You make it and you try it out: Seeds of design discipline futures

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This paper takes a narrative seam through the design discipline, attempting to explain how design methodology, one of the three types of Nigel Cross' designerly ways of knowing, has changed over the 40 years of Design Studies. *Specifically, the paper identifies the point when a 'social turn' in the discipline occurred, allowing more nuanced and critical studies of designing, and shifting the balance from an objective ('scientific') perspective to one more based on relativist approaches. The paper concludes by noting the plurality of present-day study, arguably enabled by design thinking, and sketches what this holds for the future of the discipline. The references in the paper are mainly restricted to those published in, or strongly relating to,* Design Studies.

Keywords: design methods, design studies, design research, design process, design thinking

> "It is difficult to recall any other year in the post-war period that has started so badly, in so many ways for so many people in so many lands."

The year is 1982, and the quote comes from the introduction to an international conference on Design Policy[1] written by the then Commonwealth Secretary-General Shridath Ramphal and organized by the Department of Design Research at the Royal College of Art in association with the UK Design Council and the Design Research Society. The foreword to the conference was written by then Prime Minister Margaret Thatcher who wrote more prosaically:

> "Design should be the starting point where the customers' needs for effective and reliable goods are brought together with the realities of manufacture."

Thatcher viewed design as an opportunity to increase consumption and hence economic growth, which was somewhat in contradiction to the 'Design and Society' sessions of the conference (Thatcher famously said "there is no such thing as society"[2]) some of which were chaired by Victor Papanek (who

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famously said "There are professions more harmful than industrial design, but only a very few of them"[3]).

Another session chair for the conference, chairing sessions on 'Philosophy and Design Theory', was the British philosopher Roger Scruton, now a somewhat controversial figure in UK politics, but in 1982 someone deeply interested in architecture and design. Reflecting on his unfavourable experience of the conference, Scruton (1982) rounded on design methods as the cause of much of what he considered to be bad design. The "rational" approach of design methods attempted to quantify, in Scruton's view, things that could not be quantified resulting in design products that were overly functional and inhuman ("a forceful denial of life", p.71). He singled out Lionel March, the new Rector of the Royal College, for particular criticism. Citing March's production-deduction-induction (PDI) model of design (March, 1976, pp. 19–20) as representative of the general paucity of the subject area, he criticised its "unnecessary arithmetization of the sequence […] occultist pretense at system, and […] absence of any serious scientific or mathematical concept". He concluded by saying that:

> "March's careful examination of the underlying "methodology" of his subject enables us to see what "design theory" is all about. Translated into plain English, March's "model" amounts to this: you make a design, and you try it out". (p.75)

Scruton correctly calls out the 'scientism' of design methods but in the process succumbs to the reductionist view he seeks to criticise. Design (and design methodology) *is* about making things and trying them out. One only need consider for a moment how things like sketches, prototypes, models, and conversations function in a basic iterative model of design.

Three other participants at the Design Policy conference; Nigel Cross, Norbert Roozenburg and Johan Eekels have since shown us this 'basic cycle' (Roozenburg & Eekels, 1995) or 'co-evolution' (Dorst & Cross, 2001). *How* designs are made, and *how* they are tried out, are not simple processes. The factors involved and how choices are determined are precisely what defines a discipline like design. When Cross first called for a 'touchstone theory' for the discipline, to outline 'designerly ways of knowing' (Cross, 1982, 1999), this basic cycle of design was at the core of it. He identified three distinctive areas of designerly knowledge: epistemology – what it is that designers know; methodology – how design happens; and phenomenology – what it is that designs themselves tells us (Cross, 1984a). Design and design theory aren't complicated, Scruton suggests, yet he is essentially pointing to a strength and distinctiveness in the discipline that Cross cemented into place. The fact that a complex subject can be made simple to understand also means that it

can be effectively communicated. As we will go on to see, this has led to considerable growth and success for the discipline. The touchstone, firmly cemented into place, is now smooth to the touch.

1 *Design methods revisited*

The 1982 Design Policy conference represents, I think, a key point in the history of the discipline. 20 years on from the original Conference on Design Methods (Jones & Thornley, 1963) it set the ground for themes in design research that are flourishing today, not least in government, with the advent of various policy design labs around the world (Bailey & Lloyd, 2016, pp. 3619–3634). The first special issue that *Design Studies* published (Volume 3/3 1982) was from the conference and the editorial from that issue described its scope:

> "The Design Policy Conference has an elephant-size theme: it provides scope for anyone who wishes to talk about design in relation to almost anything else - provided some part of it moves. Governments may or may not have policies and these may or may not reflect the realities of their situation or the wishes of the people or sectors of the population. Within national economies - or even the world economy - there may be influences at work, as there may be at company board level, which affect decisions about product areas, products or services which are the subject of design. These influences may range from the abstract and spiritual to the material or ephemeral." (Volume 3, p.114)

The conference drew together a huge number of themes and discourses from all kinds of places under the rubric of design: academia, industry, politics, science, social science, technology and humanities. In doing this it exposed very real and fundamental tensions, some of them outlined at the beginning of the paper. And not only inside the conference. On Tuesday 20th July 1982, on the first day of the conference, the Provisional IRA detonated two bombs that killed 11 military personnel, one of the bombs only a few hundred metres from the Royal College of Art, in Hyde Park, that was heard by delegates as the welcome speeches were taking place.[4]

Roger Scruton wasn't the only session chair at the conference to have concluded that design methods had failed to achieve what they had initially promised. John Chris Jones, whose book *Design Methods: Seeds of Human Futures* (1970) had been so influential in the design methods movement, had already partly distanced himself from their misappropriation by turning to, amongst other things, chance processes (Jones, 1980) and other forms of narrative formation (Jones, 1984). He wrote:

> "Rationality, originally seen as the means to open intuition to aspects of life outside the designer's experience, became, almost overnight, a toolkit of rigid methods that obliged designers and planners to act like machines, deaf to every human cry and incapable of laughter." (Jones, 1980, p.173)

The generational history of design methodology has been well documented (Cross, 1981, pp. 3–4; Cross, 1984b) but I think the point of the quote above, reiterated by Mitchell (1993) and Cross (1996), is worth restating. Making aspects of the design process objective by using a method affects to take the process away from individual or group 'intuition' (to overly quantify the factors involved, in Scruton's words). Fetishizing the method in this way, however, was not the original intention. In practice using a design method leaves the individual or group to make subjective judgements about objective data. A method guides and challenges designers to consider things outside of their intuition and preconceptions; they were never meant to enslave the designer in a mechanical process where their judgment has no value. Nowhere is this clearer than design processes that involve ethical judgment (arguably all design processes (Lloyd, 2008)). However many cost-benefit analyses, brainstorms, quality function models, or morphological charts are deployed, the integrity of the design lies with its designers. No-one ever sued a methodologist for a design that didn't work out. A design method isn't responsibility deferred, it is responsibility challenged.

A design method can provide valuable data in a design process to reflect on, and represents a certain kind of knowledge, but it doesn't necessarily help one to *think* like a designer. This is something that is acquired from experience. In the introduction to *Design Methods: Seeds of Human Futures*, published in 1970, John Chris Jones emphasised this by referring to the idea of design thinking:

> "Non designers who wish to apply their knowledge to design problems should precede their first attempts by the experience of getting deeply involved in the complexity and instability of design thinking" (Jones, 1970, p.xii)

You make it, and you try it out, in other words. *That* is the route to thinking like a designer.

So the concept of design thinking, prevalent now, has its origins long before the first volume of *Design Studies* was published in 1979. Archer (1979) refers to the idea in the very first issue and by the time of the Design Policy conference in 1982 it had become a familiar term. Clive Dilnot, presenting a paper at the conference that was published in the special issue (Dilnot, 1982) draws on Archer when he writes:

> "design thinking and communicating has its ends in the material transformation of the world, or better, has its ends in the desired transformation of human social relations achieved through (in design's case) transformation of the material surroundings." (p.144)

The currency of the concept, and of Cross' touchstone theory, is well-established at the centre of the discipline in 1982, though as Dilnot showed, open, even then, to different interpretations.

2 *A social turn in the design discipline*

Before returning to more recent developments in design thinking and design methods I want to highlight the beginning of another significant stream of design study during the 1980s (and a notable absence from the Design Policy conference). In 1984 (Vol 5/3) and 1988 (Vol 9/3) *Design Studies* published two special issues featuring the work of MIT's design theory and methods group, including the work of Donald Schön and Larry Bucciarelli. These consciously eschewed overt discussions of science and objectivity instead drawing on the precepts of pragmatism and social constructivism (for e.g. Goodman, 1978) to present studies that were at once theoretical and empirical, and general and particular; inquiries into the 'complex and unstable' activity of designing mentioned by John Chris Jones in his introduction to *Design Methods* quoted above. The subjects and design disciplines covered were familiar, but the deliberately relativist approach was not. The MIT papers, as with other research in the emerging design discipline, ranged across a wide variety of design disciplines, from the highly technical (Bucciarelli, 1984), computational (Gross, 1984), to the more 'designerly' disciplines of architecture (Schön, 1984) and planning (Porter, 1988) as well as generic processes (Habraken & Gross, 1988). Above all there was a concern for language, grammar, dialogue, and meaning; prioritising discourse over 'science' or objective truth.

Although not the only work to draw on pragmatism,[5] these studies, I think, opened up new types of inquiry in the design discipline that recognised the fundamental social and dialogic nature of the design process, particularly the need to establish frames of understanding (Schön, 1984) and languages of design (Schön, 1988). Designers – as Schön has convincingly argued – work through dialogue; with clients, with collaborators, with stakeholders, with themselves, but also with method. The achievement of these papers was to enable work that, either implicitly or explicitly, recognised this tenet; that the study of design is both a study of a complex human ability, but also one that involves agency beyond the human – in methods, representations, computers, and of course designs.

Two studies are worth mentioning specifically in this context, presenting social studies of design methods in more complex and social ways and representing a

social turn in the discipline. The first is from Larry Bucciarelli's book *Designing Engineers* (1995). Building on papers previously published (1988) Bucciarelli conducted an observational study of a professional engineering design process and focused on one particular meeting, ostensibly about evaluating new ideas to solve a technical problem. 'Sergio', the person who calls the meeting, aims to use the 'Pugh method' of concept selection (Pugh, 1991) to establish, objectively, which solution might be the best one. The meeting, Bucciarelli records Sergio concluding, doesn't go well. Instead of laying out the information and making a decision, the participants cannot decide on the weighting factors between different criteria, and indeed the criteria themselves. Bucciarelli observes this through the prism of the language that is used and concludes that the discussion results from the different worldviews that the participants have (Bucciarelli terms them 'object worlds'). The layers of analysis in play with Bucciarelli's study are significant and highlight engineering design as a complex *human* activity. First, the study is of a naturally-occurring professional practice. Second, the study engages specifically with established knowledge in design methodology and (significantly) its use. Third, the focus is on language and is thus only indirectly concerned with the design under consideration. Finally, the activity is theorised in relativist terms, explained with reference to the transactions and interactions taking place. Bucciarelli's study is undeniably a design study but, as with other 'MIT' studies, it shows a level of sophistication and thoughtfulness about design that was unusual.

The second study occurs 15 years later and is by Ben Matthews (2009). Matthews' study follows a similar set-up to Bucciarelli's, looking in detail at naturally-occurring design activity in the form of an engineering design meeting. This time the purpose of the meeting was to generate solutions to a problem, and for this the participants use a brainstorming method. In his study Matthews shows how the 'rules' of brainstorming are often in conflict with the 'rules' of social interaction and especially 'turns at talk', the implicit social requirements of an interlocutor to relate in some way to what was previously said, not just in terms of design content, but in terms of managing a *human* social interaction, for example gaining the 'floor' in conversation or maintaining 'face' (Oak & Lloyd, 2015). Though drawing on a different body of conversation analysis theory, Matthews' study embraces the social context of design discussion and displays a similar subtlety in the levels of analysis employed.

Bucciarelli and Matthews frame their studies in social contexts whilst looking at the 'how' of designing through the use of design methods. Temporally placed between these two studies is a third paper which provides further clarity about design methodology by describing the field of ethnomethodology, a field which arguably design methodology could fall under. Button (2000) points out that ethnomethodology differs from the now widespread deployment of

'ethnography' by designers and design researchers. In simple terms ethnomethodology is the study of how people – usually culturally very different people to the people observing – get things done. Of course 'get things done' covers a vast amount of cultural material, tangible and intangible, but the thing to note is the focus on *methodology*, on process: the *how* of the proposition. Button describes the field more eloquently:

> "[Ethnomethodology] shifts the emphasis away from the production of sociological accounts and theories of social doings to an emphasis upon the description of the accountable practices involved in the production of naturally-organised phenomena" (p.325)

In other words, ethnomethodology looks at particular practices of how particular things are achieved, and that includes designing.

The focus on both methodology and social practice has enriched the study of designing by letting the idea of discourse explicitly percolate through the discipline, allowing different perspectives and ways of thinking to coexist. Design methodology could even be productively seen, in the spirit of 'designerly' thinking, as a branch of ethnomethodology focused on the production of design 'things' with a much richer array of concepts and theory to draw on.

Though selective, these studies show how general theories relating to human behavior and thinking can be used to enhance our understanding of how particular episodes of designing, glossed as the use of design methods, are constructed. They also suggest how abilities that the majority of people have – the ability to converse, and draw on personal experience – can relate to design activity. In doing this they have effectively extended Cross' touchstone theory of the design discipline, designerly ways of knowing (1982). There are, of course, other studies that represent what I am arguing was a shift in the discipline; a *social turn*. My aim here has been to illustrate how two particular studies, when set against the broader research of the MIT school, have enabled new kinds of study to take place, and for the design discipline to progress. The discipline of design thus moved from a self-conscious comparison with science and scientific discovery to the relativism of more pragmatist approaches.

In this light, rather than science, the discipline that more closely resembles the developing design discipline is that of ethics. The balance between the normative models by which we make ethically good decisions – for example, a consequential or non-consequential ethics – resemble the ontology of design methods and are subject to the same criticisms. To the vast majority of people they provide ways in which to help think about ethical problems, not a guaranteed way to resolve an ethical problem. Similarly, the messier world where ethical decisions actually get made – in hospitals, in courts of justice, in organisations, and also in design studios – is reflected in empirical studies of how

designers construct their design decisions. Looking to the particulars of a situation, in a casuist manner, we can also see that ethical case studies provide insight in ways that correspond with design case studies. And hovering above the ethical models and messier reality is a meta-ethical discussion about the concepts that make up the discipline. One can imagine such thing as an ethical method, or an ethics methodology – the study of how people make ethical decisions. It might not turn out to be too different from design methodology.

3 *A short history of design thinking*

Central to the development of both social approaches to designing and to more cognitivist conceptions of design thinking was the sequence of publications deriving from the Design Thinking Research Symposia series. The first, held in Delft in 1990 (Cross, Dorst & Roozenburg 1992), brought together the MIT School with design methodology. The progression of the series is well documented elsewhere by two of the initiators of the series – Nigel Cross (2018a) and Kees Dorst (2018) – but the general shape of the development bears repeating. During the 1990's the idea of design thinking became more specialised as empirical studies of design cognition, following the thinking patterns of designers, established the mechanisms by which designers conducted their 'thought-by-thought' activity. A wide variety of papers looked in detail at how design problems are solved; the process of design. These started off as laboratory studies, tracking individual designers working on simple design problems, but soon branched into more collaborative, social, and practice-based environments, and more complex problems. Thinking here was intimately associated with talk: monologue or conversation as the externalization of thought, but combined with the earlier cognitive approach made up a comprehensive body of work on the subject and the results were formalized into new models and methods of the design process.

Though there have been partial accounts of how the idea and methods of design thinking travelled beyond the discipline of design (Kimbell, 2011; Lindgaard & Wesselius, 2017,[6]) the relationship between the work of the DTRS community and Silicon Valley, in particular Stanford University and IDEO, has been underplayed. Key early works such as the *Universal Traveler* (Koberg & Bagnall, 1973) inspired teaching in creative problem solving at Stanford, setting a fertile context for the first 'shared data' DTRS collaboration in 1994 (Cross, Christiaans & Dorst, 1997) with the eventual result being the simultaneous development of the academic study of design cognition ('thinking') and its successful commercial counterpart: the 'design thinking method' of IDEO (Brown, 2008, pp. 84–95).

Certainly the roots of design thinking, if it can even be considered as one thing any more, have become tangled, but one thing remains clear: the export of design thinking is one of the few ideas from the discipline of design that

have been taken up outside the design discipline across the world in all kinds of contexts[7]: education, health, transport, IT, policy, energy, and of course design itself. *Design thinking* has become a familiar term to people who have never heard of the design discipline. It has also become widely taught across the world in d.Schools, business schools, via distance education (Lloyd, 2012), as well as in 'conventional' design schools.

To some this is anathema, the evidence that it is now an empty concept, applied everywhere in all kinds of questionable ways. There is certainly a case to be made in this direction, but I think this willingness to dismiss design thinking as a fad (clearly, as I hope to have shown above it is not) is mistaken and anyway misses the point about what can change when even the simple core ideas of design thinking are embraced.

Taking a constructivist view, if design thinking is considered as a way of working, rather than as strictly a method, then I suggest that certain interesting ideas about design thinking have penetrated far into many organisations. The first is the idea that design thinking involves a 'site' of structured creative exploration, a space that enables a 'designerly' conversation to take place. This might be a permanent place (a creative 'lab' for example) or a temporary space in the form of a workshop or other type of meeting framed as 'co-designing', or even simply an 'idea generation session'. Communicating a work activity as creative sets expectations both about what will take place (i.e. new ideas will be generated and things may be 'made'), and how the individuals involved will act (i.e. in an open-minded, non-judgemental way). There may be a type of control in such a situation – someone to ensure that the process, whatever it is, is followed – but this is not the same as a meeting that is, for example, more formally chaired by a person with a specific agenda. One meeting tends to be divergent and tentative, exploring a metaphorical 'space', while the other tends to be convergent and definitive, honing in on specific actions and outcomes. Of course, formal meetings have creative aspects when problems need to be resolved, but the turn-by-turn social structuring of activity is fundamentally different.

The second general aspect of design thinking is that it involves collaboration in sharing and developing ideas. In an organizational setting this tends to involve people working in different areas or from different disciplines or functions. The underlying concept is that everyone's experience and ability to think creatively is valued equally when it is shared in the site of structured creative exploration. Design thinking facilitates a process of collaboration that involves posing questions and proposing answers to multi-dimensional problems. Politically then, design thinking perhaps reads as a democratic process allowing multiple voices to participate and contribute.

The natural consequence of this is that for design thinking to work, the voices contributing should be diverse. This diversity could be in terms of organization function or expertise (as it was, for example, in Bucciarelli's study mentioned earlier), but also in terms of ethnicity, gender, and age, etc. An approach that depends on diversity to work also has a claim to being more representative of interested groups and populations – those implicated in alternative solution forms, for example.

Presenting design thinking in this overly simplistic way of course glosses over some key paradoxes. Surely *someone* has to control the process? Is the person with the particular implementation of design thinking the person with the real power? Could design thinking be used as some kind of front for malign intention, like the open-but-ignored consultation that legitimises a prior decision? Is the process more about venting than creating value? These things are of course possible but essentially illustrate how far the idea of design thinking has travelled from the discipline of design; how popular a design method it has become for those not trained as designers. The research journey has been a long one but the impact has been huge.

4 *Shifting balances: the future of the design discipline*

What the example of design thinking highlights is that design methods, although seemingly aimed at achieving practical ends, are not politically neutral instruments. They embody, and perhaps disguise or prioritise, a certain kind of knowledge. Indeed, coming up with a new design method is increasingly seen as an effective vehicle for articulating a certain type of knowledge, raising awareness in an experiential and collaborative way about particular issues important to the designer of the design method. The proliferation of PhDs producing methods or frameworks is evidence of this. Using a sustainable design method, for example, becomes a means, not only of (putatively) achieving more sustainable outcomes, but also of breaking down the components of what a certain kind of sustainability means at the practical level, when designing new things. This might suggest that design methodology has become entwined with design epistemology but this was always the case. A method embodies and communicates a certain kind of knowledge.

While design thinking represents considerable success for design methodology (and the discipline more generally) then it also carries dangers too. The social turn in the design discipline, in showing design to be much more a process of dialogue, allowed more critical stances to develop that have grown in recent years. Whose practice and knowledge does a design method reify? Whose power does it frame and legitimize? Whose interests are excluded? These questions were made possible with the social turn, but we need to keep asking them in our discipline. As the purposes and pretexts for design thinking expand, researching the way that methods are *used* in specific practices

becomes ever more necessary.[8] The question of automation and use of technology in design processes also arises. Whose knowledge is encoded when increasingly intelligent algorithms to support designing are created and deployed? With digital data, the materials and outputs of design are more protean; there is a feeling that 'technology' is what is driving progress, but at the heart of all technology lies design and a design process. The social turn revealed a more complex picture of how 'knowledge transactions' involving design methods take place (mainly through them breaking down in social situations) and the positive gloss of design thinking methods, as I argued earlier, is that they have introduced practices of creativity, collaboration and diversity within more bureaucratic organisations.

These are ethical and political questions deserving of closer attention in future design studies. But these studies also need new kinds of researchers, able to understand complex technological issues certainly, but able to situate them in social practices. Articulate researchers that do not see the now clichéd distinction between practice-based work and more scientific and social scientific forms of design study. Researchers able to put the case for the design discipline and designerly ways of thinking as central to modern ways of working.

It is a truism that the designers of design methods, indeed the body of work in the discipline of design, has predominantly – though happily with many notable exceptions[9] – been produced by men. Consider through this lens the opening sections of this paper: in between Sridath, Roger, Lionel, Bruce, Victor, and John[10] the only female that is mentioned is Margaret.[11] Of the 140 paper authors in the programme for the 1982 Design Policy conference only 15 (11%) were female. Might this suggest that certain types of thinking and knowledge in the discipline of design have been developed, privileged, and valued?

This is one thing that has changed over the 40 years of the Design Discipline. Of the 512 paper authors in the programme for the 50th anniversary 2016 Design Research Society conference (Lloyd & Bohemia 2016) 258 (52.5%) of the paper authors were female. Discourses of gender, ethnicity, decolonization, and power are often hidden in plain sight and design research needs to be alive to the plurality and complexity of the 21st century world. If design thinking is based on the cognitions of designers in laboratories, what are the cultural aspects of cognition? of thinking itself? how is that different to the cognitions of designers in countries affected by war, for example, or those living in poverty?

A mature (or rapidly maturing) discipline also demands a reflection about itself. Not just sketches about past, present, and future but serious historical, contextual, and critical work about the development of the discipline of design. Designers are good at telling 'origin' stories, design researchers

much less so. It is a skill we need to develop in understanding, defending, and growing the body of knowledge in our discipline.

5 *Epilogue*

At 9:30 on Thursday 22nd July, the third day of the Design Policy conference, the session chair, Nigel Cross, introduced the first paper of the day: *Feminist Design* by Sheila Levrant de Bretteville (Levrant de Bretteville, 1984). In her paper she writes:

> "One of the ways in which design can provide the egalitarian context for participation […] is to extend itself toward the public and invite dialogue by asking questions that honour the intelligent thinking processes of the viewer […] and at the same time asking for a response". (p.87).

The seeds of one possible future were about to be sown. 'You make it and you try it out' turns out to be a lot more complex than at first sight.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Notes

1. The conference featured 123 paper presentations in 6 parallel tracks and 7 workshops. The proceedings from the conference were published two years later in five elegant volumes with different editors: Design and Society (Langdon and Cross 1984), Design and Industry (Langdon, 1984), Design Theory and Practice (Langdon & Purcell, 1984), Design Education (Langdon, Baynes, and Roberts 1984), Evaluation (Langdon & Gregory, 1984) and Design Information Technology (Langdon & Mallen, 1984). The programme for the conference can be viewed here: https://tinyurl.com/yxarzoxm.
2. Thatcher's remarks were made in an interview for the UK magazine Woman's Own (23rd September, 1987) https://www.margaretthatcher.org/document/106689.
3. Papenek, V. (1973) Design for the real world: Human ecology and social change, Pantheon.
4. One of the bombs was let off under a bandstand in St James' Park where a military band was performing. Later commentary suggested the bomb was 'designed' not to injure members of the general public (Foxwell, 2013, https://tinyurl.com/y6fv5n7e); a macabre take on the design methods being discussed close by.
5. Anita Cross (1983) had previously engaged with John Dewey in educational contexts and of course Lionel March's PDI model, dismissed by Scruton, was based on C.S. Peirce's logic of abduction in scientific discovery (Peirce, 1932).
6. This paper is followed by seven 'commentary' papers, exploring various aspects of design thinking, and a follow up response from the authors.
7. CAD, as Cross (2018b) argues, is another such 'export', though is mainly limited to design organisations.
8. Bucciarelli (1995) and Matthews (2009) paved the way in this respect.
9. For example, Jane Darke, Janet Daley, Gabi Goldschmidt, Janet McDonnell, and Rachel Cooper to name a few.
10. The first two men of this list have also been knighted.

11. *Mea Culpa*, this paper is self-evidently written by a male, and therefore subject to the criticisms that follow, which serves to highlight the problem, I think.

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