NordDesign 2016
August 10 – 12, 2016
Trondheim, Norway

'What Ideality Tool' (The WIT) for Product Design Briefs Fusion and Confluence in Design Management

Alon Weiss[1], Prof. Iko Avital[1], Prof. A.K. Das[2], Dr. Mazor Gedalya[1]

[1]SCE-Shamoon College Of Engineering, Israel
[2]Indian Institute of Technology Guwahati, India.
alonwe@sce.ac.il

Abstract

This article presents the key advantages of using an innovative automated Design Thinking Tool for enhancing the value of sustainable design management. The tool is intended for product designers (PDs) who seek to foster sustainability in the ideation and formulation stage of product design brief. WIT was developed to comply with PDs' needs and new role definition, targeting to bridge existing gaps between sustainability and the traditional business approach. It assists in current design challenges within the limitations of traditional briefs, establishing a shared lexicon and offering a solution for tackling "design fixation" and overcoming the "Design Paradox", wherein the more experience a designer has, the less ideation flow there is and the less flexible his or her design approach becomes. Due to designers' tendency to skip the stage of idea expansion (the "WHAT") and rush into a specific design solution (the "HOW"), the **author offers a solution for focusing on the "WHAT" analysis level in order to enhance the "HOW".** The WIT is based on the TRIZ ideality concept designed according to nature's Ideal strategies and it serves as a method for creating a more extensive pool of sustainable concepts. This article presents practical contributions through qualitative research evaluation, conducted with experienced PDs as subjects.

Keywords: design thinking, design fixation, design process paradox, product design, bio-mimetics

1 Introduction:

Sustainability is the "terms and conditions" for human survival (Orr, 1992) and can be used to form a link between economics, society and the natural environment while handling issues such as business ethics with new sustainable approaches (Kuhlman, 2010). During the Industrial Revolution, the term Anthropocene defined human actions as the force of nature that shaped the world while severely damaging ecological systems (Crutzen, 2002), emphasizing the crisis via the *funnel metaphor* of the Natural Step organization (The Natural Step, n.d.). Sustainable Innovation is a key factor for economic growth, promoting the creation of a competitive advantage, efficiency and functionality as the driving forces in the economy. Sustainable Innovation allows for the recognition of a critical mass of technologies that can offer new solutions to human needs (Vincent JF, 2006). The source of innovation in nature is in necessity. In light of the constraints and limitations in various ecosystems, nature offers design sustainable solutions from wisdom accumulated over millions of years, versus the mere 200 years of human industrial development. Comparative research conducted evaluating principles of design solutions in nature and man-made technologies found that so far we have reached just 12% similarity between the solutions offered by the different disciplines (Vincent JF, 2006). The fundamental difference is the respective sustainability and business-oriented approaches, which relate to the philosophy, values, morals, objectives and measurements of success and profits (Mishori, 2016). The need to find a balance and adjust the correlation between these two disciplines has increased. The dilemma between business and environment relates mostly to two major aspects: **externalities**, which describe business gains that come from harm to society, community or ecological systems, and **unintended consequences**, which are unintended catastrophes that result from negligence resulting in ecological disasters (Mishori, 2016).

The main challenge faced by environmental ethicists lies in persuading businesses to make an environmental commitment to internalize external costs as a preventive cautionary measure (Mishori, 2016). In addition, some argue that the free market is characterized by the Darwinism philosophy, allowing only the best product or company to survive. However, it is important to note that economic development is crucial to the progress of sustainable solutions as it can speed up environmental salvaging via green capitalism (Tienhaara K, 2014). Sustainability will be a short-lived trend if not generally practiced in the world of international business, therefore, it is important to implement what is known as the Dark Green Agenda (Bowie NE, 2005), an eco-centric approach that accompanies sustainability ethics and incorporates values that support trade committed to sustainable principles.

At the same time, in light of humanity's challenges in the 21st century there is a growing need for sustainable developmental solutions, which emphasize the object of finding solutions for the complexities and fast-paced changes of our modern way of life, both environmentally and socio-economically. Furthermore, we have witnessed significant advances in the availability of information regarding biological systems as well as an increase in computational and technological competencies (Coelho, January 2011), which allow for the creation of new possibilities. The current problems designers must solve are considered to be “ill-defined" (Cross, 2008) or "wicked" (Wahl, 2006), thus, they cannot be solved using traditional methods that are no longer relevant (Jones, 1970). It is also imperative that designers keep track of the changing demands, and maintain interdisciplinary skill collection to decide upon the best method for promoting the design processes (Cross, 2008).

Significant cognitive challenges faced by designers during the ideation stage include the "Design Fixation" phenomenon, particularly prominent among experienced designers (Agogu'e, 2014). Mental blocks that limit creativity and prevent them from keeping an open mind appear for various reasons such as mindedness attachment to first concept they develop or to previous sources of inspiration. Other constraints include limited resources, which may lead to fear of taking unknown risks cause the designer to remain in a safe zone, (Crilly, 2015). The “Design Paradox” is the tendency to skip the stage of idea expansion (Ullman, 1992) (the “WHAT” stage), and rush forwards with a specific design solution (the “HOW” stage). In both cases, the more experienced the designer, the less freedom her or she has in developing novel concepts. Their limited range of ideas essentially becomes their fixed design style. During my twelve years as a PD working with senior designers, I have come to learn and witness first-hand the cognitive obstacles in the work process that lead designers toward this limited perspective. By skipping the “WHAT” stage, we create a “black hole” in the design process. By using the WIT we can enrich the “HOW” and select the most effective solutions. Defining the "HOW" at the start of the brief will likely narrow down the designer's options for finding additional solutions. The evolution of the PD's role and areas of influence has shifted from just development and manufacturing to serving as a critical component of design management and a major tool in the product's implementation and user experience (Green & Jordan, 2002). The PDs' role expanded of late and they are essential on a broad scale with true impact in our lives (Barratt, 2015). Current role definition combines both artistic and engineering domains, as designers search for ways to innovate via engineering-based solutions that rely on analogies during the ideation stage. Nature serves as the cradle for developing analogous solutions of functional models, abstractions and flow (Chakrabarti A. a., 2009). However, PDs interested in applying biological analogies are often limited by the unfamiliar terminology of the new target domain and therefore must work with professionals from other disciplines (Boden, 1994). Exposure to natural phenomena increases the novelty of the design concepts generated, as the source has a significant influence on design ideas variability (Diana P. Moreno, 3 May 2014). Design models that rely on nature-based solutions are therefore more promising for innovation and sustainability (Helfman C. R., 2014).

2 Nature as a Model for Ideality

It was Tsung-Dao Lee, Nobel laureate in Physics, who claimed that science and art support the way we observe and decipher nature's ways: through science we untangle the ways and through art we interpret nature's emotions (Lee, 1993). This notion was further emphasized by scientist Ray Kurzweil, who believes that in the future, human and artificial intelligence will be fused, leading to a new revolution he refers to as the "Singularity" state (A Review of Transcendent Man, 2011). Nature's systems operate within restricted sets of conditions, minimizing waste and irreversible damage to the ecosystem and even enriching and sustaining it. Bio-inspired sustainability design tools are based on patterns that are essentially simplifications of nature's solutions. They offer ways to support the global, systematic, bio-inspired design approach (Jacquelyn K. S. Nagel, 2010), to encourage conservation of nature and function as a source of inspiration for innovative solutions (Jeannette Yen et al, 2010). These tools support designer's access to nature's vast "database" by offering a systematic method for finding the relevant biological systems and abstracting their design solutions (Glier, 2012). Life Principles are strategies that nature maintains in order to survive under the conditions on planet Earth (Benyus, 1997). The Biomimicry approach focuses on innovative solutions inspired by nature and is a part of the nature-inspired design strategy. This strategy takes nature as a model for developing products, systems (Benyus, 1997) even suggesting design methods, aiming for sustainability and resilience, and thus forming valuable influences (Pauw, 2014). By definition, it mimics nature's characteristics, while translating and implementing nature into solutions needed by human kind (Vincent JF, 2006).
Biomimicry design methods can be categorized into **Search, Abstraction** and **Transfer Methods.** Search methods focus on the search for biological solutions, such as *AskNature*, a biomimetics database of biological systems, as well as *Keywords of Associations*, which finds links between technical and biological terms (Lindemann, 2004). Abstraction methods focus on the analysis and representation of biological systems as the basis for analogical reasoning, such as the *DANE* interactive computational tool based on design through analogy by Goel (Swaroop Vattam, 2010), the *SAPPhIRE Model* (Srinivasan, 2009), the *"Idea-Inspire"* software tool (Chakrabarti A. S., 2005), and the *functional modelling design space analysis via functions* (Nagel, 2008). The Transfer Methods focus on guidelines to support designers during the transfer development, such as *comparisons between biological and functional models* (Nagel, 2008). The suggested tool is based on the *Ideality Tool for Sustainable Design* (Helfman C. R., 2015) and serves as a Design Thinking Tool for the formulation of a design

brief using the biomimetic approach. In biomimicry, the tool emulates nature's process and strategy from a holistic perspective, examining how nature manufactures solutions (Emily Kennedy, 2015). Within the scope of the Biomimetic design tools we can find the Ideality principles, which are also a basic concept in TRIZ the theory of inventive problem solving (Altshuller, 1999). Ideality tools utilize nature's strategies to increase the system's benefits and reduce system costs. Thus, the use of the Ideality model is based on available resources that can accelerate product's potential success (Jahau Lewis Chen, 2011). Another example of nature's sustainability patterns formulated by the Ideality framework is *the Eco-Innovation by Integrating Biomimetic with TRIZ Ideality and Evolution Rules* (Jahau Lewis Chen, 2011). The relationship between sustainability and Ideality was the basis for the development of practical eco-guidelines for product innovation and sustainability, while nature's strategies can serve as sustainability tools (Helfman C. R., 2015). However, these tools do not specifically incorporate product design brief methodologies, and adaptation for product design is therefore required for improving efficiency and risk-management policies through implementation of sustainable guidelines to bridge the existing communication gap.

2.1 'What Ideality Tool' (The WIT) For Product Design Briefs

The tool was constructed based on principles from two domains: product design briefs and Ideality design. The interaction between these two domains encourages designers to examine how each Ideality principle can be realized in every product design brief and refers to the "WHAT" aspect which then leads to the "HOW" component. The main objective is to achieve an ideal brief that focuses on the "WHAT", while avoiding the tendency to "flee" towards the "HOW" in an effort to overcome design fixation. An additional objective was to stimulate broader reach within existing constraints, serving as a design platform for the creation of a schematic but creative thought process for PDs. The structure of the model provides a useful starting point for handling the client's brief, along with a set of constraints and instructions that must be followed. The model promotes design management, identification, definition and expansion of the opportunities the product embodies while maintaining the product function.

2.2 Model Usage

The tool is an interactive, dynamic, analytical Excel-based program, built to formulate a singular modular structure question. The question's structure can be applied multiple times and offers numerous choices from which the user can select. The use of a Modular Question format in the screening process supports the definition of the attributes and is crucial to the design and optimization of the brief composition. The model is used as a checklist divided into topics, sub-topics and attributes that direct the designer inwards, emphasizing the various user scenarios and product usability. The modular question format improved usability by displaying each variable visually, thus assisting users in the visualization of the project's complexities and identification of possible solutions and vastly increasing usability. In order to collect and construct the desired core data, users are guided to create a pool of related attributes from the main characteristics of the product's checklist and sub-topics, emphasizing the various possible user scenarios and the product usability. The tool also offers statistical analysis of the attributes and strategies used in the brief, perhaps pointing users towards even more solutions.

The WIT model is presented in Fig. 1. The tool is composed of five main stages with instructions for each stage. The stages are as follows: personal data, evaluation, the Modular Question stage, the Designer Brief stage (board summarizing**)** and user feedback. The Modular Question stage forms the tool's core in which users fill in explorations by choosing from the following sections: Product brief checklist, Category and Sub Category, the "WHAT", Ideality Design Principle, search for an inspiration image, and the "HOW". These five parts should be selected in relation to the challenge the user has selected and they function as five components that form the leading research question. In part one, users select the product brief checklist category and subcategory for the specific chosen challenge. This section has seven main categories and the thirty most-common sub-categories and their attributes. The product brief checklist deals with elements such as target audience, ergonomics, project management, marketing, manufacturing, user experience, soft attributes and their sub-categories and related attributes. Although each product brief has a different agenda and different requirements, the checklist format can be adjusted and users can also add their own, new attributes. In the second part, users select the specific "WHAT" attribute for which seek a solution, and their added value. In the third part, users select the most fitting ideality design principle. These principles are divided into two main categories - "**cost reduction**" or "**Increasing Benefits**" and their respective strategies and design principles.Once the first three basic parts are completed, the first part of the Modular Question is formulated and it functions as a Design Thinking Frame, aiming to enhance the user's intelligent thinking process. By expanding the quantity of attributes in the product, users are increasing the product's efficiency and amplifying the values of each function to strengthen sustainability. Users are steered to think about how the selected attributes support the ideal principle. Once all sections are completed the user is left with the leading question format which can then serve as the core Design Thinking Frame question of the Tool. The following algorithm explains its implementation:

Which attribute will support the "WHAT" attributes and add value through the Ideality design principle? Practicality of the Solution will be presented via: "HOW" it can be implemented? In the next step, following the formulation of the question, users develop two additional layers to strengthen the challenge brief by browsing the web for analogous visuals in the form of inspirational images (can be any system from which they might draw inspiration). In the last part, users briefly describe the ways the "HOW" can be implemented. The result is a designer brief outline, summarizing all of the explorations performed, which serves as an inspiration board for the development of the product design brief. It includes a chart of recommended attributes and their added value with images and links to the potentials methods of implementation. The model can be used by individuals with a broad perspective or by teams.

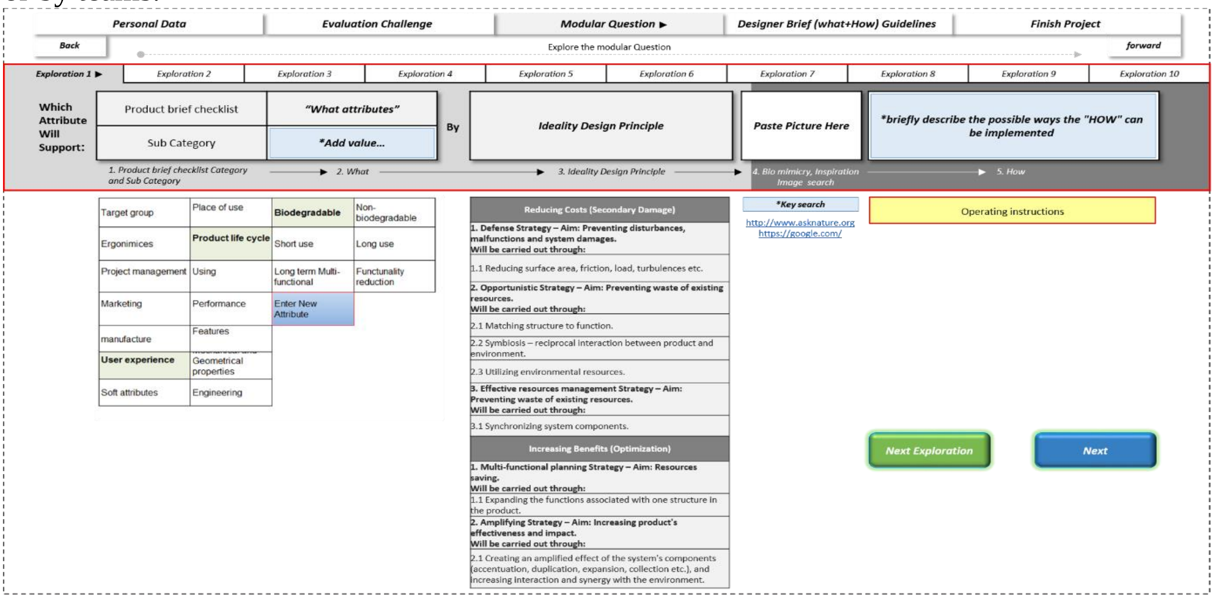

Figure 1. View to the core-the Modular Question stage.

2.3 Model Development

The model was developed as a derivative of the *Sustainability Ideality Tool* (Helfman C. R., 2015), in an effort to adapt it to the field of Product Design via modification of the terminology associated with product design brief composition. Several trial runs of the model were performed with students from the program for Mechanical Engineering of PDs (Weiss Alon, 2015) and with professional PDs. In light of feedback received during these test runs, the tool was improved and simplified to achieve better usability and results. The development process is still in progress as the tool is constantly being modified to optimize performance outcomes.

2.4 Research and Test Case:

WIT was tested in a design firm on a heterogeneous group of experienced PDs divided between control and test groups, each of which received the same challenge and each PD performed the test individually. The control group performed the experiment using varied traditional methods (Jones, 1970) and the test group used the experimental WIT method. Each group was asked to use a customer's demand brief as the challenge: Re-thinking a smart solution for food storage that prolongs shelf-life. The challenge was to create a new design brief for an existing prototype of a smart refrigerator with an electric vacuum drawer with a latex mold that preserves contents by creating an oxygen-free space.

2.5 Results:

Table 1. Comparative analysis of the focus groups

Measurable Values	Control Group	Test Group
Hypothesis	**Achieve improvement on traditional existing concepts**	**Achieve more advanced sustainable concepts**
Number of PDs	**3**	**2**
Experience	**5-7 Year’s**	**7 Year’s**
Time invested	**An average of 30 m**	**An average of 150 m**
Analogies level	**Standard**	**Revolutionary**
Design fixation	**Common fixation**	**Non fixation**
Traditional Attributes	**Advanced**	**Standard**
Sustainable Attributes	**Standard**	**Advanced**
Creativity / Originality level	**Advanced**	**Revolutionary**
Evolutionary level	**Standard**	**Revolutionary**

The Control Group: During the construction of the traditional brief, the PDs focused mainly on how to improve the existing product's features and its visibility in terms of modularity, measures, brand integration, recommended ratio in the unit between the vacuum and non-vacuum space, how to assemble and disassemble the unit, hierarchy between its parts, methods of how to use the drawer, whether it is permanent or portable, addition of a malfunction control unit, maintenance and cleaning methods, other potentially suitable materials for accommodating individuals with a latex allergy, determining if a child-proof mechanism is necessary, adding an indicator system: vocal or using lights, and the definition of a target age group and target audience.

The Test Group: The PDs focused on a variety of human-usage scenarios. During the creation of the design brief, the model served as a thinking framework, forcing the PDs to consider a wide range of product aspects, leading them towards discovering potential characteristics for future functionalities of a drawer. Their focus on the “WHAT” created a crucial difference in the subsequent thought process, preventing them from first dealing with the “HOW” of the solution, and therefore guiding them towards the direction of more

sustainable designs. The test allowed for both typical and innovative attributes in the design. Some of qualities that had been previously identified by traditional brief methods were also expanded and re-defined using the tool. For example, adjusting the product's shape for its designated space and creating unique visibility where the size and shape could be adjusted according to the necessary functions. Product visibility should be tailored to each unique brand and incorporated seamlessly in a homogenous manner. The shape can also suggest the function of a product, creating an interactive user experience. The product should be designed in such a way that any future changes in size are easily achieved.
Other, more innovative and sustainable product features offered included the creation of a unit of drawers that could serve as a **portable or fixed pantry**, connected either mechanically or electronically. The systems would have an advanced indicator system using gestures or vocal signals. The scale could be adjusted for shipping solutions and customized for **food storage solutions** (e.g. breathable packaging for food), or even **medical uses** (e.g. use of the vacuum concept for elements such as bandages in first-aid kits or emergency medical procedures). The exploration processes presented in Fig. 2 examines one of these such attributes using biomimicry, expanding the material's attributes by integrating vacuum suction and sealing, to the use of material that insulates and regulates vacuum or non-vacuum sealed products, via the use of oxygen tunnels as they appear in nature (e.g. in cells surrounded by membranes that contain protein channels). This structure is identified with repeated tube shaped channels, with or without valves, on different scales.

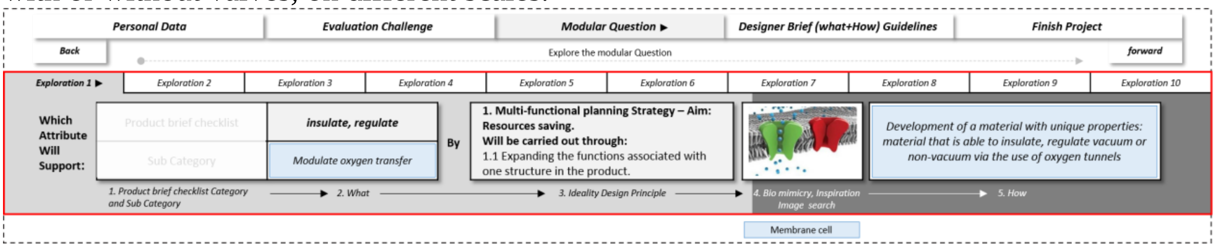

Figure 2. View of the modular question during operation.

2.6 Discussion:

Following the test, it was evident that the Modular Question structure and Ideality Principle forced the test group to focus on the "WHAT" before they focused on the "HOW" and led to three main dissimilarities between the two groups: The test group stretched the **analogy distance** in their search for new features or usages, while the control group focused on relatively similar analogies. The test group using WIT was encouraged to reach beyond the usual analogy spectrum, proving that the more distance that exists between the domains, the more they are encouraged to innovate, increasing the quantity and quality of the suggested solutions (Schild, 2004). The test group used the Design-by-Analogy (DbA) method (Moreno Grandas, et al., 2015) incorporated WIT to overcome **design fixation**, while the control group's design fixation was evident in their tendency to use analogies that were similar. **Product Evolution** - The test group's design summary board was broad and revolutionary in its creative vision with usages that deviated from the current product usage and searched for new attributes, materials and target audiences. The control group, however, focused mainly on improving the existing product by adding new features, remaining in the safe and predictable realm of the original prototype. The results showed that the test group expanded the identification and evaluation of new attributes that affected the scope of the project brief. Their findings led to new, unexpected and sustainable attributes, which although they required more in-depth examination, focused the role of the PDs in the design management process, strengthening the need for experts in the field and perhaps also highlighting the uniqueness of the suggested strategies. The test group developed and expanded upon ideas and product attributes that would not have arisen without the model, including traits that may offer

innovative business opportunities in the future. However, the test group time investment was in ratio of 1 to 5 compared to the control group and 30% of the time was invested in understanding how to use the tool.
The test also emphasized the added value of Sustainable Design Management in the difference in quantity and quality of the results generated. The test group showed a significantly greater quantity and quality of original usages than the control group. In a competitive market, there is an increasing need for achieving more sustainable innovative results for competitive differentiation. WIT stretches boundaries, offering more efficient, sustainable design management improving team performance. By transforming the business strategy beyond the traditional realm and combining Nature-inspired design strategy with technological solutions using Mozota's four design powers (Mozota, 2006), the following aspects are highlighted: **Design as Differentiator:** the foundation for competitive benefits, created via focused customer orientation and brand integrity message. **Design as Integrator:** improves new product development processes through Design Thinking and bio-tool frameworks. **Design as Transformer:** emphasizes new business opportunities and improves the ability to cope with changes. **Design as Good Business:** promoting efficiency, optimizing company profits and holistic brand values; design for the benefit of society. These four principles can serve as the core for future business concepts and act as a bridge for finding a shared language between decision makers and project teams. They also allow provide a common knowledge base and bridge the gaps between sustainability and traditional business-oriented approaches by integrating the materialistic and holistic approaches. The model provides a method for systematic expansion, capable of adapting to every user scenario based on a solution-oriented approach. Solution-oriented strategies have proven to be the most effective methods for handling poorly thought-out design challenges (Cross, 2008). The WIT method is positioned before the biomimicry search methods Fig. 2 and relates to each by being function-oriented. The model is flexible and can be adjusted for various projects, as designers that use a flexible method tend to produce better solutions (Cross, 2008).

3 Summary and Conclusions:

The "WIT" model is a Design Thinking Tool powered by the biomimetic approach. Ideally it is implemented for the formulation and fine-tuning of the PD brief process and it is suitable for design for smart, self-optimizing products and services, in accordance with the "Ideality" strategies and principles. In addition, the tool is effective for tackling the frustrating design fixation and paradox, wherein the more experience a designer has, the less flexible and innovative the ideas they have to offer. The tool amplifies PDs' intellectual capabilities by bringing hidden connections to the surface and promoting inspiring concepts through DbA, offering significant added value in design management. This tool improves the thinking processes by serving as a compass for focusing on the "WHAT" essence of a design, and refining the analysis and synthesis stages. The modular question algorithm is the core of the tool and serves as a **human-centred design automation tool,** aiming to improve PDs cognitive capacity. The stage of creating a pool of checklists is essential for the formulation of in-depth strategies and concepts for an ideal, sustainable design. The definition of the model's initial attributes exposes us to alternative innovative implementations, creating a wide platform that depicts the possible methods for reaching the "HOW". This aspect of the model serves as the means for finding a unique solution that integrates the values of sustainability into our everyday lives. The search for innovation stands to benefit from this model through improvement of the Design Thinking stages based on nature's wisdom. **Test Group Feedback:** The main feedback offered suggested that the tool should be used throughout the design brief formulation as it creates connections that would not have otherwise arisen. The tool expanded the scope of thinking and forced the user to confront issues in a new way, while making seemingly accidental connections that are found to be crucial and meaningful. The tool was initially difficult for users, but once actually used, it became more usable.

4 Suggestions for Continued Research

Further exploration of the traditional checklist categories and sub-categories as well as modification into three main checklists: hard, soft and sustainable categories are important. Expansion of checklist types will likely offer more mental flexibility and help prevent design fixations while addressing the new "WHAT” and “HOW" concepts. Further research is needed to evaluate and expand upon the tool with different multi-design disciplines.

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