A place at the table for research through design

Jules Moloney¹

¹Deakin University
jules.moloney@gmail.com

Abstract. This paper addresses an issue that has been omnipresent in the history of CAAD research: the tension between scientific method and the design discipline in which it operates. Outside the CAAD community, research through design has been undertaken by a new generation. Through a discussion of research methodologies, a survey of CAAD activity and the examination of design projects, it is proposed that this provides a valuable opportunity to redress the balance between scientific and designerly modes of research and in so doing engage with a new generation of design computing researchers.

keywords: Research Through Design, Methods, CAAD History.

1 Introduction

2015 marks the thirtieth anniversary of the establishment of CAAD Futures. It is also the twentieth anniversary of CAADRIA, while ACADIA, ECAADE and SIGRADI were founded respectively 34, 32 and 18 years ago. These are substantial periods of activity and the organizations have been highly successful at advancing research and teaching of computer aided architectural design around the globe. My first engagement with these communities was attending the 1995 CAAD Futures conference in Singapore, on route to my first academic job after a decade in architectural practice. In many ways the 1995 conference was seminal: with the title of The Global Design Studio, the conference showcased virtual design studios enabled by the newly available ‘internet’; and a generation of researchers from the pioneering 70’s and 80’s reflected on progress; including Tom Maver’s infamous CAAD’s Seven Deadly Sins [1]. Twenty years on, another generational shift has occurred, alongside the ubiquitous use in practice of what were considered advanced computing techniques such as generative algorithms, real time visualization and computer aided manufacture. Given the majority of design is now undertaken through the computer, it is timely to consider the role and relevance of specialist CAAD research organizations. The position explored here is that the contemporary users of CAAD – young designers, practitioners and consultants – have much to offer. One potential way to engage with this new generation is to be more accommodating in the recognition of designing as a significant research activity. This position recognizes that much of the
cutting edge computational activity now occurs through expert users in the latter stages of their education or as recent graduates in practice.

This presentation is organized in three sections. In the first I note the dual heritage of CAAD- science and architecture - and locate the tension this has caused in relation to research method. From this I explore the establishment of research through design outside the CAAD community, through the contributions by Downton and Blythe. The framework has settled around a tripartite understanding of research: about (the methods, media and techniques that are used to carry out design); for (research that will enable design such as material, construction and performance simulation); and through design (where a project embeds significant understanding or insight that can in turn inform subsequent design research). A second section presents analysis of a survey of publications from the CAAD community since 1994, which locates the spread between research about, for and through design. This enables a comparison of activity within CAADRIA, ACADIA, eCAADe and CAAD Futures conferences. The final section examines examples of research through design, identifying a range of approaches. The aim of the paper is to stimulate discussion on how to engage the current generation of designers, who through innovative adaptation of digital technology are, arguably, the new experts.

2 Design Research Methods Inside and Outside CAAD

In a paper entitled the Dual Heritage of CAAD Thomas Kvan locates the founding of CAAD in science and the creative arts, and the tension between computational logic and the creative practices of designing.

‘On the one hand, we find ourselves in the culture of design in which discovery is observed as an ineffable act of creation, tested only in its manifestation. On the other hand, the artifacts of our research must be expressible in the definitive and unambiguous clarity of data and procedures, to be evaluated in the integrity of their reasoning.’[2]

Research methods are well established in relation to the scientific legacy and provide one robust and well established mechanism by which to evaluate quality. However, where designing as the method to undertake research is foregrounded, there is not the same level of agreement. In a series of CAADRIA presentations between 2009 and 2011 Thomas Fischer discussed the non-acceptance of research through design as a methodology within the CAAD community. Fischer highlighted the tension between the scientific bias of CAAD research and the typically subjective and circular methods used by designers. He locates alternate approaches to causality as the key issue, proposing that there are positives and negatives from an emphasis on linear (scientific) causality and circular (designerly) causality. His analysis is summarized by
way of a useful diagram (Figure 1) that articulates the problem for CAAD researchers. While circularity may lead to novel, exciting and adaptable outcomes, the approach is unpredictable, instable and unreliable. Hence as Fischer states, 'Much of CAAD, and neo-positivist scientific research in support of it, are preoccupied with the deployment of techniques developed to detect and enforce linear causation' [3]. This is reinforced by guidelines for paper reviewers that often include the requirement that the methods should be stated such that they can be reproducible. This requirement, while appropriate for linear scientific based methods, is typically not well articulated by those adopting circular design methods. Moreover, the emphasis on reproducibility or repeatability, while vital for science, is at odds with a design methodology that typically is either deliberately seeking a novel outcome, or the particular context will generate the novel redeployment of a design precedent.

Fischer cites the work of Nigel Cross, who is a key figure in the establishment of research through design outside the CAAD community. Cross in his seminal *Designerly Ways of Knowing* [4] set in 1984 a challenge for the design disciplines to develop an intellectual culture that can demonstrate standards of rigor that match those of the sciences. This challenge has been gradually taken up within the architectural design disciplines and while not fully mature, there is a growing body of thinking and exemplar research. At the vanguard are two institutions – the Bartlett School of Architecture and the Royal Melbourne Institute of Technology. Both have well established Doctoral programmes undertaken ‘by project’, where the outcomes are typically a series of designs interwoven with reflective commentary, which situates the design in relation to precedent and projects the trajectory for further design. While there are a growing number of publications articulating aspects of this agenda, Peter Downton’s *Design Research* provides (to my mind) a rigorous articulation of research through design, as distinct from research about or for design. Research about design focuses on the methods, media and techniques that are used to carry out design. This form of research will be very familiar to the CAAD community as arguably, research about the impact of the computer on architecture is the very genesis for the
identification of CAAD as a distinct field. Our proceedings and journals are thick with analysis of the impact of techniques enabled by computation and the methods (survey, interview, graphic analysis etc.) are well established. Alongside this, according to Downton’s study, research for design encompasses a distinct body of research that is undertaken to enable design. This includes site analysis, material and technology studies, and the building performance modelling, simulation and data analysis typically carried out in Architectural Science. Again, this mode of research is central to CAAD and the methods (empirical testing, calibration, etc.) are well understood and articulated by researchers. The third category of design research is underpinned by the logic of Downton’s opening sentence to his book.

‘Design is a way of inquiring, a way of producing knowing and knowledge; this means it is a way of researching.[5]’

Research through design typically examines a specific context to conceive and develop an architectural outcome that may be eventually realized, or it may be a ‘paper’ project produced for an ideas competition and/or as part a thesis. Presuming CAAD researchers have undertaken an architectural education and or worked in practice, designing will be familiar, albeit I suspect few would consider this a research activity in itself. As articulated by Fischer, research through design, without some form of scientific validation, would appear to be problematic for much of the CAAD community. According to Downton’s RMIT colleague Richard Blythe, the key to conceiving/designing as research is the critical reflection that accompanies and informs the design. He identifies three forms of reflection at play: reflection on previously completed designs; the intuitive reflection that accompanies the active design stage; and reflection that projects forward from the current project to suggest new designs. These three frames are identified separately as a way to understand the nuances of designing, but according to Blythe they are present simultaneously when designing, to produce a sophisticated ‘synthesised synthetic space[6]’ of research inquiry. Arguably, to meet the standard requirement for research that results are transmitted to others, the design researcher would need to articulate the reflective process as a commentary on the design. It is at this point that some difference can be perceived between the RMIT approach and that of the Bartlett, particularly in relation to the role of writing in research. For Jonathan Hill, Director of the Bartlett PhD programme, design research ‘has two inter-related elements of equal importance—a project and a text—that share a research theme and a productive relationship.[7]’ Thus the contribution to knowledge and its transmission to others is through a more or less equal weighting of text and design artefact (drawing, computer model, video etc.). This contrasts with the stance by Downton that design knowledge ‘has the distinct character of being embodied in the process of designing itself’ and that the ‘knowledge produced in design is stored, transmitted and learnt through works’[8]. The programmes at the Bartlett and RMIT
locate two points between which there is much middle ground. For example, our one year Masters thesis programme at VUW operates on guidelines of 75% weighting to the design component and 25% to the accompanying text (typically 12,000 words). We have found this strikes a balance between emphasizing the primary mode of research is communicated with design representations, but that the expectation is that critical reflection will be substantive: locating the project in relation to the particular design scope; and communicating the insight / knowledge achieved in the thesis.

In summary, outside the CAAD community there is a substantive intellectual culture that articulates methodologies, critique and precedent for research through design. This culture is still maturing and there is a valuable plurality of modes of operation within different parts of the worlds: the RIBA have identified guidelines for conceiving research in professional practice; there is a shift from individual design thesis to a collaborative research studio model in many US schools; while some Scandinavian researchers have explicit expectations for designing as research. There is substantial momentum—for example in the three schools of architecture in New Zealand where the final year of study is a full thesis, over 500 Design Research Mastersthesis have been completed in the last four years. This breadth and depth of activity provides an opportunity and a challenge for the CAAD community. Provocatively titled There is No such Thing as Digital Design, Neil Leach, in effect, predicts the demise of organizations such as ACADIA [9]. From this perspective, wheremost design is computational and much of the technical advances are now occurring within practice and the design studio, what role will traditional CAAD organizations play? My view is that the acceptance of research through design provides a valuable opportunity to redress the balance identified by Fischer, and refresh the established CAAD organisations. The challenge is to find ways in whichthe positives of circular (designerly) causalityand linear (scientific) causality can mutually inform a new generation of CAAD research.

3 Trends within CAAD research 1984-2014

As a way forward, this next section tests Fischer’s observations that research through design has been marginalized by the dominance of scientific research paradigms and methods. This is undertaken by a targeted survey of publications since 1994 taking in CAAD Futures, ACADIA, eCAADe, CAADRIA and SIGraDi. The aspiration to obtain a useful snapshot of activity across such a timeline and involving five different organizations, has proved challenging. While Cumincad provides an extremely useful resource of all the relevant publications, there is no rigorous cataloguing system in place. The aim at the start of the survey was to use Downton’s classification of research about, for and through design to identify trends over time and any points of difference between each of the organizations. This would be reliant on the consistent use of keywords across thousands of papers, and it soon became apparent this was not
the case. In order to progress a trial and error approach was utilized, using keywords that appeared in publications that met Downton’s definitions. Through a process of trial and error a range of keywords were identified that enabled a sample of approximately 10%. The five sets of keywords used in the survey were prototype, project, practice, architectural design, design method, and design process. These keywords resulted in identifying 642 publications from a total of 6741 within the period 1994 – 2014. Each of these publications were categorized as primarily using a methodology about, for or through design. In most cases this could be ascertained through the abstract and where it was not obvious the full paper was reviewed. In some cases multiple modes of research were present and for these as long as there was a strong applied design component they were indexed as through design. A summary of the results of the survey are illustrated in figure 2.

Fig. 2. Indicative trends from 1994 – 2014 identified by keywords (prototype; project; practice; architectural design; design method; design process) indexed as about, for or through design.
It must be emphasized that the survey was intended to identify research through design as defined by Downton and to locate indicative trends over time and between CAAD organization. In this it serves its purpose, but it should not be considered authoritative. The results confirm expectation in terms of a dominance of research about design representing approximately 67%. Research for design was the focus of approximately 9%, likely reflecting the choice of keywords that avoided simulation, materials and others identifiable with such enabling research. Conversely, due to the targeting of key words, approximately 24% of the sample included a significant research through design component. While this cannot be considered definitive, some trends over time and differentiation between between organizations are identifiable. Below is a discussion of these trends with an interpretation in relation to the regional characteristics and tendencies, as observed by the author.

CAAD Futures has had minimal presence of papers that have a focus on research through design. It could be surmised that occurring bi-annually and typically attracting established researchers, that the scrutiny is higher and either the conference is not attractive to designers, or they do not get accepted. ACADIA has intermittent presence with a noticeable bulge in 2014. My observation is that ACADIA conferences have typically been more rigorous in selecting papers that directly address the yearly theme and preoccupation of the hosting institution(s), which might explain the intermittence. The hosts of the 2014 ACADIA conference—the University of Southern California—selected renowned designer Zaha Hadid as the main keynote and marketed the venue Los Angeles as ‘a global center of progressive design in architecture’ [10]. These factors are likely to explain the comparative number of research through design papers identified in that year. eCAADe has had the most consistent presence over the time surveyed, with a growing number of papers that foreground design as the vehicle for inquiry. My experience of attending multiple eCAADe conferences is that there generally is a greater range of topics and mix of academics and design professionals. It is also unique in that the review for acceptance is based on an extended abstract, rather than a full paper review. In contrast CAADRIA has until recently, not attracted designers or found research through design papers acceptable. This perhaps can be explained by the focus of CAADRIA on supporting young regional researchers and PhD students, who typically are working in institutions that have a tradition of science and engineering. These include Asian universities and a number of Australasian universities founded on design science, as evidenced by the long established Australian and New Zealand Architectural Science Association. SIGraDi has a similar trend to that of CAADRIA, with a noticeable increase in ‘hits’ in the last several years based on the keyword search. While I have not attended this conference, SIGraDi is differentiated from its sister organizations by an emphasis on graphics, rather than architecture per se. This perhaps, has resulted in less architectural design-led publications.
The intent of the survey was to evaluate Fischer’s observations that CAAD researchers (as quoted earlier) ‘are preoccupied with the deployment of techniques developed to detect and enforce linear causation’. This certainly would appear to be the case for CAADRIA, the conference in which Fischer presented his critique. In other institutions, notably eCAADe and at times ACADIA it would appear circular (designerly) research methods are to varying degrees present. However CAAD Futures, considered by most the premier conference in CAAD, almost entirely consists of research that adopts scientific research methods.

The differentiation between regional organizations observed above is not necessarily an issue, and indeed may well be celebrated by many. It must also be noted that research through design is not universally accepted in mainstream architectural research. The motivation for highlighting the dominance of scientific paradigms in our organizations is that this would appear to be excluding much of the computer aided architectural design of the current generation. Their introduction to computing has typically occurred in a design focused environment, where the customization of software through graphic programming interfaces and experimentation with rapid prototyping techniques is the norm. While these young designers may be considered ‘mere users’, many are pushing the boundaries of design computing in a way that is innovative and directly relevant to practice.

4 Design Research Examples

This final section discusses two research through design publications located in the survey that illustrate a practice inspired project and a design thesis project. This is followed by a further example by a young designer outside the CAAD community. The objective is to briefly discuss some typical examples of research through design.

The first project will be known to many CAAD researchers – the AegisHyposurface©. The documentation of this design-led research was presented at the 2001 ACADIA conference. The project team was led by Mark Gaulthorpe who at the time was the director of a small practice dECOi Architects. dECOi won a competition that conceived a kinetic surface that could be used to visualize patterns, graphics and text as a dynamic relief. While there are precedents in the mechanical televisions of the 1920’s, this was the first time that an architectural surface would embed real time graphics. It has since stimulated a number of other prototypes and led to significant research into interactive architecture. The design led to a number of technical innovations in order to be realized, involving collaborative research from mathematicians, and multiple engineering disciplines – structural, rubber, adhesive, and pneumatic[11]. This is a seminal example of a design that has led to advances in computation and stimulated much further research. In conclusion Gaulthorpe reflects on the wider implications for the research in terms of interdisciplinary collaboration.
So, perhaps the most innovative aspect of the device... is simply the revolution in creative process that it celebrates. A group of 'local' thinkers have come to understand the value and kinship of interdisciplinary partnership...[12]

Fig. 3. Design for AegisHyposurface©. (Gaultorpe, 2001)

The second example is a Masters design thesis project under my supervision, where the student was encouraged to publish the research. The project was documented with my editorial assistance and submitted to CAADRIA where it was rejected in the review process. Subsequently the same paper was submitted to eCAADe where it was accepted and presented [13]. The context in which this project was undertaken is the legacy of South Indian temple design. The carved temple walls developed by the people of the Hindu culture existed as a tool to document and dictate a way of living. Trying to reproduce the temple, in particular the intricately carved surfaces, requires the architectural skin to either lose fidelity through compromise in craft or require an enormous budget. The project proposed that by translating traditional handcraft ideologies to the digital medium of augmented reality, the traditional role of temple architecture could be realized in contemporary architecture. This proposition was explored through designs and technology mockups. From these designs the student reflected on the wider implications. He proposed the design precedent opens up a complimentary field of research within a cultural context, which can be considered as a form of cultural augmentation, to set a new agenda for mixed reality in architecture. Further reflection was undertaken on the range of ways in which AR had been conceived in the design: urban, building, wall and artefact. While the scalar strategy has been developed in relation to the traditional role of the temple, it was proposed that the design provides a basis for others to consider in terms
of the use of augmented reality as an active component of architecture. This was abstracted in terms of a diagram where augmentation can be considered as a continuum from the urban scale to that of an individual artefact.

The third example, taken from outside the CAAD community is a PhD by project, undertaken by Roland Snooks at RMIT University, which engages ‘with complex systems, generative design strategies and algorithmic techniques ... a process of embedding architectural design intention within generative algorithms[14].’

The designs embeds novel computational techniques that are captured by the phrase Behavioural Formation, the title of the thesis. While this is not an original concept, some of the tactics used by the candidate to intervene as a designer in the algorithmic process are. In particular the combination of explicit modelling and algorithmic procedures referred to as ‘strange feedback’ and ‘manifold swarms’. These and other strategies enable the candidate to imbue his architectural designs with a novel formal aesthetic. While the algorithms do not appear to be substantial, their application with an architectural design context is. In particular the candidate has contributed to discourse within a lineage of researchers who have explored generative algorithmic tactics based on the metaphor of the garden: John Frazerand his packet of seeds approach [15]; Richard Latham’s analogy of the designers as gardener, pruning and shaping form [16]; while Roland Snook’s tactics include the mechanism of the scaffold or trellis, around which generated form can coalesce. Snook’s research is
included in this discussion as an example of the sophisticated use of design computing within the current generation. This generation are typically not aware of the CAAD organizations, nor generally of the large body of design computing that, in effect, has underpinned their design explorations. While this ignorance of precedent breaks one of Tom Maver’s sins, the uninhibited tuning of algorithms in pursuit of a design agenda can, as evidenced by Snook’s projects, make a significant contribution to this legacy.

Fig. 6. Volatile formation (Snooks, 2012)

5 Concluding Remarks

This paper addresses an issue that has been omnipresent in the history of CAAD research: the tension between scientific method and the design discipline in which it operates. In Kvan’s elegant description of this dichotomy, he refers to the outcome of design computing as artefacts ‘expressible in the definitive and unambiguous clarity of data and procedures, to be evaluated in the integrity of their reasoning.’ The use of the word artefact is interesting, in that it is the same term used by many design researchers in the context of arguing that knowledge is embedded in the artefacts resulting from designing – drawings, models and ultimately buildings. The requirement for integrity and reasoning is also present and, as identified by Blythe, lies in the critical reflection that precedes, accompanies and follows the act of design. The examples briefly reviewed above illustrate how this reflection can be of value to
the agenda of CAAD research, beyond the individual design project or thesis. From a wider perspective, arguably, the establishment of CAAD was in response to issues that came from designing, in particular the complexity of large scale building with a high servicing component. This argument can be traced further back through the example of Mark Burry’s innovative research in realizing the Sagrada Familia. Without Gaudí’s 100 year old design Burry’s 1993 paper ‘The need to Step Beyond Conventional Architectural Software’ [17] is unlikely to have been published, and with it a substantial body of research. The issues raised here are far more complex than presented, but it is hoped that this stimulates some reflection by the CAAD community on the potential of engaging with a new generation of designers who use computers as a research medium.

References