skill to create and invent things and methods that have not been thought of yet. Among so many definitions of creativity, the one coined by French mathematician Henri Poincaré stands out for its simplicity, accuracy and precision: "Creativity means combining existing elements through new useful connections." The use of the terms "new" and "useful" is linked with the common understanding and the social recognition of creativity and its ability to produce new knowledge.
The creativity used in professional activities and in skill development allows us to reformulate the problem on your hands from a different point of view. A very useful method to improve the creativity, can be the critical observation of the existing solutions, that represent the cultural heritage. Such heritage could be constituted by two kinds of solutions: natural solutions, that are be found from Nature of billion years and historical solutions that are found by man in thousands years.
In particular, the observation of phenomena and aspects of reality is a stimulus to develop creativity to the extent that new technologies are invented. The application of

new technologies can be made both in a new context and in an existing context to be revised and improved.
Creativity and the ability of problem solving are qualities that every one of us has. Besides there exist intellectual and professional activities that more than others use creativity to carry out their functions. One of these is design, whose aim is to find solutions and innovative principles starting from the demand for a function.

2 DESIGN ROLE

The word industrial design indicates activities, knowledge, tools finalized to the attainment of a purpose. The purpose of modern industrial design is to translate technological opportunities in to new qualities of performance, ergonomics, communicativeness and aesthetics of industrial products. In this way it is possible to make perceivable the product is qualitative values, both technical and semantics.
Industrial design is aimed at the typological definition, the use, the sustainability of the industrial product and its life cycle, at costs control, the relationship between real and perceived value and the generation of the product sense. The design process is complex and articulated. It is decisive in all factors that constitute the main motivations for buying the product starting from concept development and ending with market placement. The designer has to take on the role of integrator between the different competences of the project. He has to collaborate and share the information during the phases of product development because he is the only one figure able to converse with all the company souls. The designer is in a privileged position since he has a 360° vision and is a catalyst that reacts according to the environment around him. [1]

3 CREATING INNOVATION

Product innovation starts especially from design activity, since the designer is the only one who can give sense and form to ideas, to visualize possible future evolutions, concretizing them in to concept. [2]
design can be defined as the creative process thanks to which a flow of information is transformed in to tangible results. Nowadays design can play an important role in the attainment of industrial product innovation. At the base of the project there is the assumption that a correct integration of the design activity in the development process of new products can represent a fundamental lever for enterprise competitiveness. Contemporary design is a tool able to produce continuous and transferable innovation in the product development processes. The innovation produced through design is a real test of how effective and the efficient such process is. The process of managing the development of the new product is inspired to the principles of management that places the designer within business process. The designer’s is a strategic competence, because he contributes the balance between the ability to satisfy the needs today's client and that to realize and to anticipate future expectations. The aim of design is to define new conceptual models and tools, and in this context bionics is the tool supporting the role of design inside the company.

4 ANALOGY

In today’s Italian “analogy” means a "relationship of similarity between some constitutive elements of two facts or objects, which allows you to mentally deduce a certain degree of likeness between the facts and objects themselves. [3]

The word "analogy" comes from the Greek analoghía. Its origin, however, is very ancient and it is founded upon the mathematical concept of "proportion" (a: b = c: d), which establishes a similarity due to an equality of relationships.
The analogy process is a tool used for elaborating new theories, scenarios and ideas in the sciences, art, architecture and design. In particular the use of analogy is evident in the applied arts. An example of the use of analogy within in architecture and design is biological analogy, between living organisms and man-made articles. In the field of design and product development it is possible, through the process of analogy, to transfer to consolidated products, innovations coming from specific and extremely advanced sectors.
If the use of analogies is not accidental, but is designed to meet specific demands for improved/renewed lifestyles, that innovation becomes effective. In this way the innovation process does not have to rely on invention but can simply become a technical and cultural interpretation of something that already exists. [4] Figure 1.

Figure 1 Analogy

5 INNOVATION TOOLS

In the process towards product innovation designers have at their disposal all the knowledge that is to be found in history and culture. However, there are other tools for producing innovation based on analogy.
In the research we have been considering a number of methods, assessed according to their applicability, limits, objectives and advantages – high availability of information, good structuring degree, easy of application. Among these we can quote Triz, Creax, the sum of historical knowledge critically reconsidered and last but not least Bionics, i.e. the analogy with Nature. The use of the analogy can be defined the basic principle on which Bionic is founded. Bionics (bio-analogy with Nature) is founded upon the ability of the designer to observe. The observation of Nature is source of innovation, because it transforms the study and the analysis of a natural element into an innovative product.
The approaches to investigate the various sources of Bionic knowledge are different. These start from the intuitive creativeness to the systematic search, from the formal search to the solutions by analogy. The observation of natural phenomena can be a useful method for generating new ideas and for stimulating creativity. Bionics is based on the designer's ability to observe, as it not only pays attention to the design of a natural shape, but it also considers its mechanical and morphological features. These are typical in biological systems where the realization of products must take into account new materials and structures that are both economically advantageous and environmentally friendly.
The concepts explained above, illustrated through case studies, show the phases of observation, analysis and transformation of natural shapes into new products and industrial systems. Apart from the tools and processes employed it is important to underline the new "project approach" provided by Bionics: a new way to deal with the project in the mutable reality of today's market. The purpose is to reach a new level of

knowledge and to implement a method that can innovate the product development process in the educational field. Figure 2

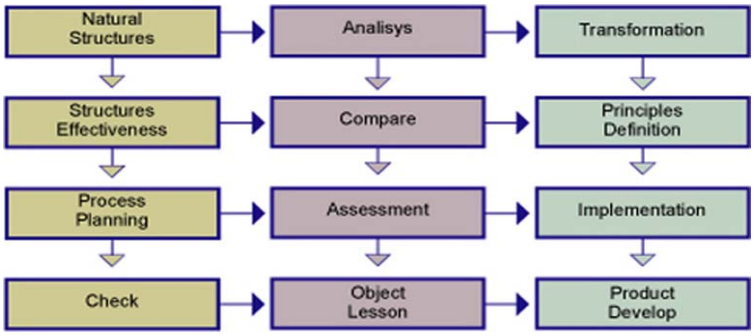

Figure 2 Diagram of the process employed, from analysis of natural structure until product develop.

6 CASE STUDY

The method described represents an application of Bionics at the Architecture and Design Department of Aalborg University in Denmark. This methodology is used in a mini project during the 4th semester of studies. The course has engineering characteristics and it is oriented to product development. Bionics is a useful tool able which enables students to acquire basic knowledge. The students, during the workshop, work individually and the subdivision of the project in following phases has as purpose to strengthen the process of design and to guarantee that the objectives of the workshop have effected and brought to term. The select approach in the process of teaching, that during the workshop, it uses the bionic it is to avoid of "to furnish answers ", because the method' aim is to stimulate the students bringing to study the object or the natural element chosen by a different point of view. To reach a good result it is necessary to pay a lot of attention to the analytical phase because it furnishes a criterion of evaluation founded to the student and formulated in precise way and besides, the phase analytical it results to be also the most important the study of an object

Phase 1 – Analysis.

Hands-on session. In this part the students choose an object or natural product and they analyze it. At first the objects are observed with the naked eye, with the students making sketches and taking notes. After that the sample is cut, sectioned and examined inside, and next the object is observed through a microscope. In addiction to sketches and notes digital photos are used to record and later analyze the characteristics and structure of the object in question . The aim of this first phase is to understand "what", "why", "how" and to understand the object's shape, structure, and functional principles. [5] Figure 3

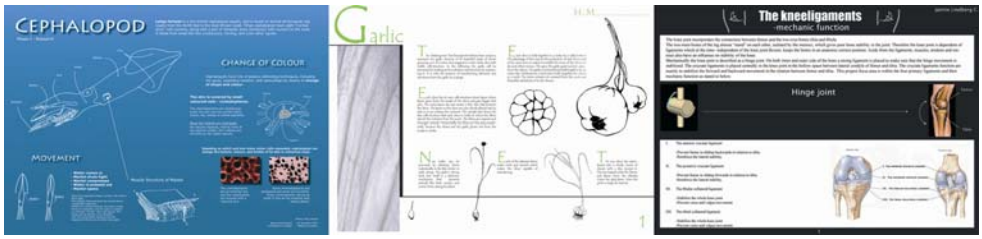

Figure 3 Phase 1, analysis

Phase 2 – Transformation. The purpose of the second part is the definition of principles. The students operate a selection of the information collected. The first step is defining the project focus. That means focusing the attention on one element that characterizes the object selected in a unique and original way.
The aim is to extrapolate mathematical, geometrical and static principles through a process of abstraction and simplification. This is done through static and mechanical resistance tests, applied to three-dimensional models that show how these principles work practically and correctly. In this phase it is not always possible to come to a definitive conclusion, but through practical analysis one can deduce some elements that will also be useful in other fields of research. Figure 4

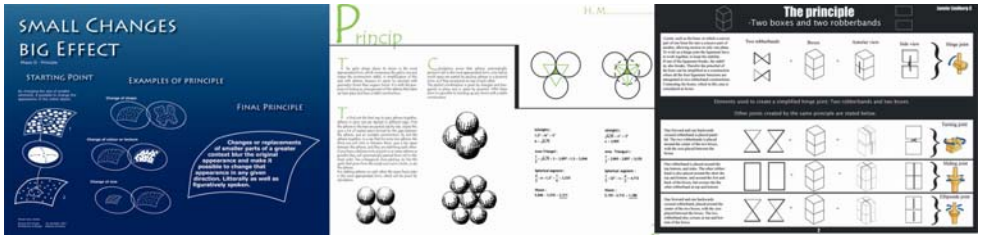

Figure 4 Phase 2, transformation

Phase 3 – Implementation. The aim of this stage is to implement principles of form-structure relations found in the analysis of natural objects and elements in the development of a new design. This shows how Nature can be a valuable source of inspiration for design in terms of construction, form and function. Figure 5

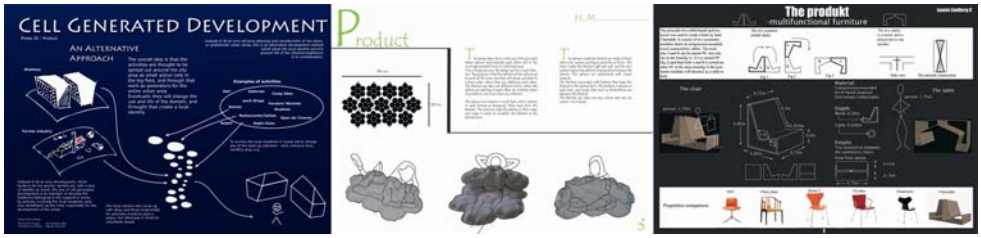

Figure 5 Phase 3, implementation

Through the results of fieldwork, the study we have carried out underlines the role of Bionic design as a pragmatic and interdisciplinary tool in the learning process.
Nature can offer two different types of reference:

- A formal one, considering the forms of nature, only from the aesthetic point of view.
- A functional one, considering how Nature performs its functions.

The problem is how to find a systematic use for the solutions provided by Nature.
Two steps are suggested:

- Analysis - the critical observation of case studies of various such solutions.
- Synthesis - a catalogue of such natural solutions realized through analogy.

The above considerations highlight the importance of the knowledge of natural phenomena in design education. It is possible to propose to include such argument in the design curricula.

7 CONCLUSION

Biomimetic design is an appealing subject. The observation about Nature can provide a valid alternative methodology to apply in the process of product development and learning process. Because on one-side Nature shows lightness and elegance from the other side it has the technical ability to bear inside and external strengths.

Now Biomimetic design is moving towards integrated and complete planning systems. The research is bound for interdisciplinary realization of models even if Biomimetic is not an exact science and the realized projects are still in a limited number.

The technologies and their original application through Biomimetic design, can define a new modality for promote the research, where the traditional distinction among inductive and deductive method disappear.

Biomimetic design is founds on the concept of "active learning, that implies that you are learned making exercises, experimenting, studying concrete problems. In fact, the disciplinary nature of design represents a challenge towards the traditional formalities of e-learning. The didactics of project is characterized for its participatory dimension, from the cooperation and the central role of the experience in the learning activity."[6]

Biomimetic design can operate a role of leading in the improvement of the new educational trials to scientific community service. The responsibility of the scholastic institutions has to be that to use Biomimetic design as a tool, through which to strengthen and to improve the design process. It needs to starts from the education system of the students, future professionals. What it wishes for the future is to develop interdisciplinary knowledge, where Biomimetic design can represent more and more a tool for the promotion and the formation in the interdisciplinary applied research.

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