Living Designs

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Abstract. This paper will outline why product designers are exploring making processes of the natural world and how this is of benefit to traditional product design practice. This type of experimental design work pushes the boundaries of conventional product design in which mass-manufacture efficiency drives the design and production process. Products, which use growth processes as fundamental to the making process, are increasingly becoming more feasible for end-user acquisition. This paper will provide two case study examples. These case studies contextualise these products and how they co-exist and contribute to the well-established design approaches of digital fabrication and co-creation.

Keywords: Biodesign · Object design · Material technology · Emotional design

1 Introduction

Product designers are increasingly exploring the opportunities afforded by using living and artificial systems in material technologies and manufacture-related processes. This type of experimental work pushes the boundaries of conventional product design, in which mass-manufacture efficiency drives the design and production process. This paper provides two case study examples of bio-design - one is a product, a chair, and one a piece of jewelry, a ring. These designed artefacts demonstrate the use of natural growth processes for the creation of a finished product or artefact.

This paper questions how the emerging field of bio-design is of benefit to traditional design practice, particularly product design. This discourse rests on a rich foundation of design theory that has been developed since modernism. Bio-design crosses over and intersects some current paradigms in very interesting and innovative ways. The authors, researchers in the field of both product design and interior design, see the potential of bio-design to co-exist and contribute to a series of well-established design approaches including digital fabrication and co-creation approaches.

2 Defining Bio-design

Within the design disciplines, the term bio-design is used in reference to designed works that incorporate living organisms. The term bio-design is a broad one, capturing in its use of the word ‘design’ many disciplines including architecture, fashion, and products.

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A clarification of the prefix 'bio-' is required. William Myers, author of the 2012 publication BioDesign: nature + science + creativity and curator of the exhibition BioDesign: on the cross pollination of nature, science and creativity, explains that:

> "Biodesign goes further than other biology-inspired approaches to design and fabrication. Unlike biomimicry, cradle to cradle, and the popular but frustratingly vague 'green design', biodesign refers specifically to the incorporation of living organisms as essential components, enhancing the function of the finished work. It goes beyond mimicry to integration, dissolving boundaries and synthesizing new hybrid typologies. The label is also used to highlight experiments that replace industrial or mechanical systems with biological processes." [1]

Such a definition enables many design approaches to fall under the umbrella of bio-design. Rather than explore products that incorporate living organisms to varying degrees and for various purposes, this paper seeks to instead consider products or artefacts that use actual growth processes as fundamental to the making process. In other words, without the biological processes, there would be no tangible or useable product or artefact – the product is quite literally grown. This requires a rethink of traditional product manufacturing systems.

Bio-design products and artefacts remain in their infancy, many as conceptual works or prototypes rather than available for user acquisition. The two pieces selected as case study examples below are either one-off prototypes or concept designs. [2] The case study examples will not be positioned to engage with ethical dilemmas that arise with such modes of production and the utilisation of biological processes. This is however, an important aspect of bio-design that demands in the future greater attention in the literature. Design and art historian Christina Cogdell has commented that, "it appears that none of the architects or designers who uphold their bioart as a prototype for biodesign has seriously engaged with their critical intent or with the ethical problems". [3] This is not to say that designers have not considered these issues as part of their practice but may have instead not articulated them, focusing on other facets of the bio-design process, such as material application, aesthetic values and collaborative processes.

3 Bio-design and Digital Fabrication

Digital fabrication is a well-established product design manufacturing practice and new making opportunities are presented when coupled with bio-design processes. According to computer scientist Albrecht Schmidt "Historically, the separation of the physical and digital worlds has been very clear, but digital fabrication is blurring that dividing line." [4] In design, digital fabrication is definable as:

> "a process whereby an object design is created on a computer, and the object is then automatically produced by a machine. Digital fabrication machines can be roughly sorted into two categories: subtractive and additive. Subtractive approaches use drill bits, blades or lasers to remove material from an original material source, thus shaping the three-dimensional object. Additive processes deposit progressive layers of a material until a desired shape is achieved." [5]

Digital fabrication includes technologies such as 3D printing, laser cutting and computer-numerically controlled (CNC) routing. Additive digital fabrication processes

such as 3D printing, is relatively new. Like bio-design, its integration with and overlap with existing design paradigms, is still being explored.

Eric Klareenbeek's MyceliumChair (Fig. 3) is a bio-design example integrating both biological elements and digital fabrication technologies - "a chair in which 3D printing and growing material are combined." [6] Klareenbeek collaborated with a number of scientists on the project. [7] The final chair, exhibited at Dutch Design Week in 2013, has been printed from a mixture of materials, including water, straw, biodegradable plastic and mycelium, which Klareenbeek describes as "the threadlike network in fungi". [8] The mycelium itself grows inside the chair, giving it strength - the chair is effectively alive.

Fig. 1. Studio Eric Klarenbeek's, *MyceliumChair* complete with living oyster mushrooms. http://www.ericklarenbeek.com/

Although the growth of the mycelium within the chair is not visible, remarkably the chair supports a colony of oyster mushrooms actually grown from the chair (Fig. 3). Unlike the presence of the mycelium, which provides strength to the chair, the oyster mushrooms themselves are purely decorative. [9] With the mushrooms in full bloom, their continued growth was halted by drying the structure, and coating it in biodegradable plastic. [10] The materials used in the project have a raft of implications for production. For instance, Eric Klareenbeek has said:

> "its all living material; meaning its growing and multiplying, so if you treat the organism well, you'll never run out of 'glue'. In other words, it's theoretically inexhaustible!!"

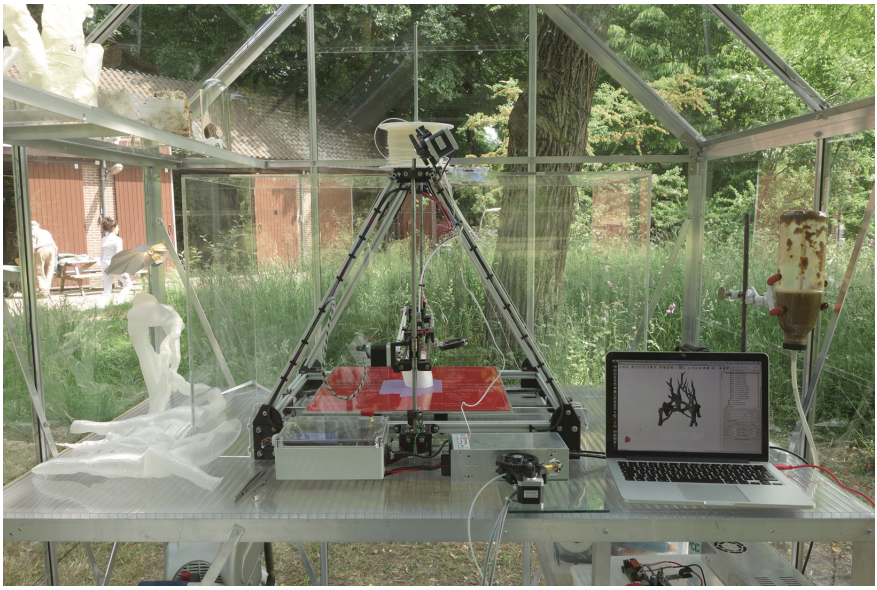

Fig. 2. Digital fabrication of Studio Eric Klarenbeek's, *myceliumchair*. http://www.ericklarenbeek.com/

Bio-design when used with digital fabrication, such as 3D printing, presents diverse possibilities for material use and its assembly. In the case of the MyceliumChair, 3D printing facilitated the application of a new composite material that could generate a desired complex form (Fig. 4). Digital fabrication technologies enable designers to experiment with new materials and with increasing home-based platforms, have the capacity in the future to extend the making into the hands of the users themselves.

4 Bio-design and Co-creation

Bio-design involves designing with nature. In this way, it could be considered a form of co-creation, which is defined by Elizabeth Sanders and Pieter Jan Stappers who are leading practitioners in the field of co-creation and co-design, as;

> "any act of collective creativity, i.e. creativity that is shared by two or more people. Co-creation is a very broad term with applications ranging from the physical to the metaphysical and from the material to the spiritual…" [11]

We propose that bio-design presents an important new avenue for undertaking co-creation. Not only does bio-design require collaboration between different disciplines, including those beyond the design disciplines, but it also facilitates the creation and use of multi-, cross-, and inter- disciplinary knowledge. [12]

A bio-design artefact example that reveals alignments with co-creation is the *Biojewellery* project (Fig. 1). This project brought together researchers and designers Tobie Kerridge and Nicki Stott at the Royal College of Art, and Ian Thompson a bioengineer from the Kings College London. This project arguably provided a groundbreaking new approach to jewellery design. The dedicated project website provides the following overview of the project;

> "Biojewellery started out by looking for couples who wanted to donate their bone cells. Their cells were seeded onto a bioactive scaffold. This material encouraged the cells to divide and grow rapidly, and the resulting tissue took on the form of the scaffold, which was a ring shape. The couple's cells were grown at Guy's Hospital, and the final bone tissue was taken to a studio at the Royal College of Art to be made into a pair of rings. The bone was combined with traditional precious metals so that each has a ring made with the tissue of their partner." [13]

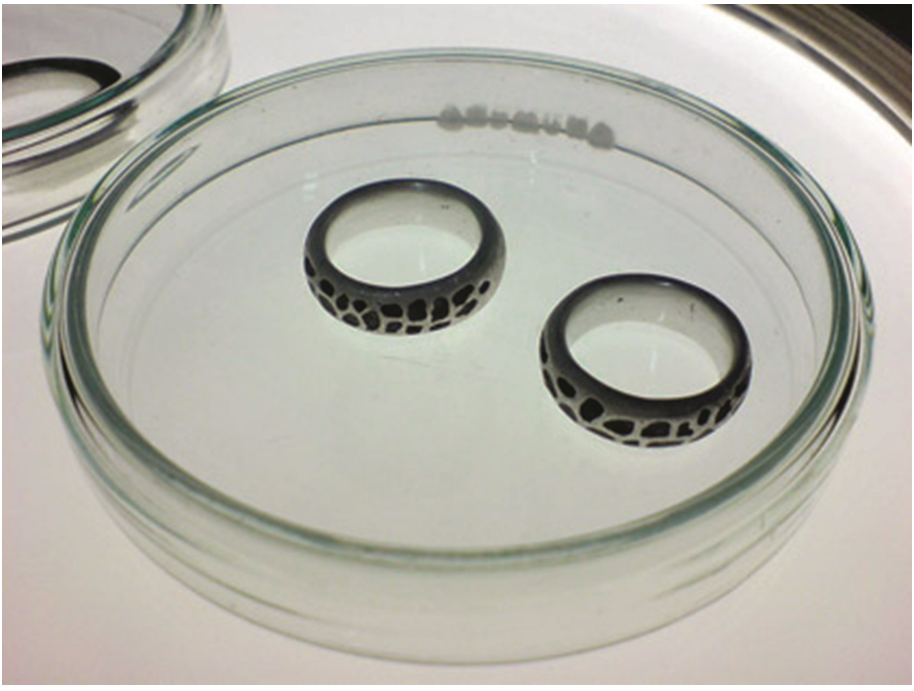

Fig. 3. Final rings grown for two of the *Biojewellery* project participants. http://www.biojewellery.com/project6.html

The *Biojewellery* rings were grown from the cells of a loved one, enabling the wearer to adorn their bodies literally with a part of someone else. As described in the exhibition catalogue accompanying the project, "each person wears the body of their lover on their hand." [14]

The success of the project required interdisciplinary involvement harnessing various disciplinary expertise and material knowledge (Fig. 2). In the approach taken to the coming together of various disciplines for the *Biojewellery* project:

> "instead of attempting to smooth over tensions between the disciplines involved, we actively sought to highlight areas of conflict. Our aim was to provoke debate – not only between specialisms but amongst the public at large. In other words, by confounding expectations of the nature of this kind of multi-disciplinary work, we hoped to surprise both ourselves and others." [15]

In this project the users were also significantly involved, donating cells to grow the rings and providing designs of decorative patterns for the metalwork. The ability to grow the rings from bone provided an additional layer of potency to the meaning embedded in these rings. It also forms a strong emotional bond between the product and the user. The emotional connection differs from that of mass produced products, as the bio-product described is both co-created, and is made up from tangible user bio-products, forming an intimate extension of user with product.

Designer Toby Kerridge has said that "my aim was to reflect on how we (Ian, Nikki, myself) executed project work, including working with organisations and the function of these designs once they get out into the world, for example in accomplishing some form of public engagement." [16] This further suggests that the co-creation aspect of the project was extremely important, as well as the dialogue that exists in relation to the project outcomes.

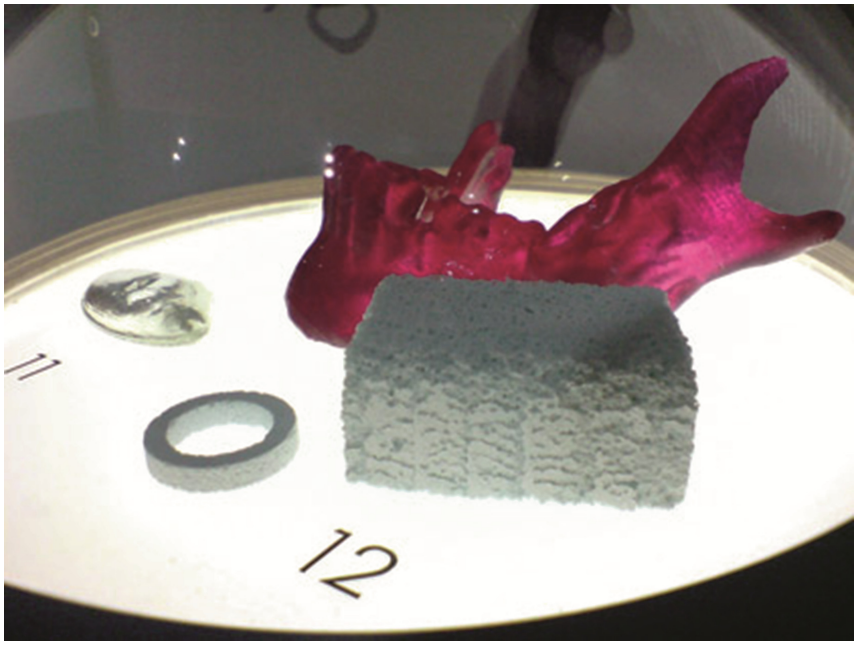

Fig. 4. Examples of some of the biomedical materials used in the *Biojewellery* project. http://www.biojewellery.com/project6.html

5 Conclusion

Bio-design continues to grow and attract interest in the product design discipline. However little seems to have been said regarding how bio-design fits within the existing established design paradigms. Through co-creation, bio-design has the potential to create strong emotional connections between products and users, by having users intimately involved in the creation of the product. Digital fabrication processes and in particular 3D printing, when teamed with bio-design presents the opportunity to increase the designer's palette of materials and open new form possibilities.

Bio-design presents more than the promise of product manufacturing splintering from industrial production processes of old and incorporating biological processes. The case studies here of Tobie Kerridge and Eric Klareenbeek present a tantalising glimpse of how bio-design is being incorporated in the design methodologies of practicing designers and researchers.

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