



# BIOINSPIRED!

Volume 8, Issue 1

March 14, 2011

CENTER FOR BIOLOGICALLY INSPIRED DESIGN

## The First Year of the BID Community



Although discussions with CBID about the BID Community started in September 2009, work on the website began in March 2010, followed by a soft launch in August, the official launch in September and the first issue of the new *BioInspired!* newsletter. Three newsletters have been published, with a growing focus on exploring pragmatic issues and documenting practical solutions. This issue includes articles on the Fully Integrated Thinking (FIT) process (Taryn Mead), the *Turning Ideas into Reality* conference call (Emer Natalio), the relationship of biomimicry to Industrial Design (Karen Verbeek) and how Ernst-Jan Mul is using biomimicry as the core of his design business.

As of the end of February, the website contained 329 documents including 52 newsletters, 17 individual stories, 59 events, 93 resources and 92 forum topics. A total of 165 comments had been posted. Three community conference calls have been held on:

- biomimicry and business/organizational models ([Skype Community Call: 'Forest Fractal'](#))
- exploring the challenges of practicing biomimicry ([Turning Ideas into Reality](#))
- ['Making a Living with Bio-Inspired Design'](#) (see [2011/03/02 Conference Call](#))

To date, 123 users have registered on the website. During registration, users had the option of answering four questions. The most common roles were **Aspiring Practitioner** (28), **Practitioner** (24) and **Facilitator** (24). The most common disciplines were **Science** (21), **Education** (20), **Architecture** (19), **Design** (19) and **Business** (11). The following table relates responses to *Are you interested in becoming a charter member?* with the users' assessment of the \$15 quarterly membership fee.

The [Paid Membership Process](#) is now in place supporting automatic quarterly payments through PayPal. The membership rate has been reduced to \$10 per quarter until March 14th. A [Participation Rebate](#) program will apply to all paid-up members as of March 31st to help reduce the cost of memberships and encourage member participation.

Enjoy the rest of the newsletter. Please let us know what you think, either through comments on the website or using the [Contact Us](#) link at the bottom of each website page.

### Inside This Issue:

|  |    |
|--|----|
| <b>The HOK/Guild Partnership and the FIT Process</b> | 2  |
| <b>Turning Ideas into Reality</b>                    | 4  |
| <b>Biomimicry and Industrial Design</b>              | 5  |
| <b>An Interview with a Bio-Inspired Designer</b>     | 8  |
| <b>Calendar of Public Events</b>                     | 11 |
| <b>BID Community 'Participation Rebate'</b>          | 12 |

Globe with hands: © Don Hammond/Design Pics/Corbis

|               | Too Low  | Just Right | Too high  | Not Specified | Total      |
|---------------|----------|------------|-----------|---------------|------------|
| Yes           | 0        | 10         | 7         | 1             | 18         |
| Maybe         | 0        | 25         | 27        | 3             | 55         |
| No            | 1        | 9          | 12        | 8             | 30         |
| Not Specified | 1        | 0          | 0         | 19            | 20         |
| <b>Total</b>  | <b>2</b> | <b>44</b>  | <b>46</b> | <b>31</b>     | <b>123</b> |

Table 1: Interest in Charter Membership vs. Assessment of Membership Fee

The *BioInspired!* newsletter publishes material from a wide range of sources. The opinions expressed in articles are entirely those of the authors and do not necessarily represent the views of the Center for Biologically Inspired Design.



[Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License](#)





# The HOK/Guild Partnership and the FIT Process (Taryn Mead)



The HOK/Guild partnership has provided the Biomimicry Guild with the opportunity to work on significant, high profile and complex opportunities. This has led to the development and refinement of a number of tools, including the Fully Integrated Thinking (FIT) process which supports integrated and holistic thinking and helps integrate the

Life's Principles into the full range of the design cycle.

The idea for the FIT tool came out of a charrette for an urban development project in India and was subsequently co-developed by the Biomimicry Guild and HOK. During the charrette, Dayna Baumeister and I had brainstormed about the functions that a city needs to perform. Humans design cities to provide shelter; collect, store, filter and distribute water; generate and distribute energy and many others - about 40 functions were eventually identified.

In addition to looking for potential models from nature, each function was explored in the context of key Life's Principles to develop innovative and more sustainable ways of delivering that function.

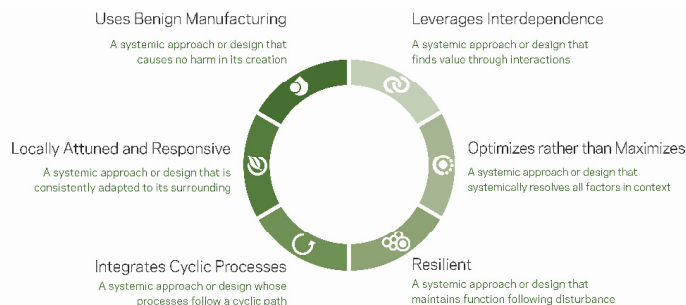


Figure 1: Key Life's Principles

## FIT as Tool

FIT is closely aligned to the Triple Bottom Line by integrating the key functions a design must deliver to accomplish economic, social and environmental objectives. By focusing on function, FIT makes the goals and objectives of the Triple Bottom Line meaningful to both clients and designers.

The FIT matrix arranges functions down the side and the Life's Principles across the top, helping designers interconnect and align the decision making processes associated with the often disparate systems that make up a 'whole' solution. It can help organize, relate and communicate the breadth and depth of the resources and systems (both natural and technical) that make up a specific place.

| triple bottom line |    | realm        | functions                  | goals  |
|--------------------|----|--------------|----------------------------|--|
| ECONOMIC           | 14 | COMMERCE     | foster commerce            | fosters the balanced exchange of goods and services  |
|                    | 15 | VALUE        | provide value              | sustains value for investors   |
| SOCIAL             | 7  | COMMUNITY    | foster community           | fosters integrated, connected community identity for all inhabitants   |
|                    | 8  | CULTURE      | support cultural exchange  | reflects a vibrant exchange of historical and modern identity, food, art, music, and science rooted in place |
|                    | 9  | HEALTH       | promote health             | ensures health and well being for all citizens and universal access to quality health care                   |
|                    | 10 | EDUCATION    | provide education          | fosters world-class, life-long learning opportunities for all citizens                                       |
|                    | 11 | GOVERNANCE   | provide comfort            | maintains responsive accountable stewardship   |
|                    | 12 | TRANSPORT    | provide mobility           | provides congestion- and pollution- free mobility  |
|                    | 13 | SHELTER      | provide comfort            | protects inhabitants comfortably from biotic and abiotic factors   |
| ENVIRONMENTAL      | 1  | ECOSTRUCTURE | provide ecosystem services | maintains and fosters the health and integrity of the native physical and ecological landscapes              |
|                    | 2  | WATER        | manage water               | protects and enhances water quantity and quality   |
|                    | 3  | ATMOSPHERE   | protects air               | protects and enhances air quality  |
|                    | 4  | MATERIALS    | manage materials           | fosters closed material loops and eliminates waste   |
|                    | 5  | ENERGY       | provide energy             | provides safe, clean, abundant, reliable, consistent, free energy for all inhabitants in perpetuity          |
|                    | 6  | FOOD         | provide sustenance         | provides safe, clean, abundant, reliable, consistent, free sustenance for all inhabitants in perpetuity      |

Figure 2: Triple Bottom Line Functions and Goals

The FIT matrix can assist the decision-making process when different options have to be balanced. For instance, when considering what type of wastewater treatment system is appropriate, the human tendency is to create a centralized system and put an enormous amount of energy into the collection, processing and redistribution of wastewater through a treatment facility. On the other hand, if we use Life's Principles to determine the most appropriate strategy, we would employ solutions that are decentralized, distributed, diverse and redundant so that resiliency is designed into the system. The FIT matrix starts with the local context as the basis for design and uses biological design principles to inform the appropriate width for corridors and land conservation around waterways. We also establish design codes to maintain ecosystem function in high density urban environments based on the performance of the native ecosystems.

## FIT as Process

FIT helps turn design challenges into opportunities for better solutions that go beyond 'doing less bad' to making a positive impact in multiple areas. The Life's Principles encourage us to view our designs as part of the complex and adaptive systems of a specific location. The FIT matrix can reveal the latent potential of 'place', including site selection, available ecological services, potential partners and opportunities for new industries.





## The HOK/Guild Partnership and the FIT Process (*continued*)

FIT can help identify and prioritize opportunities throughout the design process. It can assist in establishing benchmarks based on existing standards or site-specific requirements which in turn can lead to monitoring mechanisms. As a framework, FIT encourages constant re-evaluation of the project as requirements change or new opportunities emerge.

### Examples

Cities need to deliver pure water. The traditional solution is a standardized, centralized water purification system. The Life's Principles suggested a number of options, including using benign methods, searching for local resources, integrating cyclical processes and distributing key processes. The transport system is usually designed solely by transport engineers. The FIT model suggested that transportation corridors in the city can be multi-functional, supporting the movement of other organisms as well.

In the case of existing cities, the FIT framework has been used to evaluate the current sustainability of the city and identify opportunities for deepened our understanding of 'place'. It has suggested ways of integrating cyclic processes in community and commerce for long term local social and economic sustainability. Encouraging local resilience is becoming increasingly important. Linkages between the materials and education systems of a city suggested new ways to engage students in a community-wide materials up-cycling program.

### Relevance to Designers

The FIT process helps designers to understand the 'genius of place' and better leverage existing resources by linking place, challenges and outcomes. It helps break down barriers between municipal and jurisdictional borders and facilitates communication across disciplines by focusing on commonly understand functions. These factors can help reveal symbiotic relationships and solutions that address multiple problems. The FIT process is scalable and generalizable across a wide range of situations.

Designers are increasingly called upon to deal with complex situations, both in terms of the problem as well as the stakeholders that are involved in the solution. The Fully Integrated Thinking tool can help designers handle the complexity and even turn complexity into an asset in terms of developing broader solutions.

### Suggested Readings:

- [Biologists and Designers Team Up to Do It Nature's Way](#) (results of the FIT process in Lavasa)
- [FIT Gathering 2010](#) ("Share the thinking behind FIT, how we got here and explore its future. Bring together pioneers of FIT to cross-fertilize experience and ideas. Confirm the key components and identify missing elements of the FIT process we gathered.")
- [FIT Organizations](#) ("how FIT, Life's Principles + Biomimicry can work to help organizations maintain the ability to adapt and evolve while enabling them and their communities to flourish.")
- [Tu Bong Urban Master Plan: HOK - 2011 Honor Award](#) (a model of sustainable development for new cities along the entire coast of Vietnam that applied the FIT process)
- [Perspectives on the HOK/Biomimicry Guild Partnership](#) (December 2010 *BioInspired!* newsletter article by Mary Ann Lazarus)

### Image Credits:

- Gear and tools: [© Fribourg - Fotolia.com](#)
- Life's Principles graphic: [The Biomimicry Guild](#) (check [The Biomimicry Institute](#) website for the latest version)
- Triple Bottom Line matrix: [The Biomimicry Guild](#)

[Taryn Mead](#) is a Biologist at the Design Table and HOK Lavasa Project Liaison. An ecologist by training, her specialization lies in the application of nature's genius to the landscape and systems levels of design.







# Turning Ideas into Reality (*Emer Natalio*)



One way to build momentum and create tangible change is by turning good ideas into successful products or services. Achieving broad market acceptance demonstrates value, can change people's perception and may even influence their behavior for the better. Are there medium-term opportunities to take bio-inspired design ideas and turn them into business opportunities?

Based on the experience of Swedish Biomimetics 3000® (see the [February 2008](#) newsletter), developing new bio-inspired technologies is an expensive and time-consuming affair. It is not clear if there are sufficient 'off-the-shelf' bio-inspired products or services that entrepreneurs can re-package or combine. On the other hand, it may be possible to combine existing components in bio-inspired ways to create novel and useful systems.

An alternative approach may be to assist in the refinement and development of low-cost prototypes that could be entered into competitions. A significant number of students have graduated from various bio-inspired design courses at institutions such as Georgia Tech, OCAD and the University of Maryland. What student projects and assignments explored ideas that might have commercial viability? What ideas have graduates generated since then that could benefit from a boost?

The participants on the January 25th Skype conference call about *Turning Ideas Into Reality* discussed a wide range of personal goals:

- framing bio-inspired projects so that they are manageable and meaningful
- bridging from the classroom environment to practical applications of bio-inspired design
- building the relationships required to bring biomimicry into reality
- communicating the value of biomimicry and demonstrating credibility
- bridging biology and design in a meaningful and relevant way
- building critical mass, generating momentum and making a difference

The growing interest in sustainability and a need to effectively deal with complex issues creates opportunities for bio-inspired design. Of the sustainable design strategies that look to nature for inspiration, biomimicry seems uniquely positioned in terms of seeking to increase the positive impacts of our activities, having defined methods and tools, and tapping into a wealth of novel solutions (Mul, 2009; de Pauw et. al, 2010). Lisa Schmidtke talked about the extensive body of information on biomimicry designs, processes and case

studies that she is compiling. 'Open innovation' services like [InnoCentive](#) and [NineSigma](#) that connect seekers with solvers provide a ready supply of challenges with awards ranging from \$5K to as much as \$100K. Although most challenges are quite narrow in scope, some could benefit from a biomimetic approach. The Biomimicry Guild has found that submitting solutions often lead to engagements even if the solution did not win the award.

A number of participants commented on the amount of time that had to be invested in the front end design process for a product, with or without incorporating biomimicry. Carla Gould and Jessica Ching were involved in a project for Herman Miller that required almost a year to deliver a catalog of product directions. Finding the right people and getting them engaged can be a challenge, particularly if specialized knowledge is required. It can be difficult to find funding, although 'open funding' services like [Kickstarter](#) (check out the [Design](#) category) may be useful in some situations.

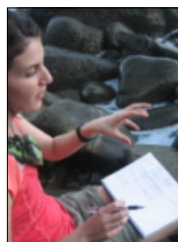
Emer Natalio suggested that the group tackle a real problem that results in a clear outcome and ideally a prototype that could be used to raise additional funding to develop a commercial product or service. We discussed exploring areas such as energy or pollution where bio-inspired design principles could result in solutions that have a significant impact (environmental, social and economic).

A complementary approach is to find suitable competitions where we can explore different biomimetic approaches and at the same time increase the visibility of biomimicry. Janet Kubler identified the [2011 International Algae Competition](#) that has a reasonable timeline and appears suitable. Competitions would force us to find ways of using biomimicry to *reduce* effort and *increase* speed, through a combination of qualifying opportunities and identifying the most appropriate methods. Future calls are planned to further explore the competition.

### Suggested Readings:

- de Pauw, I., et. al. (2010). [Nature Inspired Design: Strategies Towards Sustainability](#)
- Mul, E-J. (2009). Biomimicry in product design: exploring the possibilities. (contact [author](#))

**Innovation/creative:** [@ Kheng Guan Toh - Fotolia.com](#)



[Carla Gould](#) graduated from the [Ontario College of Arts and Design](#) (OCAD) biomimetics program.





## Turning Ideas into Reality (continued)

[Casey Wong](#) graduated from the OCAD biomimetics program and is a Toronto industrial designer working on a rooftop greenhouse project involving biomimicry and nanotechnology. He is also interested in self-erecting structures.



[Karen Verbeek](#) has a biology and industrial design background and attended the Costa Rica Biomimicry Workshop. She is currently focusing on education in the Greater Toronto Area and building a biomimicry network.



[Emer Natalio](#) is a project manager at Nova Southeastern University (Florida). He is an entrepreneur interested in biomimicry, nanotechnology, cross-pollinating ideas and turning ideas into products.

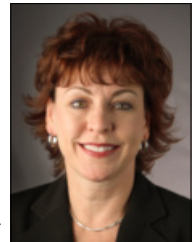


[Kaveri Joseph](#) graduated from the OCAD biomimetics program and is looking for ways to leverage biomimicry in her search for employment.

[Janet Kubler](#) teaches biology at California State University Northridge with a particular interest in biology from a functional perspective. She took the Biologist at the Design Table (BaDT) course in 2004.



[Lisa Schmidtke](#) works as a Certified Biomimicry Professional at [Clark Nexsen](#), an architecture and engineering firm in Norfolk (Virginia), and has been given the mission to integrate biomimicry into the firm's practice. She studied architecture and interior design as an undergrad and is 1 of 15 graduates of the first Two-Year Certificate Program offered by the Biomimicry Institute.



[Jessica Ching](#) graduated from the OCAD biomimetics program and is a Toronto industrial designer looking for opportunities to apply biomimicry outside of the educational environment.



## Biomimicry and Industrial Design (Karen Verbeek)



Biomimicry is increasingly becoming part of the regular lexicon of industrial design and sustainability. It is even making its way into mainstream media and popular print. *Now Magazine* ran "[Bring on nature's design firm](#)" this summer as the cover story. Our local community paper, "*The Banner*" recently featured the article "Nature's

brilliance offers hope for future" by David Suzuki. Those of us in the biomimicry community are asking "Great! Where are we making progress with biomimicry in business and to what degree are we involved at the product development level?"

The business case for sustainability hinges on design. To put a plan into action or give form to an idea or attributes to a

concept requires that we consciously design towards those goals. In the past, companies seen as design leaders have harnessed the strength of industrial design to become market leaders and produce iconic designs. Companies such as Braun and Olivetti applied the highest standards of ergonomics, aesthetics and manufacturing processes to a very carefully thought out product line. Today, Apple develops a limited product line of very well designed products with the highest level of attention to these traditional design criteria.

Increasingly, we are adding sustainability to the design brief and industrial designers must translate this requirement into viable solutions. Biomimicry provides a framework and a methodology for the sustainable solution space. The leadership of companies such as [PAX Scientific](#), [Interface](#), [WhalePower](#) and [REGEN Energy](#) show how biomimicry has influenced product development and placed these companies into a class of their own.





# Biomimicry and Industrial Design (continued)

This article is based on an informal survey of industrial designers and other sources to better understand where we are today in implementing biomimetic approaches.

## Sustainability and Design

Design is central to the social, environmental and economic benefits of sustainability in product development. Traditionally, the business case for design was based on criteria such as cost savings, product improvement, ergonomics and user needs. The current driver of sustainability is significantly more complex and multidimensional. How do designers address a greater variety of difficult criteria regarding sustainability issues while balancing cost, manufacturing and consumption issues? Although challenging, incorporating sustainability significantly multiplies the benefits of what industrial design can offer.

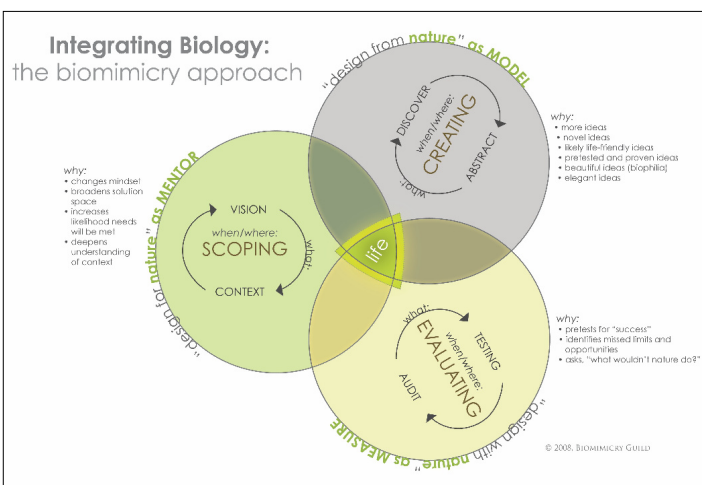


Figure 3: Integrating Biology: Mentor, Model, Measure

As a key conduit for biomimicry knowledge, design has to capture the attention and imagination of business. What does business want from design that biomimicry can provide? Systems and solutions that are more responsive to a more dynamic environment, inherent smartness and ongoing improvement are expected from product solutions of the 21st century. Interdisciplinary collaboration across traditional silos such as departments, faculties and professions is increasingly required to generate creative and innovative solutions in today’s complex world. These benefits are often attributed to the biomimicry design process. Biomimicry offers a useful framework as it focuses on functions and outcomes developed with input from a variety of disciplines.

Participants in this informal survey cited some challenges to successfully implementing the biomimicry process. Two that were most often cited are timing and repeatability. There has not been enough time to reach critical mass through educational avenues or practical applications. Designers, educators and students also mentioned how the biomimetic

approach can extend project timelines for a variety of reasons. In addition, repeatability is critical to give designers the confidence that they can develop a robust, implementable solution every time.

## Impact of Biomimicry on Design

Biomimicry serves as a lens that expands the solution space by directing us to the functional solutions already available in nature. It becomes second nature for us to ask questions about the natural strategies and principles. The degree to which strategies can be understood and applied depends on circumstance, communication and opportunity. This presents a broadened role for designers as biomimicry educators and advocates, not unlike the role designers play in advocating for sustainable design by adopting the Designers Accord initiated and championed by Valerie Casey.

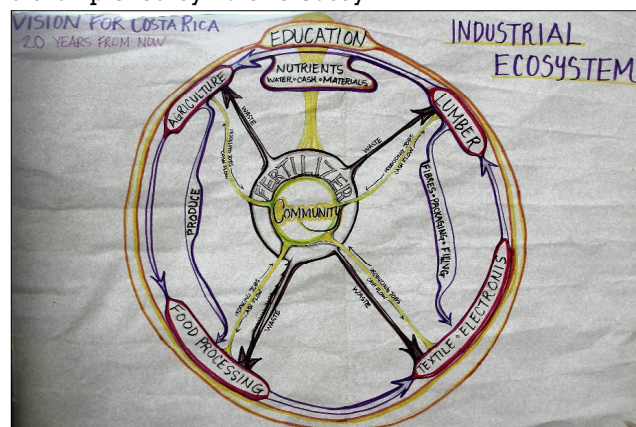


Figure 4: Costa Rica 2009 Biomimicry Workshop

We cannot simply add sustainability as yet another design criteria. Sustainability needs to be incorporated into all phases of the design process. If we are to gain the greatest benefit, we will need to revisit our understanding of the root causes of the problems we are trying to solve. Biomimicry can encourage a mind shift to see problems from a new perspective.

## Barriers to Practicing Biomimicry

What are the common challenges designers are facing using biomimicry? Biomimicry is complex, multi-dimensional, interdisciplinary and collaborative. While it is a strong and powerful approach, it is not especially easy to manage. There are relatively few case studies compared to standard engineering and design success stories. While this is true of any new discipline, the numerous environmental challenges we face are forcing us to move fast. Biomimicry offers the advantage of being based on an existing body of time-tested solutions. In addition, it is a bridge between other disciplines, giving it strength, flexibility and wide application as a methodology. By understanding and mimicking what has worked in the natural world, we can use these principles with the current available technology to moving biomimicry forward in the most productive manner.







## Biomimicry and Industrial Design (continued)

There is a strong online presence to showcase the classic examples of biomimicry and increasingly to show the systems applications. Beyond the mainstream publications I mentioned earlier, biomimicry has been covered in [TIME Magazine](#) in 2007, [National Geographic](#) in 2008, [Popular Mechanics](#) in 2009, [Discover](#) magazine in 2010 and also in design trade magazines such as *DOMUS* and *Azure*. Actual practice-based information is in short supply: that is where networks such as the BID Community can deliver value. There is the need to swap information and use the language and vocabulary we are in the midst of developing. The taxonomy and content provided through AskNature helps but as with learning any language, practice and even immersion is necessary for fluency. Several participants in my informal survey for this article expressed a need to intensively converse and work in the language of biomimicry.

To summarize, concerns that have been mentioned in using the biomimetic approach are:

1. the shift in the design approach – integrating the biological discovery phase into design
2. managing the changing role and opportunities of design
3. role of the designer as educator and advocate
4. strong and varied examples
5. the learning curve and time for the discipline to be adopted
6. translating the principles (abstraction to the design concept)

### Designers' Aspirations for Biomimicry

What about the changing role of products in the product ecosystem? How does this relate to natural systems? The functional adaptations of organisms are a specific reaction to stresses in their environments. In many ways, this describes what a product is. Ecosystems



Figure 5: Costa Rica 2009 Workshop

provide everything for that organism to flourish. As the nature of the very products we design changes, the relationship to the product ecosystem becomes increasingly important. For example, many of our products are now incorporating wireless communication. These products have a complex relationship with numerous other products: the boundaries are porous and not necessarily distinct. It emphasizes how different the material, form-giving aspects of industrial design have become compared to just a relatively short time ago. These products may have physical boundaries but their function does not end there.

The role of the designer in the product development team is expanded when biomimicry informs the process and leads to new product opportunities. The designer becomes the facilitator to move between different disciplines, looking through the functional biological lens to clarify the problem statement and to generate concepts. The classic definition of an industrial designer has always been more or less like this definition from [Carleton University](#): "A physical solution that optimizes the function, value and appearance of a product or system for the benefit of the user. It includes features such as shape, configuration, pattern and ornamentation or any combination of these features." Or from the [Industrial Design Society of America](#) (IDSA): "Industrial design (ID) is the professional service of creating and developing concepts and specifications that optimize the function, value and appearance of products and systems for the mutual benefit of both user and manufacturer." Sustainability is integral to the design process and biomimicry fits right into the definition of industrial design, especially if we expand the scope of words like function, value, user, systems and of course, manufacturer!

Design has always been a collaborative, facilitative process that brings about solutions based on asking the right questions. Using biomimicry as a framework allows these questions to be framed in a sustainable context. The solutions are based on a much wider solution space yet are based on a much more focused functional subset. Biomimicry is so much more complex and complete in how it addresses systems issues, resilience, symbiotic relationships and benign materials: the very issues we have been highly unsuccessful in dealing with to date. Have we been so enamored with our own cleverness at making new things that we might have missed the existing solutions right under our own noses? Our entire manufacturing and world-wide economy is petroleum-based and relies on resource-extracting manufacturing processes. This has prevented us from exploring natural water-based, low-temperature processes that are at the heart of biomimicry, and that are the focus of green chemistry. Life is supported by dynamic non-equilibrium as an operating condition. Managing dynamic non-equilibrium to provide the continuous change and control for our human needs will take creativity, insight and co-operation. This is a completely different paradigm and a new exciting landscape.

Those who have taken biomimicry courses say that it forever changes how they see problems and solutions. Life's principles become constant guidelines. What would nature do? How would nature solve this? There is no going back.

### Suggested Readings

- Klein, A. (2010, August 19-26). [Bring on nature's design firm](#). *Now Magazine*, 29(51)
- Suzuki, D., with Moola, F. (2010, October 31). Nature's brilliance offers hope for future. *The Era Banner*, 6
- Casey, V. [The Designers Accord](#)





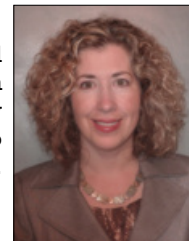
# Biomimicry and Industrial Design (continued)

- Gulmanelli, S. (2008, February). BioMimicry. *DOMUS*, suppl.Green, 32-37
- Pulfer, R. (2008, May). Form follows Nature. *Azure*

### Image Credits:

- Segmented ball: © [Yang MingQi - Fotolia.com](#)
- Integrating Biology: [The Biomimicry Guild](#) (check [The Biomimicry Institute](#) website for the latest version)
- Industrial Ecology: Carla Gould
- Biomimicry Costa Rica Workshop (2009): Karen Verbeek

[Karen Verbeek](#) has a biology and industrial design background and attended the Costa Rica Biomimicry Workshop. She is currently focusing on education in the Greater Toronto Area and building a biomimicry network.



# An Interview with a Bio-Inspired Designer (Ernst-Jan Mul)



Norbert Hoeller caught up (virtually) with Ernst-Jan Mul in a Barcelona café. Ernst-Jan had just participated in a brain-storming session organized by Fco. Javier of [Aleen](#) on the bio-inspired development of a deep-sea robot. Although many people are looking to nature for design ideas, Ernst-Jan is one of the few who has tried to build a career around practicing bio-inspired design. He has been active in promoting the field of biomimicry by developing new tools, educating students, training companies, applying biomimetic strategies in design projects and through research.

**Norbert:** How did you get involved with biomimicry?

**Ernst-Jan Mul:** I have always been intrigued by the idea that products could be like organisms: growing, adapting, learning and being an integral part of their own sustainable ecosystem. I selected biomimicry as part of my Masters program in Integrated Product Design at the Delft University of Technology, even though the faculty was not familiar with the concepts of biomimicry. My graduation project combined my interests in research, sustainability, biology and technology. I translated the sustainability paradigm of biomimicry into a structured design strategy using the [design of an electric scooter](#) as a practical application.

connection of ribs and vertebrae by ligaments detachable flexing attachments between body and frame

trees bending in the wind  
body bends in the wind

optimal body length-width ratio of dolphin  
length - width ratio 1:4,5

materialized stress lines in (thigh) bones  
material where force is in frame-parts

hierarchical build of tendons  
hierarchical build of frame

eco-mo>ement Ernst-Jan Mul Bio Inspired Design

eco-mo>ement

Figure 6: Inspiration for electric scooter







# An Interview with a Bio-Inspired Designer (continued)

**Norbert:** Since graduating in 2009, where have you taken your interest in biomimicry?

**Ernst-Jan Mul:** I have been working as a [freelance designer](#) since January 2010 on a wide range of projects including rapid manufacturing, writing papers and several articles on Biomimicry, taking part in an international think tank as a biomimic, working together with the sustainable design agency [Ideal&Co](#), and helping designers, architects and companies like [TenCate](#) to appreciate and implement sustainability in their design practices.

**Norbert:** How has biomimicry changed the way that you approach product design?

**Ernst-Jan Mul:** We need to switch from a mindset of reducing negative impacts to one where we make positive contributions to the environment. Biomimicry has helped me see product development as strongly shaped by the context, in the same way that the development of organisms is heavily shaped by their environment. To be successful, products need to be strongly connected to their environment, both the technical and the natural. To be sustainable, we need to be able to map, analyze and develop these connections.

**Norbert:** What tools have you found useful in your bio-inspired design activities?

**Ernst-Jan Mul:** I have used a wide range of analysis, synthesis and materialization tools including function analysis, the Life's Principles, AskNature.org and Life Cycle Analysis. I was not able to find tools relating to the connectivity of products to the environment. I created an *environment scan* tool that analyzes the environment of a product throughout its lifecycle, considering energy forms, materials, organisms and organizations. The output of this tool feeds into a *connection diagram*, a visual representation of the key elements in the ecosystem of the product from the perspective of the product's functionality. The goal of my design process is to increase the degree of connectivity as well as enhancing synergistic relationships. The visual nature of the tool lends itself to mapping, understanding and communicating complex situations.

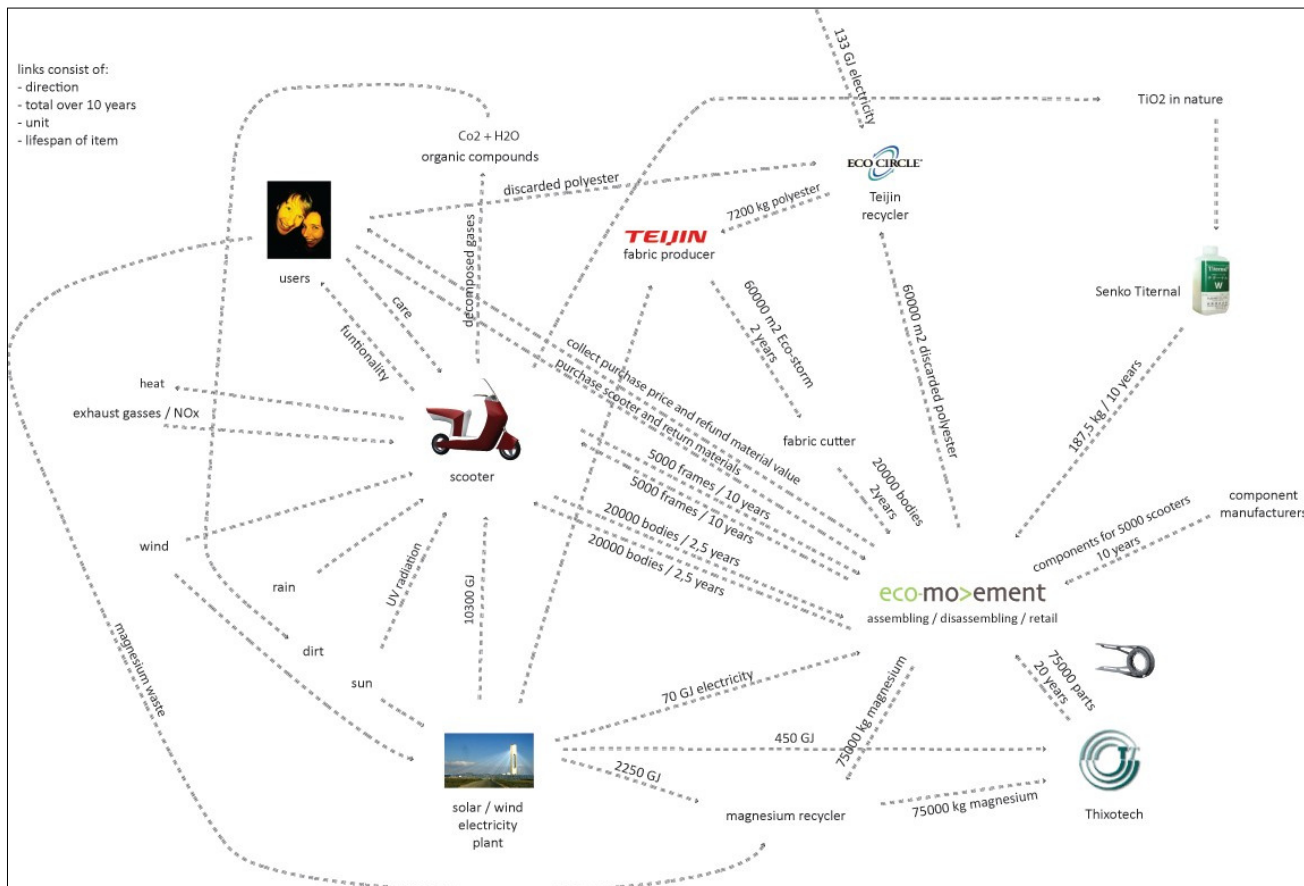


Figure 7: Connection Diagram for Electric Scooter





## An Interview with a Bio-Inspired Designer (*continued*)

**Norbert:** How do you see bio-inspired design relating to sustainability?

**Ernst-Jan Mul:** Although sustainability is one of my primary goals, additional research is required to prove that bio-inspired design can deliver more sustainable products. When we look to nature for solutions, we often use physical or engineering terms which may prevent us from fully appreciating how nature works. As in all complex systems, cause and effect relationships between what we see in nature, how we interpret what we see and what we design are rarely straightforward. I believe we can increase the likelihood of sustainable products by moving beyond mimicking individual organisms to creating human designs that live in the environment and bring value to that environment.

**Norbert:** How have you been able to influence other designers?

**Ernst-Jan Mul:** I have presented the connection diagram tool at a number of workshops as a way to generate ideas and help designers see how products can be a positive force in the environment. I tend to introduce bio-inspired design in an unobtrusive and pragmatic way so as to include designers who do not 'get' biomimicry.

**Norbert:** What are your future plans?

**Ernst-Jan Mul:** I would like to use the connection diagram to integrate information from meteorological and ecological databases to incorporate a deeper understanding of the "habitat" of products. We need comprehensive and integrated toolkits that incorporate not only our growing knowledge of nature but also new design paradigms and manufacturing techniques.

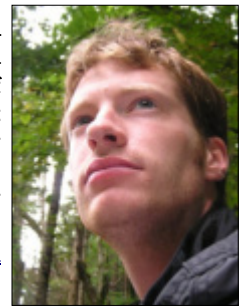
**Norbert:** Ernst-Jan, on behalf of the BID Community, thanks for taking the time to talk about your experiences as a bio-inspired designer!

### Image Credits:

- On Air: © [frank peters - Fotolia.com](http://frankpeters-fotolia.com)
- [electric scooter](#): Mul, E-J. (retrieved 2011/03/05)
- connection diagram: Mul, E-J., (2009). Biomimicry in product design: exploring the possibilities

---

[Ernst-Jan Mul](#) graduated in 2009 with an MSc in Integrated Product Design from the Delft University of Technology. Combining his interest in research, sustainability, biology and technology, he translated the sustainability paradigm of biomimicry into a structured design strategy. He works as a freelance [bio-inspired designer](#) since January 2010.





## Calendar of Public Events

| Date                | Location                | Event   |
|---------------------|-------------------------|---|
| Mar. 15, 2011       | web conference          | <a href="#">2nd 'Making a Living With Bio-Inspired Design' community conference call</a>                            |
| Mar. 20, 2011       | Palo Alto, CA           | <a href="#">NSF Bio-Inspired Design Workshop: Charting a Course for Computer-Aided Bio-inspired Design Research</a> |
| Mar. 21-23, 2011    | Stanford University, CA | <a href="#">AAAI 2011 Spring Symposium: Artificial Intelligence and Sustainable Design</a>                          |
| Mar. 24-31, 2011    | Uvita, Costa Rica       | <a href="#">Costa Rica Biomimicry and Design Workshop #2</a>  |
| Mar. 28, 2011       | online                  | <a href="#">MCAD: Biomimicry for Designers (Spring 2011)</a>  |
| Mar. 31, 2011       | Cleveland, OH           | <a href="#">Second Nature: The Biomimicry Evolution (movie, 5:10PM)</a>   |
| Apr. 1-3, 2011      | Austin, TX              | <a href="#">3-day Backyard Workshop</a>   |
| Apr. 14-16, 2011    | San Diego Zoo, CA       | <a href="#">2011 Biomimicry Conference</a>  |
| Apr. 30-May 2, 2011 | Vancouver, BC           | <a href="#">3-day Backyard Workshop</a>   |
| June 6-7, 2011      | Berkeley, CA            | <a href="#">The International Society for Industrial Ecology (ISIE) 6th International Conference</a>                |

| Date              | Location                           | Event  |
|-------------------|------------------------------------|--|
| June 27-29, 2011  | Cleveland, OH                      | <a href="#">2011 Biomimicry Education Summit</a>   |
| June 18-20, 2011  | Rhinebeck, NY                      | <a href="#">Biomimicry: a Beacon of Light for Today's Innovative Educators</a>                         |
| June 18-21, 2011  | Las Vegas, NV                      | <a href="#">The 2011 International Conference on Genetic and Evolutionary Methods</a>                  |
| June 18-21, 2011  | Las Vegas, NV                      | <a href="#">The 2011 International Conference on Artificial Intelligence</a>                           |
| Sept. 18-20, 2011 | Boston, MA                         | <a href="#">International Bionic Engineering Conference 2011</a>                                       |
| Sept. 2011        | Gibraltar Island, OH               | <a href="#">Biomimicry Workshop</a>  |
| Nov. 11-17, 2011  | Denver, CO                         | <a href="#">ASME 2011 International Mechanical Engineering - Congress &amp; Exposition</a>             |
| Nov. 28-30, 2011  | University of Dammam, Saudi Arabia | <a href="#">Sustainability Through Biomimicry: Discovering a World of Solutions Inspired by Nature</a> |
| Dec. 2011         | Lavasa, India                      | <a href="#">Biomimicry Workshop</a>  |

An online events calendar readable by anyone is available at <http://bioinspired.sinet.ca/Events>. Users who have registered on the site can post new events.







## BID Community 'Participation Rebate'



Some members have raised concerns about the cost of membership, particularly if we want to attract students. The Advisory Group has proposed a 'participation rebate' to help address this issue by returning a portion of the membership fees to active members. Such a program would also recognize and encourage member contributions to the community.

Many co-operative organizations reward their members by returning profits based on the amount of purchases made by the members. We could adapt this process by setting aside 20% of membership fees and allocating it to paid-up members based on the extent and nature of their activity within the community. The 20% figure was chosen based on the 80/20 'rule': if 20% of the members drive 80% of the activity on the website, then these members could potentially eliminate their membership fee.

One approach would be to assign a point value to each activity type, such as:

- 1 point for rating or tagging content
- 5 points for posting a comment/event/resource or contributing content to an article

- 15 points for participating in a community or Advisory Group conference call
- 25 points for writing an article or hosting and summarizing a community conference call

Over the period of a quarter, the points accumulated by a member would be divided into the total points for all members to determine that member's fair allocation of the participation rebate. To reduce transaction fees, participation rebates will be processed as a refund of membership fees, either against the current renewal (if within 60 days) or the upcoming renewal. If the rebate exceeds the membership fee, it will be carried forward to the next quarter. Refunds will only be issued if they exceed 75% of the membership fee, again to minimize transaction costs.

The following preliminary table shows activity for January and February, on the assumption that all participants have become paid-up members by the end of March. The final figures will be calculated based on activity and paid-up membership at the end of March.

*Ashok Goel, Petra Gruber, Norbert Hoeller, Janice McDougall, Tom McKeag, Eileen Stephens, Karen Verbeek, Marc Weissburg, Jeannette Yen*

Pen: [© Lim Jerry - Fotolia.com](http://Lim Jerry - Fotolia.com)

|                          | Tags/<br>Ratings | Comments, Events,<br>Resources, Article<br>Contributions | Community<br>Calls | Writing<br>Articles,<br>Hosting Calls | Total Points | % of Grand<br>Total |
|--------------------------|------------------|--|--------------------|---------------------------------------|--------------|---------------------|
| <b>Points</b>            | <b>1</b>         | <b>5</b>   | <b>15</b>          | <b>25</b>                             |              |                     |
| <b>Karen Verbeek</b>     |                  | 7  | 2                  | 1                                     | 90           | 25%                 |
| <b>Emer Natalio</b>      | 1                | 1  |                    | 1                                     | 31           | 9%                  |
| <b>Taryn Mead</b>        |                  |  |                    | 1                                     | 25           | 7%                  |
| <b>Mike Westdijk</b>     | 3                | 3  |                    |                                       | 18           | 5%                  |
| <b>Ashok Goel</b>        |                  |  | 1                  |                                       | 15           | 4%                  |
| <b>Carla Gould</b>       |                  |  | 1                  |                                       | 15           | 4%                  |
| <b>Casey Wong</b>        |                  |  | 1                  |                                       | 15           | 4%                  |
| <b>Fil Salustri</b>      |                  | 3  |                    |                                       | 15           | 4%                  |
| <b>Janet Kubler</b>      |                  |  | 1                  |                                       | 15           | 4%                  |
| <b>Janice McDougall</b>  |                  |  | 1                  |                                       | 15           | 4%                  |
| <b>Jessica Ching</b>     |                  |  | 1                  |                                       | 15           | 4%                  |
| <b>Kaveri Joseph</b>     |                  |  | 1                  |                                       | 15           | 4%                  |
| <b>Lisa Schmidtke</b>    |                  |  | 1                  |                                       | 15           | 4%                  |
| <b>Marc Weissburg</b>    |                  |  | 1                  |                                       | 15           | 4%                  |
| <b>Petra Gruber</b>      |                  |  | 1                  |                                       | 15           | 4%                  |
| <b>Tom McKeag</b>        |                  |  | 1                  |                                       | 15           | 4%                  |
| <b>Dena Emerson</b>      |                  | 2  |                    |                                       | 10           | 3%                  |
| <b>Steve Williams</b>    |                  | 1  |                    |                                       | 5            | 1%                  |
| <b>Ventrell Williams</b> | 1                |  |                    |                                       | 1            | 0.3%                |
| <b>Totals</b>            |                  |  |                    |                                       | <b>360</b>   | <b>100%</b>         |

Table 2: Preliminary Participation Rebates as of February 27/2011

