Viewpoint

Design research: a revolution-waiting-to-happen☆

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Thomas Kuhn described scientific progress as a process of leaps and bounds. Long periods of 'normal science', in which a research community works within a well-established and fruitful paradigm, end when there is a build-up of anomalies: phenomena that cannot be explained within the conventional wisdom. Then the research community enters into a state of 'revolution', in which a new paradigm emerges that is superior in explaining these anomalies.

In this paper, I will argue that the design research community, which has flourished so much in the last 40 years, shows signs of being in a period now that is prior to such a 'revolution'. Such periods are characterised by a mounting number of anomalies, and by the response from those working within the 'normal science' paradigm to ignore them, belittle them, or push them away as irrelevant because they do not fit in 'the way we see things'. Their normal way of working is under threat, and this makes them acutely uncomfortable. The concepts that are under fire in this revolution-waiting-to-happen are the core concepts of our field. I think we should reconsider the very nature of the object of our studies (what do we consider to be 'design'?), the character of the tools and methods we aim to create, and the way we create them.

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The paper is built up as follows: first there will be a brief anatomy of design research as we find it right now, dissecting the field down to some of the core assumptions that underlie our current ways of working. Then we will consider some of the anomalies that are emerging, and see where we can find footholds for a further development of design research. In the latter part of this paper, two possible ways in which design research could be re-conceptualised, extended and developed will be presented for discussion.

1 An anatomy of design research

Let us start with a thought experiment. If one would start a new scientific discipline that is aimed at the study of a complex area of human activity like design, how would one go about it? One would probably first *observe* this complex activity, and then *describe* it (which already involves a degree of interpretation). Then one would seek to create models that could *explain* the phenomena as observed and described. That explanatory framework could then be used to *prescribe* ways in which practice could be improved, developing methods and tools to support the practitioner and the student.

There is a certain logic to this progression, yet historians have shown us that in our own field of design research, this is not what happened at all. The field emerged from practitioners developing ways of working to help them cope with the problems they faced. These prescriptive statements

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were put into words and published as more formal methods and tools. Engineers were particularly strong in this: they used their systems thinking and the formal language that comes with it to describe their own working processes. This can be seen most clearly in some of the early papers that came from chemical process engineering: the design process is not modelled in boxes and arrows, but as a sequence of activities that flows though pipes from vat to vat, and that is regulated by taps. This is also where the first assumptions that we will reconsider in this paper sneaked into our thinking on design.

If we continue our thought experiment now, let us zoom in on what you would need to do if you want to describe an area of complex creative human endeavour like design. What would be the elements of such a descriptive framework? Well, one would need to describe the *object* of this activity (in this case, the design problem and the emerging design solution – the 'content'), the *actor* (the designer or the design team/designing organisation), the *context* in which the activity takes place (as far as it impacts upon the activity) and the structure and dynamics of the complex of activities that is being studied ('the design *process*').

Yet when we look at the design methods and tools that are being developed within the design research community, we see that three of these four 'aspects of design activity' are often ignored within the descriptive framework that implicitly underlies our thinking on design. The overwhelming majority of descriptive and prescriptive work in design research focuses on the design *process*, to the exclusion of everything else. Therefore the design methods and tools that are being developed inevitably focus on enhancing the *efficiency* and *effectiveness* of design *processes*. And apparently, this total ignoring of the design content, the designer and the design context allows us to claim that we are constructing models, methods and tools that will be valid for every designer, dealing with every possible kind of design problem, in any situation.

Within design research, the emphasis on the process of design is still overwhelming. This is hardly surprising, because the models of design processes that have been developed over the years have been a great success. They have proven to be a very powerful tool in the development of design practice and design education. Having some measure of control over their design process has empowered designers and design students to tackle complex problems that otherwise would have been out of reach for most of them.

However, we have seen above that the design process is only a part of the bigger story of design…We feel this very keenly in design education: it takes only an afternoon to explain one of the design process models to a group of design students. But knowing that model doesn't make these students designers at all: to train them in design we have design studios, where we give them multiple design projects in which they learn to grapple with different kinds of design problems, with different design contexts, and with themselves as designing human beings. The art of design is to deal with these *other* aspects of the design activity, the ones that a process model so conveniently ignores… That is the price one pays for abstraction, for 'bracketing' elements of the design activity. Putting things between brackets (and ignoring them for a while) is all very well if you just want to create an abstract theory or model, but when you then try to apply this theory or model all the elements of the design activity that you have 'bracketed' come back to haunt you. Of course there is nothing wrong in science with ignoring aspects of messy reality to arrive at a clearer picture of the object of study. We need to abstract from the complexities of real-life design in order to create models and theories. It is just that this abstracting away from the design content, designer and design context have become such a standard ('normal') way of

doing in design research, that the whole field is skewed towards the process-dimension of design; to the point that 'doing research into design processes' has become synonymous with 'doing design research'.

The good news is that we are slowly getting to grips with some elements of design problem and design solution, through more content-oriented research streams like 'Design and Emotion', 'Experience Design' and 'Design for Usability', among others. However, we still tend to 'bracket' the designer and the design context, perhaps because they are so complicated and open-ended. I propose that it is time we tackle them, because we have really reached the point where our overriding focus on design processes is holding us back from a deeper understanding of the design activity itself. I will argue that we should refocus our attention and enrich academic design research by working on a deep and systematic understanding of the 'design object', the 'designer' and the 'design context'.

2 *The state of the art*

The above-mentioned assumptions have shaped the 'normal science' of design research in the last decades. Let us now critically consider the current situation in design research, and decide whether we can go on in this way or whether we need to reconsider these assumptions and our way of working. Do we need a revolution or not?

I see five following major areas of concern. (1) Within design research there are two fundamentally different ways of looking at design process, those of rational problem solving (a goal-oriented problem solving process) and reflective practice (a process of learning). Yet the status of these models of design is unclear: they both seem to be process-oriented and prescriptive, rather than provide an explanatory framework for design activity as a whole. (2) There is an overwhelmingly strong orientation towards practice, which is also a weak point in design research. It causes a large gap in the logical progression from *observation* to *description* to *explanation* and then *prescription* (developing methods and tools to support the practitioner and the student). Too often in design research papers we find very little by way of explanatory framework: most papers, if they have an empirical basis at all, jump from description right into prescription, without pausing to think why the observed patterns occurred. Observations are followed by a big 'So …', and then the author happily launches into methods and tools, apparently without an in-depth understanding of the observed phenomena. Design researchers seem to be practical people, and rather trigger happy in this respect ('jumping to prescriptions' all the time). Consequently, our explanatory framework about the 'why' of design activity is still weak, making it hard to build up a core of scientific knowledge in our field. (3) Another criticism that can be levelled at design research is that it is still in a 'pre-scientific' stage, because design researchers seem to be happy to develop methods without rigorously testing them, thus again imperilling the knowledge build-up in the field. Moreover, the methods and tools often come without any indication in which kind of design situation they would be applicable and effective, making such testing well-nigh impossible. (4) Actually, this is severely aggravated by the fact that we have never explicitly defined what the kind of Quality is that these methods are supposed to attain. Is that 'efficiency'? (If so, what do we mean by that word?). How is that operationalised in different contexts? For instance, some of the very interesting work that is being done on communication in design teams seems to rest on the assumption that this communication should be as smooth as possible. That is very much a question… (5) Lastly, there seems to be no view of what the design activity entails beyond the confines of 'the design project'. Higher-level design activities (like those performed by senior designers) do not seem to be

part of the design research agenda, apart from a very few cases.

As it is, the lack of an explanatory framework for design makes it hard to build up an academic knowledge base, and it makes it well-nigh impossible to reflect critically upon each other's work. This gives rise to a suspicion of shallowness and leaves us with a pretty bleak picture of design research as a field of intellectual, academic inquiry. And as an applied science that produces methods and tools for education and practice, the picture is not pretty either: untested tools and methods, that come without a 'manual' for application, that are not connected to the design content, and are not built upon an understanding of the designer who is supposed to apply them. A deeper understanding of design activity can only be built when we start considering all aspects of the design activity, and build a new kind of design research in which the process and content of design activity are connected with a model of the designer and the context in which designing is taking place.

3 *Anomalies*

And yet we are surprised that many professional and experienced designers say that they do not use methods. This is something of a classic observation, which has always been shrugged off by the design research community. The traditional answer given is that they in fact *do* use methods, but that those methods have become implicit through years of experience. This answer is of course in no way satisfactory. It is a standard put-off, with all the logic of teenage thinking. When leading exponents of the professions we are working for all come up with such a statement, we should take it very seriously indeed, and ask ourselves: 'is this true?', 'how come?', and 'why?'. We cannot just shrug off this anomaly any longer, but should use it to learn and develop ourselves – especially when the number of anomalies is mounting.

Likewise, we are surprised that the tools we are developing are not widely used in design practice. Again, this can be shrugged off with arrogant statements about how little the design community understands us. But we are the ones who should study this apparent rejection, and should be reconsidering what assumptions are behind the tools we produce that could make them less than suited for design practice.

These two glaring anomalies are about the things we do. Yet there are more anomalies that have to do with what we are *not* doing.

The momentous changes in design practice that are taking place at this time don't seem to influence design research at all. But they should: the design activities of professional designers are changing under the influence of globalisation, the coming of the digital age, the imperative to create a sustainable world, and the fragmentation of value systems in western societies. These developments all put together lead to an enormous increase in the complexity of the challenges designers have to deal with. This translates itself in a true revolution in the design professions – for instance, designers now more than ever need to incorporate (value) research into their professional design practice, and this renewed engagement with the outside world could even lead towards a complete re-casting of the role of the designer through the adoption of co-design approaches. Yet, as we have seen, design research has a blind spot for issues to do with the designer, the content of the design activity and the context in which that activity takes place. So these momentous changes do not show up on our radar.

To give a concrete example: the forces of globalisation have meant that product design agencies in the western world have to completely rethink their business models. Design agencies traditionally used to offer strategic consultancy, conceptual design and embodiment design. Of these three activities, the embodiment design is what keeps the agency afloat: those are lots of billable

hours, the work is done by the cheaper people in the design studio, and the risk is limited. But in recent years, a large proportion of this embodiment design has moved abroad, following the transfer of manufacturing to newly industrialising countries like China and India. Thus traditional design firms have lost their economic basis, and many have had to close down. But others have flourished, through working in a completely different way. They have learned to take a more pro-active role. They develop new product concepts in close concert with future users, and then offer these pre-designs to companies (holding on to the Intellectual Property rights themselves). This gives the designer a much stronger position in negotiations with their clients: the conversation is no longer about 'Could we do a project for you?' but it is about 'This is a design concept, the users want it, can you make this?'. Many leading design agencies now work in this way – this and other new design approaches that are really changing the very nature of the design professions. There is a revolution going on out there, yet the impact of all these developments is not seen within design research.

4 Ways forward

I think that we should be worried about this. The anomalies are mounting, and they cannot be easily tackled within our normal way of working. They potentially touch the core of what we see as design science. We should rethink what really is the object of our studies (what do we consider to be 'design'?) and the very nature of the tools and methods we aim to create. In the remainder of this paper, two possible ways forward are described in some more detail. These are by no means the only ones; they are given here as examples of possibilities for a new reframed science of design.

4.1 Studying design expertise

One issue we need to tackle urgently in the face of the anomalies that were described above is the creation of a framework to describe 'the designer' – still the missing person in design research. For this we could turn to the theoretical work done in other fields on expertise development, and see if we can apply them to the development of a designer. The assumption we need to make in adopting this approach to design expertise is to say that we expect expert designers to work differently from novices, and that gaining design expertise is not a gradual process; both of these statements can be well-supported by earlier research.

We will here base ourselves on the work of Hubert Dreyfus, who distinguishes six distinct levels of expertise, corresponding with six ways of perceiving, interpreting, structuring, and solving problems. A first step to adapt this model to the design profession has been taken by Bryan Lawson and myself – here I will very briefly reiterate some of our findings. The easiest way to do this is level-by-level.

(0) *Naïve*. This is an extra level, preceding the 'novice' level that is the start of the Dreyfus model. This state is required in a model of design expertise since design-like tasks are not only performed by professionals, but also by ordinary people in their everyday life. This naïve state of designing is adequate for everyday use in conventional situations. Many students who enter design schools will display this naïve design behaviour. They do not yet understand that design is a series of activities, and treat it more as a one-off choice from a set of design solutions that they know and want to emulate ('I want to make something like that').

(1) A *novice* will consider the objective features of a situation, as they are given by experts, and will follow strict rules to deal with the problem. In this novice stage the students encounter design as a formal process for the first time. To tackle the complexities of design they need to learn a whole series of techniques and methods of representation.

(2) For an *advanced beginner*, situational aspects are important; there is a new sensitivity to exceptions to the 'hard' rules of the novice. Maxims are used for guidance through the problem situation. At least one aspect of the increased expertise developed by these students during their education is in terms of their acquisition of schemata or 'design prototypes'.
(3) *Competent* designers act in a radically different way. They select the elements in a situation that are relevant, and choose a plan to achieve the goals. Problem solving at this level involves the seeking of opportunities, and of building up expectations. In process terms a competent designer is likely to be able to become the creator of the design situation, through strategic thinking. This is a very empowering ability, in contrast to the earlier levels of expertise in which the designer was basically just reacting to design situations as they might occur.
(4) The real *expert* has many years of experience which allows them to recognise high-level patterns in design situations and respond to a specific situation intuitively, and performing the appropriate action, straightaway. There is no problem solving and reasoning that can be distinguished at this level of working. This can actually be a very comfortable level to be functioning on, as a well-respected creative professional within an established field. Yet the expert is quite vulnerable to radical changes in the context of the profession: the product design firms that had to close when a major part of their embodiment design moved overseas were very expert in the game of design as they knew it. But they were helpless when the rules of the game suddenly changed.
(5) With the next level, the *master*, a new uneasiness creeps in. The master sees the standard ways of working that experienced professionals use not as natural but as contingent. A master displays a deeper involvement with the professional field as a whole, dwelling on success and failure. This attitude requires an acute sense of context and openness to subtle cues. The master designer is really a development of the Expert who may have taken their set of guiding principles to a level of innovation such that their own work is seen as representing new knowledge in the field. At this level of performance designers are producing design ideas that are innovative responses to situations that may have been previously well understood. Such work is published and becomes the new precedent for other designers to study. This could be deemed 'practice based research'.
(6) The '*visionary*' consciously strives to extend the domain in which they work. The world discloser develops new ways things could be, defines the issues, opens new worlds and creates new domains. A world discloser operates more on the margins of a domain, paying attention to other domains as well, and to anomalies and marginal practices that hold promise for a new vision of the domain. The design world deliberately creates an opportunity for this with design idea competitions, exhibitions, and the publication of professional journals.

Most of these levels are intuitively recognisable to anyone involved in design education or design practice. But please note that these fundamentally different ways of looking at problematic situations can actually co-exist in a design project. Designers display rule-following behaviour, as well as the interpretation and reflection that characterise higher levels of expertise at work. And in this model, design expertise is described as a set ordering of discrete states, although it is far from clear that individuals would necessarily progress one level at a time. But the levels are distinct in that what is required developmentally to move up a level in each case is different, and, most crucially for this paper, in that *each level comprises its own kind of problem solving and reflection*. For instance, the kinds of issues that are faced by the designer at the novice level ('How can I use my methods?') are quite different

from those on the advanced beginners level ('When should I use this particular method/rule of thumb?'). Likewise, the reflection that takes place on the novice-level deals with the rules themselves, the reflection for the advanced beginner centres on the applicability of a rule in a specific design situation. Etcetera…

Combining this undoubtedly simplistic model of design expertise with our earlier findings within design research effectively produces a new, quite rich map of design. It opens up a whole new set of fundamental questions that could help us be more specific about what we mean when we say 'design': which level of design activity do we then actually mean? The rule-based 'design' of the novice? The situation-based 'design' of the advanced beginner? The strategy-based 'design' of the competent designer? The pattern-based 'design' of the experts? Do we mean the 'design' that takes place within a project, or the meta-design work that is part of every designer's practice? etc… And apart from raising these questions, the expertise framework also allows us immediately to propose a tentative answer to one of the anomalies we flagged above, on the problems surrounding the take-up of methods and tools by experienced designers: the methods and tools we make are mostly rule-based, and experienced designers tend to think in a pattern-based way! This is a real mismatch, which needs to be addressed.

4.2 Studying design practice

We can see that a framework like this, that roughly begins to describe the nature of 'the designer', could lead to a much richer picture of the design activity. Especially when we connect this new expertise framework to a model of levels of design activity, when we consider that designers work within a *project* (1), but over these projects they also build up expertise on how they approach projects: the *meta-process* level (2). These approaches to design projects, together with the context that designers create to work in, make up the *practice* (3) of a group of designers. What we see is that senior designers, like partners in design firms, actually do very little work intervening in design projects directly, but that they develop and guard precisely this 'practice'-level of design activity. This is an important part of what the 'experts', 'masters' and 'visionaries' that were named in the expertise model actually do.

So we should realise that the 'design context' in which design projects takes place is actually a man-made thing. Designers do not just 'design'; a major and crucial part of design practice consists of a long list of meta-activities. Designers create the environment they work in, their approaches to design situations, the role they take in design projects, the coalitions they work with, the way they deal with stakeholders. They put together design teams (from the sets of skills and knowledge and experience in the pool of designers that they create around them), they seek inspiration inside and outside of design projects, they create ways to keep on learning from their design activities, they create a view on the specific design quality they strive for, they create places and moments for reflection within their professional practice, etc… All of these meta-activities are part and parcel of 'being a designer', and they should be an integral part of the science that studies design.

Again, this can be done in many ways. At the University of Technology, Sydney, we have chosen to set up a new research centre, the Centre for Contemporary Design Practices, between the faculties of Design, Architecture and Building, Humanities and Social Sciences and Information Technology. The aim is to start research programmes focusing on design practice, nurturing cross-disciplinary insights into design (the centre includes people with backgrounds in industrial design, interaction design, fashion design, interior design, architecture, building, visual communication design, sound design, etc. as well as creative writers, media

specialists, researchers in semiotics, artists involved in interactive art, etc.) There is a clear common agenda, centering on the impact of the new technologies, globalisation, and social change on the practice of these fields – now and in the years to come. These overwhelming forces that impact on all design professions create a common ground for renewed engagement and experiment. The different design professions are responding in subtly different ways, as they bring their own knowledge, skills and traditions to bear upon the new situation. The aim of the centre is to learn from each other's responses through intense cooperation within shared projects, and from there to develop new design practices.

5 *Towards a new science of design*

The new, broader science of design that is outlined above can only come about when design researchers radically redefine their role *vis-à-vis* design practice. The purely analytical models of science that we have been using will only get us so far: in the face of such an immensely complex area as design, only experimental methods can bring the clarity and understanding we are seeking. We need to re-engage with practitioners, and get involved in experiments within the rapidly changing design arena. Design researchers should join design practitioners in co-creating the design expertise and design practices of the future.

This is a huge paradigm shift, changing the very nature of design research. This is the *real* revolution that is still waiting to happen.

☆ This is a revised version of a keynote speech delivered at the Congress of the International Association of Societies of Design Research, Hong Kong Polytechnic University, 14 November 2007.