Academic Design: Towards a definition in a product design context

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Abstract
The TU/e 2013 inaugural lecture by Kees Dorst presents the formation of Academic Design as an emerging, new practice that differs from design practice and traditional research practice – a form of design that *'sits between the field of design practice / problem solving (in the real world) and the field of academic discussion'*. Building on his definition, this paper attempts to develop a further definition of the term by studying Academic Design practice at the University of Technology Sydney, which launched its new Integrated Product Design, Honours Course in the School of Design, in 2016. The course has been designed by academics in the Integrated Product Design Program to facilitate self-initiated product design projects with the key objective of setting knowledge directives and applying theoretical frameworks through Constructive Design Research. A case study of a capstone project completed for the Degree is articulated through an operational framework that makes relevant, the role of hypothesis-making and motivational contexts in Constructive Design Research. Further, the presence of the key features of Academic Design demonstrated in the case study, are able to be located and described in terms of *this* operational framework and other research that explicates certain forms of Constructive Design Research practice, thereby enabling us to move closer toward *defining* Academic Design. Significantly, the course may represent a workable structure for the conduct of Academic Design in (advanced-level) product design education, and as such, could be extended, through further research, to define Academic Design in other product design contexts.

Keywords: Academic Design, Integrated Product Design, Design Education, Constructive Design Research

Introduction

Academic Design, as described by Dorst (2013) centers on the way design differs from other academic disciplines, in terms of problem reasoning and through demonstrating that while 'deduction' and 'induction' are two forms of reasoning that enable scientist to predict real world phenomena; 'abduction', used by designers and engineers, is a form of reasoning that is uniquely solution-focused. A second form of abduction - referred to as design abduction (Dorst, 2013; Koskinen and Dorst, 2015) - is where, the outcome can only initially be described in terms of a type of value and the, so called, 'what' and 'how' must be determined concurrently in order to form a desired outcome. Design abduction is unique to design and is fundamentally, a different way of thinking from that used in scientific fields, including engineering (normal abduction). By mapping design in its practical and academic environments, it is hypothesised that Academic Design, situated between these two areas, has connection to two types of knowledge - practical and theoretical - and typically proceeds by developing models (or 'frameworks'). In an elaboration of Dorst's concept, Koskinen and Dorst (2015) propose that the development of Academic Design may represent a means of advancing the formation of academic design practice, to be as rigorous as other academic

fields. Figure 1 describes the relationship between the components of Academic Design, reproduced from Koskinen and Dorst (2015).

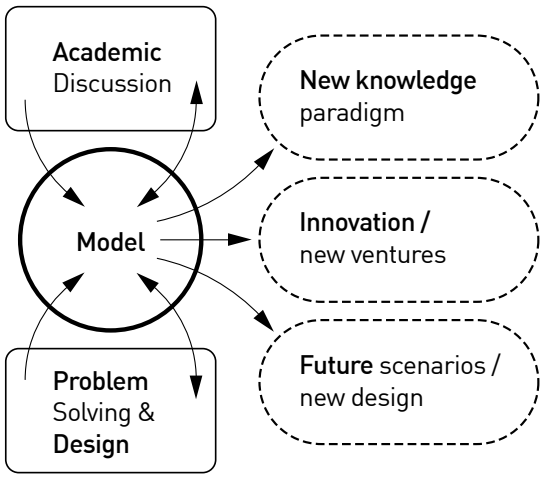

Figure 1: Academic Design
Academic discussion combines with design practice in the form of a 'model'. The diagram describes the abstraction of the model (in the center of the diagram) to guide the development of new knowledge and innovations that can be physically implemented.

Academic Design refers to a new hybrid form of design that combines academic discussion and problem-solving design practices, to frame complex, real-world problems so that both new knowledge outcomes and implementable innovations can be developed. Koskinen & Dorst (2015) propose four distinguishing features of Academic Design:

1. That Academic Design is situated between the field of design practice / problem solving and academic discussion; with the dual purpose of framing real-world problems and translating academic thoughts and discussion into (experimental) action. Through the 'modeling' of reality, abstracting from everyday problem solving creates a 'new vantage point'. Academic design practice develops models that 'express' new possible futures for the field, while the integration of design and experimental research can lead to new knowledge and radical innovations.
2. That Academic Design is a 'construction' born from the need to improve rigor in design research. Hence it is open to criticism from both 'parents', but particularly from professional practice where it may be perceived as a threat. This must be considered carefully, because, we in fact wish to improve the accountability and relevancy of academic design research within the industry.
3. That Academic Design is neither 'pure research' or 'applied research', but a response to the complex, farther reaching challenges faced by design professions, in more sophisticated ways than conventional practice can allow. In companies seeking to become design-led in their development of technologies, there is a shift from classic R&D (where design follows developments in science and technology), toward a (new) 'D&R' model (where design is required to lead investment in research and technology development.
4. That Academic Design can 'move' in and out of academia. It is essentially nomadic as academic design practitioners have a foot in practice as well as in universities.

Academic Design has yet to be fully defined and at the conclusion of their paper, Koskinen and Dorst (2015) concludes with the following questions.

- How could/should or will this new practice evolve?
- How will the other species - professional design and academic practices - adapt?
- Who will take the lead in the development of academic design?
- And will specific 'kinds' of academic design arise or should it be envisaged as dynamically adapting to where the issues are - not joined to particular fields of design practice?

We address some of those questions in this paper by studying a university design course that reflects the basic ideas behind Academic Design.

Product Design Practice as Academic Design

One way to answer these questions is by seeing Academic Design as a choice. For instance, *self-initiated design* relies on (background) experiential knowledge to set aspirations for forward progress (Walden & Kokotovich, 2012: see also Darke on *primary generators* 1979). In a study on self-initiated design projects by practicing design consultants by Walden (2015), it was found that the designers own experiential knowledge served as the source to 'initiating' the concept, but that the designer needed to develop appropriate domain specific and strategic knowledge to define the project (and the product) and set objectives. In the absence of a client (the definition of a self-initiated design project), industrial design consultants tend to 'fill-in' those other knowledge 'gaps' with the types of information that a client normally provides. That there is some evidence of the ability for designers to complete self-initiated design projects that are motivated by experiential knowledge, yet made operational by formulating new connections between existing and learned knowledge is noteworthy as a special type of problem formulation.

In these studies, knowledge generated in the process of designing remained the property of the designer, however. In contrast in an academically driven, research-based design project, we are interested in knowledge directives and not only exclusively, commercially viable outcomes and would prefer for designers to 'fill-in' (at least some of) those knowledge gaps - with design research and theory. We do not seek to deny acting on motivations formed in the experiential knowledge domain; but to direct its development by integrating appropriate design research and design theory – at first introduced *to* the student and later sourced by the students themselves. Understanding the unique way design differs from other academic disciplines, through the use of problem reasoning, can provides some guidance at the start of self-initiated design projects that attempt to integrate theory and practice.

A necessary vehicle of knowledge production in Academic Design is design work (Koskinen and Dorst, 2015). This notion has its roots in Constructive Design Research, defined as "design research in which construction - be it product, system, space, or media - takes center place and becomes the key means in constructing knowledge." (Koskinen, Zimmerman, Binder, Redström and Wensveen, 2011). Though the projects may be considered a form of "research through design" (Frayling, 1993), we refer to Constructive Design Research, as it offers a clearer and more precise description of the practice we intend to describe in this paper as well as in the classroom. Constructive Design Research explicitly requires the integration of theory to guide practice and denotes the 'central construction' referred to in the definition above, as (typically) a prototype of some form (Koskinen et al, 2011). A recent study of the operationalization of Constructive Design Research identifies that the

connection between knowledge and the 'experiment' (or the 'prototyping activity', as it would be in terms of product design practice) is iteratively developed through critical reflection and refocusing of the hypothesis (Bang, Krogh, Ludvigsen and Markussen, 2012). We use this finding to provide a useful structure for describing the key developmental stages in the following case study. Each prototype in the case study represents a clear refocusing of the hypothesis, critically analysed through the construction an improved iteration of the artifact. The dual outcome objective of Academic Design seems evident in this practice.

Example: A New Product Design Course as Academic Design

The Integrated Product Design (IPD) Program at the University of Technology Sydney, School of Design, introduced its first Honours Degree Program in 2016. The Honours Degree is a 1-year course (24 teaching weeks) that require students to work on a single capstone project, resulting in a research dissertation (approximately 15,000 words long) together with a prototype to be exhibited at the end of the year. The projects are presented to a panel of academics and external industry guests for assessment at key points during the year (mid-way and at the end of year 1; mid-way and at the end of year 2). The Honours Degree is only open to those students who achieve a weighted average mark of 72.5% in a relevant Bachelor (Design) Degree[1] or equivalent, and is intended to prepare students for design leadership roles in industry or further post-graduate study.

All projects are self-initiated and there is no specific design task or theme provided. The Honours Degree and the preparatory Bachelor's Degree have been developed by the IPD staff to improve the academic rigor of design research in connection with design practice. Students must establish and then argue their own basis for pursuing a particular design intervention. The course begins with the intention of providing two things concurrently – (1) an introduction and review of design research literature and (2) an acknowledgement of background knowledge and aspirations of the students. The design research and theory, selected by studio instructors or by the students themselves is interpreted and contextualized in connection with their individual projects, to appropriately achieve the learning objectives of the course, which are:

1. Create designs that innovate meanings and experiences.
2. Challenge product design convention and speculate future human-product interactions.
3. Develop a practice-orientated research methodology for product innovation.
4. Develop the ability to design, plan and craft accurate and appropriately refined prototypes.
5. Become accomplished at using prototyping methods as a central research device.
6. Manage a complex self-initiated design project responsibly and professionally.
7. Use design to engage a wide audience into the cultural dialogue.
8. Prepare excellent communication and presentation of process and designs for all deliverables.

[1] Applicants with a weighted average mark between 70-72.4% can lodge an application and may be offered a place at the Course Directors discretion and/or after successfully passing an interview where they must present a folio of work.

A developed aptitude for prototyping of three-dimensional physical models - from rough mock- ups through to more advanced iterations with a level of functionality - has long been a feature of the UTS Product Design Degree as it aligns with the strategic goals of the Faculty, most notably 'technology-led thinking with an emphasis on prototyping' and 'practice-oriented learning' (Lie and Walden, 2015).

The course further supports prototyping as a function of Constructive Design Research, in a product design context, by referring to prototyping as a central tool of design research and a core means of building connections between fields of knowledge (Stappers, 2007) and as having the potential to test (even embody) theory as 'physical hypotheses' (Overbeeke et al. 2006). A recent paper by Matthews and Wensveen (2015) also serves to define the role of prototyping in design research and referring to the descriptions they provide, the Honours Degree most predominately uses prototyping as means to generate research archetypes that are *physical embodiments of research concept, understanding or design research space*, for expository analysis. However, as can be seen in the case study included in this paper, the prototyping can additionally function (within the same project) as a vehicle of enquiry, *where the research contribution is tied to the process of crafting the artifacts,* for case analysis (Matthews and Wensveen, 2015). The integration of design and experimental research, to translate academic thoughts into experimental action (in a product design context), is made clearer through the adoption of a Constructive Design Research methodology, supported by literature that defines the role of prototyping in design research.

Academic Design as Project: A Case Study

The project described here is a capstone project developed in the IPD Honours Degree. The project produced a family of products and many more prototypes that we do not have the space to cover here, so the focus will be on the 'Beanz' Tray product. The project begins with a motivation to explore product-consumer attachment by investigating ways to elevate the meaning of products to people and the communities they live in. Broadly, it is a response to the unsustainable growth of consumerism, but soon focuses on the cultural connections with which we identify through materials, fabrication methods, forms and experiences expressed in certain products. The project is framed around research that suggests that if we design products that are more culturally relevant, they will be more highly valued, kept and maintained; rather than disposed of the moment their utility is superseded. Extending upon research by Schifferstein and Zwartkruis-Pelgrim (2008) the broad, initial hypothesis for the project is *that there is a process for appropriating Australian material histories and by doing so, new meanings can be formed that forge a strong and culturally binding consumer-product attachment*.

The first stage of prototyping is exemplified by the examples shown in Figure 2. Two timber trays for holding small items such as a wallet and keys, were made in exactly the same size, with the same form. One made from a piece of old, weathered timber and the other from a new piece of European beech. The design using recycled timber was machined so that the top edge was left unfinished, exposing the 'silvered' and splintered weathering of the material. Working with recycled timber means accepting that the material may behave in unpredictable ways and reveal imperfections underneath the surface. User testing suggests that those who preferred the recycled timber version were drawn to the product because it shows evidence of a history of past-use in the material, and an appreciation of the fact that each version of the product would be slightly different because control over the behavior of the material during processing is impossible.

Figure 2: **Storage Tray in recycled timber / European beech**
The above images are of two storage trays with exactly the same utility. The one on the left is made from a piece of recycled timber with the silvered and splintered surface exposed at the top. The one on the right from a new piece of European beech, finished in a modern way with smooth edges and surfaces.

This introduced the concept of 'rarity' and identified the need to strengthen the sense of embodied memory in the product realisation. The next series of prototypes would explore if an emotional bond might be formed by not only using recycled material, but appropriating old items for contemporary use. A new tray was designed using an old timber weatherboard, sourced from an old demolished house previously owned by a member of the designer's family. The 'weatherboard tray' was designed so that particular surfaces were left unfinished to reveal the material history. User testing with this design led to the exploration of strengthening the emotional bond between consumer and product by permitting the user to provide the source material. Building upon the previous research and extending upon it with inspiration from Mugge, Schoormans & Schifferstein (2009a), the hypothesis evolved to become, *that there is a co-design process for renewing personal product histories and by doing so, new meanings can be formed that forge a strong and culturally binding consumer-product attachment*. The designer conducted many experiments using different historical products and different materials, producing a series of outcomes.

Figure 3: **'Beanz' Tray**
The enamel baking tray pictured above was used as the basis to explore the introduction of personal items in the design process. Modifying historical products by machining them was substituted for molding leather over the tray as a means to explore ways of giving the product renewed meaning.

Part way through the project, the use of leather was decided upon for its ability to be moulded over surfaces, adopting their form and texture (Figure 3). The use of leather in this context is identified as a more appropriate way to invite users to transition from 'consumer' to 'prosumer' based on research by Toffler (1981) where he describes the prosumer as an individual who is both the producer and consumer of the product. Toffler's concept of the prosumer is built upon by Mugge, Schoormans & Schifferstein (2009b) in terms of the way product personalisation can stimulate emotional bonding with products as the product becomes an expression of the owner's identity.

The use of leather does not damage the original item but enables personalisation. Additionally, though other materials were tested, such as felt, the leather moulding, facilitates the accumulation of memories through the wear accumulated through recurring interactions (Mugge, Schoormans & Schifferstein, 2005). Through a series of prototypes, user testing and the development of various tools and techniques; not only with this 'tray' series but with other designs, the hypothesis further evolved *that there is a co-design process for renewing personal product histories through non-destructive replication of features to create new products with enriched meanings that forge a strong and culturally binding consumer-product attachment*.

Figure 4: '**Beanz' Tray with Leather Lid**
Experimentation through prototyping, of the evolved hypothesis leads to the above solution concept that uses the existing beans tray product, but augments it with a leather moulded lid accessory. The leather moulding is essentially a 'tracing' of the original product.

The next series of explorations, based on this evolved hypothesis leads to the development of solution concepts that are made up of two (primary) parts: the original (historical) item and new component made of a material that is moulded over the original product (Figure 4). The moulding is then trimmed and finished to augment the original product and renew the product both aesthetically and functionally. At this point in the project, the process becomes central to the nature of the innovation.

The moulding method acts as a metaphor for tracing history and through design, selectively determining what area of the original product to mould over (trace), is based on ensuring the moulding can be combined with the original product to augment and renew its meaning. A final and important stage of this project is experimenting with the innovation value of the process, so that it can be replicated across many historical items that carry cultural and

personal significance. A series of prototypes were produced that examined a further evolution of the hypothesis: *Tracing History is a co-design, co-production process for renewing personal product histories, through non-destructive replication of features, to create new products and product assemblies with enriched meanings that forge a strong and culturally binding consumer-product attachment*. This further evolution of the hypothesis recognizes the innovation of the process beyond the augmented product, and its potential value more broadly, to inform the design of new products that reference the old.

Figure 5: New Tray with Leather Lid made from 'Beanz' Tray tool.
The 'timber loop' used to brace the original enamel tray is further machined and finely finished in American Walnut to act as a base in a new version of the design. The tool becomes the product ending the cycle for this series.

The value of the process as a form of 'Tracing History' is given such reverence over the potentiality of the business case, that repeatability is abandoned, in the last ultimate step, by transforming the tooling itself to craft the final version of the product (Figure 5) - a production cycle of two iterations. The first, an assembly that brings together an old, valued item with a contemporary part generated by moulding over (tracing) the original artefact. The second, a completely new product that makes the tooling from the first iteration a base component in a new assembly that uses a second and final version of the moulding. A process that challenges the relationship between design and production. And designs responsibility to culture and history.

A Step Closer to Defining Academic Design?

The case study reported on in this paper may represent a form of Academic Design. Koskinen and Dorst (2015), identify four key features of Academic Design that can be found in certain knowledge intensive design projects, that do not seem to be precisely, either practice-oriented design research or industry practice – but some strange new *species* of design. These features of Academic Design are evident in the case study, though it's important to describe the presence of these features in connection with design research that explicate certain forms of practice, in order to use the case study as a step closer toward *defining* Academic Design.

The first feature of Academic Design is that it is situated between the field of design practice and the academic discussion with the dual purpose of framing real-world problems and translating academic thoughts into experimental action. New possible futures, innovations

and new knowledge are generated through 'models' that are formulated through design abduction – a form of problem reasoning unique to design, where the outcome can only initially be described in terms of a type of value and the, so called, 'what' and 'how' must be determined concurrently by framing 'patterns of relationships' between the components of the 'problem' in order to form a desired outcome (Dorst, 2013). Design Abduction may be a way of making sense of how motivations can be converted into hypotheses in the pursuit of knowledge directives, exposited through experiments or actions that take the form of prototypes in product design practice.

The case study project is a self-initiated design project where the integrity of the design intervention must be determined and rationalised by the designer. There is no 'client' or 'brief' provided at the start. The project begins with a motivation to address the *unsustainable increase of consumerism by investigating ways for product designers to improve product-consumer attachment, thereby encouraging people to keep and care for their products rather than dispose of them thoughtlessly or prematurely*. This intention broadly represents the nature of the 'value' in design abduction. Underlying this motivation is another motivation by the designer to work in a particular way, with particular materials and processes, based on their practical skills and experience.

A study of self-initiated design projects (Walden, 2015) identified that aspired ways of working, or aspired practices are necessary forenabling the designer to begin experimenting with ideas.[2] The experimental process (the second part of the motivation) provides the means of beginning to address the 'what' and 'how' parts of the design abduction 'equation'. Though there is concern that the forms of 'aspired' practice may not be best aligned with the 'value' being pursued, in this case project, the designer draws upon certain design research to form this alignment. Research by Schifferstein and Zwartkruis-Pelgrim (2008) on the attachment of gifts that 'reflect the receivers personal identity'; Mugge, Schoormans & Schifferstein (2007) on the value of the 'patina of materials aging gracefully' (additionally supported by Mugge et al. 2005, 2009a & 2009b research on product attachment); and Jung, Bardzell, Blevis, Pierce & Stolterman (2011) on the value of the 'aficionado-appeal' evident in products finely crafted in a means familiar to people; integrate to provide a credible reason for exploring the opening hypothesis with hand-crafted timber homewares.
It also sets the project in motion as a form of Constructive Design Research that adopts a (stable) prototyping methodology, close enough to industry practices that enables the prototyping to represent a form of research contribution tied to the processing of artifacts (Matthews and Wensveen, 2015), and by extension, a 'foot' in the real-world. Therefore, in the critical early stages of the project, there is the construction of a methodology, formulated into a 'model' of practice through design abduction that enables the dual pursuit of knowledge directives and real-world innovation of process and products. The nature of this methodology is clearly a form of Constructive Design Research that uses prototyping of product iterations (and challenges production conventions) as a central research device.

Further, as a proposed way of operationalizing Constructive Design Research, Bang, Krogh, Ludvigsen and Markussen, (2012) refer to the importance of motivations in forming hypotheses, to set research questions (knowledge directives) and evaluating those directives against knowledge in the evolution of hypothesis, through experimentation (or in our case

[2] We acknowledge that Academic Design must certainly also manage the practical elements of time and resource constraints, though we cannot delve into how these constraints factor into the these projects, within the scope of this paper. We consider this to be a worthwhile topic for future research.

product prototypes). They identify that motivational contexts come in many forms and (in Constructive Design Research) are more likely to be 'operationalised' through a practice-based approached rather than through a theoretical position. One of the motivational contexts they identify in their paper (2012) is *an ethical approach combined with a practice based and artistically inclined approach*, which closely resembles our case project.

Research on the role of hypothesis-making and motivational contexts by Bang, Krogh, Ludvigsen and Markussen (2012) supports the nature of design abduction and the dual-outcome 'model' evident in our case study and therefore enables the case study to provide the definition of one form of Academic Design modeled as Constructive Design Research. The second feature is that Academic Design is a 'construction' born from the need to improve rigor in design research. Evidence of this feature in the case study is provided by the learning objectives of the Honours Degree, notably, the objective to *use design to engage a wide audience into the cultural dialogue*. The requirements for meeting this objective, as explained to the students, was to produce through written dissertation and prototypes, forms of communication that invited new perspectives and discourse from academia, industry and the general public.

To be accountable to this wide audience, research methods need to be not only rigorous, but modeled to accommodate multiple outcomes, including knowledge outcomes. The third feature is that Academic Design is neither 'pure research' or 'applied research', but a response to the complex, farther reaching challenges faced by design professions, in more sophisticated ways than conventional practice can allow. The case study project does attempt to address an important issue facing society – consumerism and ecological sustainability – both from an economical and cultural perspective. And it attempts this by combining research methods in the way's Academic Design would require. However, here we potentially find conflict in the features of Academic Design, for if the Academic Design practitioner needs to have one foot in the real-world so that implementable innovations can be produced, does the extent of the 'reach' Academic Design hopes to achieve, become compromised if part of the 'real-world' problem is how the production and design of products must change for a heathier society. Based on the case we present in this paper, locating Academic Design close to the heart of product design and production processes may only achieve a 'step in the right direction' but perhaps not far reaching impact.
The fourth feature of Academic Design is that it can move in and out of academia. During the project conducted above, the student employed industry relevant fabrication methods to craft the prototypes (many more than can be shown here) of the project. An innovative process for connecting design intent and production methods have been devised through the project that certainly has industrial application at the same or larger scale. Additionally, the designer has now graduated and found permanent employment as a designer for a leading furniture manufacturing company, on the back of his project. And finally, this project along with twenty others exhibited at the end-of-year graduate exhibition led to the Integrated Product Design Program to be selected for the International Nachtmann NextGen Project. A design initiative that brings university-based design teams and industry together to develop new practices and products.

Academic Design as represented in this case study, does have important application and value to the concerns of industry practice and is a demonstration of the ways the project can move between academia and practice. Based on the arguments presented in this section, we propose that the case study does serve to define a form Academic Design in a Product Design and Design Education Context.

Conclusions and Further Research

We propose that the case study project presented in this paper represents a form of Academic Design. Identification of compatible features of the case study project and other independently conducted research on the nature Constructive Design Research (Koskinen et al. 2011), hypotheses-making, motivation and experimentation in self-initiated Constructive Design Research (Bang, Krogh, Ludvigsen and Markussen, 2012) and the role of prototypes and prototyping in design research (Matthews and Wensveen, 2015), we further hope to provide, through the case study, grounds for *defining* Academic Design in a Product Design and Design Education Context.

The case study can be proposed as a form of Academic Design because it demonstrates the primary features of Academic Design as proposed by Koskinen and Dorst (2015). The project (1) uses Design Abduction as its foundation to model a process to develop both knowledge outcomes and implementable innovation that addresses real-world issues. (2) It combines practical and theoretical knowledge in a functional response to improving rigor in design research. (3) It produces a 'model' (a framework) of value to industry practice - in terms of providing ways to radically innovate – that integrates 'pure research' and 'applied research' in a new form of hybrid design practice. And (4) it leads to the production of new knowledge that complies with the basic requirements for knowledge generation, stated by Manzini (2009) - knowledge that is explicit, discussable, transferrable and accumulate-able – in connection to the product and process innovation insights that have short-to-medium term application. A result of the project moving between two worlds – academia and industry.

In response to the questions about the future of Academic Design, put forward by Koskinen and Dorst (2015), we can only suggest partial answers for two of the four. We consider that based on the successful conduct of the case study presented in this paper, that Academic Design, should continue to evolve from within University-based design programs, though greater attention needs to be given to the practical constraints of time and resources, in relation to the disciplinarity of the Academic Design focus, and the requirement to ensure accountability to industry and professions. And in response to whether specific 'kinds' of academic design should arise or if it should be dynamically adaptable, we consider *that* to be highly dependent on how the resource constraints and related industry scope being addressed, is managed.

Though further research is required in this area, it may be that there are specific types of Academic Design because the contexts (as it was in the case study presented here) may be very restricted – not by design – but due to conditions and circumstances beyond the designers control. The significance of this study is that it identifies a bridge between Academic Design and Constructive Design Research that begins to *define* a possible mode of Academic Design practice. The research presented here may therefore open a potential gateway for defining Academic Design - this strange new species – more completely.

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