Topic: A framework for biomimetic design in architecture

Biomimicry inspires innovation in diverse fields. Recently, it has a significant impact in architectural field, where it can lead to innovation and sustainability (Ricard, 2015). Despite the numerous researches on the subject, examples of biomimetic architectures built are still rare (Cruz, 2016). Biomimetic architectural design is a difficult activity to implement, as it is based on biological knowledge where information from biology is transferred into design process. Thus the time of research and maturation of a possible transfer from biology to architecture is necessarily very long and it requires interdisciplinary collaboration from various fields.

The biomimetic design framework needs at least two domains involved. In this process experts with different backgrounds apply different approaches, which require a unique framework to allow convergence between domains (Badarnah, 2016). My research focuses on exploring different design methods and tools to achieve the unique framework of biomimetic design to fit into the context of architectural projects.

Original method of biomimetic architecture is a cross-disciplinary approach between biology and architecture. The method is initially called *"Bau-Bionik"*; it is coined in 2003 by a biologist, Werner Natchtigall and an architect, Göran Pohl (Nachtigall, 2003). As a result of a combined effort by the two disciplines describes the principles which can be used to compare nature, design and technology, how biology can be used as a source of inspiration and 'translated' in building and architectural design solutions along with current advanced technology (*Natur-Analogien-Technik*). Nature cannot be directly copied to be able to provide architects with a wealth of analogues and inspirations to achieve a true objective of eco-innovative designs. However, it is not a trivial task to understand the principles that govern the living, especially for architects who need to search for an elegant biological analogy and transfer it to solve problem in architectural designs.

Practicing biomimetics means learning from nature for the improvement of design and technology in parallel with environmental issues. One must only then be cautious of too direct interpretation (Pohl, 2015). Inspirations from nature for architecture will not function if they do not well abstract within the context of an interdisciplinary analogue. Nachtigall specify the approach of biomimetics for architecture and design in three-step process: ***Research → Abstraction → Implementation*** (*Erkennen-Abstrahieren-Umsetzen*) (Nachtigall, 2010). By observing a cognitive biomimetic design process within the context of an interdisciplinary, ***'identification'*** and ***'abstraction'*** often proves to be one of the most important as well as most difficult steps in a biomimetic project (Speck, 2008). Thus, we have found two common difficulties for an architect to apply biomimetic methodology into their design process, we define the difficulties in two transitions; ***1. What to look for in nature?*** and, ***2. How to interpret nature and transfer into design phrase?***

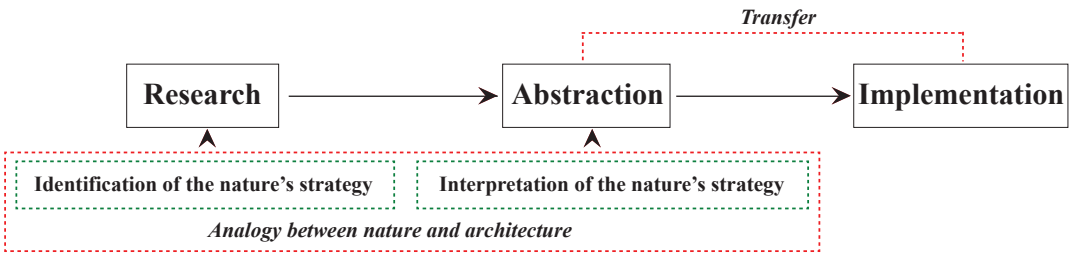

Figure 1: The two transition of a biomimetic design process

Regarding to 11th SIG Design Theory Paris Workshop, we propose to explore established design methods such as C-K framework for the biologically inspired design process (Freitas Salgueiredo and Hatchuel, 2016), to help assisting the transfer of a strategy from nature into the design process.

One example of application of the C-K framework to a real design problem was the study conducted at a French automaker (Renault) for generating bio-inspired concepts for reducing the carbon dioxide emissions of passenger cars, represented in Figure 2. In this case, researchers started with a concept space made of "traditional" concepts for reducing carbon dioxide emissions for passenger cars, then

identified a concept domain for which innovation was required, the energy during the vehicle, vehicle use phase and finally activated biological knowledge about energy in nature and found interesting properties in nature that helped generating a concept that included speed variations such as those used by athletes during long distance races (Freitas Salgueiredo, 2016).

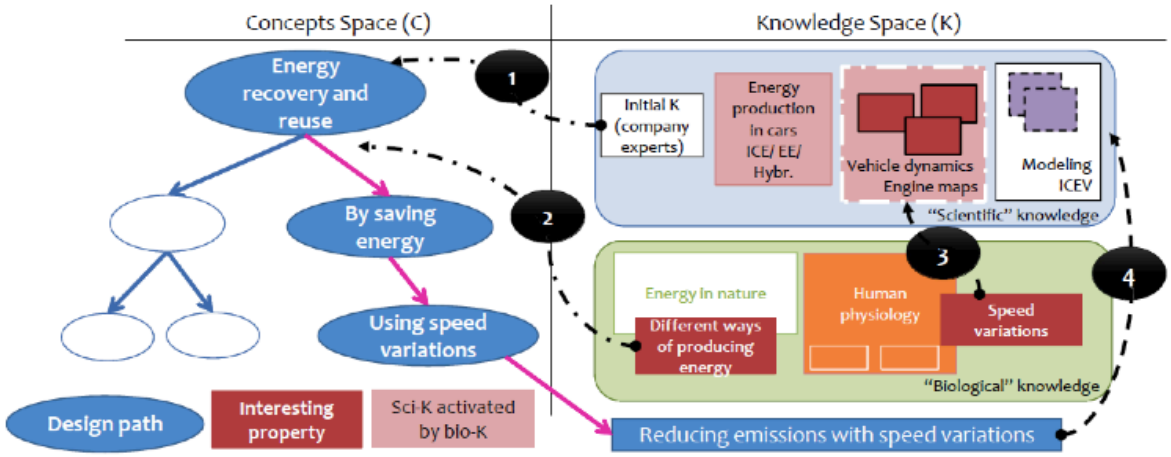

Figure 2: C-K framework for the low carbon vehicle case (Freitas Salgueiredo, 2016)

We seek to adopt C-K method (and others design methods if it's possible) to support a unique biomimetic design framework in the context of architectural project.
I believe that design theory can contribute to biomimetic framework, to help developing skill to apply biomimetic concept into various design context (product, architecture, engineer and etc.). Conversely, hoping that the biomimetic design framework could be a challenge to design theory to learn from.

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Camila Freitas Salgueiredo, C-K framework for the biologically inspired design process