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Perspective

From Biomimicry to Ethno-mimicry Introducing the Concept of Ethno-mimicry

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Introduction

"Between now and 2050 I think biomimicry is going to be one of the main tools that will facilitate the transition from the industrial age to the ecological age of mankind…" Peter Head

The renowned proponent of "biomimicry" [1], defined it as a science of imitating the designs and processes of nature to solve human problems, while using ecological standards for the judgement of human innovations. According to this paradigm, nature is regarded as a teacher to learn from rather than a source of resources for extraction. The need for such approaches as biomimicry becomes even more compelling as humans realised that our industrial activities are at the threshold of over-stretching the bearing capacity of the planet- earth. Extraction of materials for industrial application is usually associated with negative environmental impacts, and depletion of high-quality resources.

This trend threatens the same opportunity for future generations as the limited and most useful resources are converted to wastes. There are reports (Wuppertal Institute) that the movements of materials caused by human activities double that of the natural factors combined [2]. The fact that the earth is a closed system in terms of materials, the carrying capacity for such activities is being exceeded. Consequently, the need to protect the environment and the world disparity in resources availability justifies the quest for improved materials efficiency and reduced demand, whereby it is recommended that the material flux by human activities should not exceed the natural flux. Additional ecological damages caused by humans include excessive usage of biomass, accessible water, and land. Others are nitrogen fixation and hazardous synthetic chemical pollution [2,3].

As an antidote to the threat on materials stock, a concept of dematerialisation of economies and materials production was initiated. It is postulated that materials efficiency, measured in materials input per service unit (MIPS) can be improved ten times-factor 10. This can be achieved by closed-loop materials cycle and minimising virgin material inflow. It is noted that dematerialisation is not a new phenomenon, as the intensity of use index (IOU) used by industry is the same as dematerialisation derived by profitability. However, the aim of dematerialisation will be defeated if achieved through processes with negative environmental impacts or lack of recyclability. It is therefore suggested that dematerialisation should go beyond (IOU) index and focus on reuse and recycling as part of the aimed closed-loop system. While it is acknowledged that, humans may succeed in achieving dematerialisation using technology, it is however important to note the limitation of dematerialisation in addressing the wider environmental issues. Dematerialisation should also be accompanied with de-energization, decarbonisation, and detoxification of the industrial systems. There is also a view that for world to be sustainable, quality should be prioritised over quantity and over consumption and wastage should be discouraged [2,3].

On the contrary, it is realised that other living organisms have virtually recorded as much achievements as humans without depleting the natural resources or poisoning the environment to the extents of threatening their future; achievements that are worthy of emulation by humans [1,4]. Beyond the Wright Brothers' mimicry of the birds flying techniques, there is a long list of successful imitation of nature to solve human problems more sustainably in engineering, industrial design, fashion design, and medicine. This includes a solar cell modelled after leaves, a spider-style woven fibre, ceramics inspired by mother-of-pearl, cancer cures learned from the chimpanzees, perennial grains in the images of tallgrass, or a computer signals fashioned in the way of the cells [1].

Biomimicry was the inspiration for developing many concepts in the built environment as documented by Pawlyn [4]. An Italian engineer Pier-Luigi Nervi successfully achieved lightweight long-span concrete roof of Palazzeto dello Sport in Rome by imitating the structural principles of the radial rib structure of the leaves of the Amazon water lily. The West German Pavilion at the 1967 Expo at Montreal designed by Frei Otto was inspired by the spider webs. Otto made extensive publications on structural principles inspired by nature. Another class of structures inspired by biological principles is the deployable structures that change shapes in response to the external conditions. An example of this type of structures is the retractable umbrellas of the Holy Mosque of the Prophet at Medina in Saudi Arabia and Al-Husain Mosque in Egypt, designed by Frei Otto's disciple Mahmood Bodo Rasch. Moreover, there are examples of biologically inspired technology

for construction materials production, water management, energy production, and thermal control. However, the most relevant to the discourse of this write-up is the creation of a closed-loop economy in the style of the natural ecosystems as in the redwoods, coral reefs, or forests that produce zero wastes [1,4].

Natural ecological processes use materials in a close-loop cycle, utilize the renewable solar energy, and organise complex communities into niches with adaptation properties. The idea of fashioning human industrial activities to resemble the natural ecological system is the main subject of the concepts of the industrial metabolism, design for the environment, or the cleaner production, and the well-established discipline of industrial ecology [2]. This concept was accepted with enthusiasm with several conferences and fellowships on the subject, to the extents that it was recognised as the main theme of the National Technology Strategy Policy of Clinton's administration in the US [1].

While industrial metabolism refers to the use of the waste from one industrial process as a raw material for another industrial process, industrial ecology proposes a situation whereby industries will be interrelated in such a way that not only waste, but also useful energy from one industry can be utilised by another in direct analogy with the natural ecosystem. In the natural ecological food web, there are organisms that specialise in utilising the materials and energy from otherwise the waste of some other organisms. There may be some limitations of this analogy with the human industrial activities; however, human industrial waste can be treated in a similar approach in what is called "industrial symbiosis." Nevertheless, industrial symbiosis is better achieved if industrial products are designed ab-initio with the environmental agenda; a concept referred to as design for the environment (DFE). In a similar manner, minimising pollution, materials and energy throughput in the industrial process while improving the service intensity of products are among the tenets of eco-efficiency and cleaner production [2,5].

Industrial ecology on the other hand as described by Allenby et al. [5] is teleologically any method of achieving and maintaining the status of sustainable development. In industrial ecology, human economic activities are viewed in terms of their interrelationship with the natural systems with the aim of achieving sustainability. A sustainable manufacturing strategy optimises the complete material life cycle in harmony with the natural systems. On the other hand, industrial ecology is a paradigm of making human economic activities to interface with the natural systems by understanding, interpreting, and implementing the principles of the natural systems [6]. The idea of fashioning human industrial systems to simulate and integrated with natural systems in function and interrelationships of producers and consumers started from the works of H.T. Odum in the early eighties [2].

A recap of the foregoing will reveal that the main theme of industrial ecology and other associated concepts revolve around materials wastes. The built environment is the largest resources consuming sector in the OECD countries and could gain the largest proportion of savings by applying the principles of natural systems. In the UK alone, an alarming figure of annual 120 million tonnes of waste is generated from construction and demolition [7], while in the US the Figure 1 is about 140 million tonnes annually (one third of total solid waste) [8]. Construction, as the likely highest resource consuming human activity, is always in the mainline of the discussions of sustainable utilisation of resources, such as in the concept of the industrial ecology. Moreover, the peculiar nature of construction industry compared to other industries, qualifies it for a distinctive class [2]. Construction ecology is therefore an attempt to define a sub-set of the industrial ecology concerned with achieving sustainability in materials manufacture and building construction and demolition by adopting lessons from the natural systems [2].

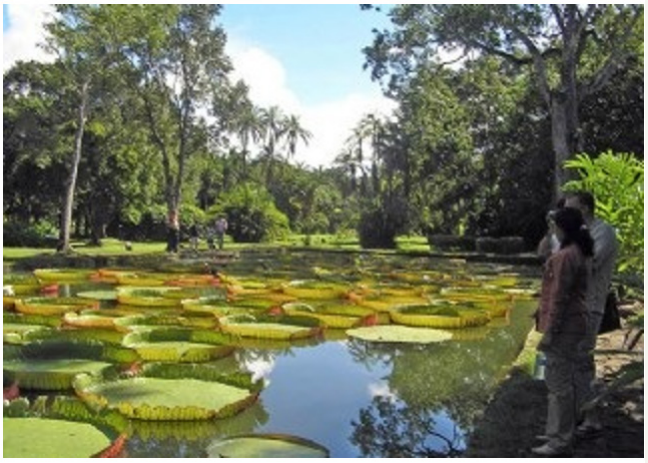

Figure 1: The giant amazon water Lilly (www.flickr.com/photos/...).

Unlike manufactured products, every building is in the words of [9], "One-of-a-kind" product that is different from any other of its type, made up of large quantities and wide range of constituents. Buildings are rather a form of art with enormous environmental impacts, and long and uncertain lifespan. On the other hand, the construction industry that produces the buildings is less receptive to innovations and characterised by wide segregation of duties with unsteady workforce. These properties of buildings and the construction industry make quality control more challenging and policies such as the extended producer responsibility (EPR) nearly impossible to implement. Moreover, buildings are made up of composite elements that are not designed for disassembly [2].

While the obstacles to achieving a perfect industrial ecology in the other sectors may be the same with the construction sector, the peculiarities of the latter require a unique approach most appropriate for the achievement of sustainability in this sub-sector. The bespoke concept of industrial ecology that is proposed to reposition the construction industry to operate in line with the principles of natural ecology as well as in harmony with the natural environment describe the term Construction Ecology [2]. The three tenets of construction ecology are the close-loop material cycle, the use of renewable energy, and conservation of nature. Buildings that are compliant with the industrial ecology paradigm should promote the health of the occupants as well as be suitable for easy deconstruction; and contain materials and components that are durable, adaptable, and friendly to recycling [2].

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On the account of Hawkes [10], the proliferation of unsustainable buildings tallies with the period of industrial revolution; could the industrial revolution be influenced by the belief of the societies that initiated it? However, human actions are many times the bye-products of their mythology [11], as believed by Gandhi, your beliefs become your actions. According to the western Jeudo-Christian belief, humans were destined to dominate and rule over all other living things [12], this is one of the beliefs repudiated by Mark Twain in his "Letters from the Earth" [1].

Nevertheless, according to some other mythologies like the mythology of the Aborigines of North America, where the earth is placed as the most important, followed by the plants, and then animals, among which man is placed at the lowest order of natural creations for being the most dependent of all [13]. The factors that influenced the industrial revolution may be beyond the scope of this work, nevertheless, had the western industrialist mythology been like that of the Aborigines, Industrial Revolution should have been pursued on a more sustainable path from its inception. In the words of Bill McKibben cited by Benyus [1], "our tools are always deployed in the service of some philosophy or ideology".

It is not only the mythology of the Aborigines that is more in harmony with the natural ecology and more sustainable in approach, as alluded by Benyus [1], it is now an extraordinary time that the urban westerners should learn from the wisdoms of the preindustrial societies on how to live in harmony and sustainably on earth. Benyus went further to say:

"…virtually all native cultures that have survived without fouling their nests have acknowledged that nature knows best and have had the humility to ask the bears and wolves and ravens and redwoods for guidance. They can only wonder why we don't do the same. …After three hundred years of western science, was there anyone in our tradition able to see what the Huaorani see?"

Conscientiously or otherwise unconscientiously as demonstrated above, there were successful simulations of nature by the western science to develop technological innovations for human benefits. However, about the humility to live within the natural order, the preindustrial societies are more advanced than their industrialised counterparts. On the other hand, if biomimicry refers to the humility to learn lessons from the nature, what about the humility to learn lessons from the native societies on how-to live-in harmony with the nature; or rather, how to live within the natural order as our co-living organisms. This is referred to as Ethno-mimicry. Ethno from the Greek ethnos, race or people, and mimesis, imitation [1,14].

Biomimicry was defined as the new science that studies nature's models and then imitates or takes inspiration from these designs and processes to solve human problems [1]. Another definition of biomimicry is "mimicking the functional basis of biological forms, processes and systems to produce sustainable solutions" [4]. Automimicry can therefore be defined as, the systematic study of the models of the native societies for imitation or inspiration to develop sustainable solutions. The task beforehand is to explore the drivers for the emergence of sustainable practices in the preindustrial societies and examine the feasibility of getting an inspiration for developing a model that can be suitable for application in a modern society. This is to be achieved using the Automimicry tool as elaborated in this piece.

References

1. Benyus JM (1997) Biomimicry: innovation inspired by nature. Morrow, New York, USA.
2. Kibert CJ, Sendzimir J, Guy B (2000) Construction ecology and metabolism: natural system analogues for a sustainable built environment. Construction Management & Economics 18(8): 903-916.
3. Schutz H, Welfens MJ (2000) Sustainable development by dematerialisation in production and consumption- strategy for the new environmental policy in Poland. In: Institute W (Ed.), Wuppertal Papers, Wuppertal Institute, Germany, Europe, 10(3).
4. Pawlyn M (2011) Biomimicry in architecture. Riba Publishing, London, UK.
5. Allenby BR, Richards DJ, National Academy of Engineering (1994) The greening of industrial ecosystems. National Academy Press, Washington, USA.
6. Keoleian GA, Kar K, Manion MM, Bulkley JW (1997) Industrial ecology of the automobile: a life cycle perspective. Warrendale, Pa.: Society of Automotive Engineers.
7. Osmani M (2012) Construction waste minimization in the UK: current pressures for change and approaches. Procedia - Social and Behavioral Sciences 40(0): 37-40.
8. Kibert CJ (2005) Sustainable construction: green building design and delivery. In: Hoboken NJ (Ed.), Wiley, USA.
9. Koskela L (2000) An exploration towards a production theory and its application to construction. VTT Technical Research Centre of Finland.
10. Hawkes D (2011) In brief: a history of sustainable architecture.
11. Campbell J, Moyers BD (1989) The power of myth: Doubleday.
12. New English Bible, Genesis 1: 28-30.
13. http://www.ajic.mb.ca/volumel/chapter2.html
14. http://www.thefreedictionary.com/ethno-