IDSA

DISCOVERING NEW KNOWLEDGE THAT'S ACTUALLY USEFUL

CASE STUDIES OF ACADEMIC RESEARCH THROUGH AND FOR INDUSTRIAL DESIGN PRACTICE WITH IMPACT BEYOND JOURNAL PUBLICATION

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PAPER ABSTRACT: The last 30 years have seen significant expansion of academic design research. This has been on a general level, such as ways in which designers think and the nature of design knowledge, but also in the practitioner disciplines, including industrial design. Having witnessed and been an active player in this evolution, it has become increasingly apparent that much of this research is for consumption and application within the academic research community, with little or no practical relevance to the activities of IDSA members – be they students, educators or practitioners. Using three case studies undertaken by the author, this paper explores approaches to academic research that can engage and benefit IDSA members at all levels; demonstrating that creative practice can contribute to a research methodology and that outputs can have significant impact beyond academic journal publication. Through the narrative of the paper and links to resources for the case studies, its aim is to provide information and inspiration for educators to adopt similar approaches. The case studies focus on research through and for industrial design, providing evidence of credible engagement with hands-on practice and impact that has been validated by key stakeholders. They demonstrate that, despite the lofty ambition of the quest for new knowledge, the methodologies of academic research can be relatively straightforward and can be of direct relevance to practice as understood by IDSA and its members.

Keywords: Academic research, practice, impact, industrial design, case studies

1. INTRODUCTION

Having made the transition from practice to education, in the late-1990s a decision was made to become one of the first candidates to undertake a PhD in industrial design. As a research-based degree with a written thesis, the prospect of countless hours in the library followed by collecting/analysing data and writing-up was somewhat daunting. Faced with five years of part-time study that would take time away from hands-on designing, a personal decision was made to explore the potential to do this as part of the PhD. With guidance from the late Bruce Archer, a highly respected professor at the Royal College of Art in the UK, and creative approach to the methodology used for data collection, the design of four products was integrated within the research and the doctorate awarded in 2002. This became the starting point for a broadening of responsibilities where, in addition to teaching, it was possible to

supervise PhD students and undertake academic research that, unlike commercial research, required in-depth preparatory literature review, transparent/rigorous methodology, with applications for funding and journal papers being subjected to peer review. Any projects involving the integration of practice therefore needed to comply with the requirements of academic research.

The reason for providing this potted history of an academic journey is because it demonstrates that the potential to generate 'new knowledge', the goal of academic research, 'through' industrial design practice is not new. In fact, as the PhD topic was exploring how the then emerging technology of rapid prototyping might be integrated within practice, the aim of the study was actually 'for' industrial design. However, despite the capacity to have impact through and for practice, having attended more than 60 academic conferences, organised one, examined 21 PhDs and served as an editorial board member for two leading journals, it appears that academic research is increasingly distancing itself from what we in the IDSA understand and value as professional practice. In fact, academic research appears to be moving to serve itself - the academic world - as opposed to making a practical/significant contribution to industrial design education and the profession. By their very nature, academic journal papers are not the most dynamic or appealing of reads for those operating in a creative discipline. It is therefore necessary to think about ways in which to communicate outcomes from academic research to the community of students, educators and practitioners. Whenever possible, every effort has been made to include or translate outcomes and outputs from research into media that can be readily understood and be validated by these groups, such as products, app, cards, exhibition, and video. Ensuring impact beyond academic journal publication is central to this approach, despite the fact that this would still end-up as an academic journal paper as part of the peer validation process and role as an academic.

To compare and contrast approaches, outputs, impact and engagement with practice of relevance to IDSA members, this paper takes a case study approach with projects from real-life contexts (Yin, 1989). It provides examples of academic research through and for industrial design practice, with impact beyond journal publication through three case studies that have been undertaken in which students, graduates and practitioners have been central to data collection via design practice, expert validation and tool use. Just as academic journal publication provides validation through peer review, the case studies demonstrate alternative but equally valid options such as through professional society, design award and exhibition, with data related to uptake and use as opposed to citation. These case studies all start with the key research question and include links to online content that provide further information.

2. THINKING MATERIALS

Q: How can value be added to indigenous materials in Africa to generate new employment opportunities?

Funded by UK Arts and Humanities Research Council (AHRC) through its Global Challenges and Research Fund, the aim of the Thinking Materials project was to explore how industrial design could add value to indigenous sustainable materials in Low and Middle Income Countries (LMICs) through the identification

of innovative new export product opportunities. Much needed employment would then be created through the ensuing supply chains. In addition to two UK-based universities, there were three academic collaborators based in Kenya, Uganda, Indonesia and Turkey (all LMICs). Following a documented materials audit in all four LMICs to list and categorise available resources, brainstorming and co-design supported by final year industrial design students generated concepts for innovative materials-led products with which to demonstrate the commercial potential of sustainable indigenous materials and stimulate entrepreneurship through their dissemination. The support (and talent) provided by the students was central to the quality of the design outcomes. Without their contribution, it is fair to say that the project would not have been economically viable as the cost of employing an agency was beyond the budget available from the UK government funder. Needless to say, students received much appreciated remuneration for their efforts and an additional project for their portfolio/resume. Examples of two of the product opportunities generated by the students are shown in Figure 1 - a speaker enclosure produced from gourds/simple metalwork and a disposable coffee cup from moulded sugar cane fibre pulp with stitched palm leaf for the heat shield.

Figure 1. Speaker enclosure produced from gourds/simple metalwork and a disposable coffee cup from moulded sugar cane fibre pulp with stitched palm leaf for the heat shield.

The outcome from the materials audit and product design was the Thinking Materials resource that identifies 39 creative product opportunities designed to make extensive use of indigenous materials and crafts as alternatives to more conventional, high volume and often polymer-based manufacturing processes. The resource was translated into an open access web-based format, but the limited availability of computing in LMICs necessitated an additional low-cost and readily distributed option. This was achieved through a paper-based, fold-out tool that embedded the same levels of information as the online solution.

The resource demonstrates the potential for supply chains in which an LMIC is always the country of origin for the manufacture of a product and growth/production of materials. When using the tool-based resources, highlighted ‘manufacturing’ tabs identify the product as being produced using one of three scenarios: Full In-Country, Partial In-Country, or Overseas. Highlighted ‘material’ tabs identify the generic nature of materials used in the manufacturing process, with C/S/G being an abbreviation for

ceramic, stone or glass. To facilitate effective communication, each product concept card is identified with a number, title, product image and brief description. The opened-up fold-out tool can be seen in Figure 2. Following the launch of the initiative with presentations and exhibitions in Kenya, Uganda, Indonesia and Turkey, copies of the physical fold-out tool were distributed to all 146 LMICs around the world. The project was also exhibited at the UK Research Innovation AHRC Design Research Showcase at the 2018 London Design Festival. Further details on the project are available at www.thinkingmaterials.net

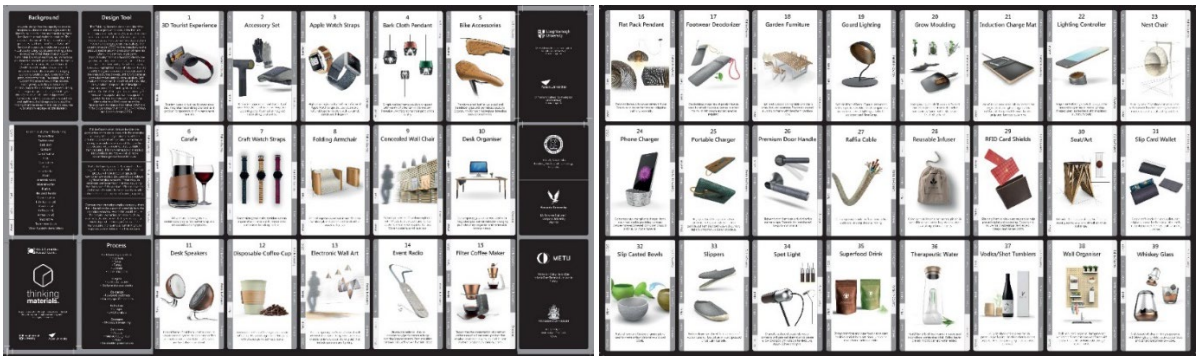

Figure 2. Folded-out Thinking Materials design tool

3. CIRCULAR PLASTIC

Q: How can a circular economy be supported in Africa by translating waste water bottles into in useful products?

The Circular Plastics project was a collaboration between three universities and one NGO in the UK, with project partners in Kenya, Rwanda and Nigeria. Funded the UK Engineering and Physical Sciences Research Council (EPSRC) through its Global Challenges and Research Fund, its aim was to develop an integrated industrial design and technology-led strategy to transform used plastic water bottles into products to support entrepreneurship in LMICs. The approach was based on adding value to plastic waste through its conversion into 3D printer filament using an extruding process developed by the team to meet the distinctive requirements and limited resources of LMICs. Prior to the extrusion process, it was necessary to devise ways in which waste water bottles would be collected, washed and shredded. Notwithstanding the technical challenges, this had the potential to generate significant employment opportunities.

Despite the travel restrictions due to the Covid-19 pandemic, with project team members based in Rwanda, Nigeria and Kenya, it was still possible to undertake the planned technical development of the filament extruder and co-design activities with communities in the three countries. These team members were also able to undertake co-design activity to generate product opportunities with a variety of community groups. As with the Thinking Materials project, the limited budget to fund high quality industrial design would not stretch to the use of an agency and this was achieved by recruiting

on short-term contracts two recent but capable graduates from UK design schools who had not yet secured permanent employment. Fortunately for the project, one of the graduates had joint UK/Kenyan citizenship and able to circumvent Covid-19 restrictions to travel between the two countries to support prototype testing.

The outcomes were what might be described as niche products to solve real problems at community level for which volume-focused manufacturing processes would not be viable. Acknowledging that there was a bigger picture to the project that economic viability alone (promotion of self-sustaining employment, entrepreneurship, sustainability), six products were developed for the agriculture, mineral extraction, fishing and mobility sectors:

Adaptable boat baler - The use of dilapidated boats can lead to sinking and loss of life. The boat baler uses discarded drinks bottles to enable the roll and pitch of the boat to pump out water through a syphoning action. A degree of customisation enables these to fit varying sizes of gunwales of typical boats and sizes of bottles.

Non-electric milk cooler - Milk quickly goes off in tropical heat due to the scarcity of electricity and refrigeration. The complexities of structures in the milk cooler made possible by 3D printing create a matrix for the rapid evaporation of water for powerless cooling.

Customised machete peeler - The machete has a tendency to remove a significant amount of produce when peeling vegetables such as cassava. This is significantly reduced by presenting the cutting edge at the optimum angle for the food that is being peeled.

Sand dredging adaptor - Manual sand dredging for the building industry provides much needed employment. The efficiency of sand-dredging is increased with a customised scoop that fits the profiles of locally available buckets to help funnel the sand and quickly allow water to escape.

Modular fish farm system - Aquaculture enables small-scale enterprises to rear fish for sale in local markets. An expandable system that integrates single component floats and connectors uses a central void for buoyancy and can be tailored to locally available bamboo/reed to connect components together.

Customised fruit picker - Fruit harvesting has a high likelihood of damage resulting in significant loss of saleable product. A long-reach attachment was developed with tangs that can be customised for specific fruits and a pole attachment socket matched to locally sourced materials. First concepts for the customized fruit picker can be seen in Figure 3 and prototype testing in Kenya in Figure 4.

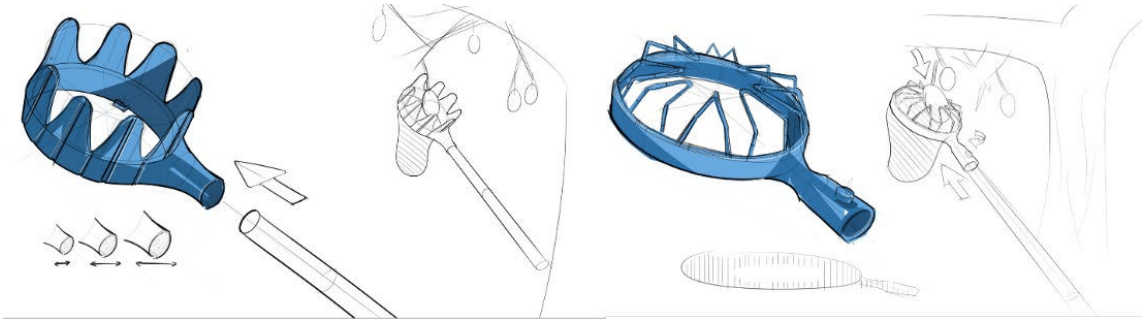

Figure 3. Fruit Picker concepts

Figure 4. Fruit picker prototype testing

As with the Thinking Materials project, the experience gained by the two industrial designers provided valuable content for their portfolios and resumes.

In addition to providing a specification for a mobile manufacturing unit that could travel to communities to co-design/develop needed products and utilise waste material in their manufacture, workshops in the African countries confirmed contribution of the approach and provided training in the underpinning technologies. The project was awarded a silver in the 2021 International Design Excellence Awards (IDEA). Further details on the project are available at www.circularplastic.net

4. ID CARDS

Q: How can communication be improved during new product development?

The starting point for the development of the iD Cards was a PhD that had been supervised by the author to explore the nature of collaboration during new product development and opportunities to make this more effective. The literature review for the study identified the problematic nature of collaboration between industrial designers and engineering designers (Jevnaker, 1998; Persson and Warell, 2003), with differences in understanding and use of design representation being a key issue.

Observations during the PhD for the commercial design of a product by industrial designers and engineering designers within a consultancy setting were used to obtain detailed insights into underlying issues. Analysis of the results identified that a lack of common language in design representations made it difficult for the two groups to collaborate on a number of levels. This resulted in a knowledge framework embodied in a card-based tool that identified the key stages of new product development (concept design, design development, embodiment design, specification); key types of design or technical information to be communicated; and 34 of the most significant design representations grouped as sketches, drawings, models and prototypes.

The card-based knowledge framework was validated through 15 semi-structured interviews with senior educators and practitioners with results indicating that it would provide a common ground in design

representations and contribute to collaboration. After refinement into a more usable tool, it was validated through a case study during in which the card-based tool was used during a client-based project.

Having noted the contribution of the tool but limitations of it as a practical resource due to cost and complexity, on completion of the PhD I produced a revised graphic design solution for a low cost, fold-out, card-based solution with the potential for commercialisation. A significant feature of the revised design was the inclusion of images of examples for each type of design representation that was produced during capstone project work by the author's undergraduate students. This proved to be a significant resource without which the revised tool might not have been viable.

Using some but not all data from the PhD, the iD Cards design tool was prototyped and, following extensive presentations and discussions with IDSA members, was validated by its Board of Directors. The way in which the 34 iD Cards deliver standardised information on design representations can be seen in Figure 5. This image is also used on the fold-out cards.

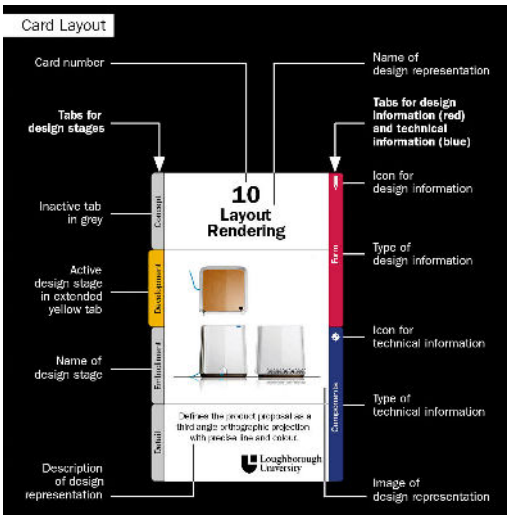

Figure 5. Image used on fold-out iD Cards to demonstrate the embedded information

Validation by IDSA enabled the tool to be distributed to 5000 members, content used to define the profession on its website and converted to PDF for open access on the website at https://www.idsa.org/sites/default/files/IDSA%20iD%20Cards.pdf

In response to demand, funding from the UK Higher Education Funding Council enabled translation into an app that had over 18000 users in its first two years and received recognition through promotion by organisations that include Design Denmark, German Design Council, Ornamo Finland, British Industrial Design Association and Design Institute Australia. The splash screen and four example images from the Sketches, Drawings, Models and Prototypes sections of the app can be seen in Figure 6 with a short video of app functionality at: https://www.youtube.com/watch?v=ZgvjhywMSwY

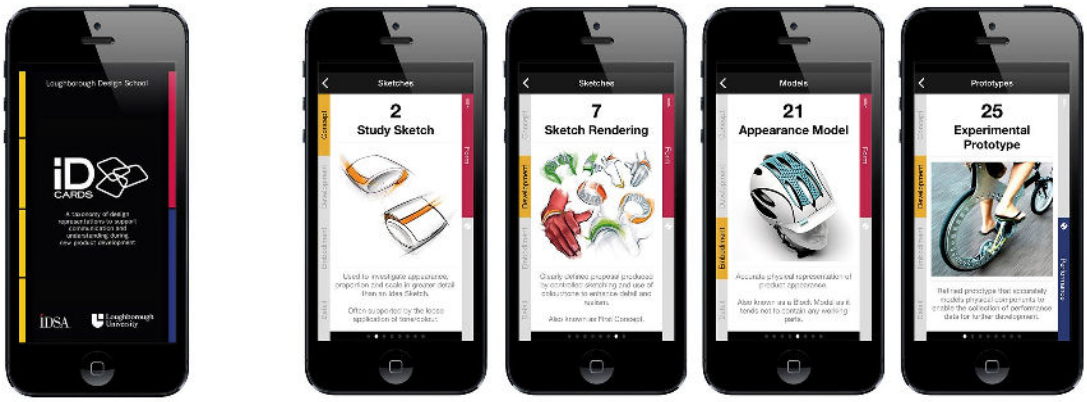

*Figure 6. S*plash screen and four example images from the Sketches, Drawings, Models and Prototypes sections of iD Cards app

5. CONCLUSIONS

Academic research through and for industrial design has the capacity to employ the unique capabilities of the profession in support of research methods to not only generate 'new knowledge' but translate theory to practical solutions that have impact above and beyond that of journal publication. It also has the capacity to engage a number of stakeholders within the methodology – from students (Thinking Materials) to recent graduates (Circular Plastic) and practitioners (iD Cards). In summarising the findings from these cases studies to provide direction for educators wishing to explore similar approaches, it is possible to conclude that:

- There are opportunities for educators with expertise as practitioners (not necessarily with PhDs) to engage in academic research to ensure that the future needs of the profession are met
- Engagement with practice based/led research ensures that educators maintain a connection with the core of the discipline
- Involving students in academic research provides an opportunity to employ core industrial design skills in unfamiliar and challenging contexts e.g. defined material/manufacturing resources that must be transformed into innovative products to meet new market opportunities
- Recent graduates can attain commercial experience with the potential to add designs from forward-thinking research to their resume/portfolio
- Practitioners can get access to new tools and resources that have been validated by their peers
- Methodologies for academic research are different to those of professional research but the high degree of overlap can make for a relatively straightforward transition

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