THE VALUE OF DESIGN RESEARCH

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DESIGNERS DON'T DO JOURNALS: CASE STUDIES IN THE DEVELOPMENT OF RESEARCH-BASED RESOURCES TO SUPPORT DESIGN PRACTICE AND EDUCATION

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ABSTRACT

This paper is in response to two positions relating to the dissemination of academic research that was undertaken in the interest of the visually creative design practitioner (e.g. industrial, graphic, fashion design). The first is that creative practitioners outside of academia do not generally read academic journals where research activity is presented. The second is that, in global design schools, there are educators whose role is to focus on the teaching and learning of professional practice with no remit to undertake academic research and, again, have no need to read academic journals. This paper identifies approaches whereby the outputs from academic research can be made accessible to the practitioner community through the presentation of four case studies. Print production, video, web, app and pdf downloads are identified as resources that have been developed by the Design Practice Research Group at Loughborough University to translate published academic research into formats that facilitate open access. The case studies identify Digital Industrial Design (a web-based resource for entirely digital modelling methods); CoLab (a designer/engineer web-based collaboration tool); iD Cards (a tool to support communication and understanding using a graphic design solution embedded as an iPhone/Android app, pdf download, physical cards, video); and Design Practice Research Case Studies (a web-based/pdf resource to demonstrate the contribution of practice-led PhD research). The paper concludes that whilst considerable effort may be required to translate academic research into resources for the practitioner/educator community, this step performs an essential role in terms of validation and impact.

Keywords: *Impact, design resources, design tools, case studies, design practice*

1 INTRODUCTION

'Publish or perish' is still very much the watchword for progression at research-led universities, despite a broadening in the scope of academic disciplines and, in particular, the emergence of university-based vocational undergraduate education. In the United Kingdom in particular, design entered the mainstream of academic research with the 1992 Further and Higher Education Act that enabled the vocationally orientated polytechnics (where the design disciplines were largely based) to become universities. With university status came the ability to award their own PhDs and a remit to undertake academic research which then became linked to the allocation of central government funding.

Whilst the author acknowledges the role and contribution of academic publication, an irony exists in that papers are published that claim to support the design practitioner (professional or educator) who does not generally read academic journals, even when open access. This paper acknowledges that designers as identified do not read journals and explores alternative strategies to make the outcomes of academic research accessible. This is achieved by the presentation of four descriptive case studies in which open access app, web, pdf, print production and video resources were employed in addition to conventional journal publication.

2 DIGITAL INDUSTRIAL DESIGN (DID) – A WEB-BASED RESOURCE FOR ENTIRELY DIGITAL MODELLING METHODS

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Incremental growth has resulted in a wide variety of digital tools that have the capacity to impact on the activities associated with professional industrial and product design practice (Aldoy, 2011; Aldoy and Evans, 2011) thereby, "enabling designers and engineers to explore and push the limits of product form and visual complexity, to evaluate better and to test more accurately" (Bryden, 2014). Despite this capability and the ambitious claims of software and hardware developers, professional practice in industrial and product design continues to be undertaken using a hybrid approach that integrates both digital and non-digital techniques (Hallgrimmson, 2012; Aldoy and Evans, 2011). One of the reasons for this is that the commercial constraints of professional practice necessitate the use of proven techniques when working in a commercial context. This can result in resistance to change due to the risk posed if design solutions fail to be delivered on time and to specification (Jerrard et al, 2008). In contrast, academic research that employs design activity is not constrained by a client/practitioner relationship and has the potential to make a significant contribution to issues relating to practice that cannot readily be explored in a commercial environment. This approach fits within what can be referred to as 'practice-led research' in which, "the professional and/or creative practices of art, design or architecture play an instrumental part in the inquiry" (Rust et al, 2007). Archer (2004) identifies this as, "research through art and design which, for certain research questions, is the most appropriate approach to data collection".

A key contribution of academic research to design practice is in the impartial evaluation of new methods and approaches that have the potential to disrupt existing practice and identify opportunities for paradigm shift. The competitive and closed nature of professional practice also means that it has a natural tendency to evolve without open reflection and academic research can make a significant contribution to exploring the potential for change.

Academic research has a history of reporting on the emergence of individual design technologies and their potential to impact on practice. There is therefore an inherent value in the contextualisation of activities that must be undertaken before and after the proposed intervention to avoid exposure of a partial picture. To fully contextualise and build on stand-alone studies that have partially explored the role and contribution of digital methods to professional practice, this paper reports on a research project to investigate the potential for a complete model of practice in which all core activities of industrial design are undertaken using only digital methods. It is acknowledged that this represents a somewhat provocative approach as opinion is divided on the capacity of digital methods to replace established non-digital techniques. In developing the methodology for the study, the research sought to answer what digital tools and methods are available to replicate those of non-digital industrial design practice; how should digital tools and methods be employed to support an entirely digital approach to industrial design; and what are the key issues arising from the implementation of an entirely digital approach to industrial design?

Having developed a theoretical methodological approach, this was used as the basis for a complete industrial design case study that explored the potential to operate entirely digitally using two contrasting stylistic directions (Geometric and Organic). This included the use of a haptic feedback device to emulate workshop-based sketch modelling and the production of a full colour low fidelity

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appearance model as an alternative to a fabricated/painted appearance model. The process resulted in the production of significant material arising from the DID phases. The DID approach plus the designed outcomes were considered to be of value to students, educators, practitioners and researchers which led to a web-based tool being developed to demonstrate the process and outcomes. This included the phases of DID in the context of Concept Generation, Design Development and Specification; thumbnail images of the designed outputs that could be enlarged for greater clarity; and a brief overview of the project. The three phases of DID with thumbnail images of the designed outcomes can be seen in Figure 1 with an enlarged image over a greyed-out background for an Organic Rendering in Figure 2.

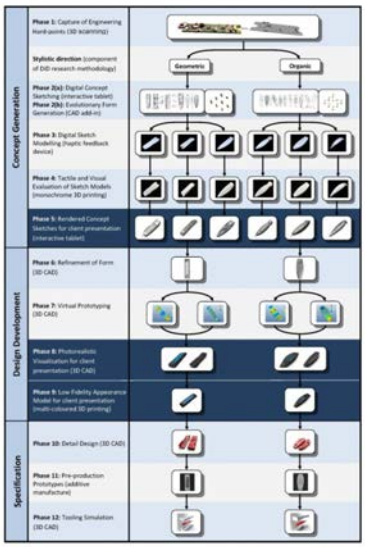

Figure 1 - Interactive web-based dissemination tool

Figure 2 - Expanded image of Organic Rendering

The DID approach to product development is available on an open access website at www.lboro.ac.uk/microsites/lds/did/ with a full record of the project accepted for academic publication in 2015 in the International Journal of Product Development as a paper titled **"**Investigating a totally digital approach to concept generation during industrial design practice".

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3 COLAB – A DESIGNER/ENGINEER WEB-BASED COLLABORATION TOOL

In an increasingly competitive commercial environment, organisations face pressure to identify and implement efficiency gains. For companies involved in product development, the interaction between industrial designers and engineering designers has been identified as being problematic (Jevnaker, 1998; Persson and Warell, 2003) as their dissimilar working methods can generate conflict (Persson and Warell, 2003). In addition to fundamental differences in approaches, another key barrier is that industrial designers focus on appearance and user-interface, whereas engineering designers focus on functionality and manufacturing detail (Kim et al, 2006). The engineering designer produces detail drawings and CAD geometry for the manufacture of a working product based on quality, performance and cost (Flurscheim, 1983). In contrast, industrial designers produce more emotive, qualitative representations such as rendered sketches and appearance models.

Effective communication is essential when undertaking new product development and Clark and Wheelwright (1993) note the importance of this in achieving cohesion and efficiency. Studies indicate that engineering designers struggle to fully understand the vocabulary used by industrial designers but, in contrast, Fiske (1998) identifies that industrial designers find it difficult to understand engineering design-related issues such as technical specifications. In addition, words may not have the same meaning for all members of a design team, with Persson and Warell (2003) acknowledging that communication becomes more effective once the team develops a common vocabulary through and understanding of communicative codes and language, e.g. symbols, product reproductions and message content. Erhorn and Stark (1994) note that because the various participants in new product development have their own vocabulary that is suited to specific activities, there can be difficulty in communicating and understanding amongst those outside the specific professional group. Although the language may be similar, identical words have been found to have different meanings (Ashford, 1969).

The issue of communication between industrial designers and engineering designers was undertaken through PhD research supervised by the author that involved an empirical study to identify and resolve barriers to effective collaborative (Pei, 2009). Following the literature review, data collection commenced with a ten week study with 17 design consultancies specialising in electronic consumer products. The subjects were qualified industrial designers and engineering designers with varying levels of experience. The fieldwork consisted of 45 hours of in-depth interviews and 80 hours of observations. The empirical studies utilised a qualitative research methodology, incorporating semi-structured interviews and the observation of participants during a commercial project. The interviews allowed respondents to fully describe their personal experiences relating to group interaction, reasons for project success and failure and methods used during the project. To increase reliability, a mix of large, medium and small companies with an equal number of industrial designers and engineering designers participated in the survey. The data was coded into a spreadsheet which identified 61 problem categories. A coding and clustering technique was then used to condense the results into a matrix using recurrence and importance.

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The matrix highlighted the 19 most frequently occurring problems that occurred three or more times which were then categorised into three groups. Conflict in values and principles identified that engineering designers tended to work with quantified solutions with a focus on efficiency whereas industrial designers favoured an open-ended approach with less constrained solutions. Differences in design representation identified that a lack of a common understanding/ language represented a significant obstacle to effective collaboration. Educational differences identified that dissimilar education resulted in different capabilities, approaches and expectations

Observations were used to obtain detailed information during a 2 week case study that involved the commercial design of an electronic communication device that required collaboration between industrial designers and engineering designers within a design consultancy. Analysis of the results identified that a lack of a common language in design representations made it more difficult for industrial designers and engineering designers to understand and empathise with each other.

A representation is defined as a model of the object it symbolises (Palmer, 1987). Internal representations encompass imagery and cognitive activity, with external representations being visual or verbal (Goel, 1995) and expressed through language, graphics or actual objects. The research project had a focus on external representations that included physical and digital formats. In the early stages of design activity, when a solution is ill defined, more unstructured representations, such as sketches, are employed. According to Tang (1991), sketching allows visualisation, communication and information storage; while Larkin and Simon (1987) point out that representations can externalise and visualise problems as they emerge. Other studies highlight the importance of product representations in enhancing team communication (Ulrich and Eppinger 1995) and as a thinking tool (Ferguson, 1992). Suwa et al (1998) note that sketches provide visual cues for further work and for the construction of 'functional thoughts'.

The potentially ill-defined nature of sketches can lead to them being interpreted differently by industrial designers and engineering designers, but this ambiguity also enables industrial designers to re-interpret them and gain new insights (Goel, 1995). While engineering designers employ formal systems, such as ISO standards, industrial designers have been cited as using less established representation types and ones that are ill-defined and imprecise (Saddler, 2001). In highlighting the differences in the vocabulary of each discipline, Smith (1997) suggests the use of a common understanding of shared definitions.

In developing a tool to promote shared understanding, the PhD research sought to provide definitions for the key design representations used by industrial designers and engineering designers; when they were used; and to identify the key types of design and technical information that they were used to communicate. Numerous formats for the emerging tool were evaluated and a physical card format was selected on the basis of portability and convenience.

The cards were developed as sets of red cards for industrial designers and blue cards for engineering designers, with the content for each set being divided into three sections. The red and blue sets differed in the fact that the popularity of use for the design representations was not the same for industrial designers and

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engineering designers as evident through the data on use that was collected via interviews. Section one of the cards identifies the key design stages of the new product development process (concept design, design development, embodiment design, specification). The front face provides a definition of a specific design stage, with four cards being used to indicate the popularity of use of representations during each of four stages with the most popular appearing at the top. Section two describes the key design and technical information used by industrial designers and engineering designers in the design process. The front face has a definition of the type of design or technical information, with the reverse showing the popularity of specific representations to communicate the design or technical information. Section three identifies the 34 most significant design representations used by industrial designers and engineering designers during the design process. The front face gives a definition of the design representation and the reverse face shows the design/technical information that is embodied in the representation plus the popularity of the representation when used during a specific design stage. Figure 3 shows the card that provides information on how an engineering designer use an Idea Sketch, including when it is used and for what types of information.

Figure 3 - Engineering Designer Idea Sketch card

The card-based tool, called "CoLab", was validated through semi-structured interviews with participants from 15 design companies and academic institutions. The results indicated that respondents felt that the tool would provide a common ground in design representations and contribute to enhanced collaboration.

Whilst the CoLab cards had a positive impact on collaboration, the cost of printing the 114 full-colour, double sided cards proved to be a barrier to commercialisation. However, having acknowledged their positive contribution, funding was received from the Royal Academy of Engineering to translate the tool into a free website. Figure 4 shows the web page for the Study Sketch where clicking on the words that describe the information that it is used to communicate opens up a new page for that specific information. This is also the case with the words for the design stages.

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Figure 4 - Study Sketch screen from the CoLab web site

The CoLab tool to support collaboration and communication between industrial designers and engineering designers is available on an open access website at www.colab.lboro.ac.uk with a full record of the project available as an academic publication in the Design Journal (Pei et al, 2011).

4 ID CARDS – A TOOL TO SUPPORT COMMUNICATION AND UNDERSTANDING DURING PRODUCT DEVELOPMENT

Results from Pei's PhD gave an overwhelmingly positive response to the concept of a design tool to support collaboration and communication being produced in a physical. During a search for more economical alternatives to a playing card-type product as proposed in the original PhD, the commercially available 'Z-Card' fold-out printing format was identified as a potential solution as it was available in a variety of sizes and aspect ratios. Unfortunately, although the Z-Card product was cost effective, the format was not suitable for the creation of 114 double-sided as used on the CoLab tool.

During a review of the potential for the Z-Card format to be used as an alternative to the 114 double-sided cards, considerable interest in the CoLab tool was demonstrated by the Industrial Designers Society of America (IDSA) after presentation at their International Conference. Its contribution in supporting student and novice designers was particularly well received. Ensuing discussions resulted agreement to produce an IDSA/Loughborough University branded design tool that included the full range of design representations used by industrial designers (when they were used and for what types of information). Significant development work was undertaken by the author to redesign the CoLab tool for the Z-Card format which was re-branded iD Cards. The iD Cards had credit card-size front and rear covers that were printed on gloss card, with the fold-out panels being on paper. Yellow tabs indicated at which stage of product development the design representations were used, with tabs to indicate if they were generally used to communicate design information (red tabs) or engineering information (blue tabs). The folded iD Cards are shown in Figure 5, with the folded-out front sheet in Figure 6 and reverse in Figure 7.

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Figure 5 - Folded iD Cards

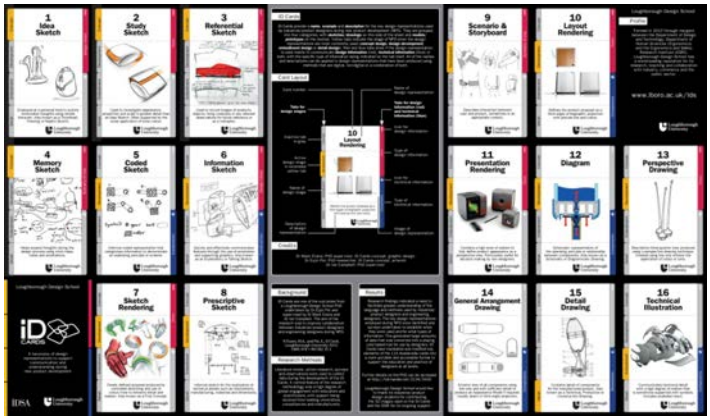

Figure 6 - Folded-out front sheet of iD Cards

Figure 7 - Folded-out rear sheet of iD Cards

The collaboration with the Industrial Designers Society of America (IDSA) facilitated the printing and distribution of the iD Cards in the UK and USA, with

the potential to access a modified PDF via a link on the web site for the Design Practice Research Group at Loughborough University (www.lboro.ac.uk/departments/lds/research/groups/design-practice/). Five thousand of the iD Cards were distributed to students and practitioner members of the IDSA in April 2011 and they were selected as a finalist in the 2011 International Design Excellence Awards (IDEA).

In response to on-going demand for the iD Cards, a PDF version was launched on the web site of the Design Practice Research Group at Loughborough University and, in 2013, funding was made available by the Higher Education Funding Council for England to translate the iD Cards into a smartphone app. Following an interaction design exercise by the author, the iD Cards app was launched as a free download from iTunes and Google Play in January 2014. By October 2014, there had been 4000 downloads and 1460 views of the supporting video (www.youtube.com/watch?v=ZgvjhywMSwY&feature=youtu.be.) Figure 8 shows the app being used to compare the capabilities of design representations and an example of how the side-swipe function reveals details from the side tabs can be seen in Figure 9.

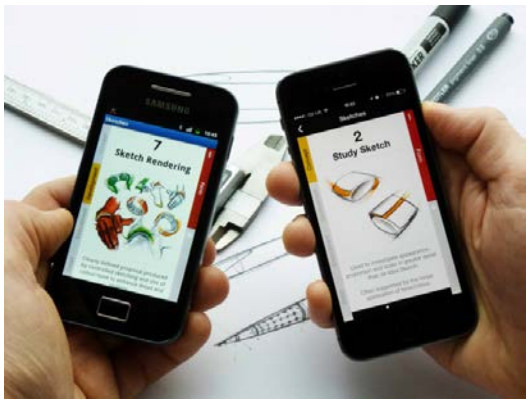

Figure 8 - iD Cards Android and iPhone app

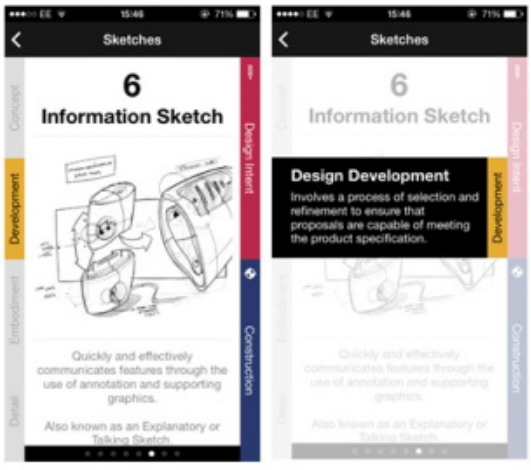

Figure 9 - Ghosted main image after tapping on Development tab to reveal additional information

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5 DESIGN PRACTICE RESEARCH CASE STUDIES – A WEB-BASED RESOURCE TO DEMONSTRATE THE CONTRIBUTION OF PRACTICE-LED PHD RESEARCH

In Innovative Product Design Practice, Liu (2007) provides a valuable insight into the methods and tools used during his career as an industrial design practitioner. The case studies show examples of the creative process and final proposals for highly visual products that were undertaken as corporate research and development for global brands. It must be recognised that, in isolation, professional practice is not academic research: "practitioner activity can count as research if, and only if, it accords with the criteria of research" (Archer 1995). To be identified as academic research, the practice must be integrated within a strategy that is 'purposive' (based on the identification of an issue or problem worthy and capable of investigation); 'inquisitive' (seeking to acquire new knowledge); 'informed' (conducted from an awareness of previous, related research); 'methodical' (planned and carried out in a disciplined manner); and 'communicable' (generating and reporting results which are testable and accessible by others) (Cross, 1999).

During the early stages of the debate on the role and contribution of practice as a method of data collection, the United Kingdom Council for Graduate Education published an overview and policy statement (UK Council for Graduate Education, 1997). The document makes extensive reference to PhDs in music but the generic distinction of outcome from methodology is clearly made: "The process – the programme of research and the research methods followed – can be distinguished from the product – the outcome of the research – although the product is a significant indicator of the process". In parallel with the development of understanding of practice as a component of research methodology within the creative arts, nursing has been evolving similar but distinctive methods, with 'Evidence Based Practice' (EBP) emerging in the 1970's (Leach, 2006). EBP is a five stage process that involves the identification of a (clinical) problem/questions; search for a solution; evaluation of the solution; the integration of the solution into practice (in conjunction with clinical expertise); and conclusions." Research into the practice undertaken by professional groups is widespread and provides an essential means for reflection and the development of strategies for the management of new and emerging working practices.

Discussions in the use of practice as a research method for PhDs in design have evolved through conferences such as Doctoral Education in Design in 2000 (Durling and Friedman, 2000), on-line forums (e.g. PHD-DESIGN JISCMail) and in 2007, Rust et al (2007) published the Research Review for Practice-Led Research in Art, Design and Architecture for the Arts and Humanities Research Council (AHRC) in the United Kingdom. Despite discourse and progress in the level of understanding of the PhD in creative disciplines, the AHRC report acknowledges the limited of amount activity in the field: "The doctoral 'production' rate is slower than in most disciplines and is building on a very low base. This is not helped by the limited number of experienced PhD supervisors, especially as practice-led research requires a good deal of flexibility from the supervisor if they are to navigate a sound route in the very complex territory indicated by the case examples" (Rust et al, 2007).

In the context of limited examples of PhDs in the creative arts that have employed practice as a method of data collection, a resource was curated by the author to summarise approaches undertaken by PhD researchers in visually creative design professions. By including a focused summary and numerous images for the creative outcomes produced by the researchers, the resource was targeted at the practitioner community as a quickly assimilated visual resource.

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The DPR Case Study resource can be accessed via wwww.lboro.ac.uk/microsites/lds/dprg-casestudies/ with Figure 10 showing the interface for the web site that categorises the current case studies as Fashion, Graphic, Industrial, Interior, Silversmithing and Jewellery, Textile and Transport Design.

Figure 10 - Design Practice Research Case Studies web site

The 'Download PDF' link accesses the individual case studies that are hosted in the Loughborough University Institutional Repository and, in the first nine months since its launch, the site received 1100 visits with over 600 downloads. Each DPR Case Study has a standard format consisting of key information plus details on areas such as research methods, experience of design practice, motivation to undertake practice, aims, questions, objectives, rationale for the inclusion of practice and how the PhD practice differed from that of commercial practice. An example of an individual case study in the standard two page format can be seen in Figure 11.

Figure 11 - Example of downloaded case study as 2 page pdf

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6 DISCUSSION

To maximize the potential for outcomes from academic research to become accessible and valued by the practitioner/educator community, three approaches emerge from the presented case studies. To avoid unexpected expense and delay, the first involves the need to integrate a strategy for appropriate dissemination within the research methodology. This also ensures that all required materials are rigorously collected throughout the research process in preparation for the creation of the resource. The second is to acknowledge that practitioner/educator resources for designers must have qualities that are appropriate for a visually literate profession. For those developed by researchers who are themselves designers, this is a relatively straightforward process as they can, in effect, undertake the design activity themselves. In fact, the author believes that researchers with backgrounds as competent design practitioners are in an advantageous position in this respect due to their in-depth knowledge of the on-going research and capacity to identify opportunities as they emerge. Without an embedded design capability, professional design services would be required with associated funding implications. Thirdly, it is difficult to make claims for the relevance and impact of a resource without evidence. Collaboration and validation with professional associations or substantial groups of designers can make this process relatively straightforward, providing of course that the resource meets their needs. Related to relevance and impact is the advantage of employing digital resources that allow view/downloads to be recorded. This then becomes a useful metric when reporting on the significance of the work to the academic community.

7 CONCLUSIONS

As academic design research continues to mature, it is timely to reflect on ways in which outcomes that are of interest to practitioners are disseminated. Whilst this paper acknowledges the significance of journal publication, it questions its validity as an end point, with a need to identify ways and means to translate key findings into an accessible resource. The resources presented in the four case studies required considerable additional effort and provide evidence for varying degrees of impact. However, at the most significant end of the scale, to have the outcomes from academic research validated, adopted, funded and distributed by the largest and most established professional body for a design discipline, demonstrates the full potential of an open access resource to the practitioner community.

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Designers don't do journals: Case studies in the development of research-based resources to support design practice and education

Mark Evans

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