DESIGN THINKING AND ANALYSIS A CASE STUDY IN DESIGN FOR SOCIAL WELLBEING

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In the last few years, "Design Thinking" has gained popularity – it is now seen as an exciting new paradigm for dealing with problems in sectors as a far afield as IT, Business, Education and Medicine. Most fields that are eager to adopt design thinking approaches seem to naturally focus their interest on the creative and generative elements of the design professions – after all, this is what design is most commonly known for.

In this paper we will seek to enrich this picture by using a case study in design for social wellbeing to describe and discuss an original approach to analysis that is also part and parcel of the designing disciplines.

Keywords: Design thinking, Abduction, Induction, Framing, Indigenous health, Design for wellbeing.

1. 1 INTRODUCTION

The term 'design thinking' has been part of the collective consciousness of design researchers since Rowe introduced it as the title of his 1987 book [Rowe, 1987]. Multiple models of design thinking have emerged over 20 years of research, based on widely different ways of viewing design situations and using theories and models from design methodology, psychology, education, etc. Together, these streams of research create a rich and varied understanding of a very complicated subject. In the last few years, "Design Thinking" has gained popularity – it is now seen as an exciting new paradigm for dealing with problems in sectors as a far afield as IT, Business, Education and Medicine (Brown 2008). The challenge before the design thinking research community is to play a role in interpreting design thinking for other disciplines, looking at what a particular perspective, insight, theory, model or set of tools within the design thinking spectrum can bring to other fields.

Naturally, a lot of the work in this area focuses on the creative and integrative nature of design thinking, and on designer's ability to reframe situations to make them amenable for solution.

In this paper we concentrate on the use of a specific kind of analytical reasoning that is part of the design thinking spectrum. We start out by using a model from formal logic to create a description of design thinking. Then we will describe a case study in which a closely related pattern of thought has been used differently: not for the creative/ generative/synthetic aims normally associated with design thinking, but to analyse a complex problem situation, and generate new approaches that reframe this situation in new and interesting ways.

2. ANALYSIS & ABDUCTION

To build up a conceptual framework that is fundamental enough to anchor the wide variety of design thinking approaches that designers take, and connect the many descriptions of design thinking that

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have arisen in design research we suspend the 'rich' descriptions of design and take the question of design reasoning back to the basics, the formal logic behind design reasoning. Logic provides us with single group of core concepts that describes the reasoning in design and other professions.

We build on the way fundamentally different kinds of reasoning are described in formal logic, in particular the way Roozenburg has described the work of Peirce [Roozenburg, 1995]. He describes basic reasoning patterns through comparing different 'settings' of the knowns and unknowns in the equation:

WHAT	plus	**HOW**	leads to	**RESULT**
(thing)		*(working principle)*		*(observed)*

In **Deduction**, we know the 'what', the 'players' in a situation we need to attend to, and we know 'how' they will operate together. This allows us to safely predict results. For instance, if we know that there are stars in the sky, and we are aware of the natural laws that govern their movement, we can predict where a star will be at a certain point in time.

WHAT plus **HOW** leads to **?????**

Alternatively, in **Induction**, we know the 'what' in the situation (stars), and we can observe results (position changes across the sky). But we do not know the 'how', the laws that govern these movements. The proposing of 'working principles' that could explain the observed behavior (aka hypotheses) is a creative act.

WHAT plus **???** leads to **RESULT**

These two forms of analytical reasoning predict and explain phenomena that are already in the world. What if we want to create valuable new things for others, like in design and other productive professions? The basic reasoning pattern then is **Abduction**:

WHAT	plus	**HOW**	leads to	**RESULT**
(thing)		*(scenario)*		*(aspired)*

Abduction comes in two forms – what they have in common is that we actually know the value that we want to achieve. In the first form of **Abduction-1**, that is often associated with 'problem solving', we also know the 'how', a 'working principle' and how that will help achieve the value we aim for. What is still missing is a 'what' (an object, a service, a system), so we set out to search for a solution.

??? plus **HOW** leads to **VALUE**

This is often what designers and engineers do – create an object that works within a known working principle, and within a set scenario of value creation. In the second form of **Abduction-2**, the ONLY thing that is set is the end value we want to achieve.

????	plus	**???**	leads to	**VALUE**
(thing)		*(scenario)*		*(aspired)*

So the challenge is to figure out 'what' to create, while there is no known or chosen 'working principle' that we can trust to lead to the aspired value. That means we have to create a 'working principle' (through a way of thinking that is close to induction) and a 'thing' (object, service, system — through a way of thinking that is close to Abduction-1) in parallel.

This will involve the development or adoption of a new 'frame' – please note that the implication that by applying a certain working principle we will create a specific value, corresponds to what is normally called a 'frame' within design literature (see [Schon, 1983]).

WHAT plus **HOW** leads to **VALUE**
————frame—————-

'Framing' is the term commonly used for the creation of a novel standpoint from which a problematic situation can be tackled – this includes perceiving the situation in a certain way, adopting certain concepts to describe the situation, a set of patterns of reasoning and problem solving that are associated with that way of seeing, all leading to the possibility to act within the situation. The ability to frame and reframe is central to reasoning in design situations (Abduction-2). Einstein is quoted as saying that 'A problem can never be solved from the context in which it arose' – and apart from the circularity of this statement (if the issue could be solved from its original context, it would probably have been solved before even registering as a real problem), it is true that designers are valued for their ability to reframe the issues before them in a way that makes the problem situation amenable to solution.

Performing this complex creative feat of the creation of a *thing* (object, service, system) and its *way of working* in parallel is often seen as the core of design thinking. This double creative step requires designers to come up with proposals for the 'what' as well as the 'how', and test them on a continuous basis. The strategy of creating solution proposals, analysing these and evaluating them, and improving them until the solution satisfices, can be recognised right across the design professions.

This brief excursion into logic helps us to establish the designing professions as thinking fundamentally different from fields that are predominantly based on analysis (deduction, induction) and problem solving (Abduction-1, see also [Dorst, 2006]). But design is always a mix of different kinds of solution focused thinking (Abduction), which includes both problem solving and reframing of the problem situation, in a co-evolution process. And it also contains quite a bit of deductive reasoning, as rigorous deduction is needed to check if the proposed frames and design solutions will work.

3. 3 DESIGN THINKING AND ANALYSIS

In the real world, problematic situations arise when the equation (*what' plus 'how' leads to 'value')* that an organization has been operating under somehow doesn't work anymore. This could be paraphrased as:

???? plus **???** leads to **?????**
(what) *(how)* *(value)*

It can be very hard to fathom what's wrong: should the 'what' be changed, the 'how' could be wrong, the 'frame' that drives the implication could be faulty or maybe the organization is misreading the values in the world? There are different ways of analyzing this problematic situation. Initially, organizations often react in a way that requires the least effort and resources: they set out in a problem solving manner to create a new 'something' that will save the day while keeping the 'how', 'frame' and 'value' constant.

This is often the nature of the design situation as it first presents itself to a designer, implicitly framed by the client organization – and the designer has to explore whether the level at which the central design problem is perceived and understood by the client is right for the problematic situation to be fruitfully approached by the designer [Paton, 2010]. Often, designers will say that the problem-as-presented first needs to be 'deconstructed' [Hekkert *et al*., 2003] or opened up.

Experienced designers can be seen to do this by searching for a central paradox, asking themselves what makes the problem hard to solve, and only start working towards a solution once they have established the nature of the core paradox to their satisfaction [Dorst, 1997]. This core paradox often requires a reframing of the problematic situation - in contrast to analytical problem solving, that takes place in a 'closed world' where there is no way to redefine the problematic situation. In her writings on Engineering Ethics, Caroline Whitbeck flags the way designers deal with paradoxes as a key special element of design thinking [Whitbeck, 1998], and one that is of great value.

In order to find such a core paradox, designers perform a special kind of analytical thinking that is aimed at achieving insights on the assumptions and frames that underlie the design situation as it initially presents itself. Experienced designers have built up the expertise to do this analysis quickly, and often informally [Lawson, 2009]. Yet in extremely complex problem areas, we need to resort to more extensive methods of a kind of design-thinking analysis. Designers need to carefully gather evidence to inform a well-supported and clear view of **facts** as well as the **assumptions** ('frames' and current interpretations) that have stood in the way of the creation of solutions to this particular problem until now. Only then can they confidently create a new frame for the problematic situation, and launch into the generation of design solutions…or decide (as we will see in this case study) that the problem is not amenable to design solution at all. The case study is in the fascinating and complex area of design for social wellbeing.

4. CASE STUDY: DESIGN FOR WELLBEING

Design for wellbeing in the context of the paper is meant as a practical way to supply health-hardware that contributes towards the physical wellbeing and to improve and sustain health for a community segment – in this case Indigenous communities in Australia.

The protagonist in this case study is an Industrial Designer who, since 1991, has been working as a consultant with NGO's and Government to improve Indigenous Environmental Health. Health in Australian Indigenous communities is poor and the indigenous population has a life expectancy that is about 13–20 year less (depending on method used) than that of a 'mainstream' Australian (Australian Bureau of Statistics, 2010). Houses are not providing access to basic health supporting infrastructure such as washing and cooking food. Less than 10% of 6000 houses surveyed (Department of Families 2007) in Indigenous Australia have adequate facilities to prepare, cook and store food. A vital link in the chain of products needed to provide meals at home is the stove. 71% of houses have electric stoves. During his involvement in this field, the designer regularly encountered anecdotal evidence about poorly performing electric cook-stoves in Indigenous communities. Indeed, some stoves are lasting no longer than 6–24 months: a very short time compared with the 10 year service life that housing providers (NT Housing Services 2007) and consumers usually expect from this appliance.

When he started investigating this issue most comments about this short lifespan were laying the blame with the users. Some typical examples: *"we should have programs that train 'them' how to use stoves"*, *"the stoves would last longer if 'they' wouldn't take a star picket to it"*, *" I wonder what 'they' are doing to them?", "they don't know how to cook with a stove, 'they' like cooking on a fire"* or *" they use the stoves to heat the houses but not for cooking food"* (quite untrue, by the way). It is obviously the users fault that the stoves do not last.

He set out to investigate what is really happening by undertaking a study of these stoves in two remote Indigenous locations over about a year. The average household population was 6.4 people per house, nearly triple the national average household population of 2.4 persons per house (Australian Bureau Statistics 2001). This 3 times higher number makes it harder to ask the inhabitants about their stove use because whom to pick to talk to? How many people do the cooking? How to ask the questions? English is at best the second if not third or fourth language, and an interpreter would be required. The chances of getting to talk to the same people every three months would have been very slim. People go to work, visit relatives, go interstate or abroad. Furthermore, the kind of rapport that would have provided a commitment on part of the householders can not be built up in a three monthly fly in and fly out kind of approach. Which is the kind of approach that is available to the designer?

So instead of doing interviews, cultural probes, ethnographic research, etc, the approach was taken to 'interview' the stove rather than the users. Data loggers were installed in the consumer switchboard on the outside of the house to measure the current draw from the dedicated stove electrical circuit. This data was downloaded every 3 months and analysed. This way was the least intrusive way for the householders, once they were happy to have their stoves monitored. The researcher had to go and access the CSB every 3 month and download the data onto a laptop, much like the person reading the electricity meter. The stove was logged every 3 minutes, an interval that should show even the shortest duration of use on an electric solid element domestic stove.

The data was collected for about one year, and subsequent analysis showed that the stoves were used on average for about 3.5 hours a day (with peaks of up to 6 hours/day). The graphic user profile generated from the data demonstrated that these hours more or less coincide with what we could call a normal working day pattern.

The manufacturer of this particular kind of stove, usually specified for public housing, is an international electric appliance corporation that through a number of brands virtually exclusively services this market segment. When they were approached with the data from this study they divulged that the specified stove is only designed to be used for 5 hours a week (Field notes).

Within that context the mere fact that a stove is being used about 3.5–6 hours a day (Table 1) for 0.5–2 years, actually accounts for its short lifespan in the Indigenous context (Tietz 2009).

The initial response to this could have been a design intervention, after all that is what Industrial Designers do, they design things, make them better, revise, update, improve, respond to the changing material and production process to make sure we maximize what is technically and financially feasible.

Figure 1. Stove new in shop.

Figure 2. Stove in the field.

Table 1. Average daily stove use. The average use across 12 stoves is 3.46 hours a day. One stove was average of 6.01 hours a day.

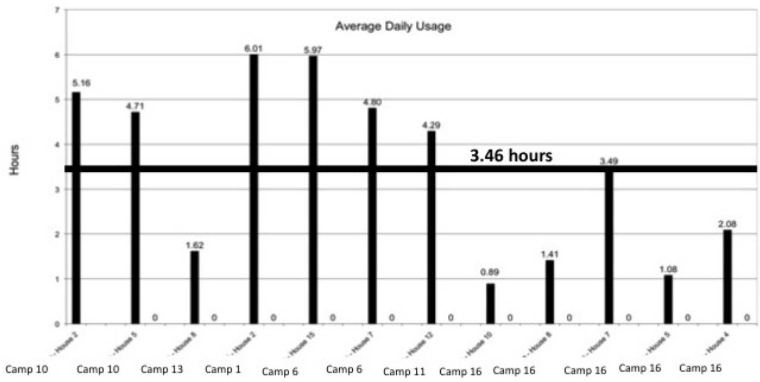
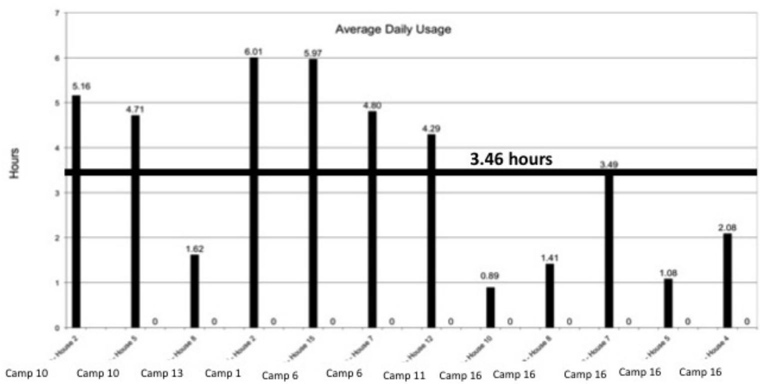


Table 2. Mean hourly stove usage as a percentage of mean total daily stove use for below houses 16-4, 16-5, 16-07, 16-08, 16-10 in community



Further investigation showed that the same stoves (Figure 1) have been ordered and reordered by the various housing providers for years. Interestingly no one deemed it necessary to investigate why the service life was so short, instead the users were blamed and more of the same stoves were ordered again and installed. Relatively low qualification requirements and high staff turnover for remote area housing officers are probably partly to blame for this repeated reordering of poorly performing products. It is also a requirement to order from a range of approved products from suppliers on the government preferred purchase list. However the ongoing expense and cost associated with ordering, shipping and installing stoves seems to have gone unnoticed in a sector were cost reduction of housing is often front page news.

The amount of stove usage that was uncovered in this study falls easily within the range of commercial cooking equipment. Commercial stove manufacturers approached with this data felt very confident that their 'machines' are able to handle this kind of use. Commercial kitchens are high pressure and very demanding environments were high performance is reliably and repeatedly required. Oven door hinges are strong enough for cooks to stand on to reach shelves above (Davidson 2010). The manufactured quality and the quality of components is of a higher order geared towards heavy use, like any other professional equipment. Therefore without any design intervention per se, but simply with re-specifying from within an existing, albeit more 'upmarket' product range it appears that this ongoing, costly, lifestyle and health affecting issue can be tackled.

After all the user is ok, there are just more of them than in an average household, the design is ok for its intended context , the manufacturer is ok as they produce for a specific market segment, and within his own limitations the specifier is ok as there are no other options to choose from - but paradoxically, the system is not OK at all and leads to disastrous results. So the design effort required here is not one to do with form, shape, texture or materials and manufacture of products but has to be reframed to deal with a feedback system within the organisation that provides the stoves, so that it can respond effectively to previously unanticipated needs and requirements.

5. DISCUSSION

But let us now concentrate on the process this designer-researcher went through. In the first instance, this project could be considered to call for a 'classic' research approach, through induction:

WHAT plus **???** leads to **RESULT**

We observe that there are stoves provided, we observe a lack in quality in the result of this, and want to investigate the 'how' – what is the mechanism that underlies the obvious malfunction? The research method used (logging the stoves) was meant to sharpen the observations, so a hypothesis could be created that would explain the problem. This insight would then help create ideas for a solution. This last remark is crucial: in the background of this purely analytical empirical study is a different project, that of a classic engineering-type problem solving scenario:

??? plus **HOW** leads to **VALUE**

The designer-researcher was ready to develop a new stove once the 'how' would have been inductively established. Effectively, the degrees of freedom in the overall project can be captured in the following equation:

????	plus	**???**	leads to	**VALUE**
(thing)		*(scenario)*		*(observed)*

This new equation could be called "Induction-2" – it goes beyond normal induction by also questioning the elements of the situation. What is required is a double inductive step, that cannot be performed without creating and proposing either elements (things) or scenarios to use as stepping stones for the analysis. This is directly analogous to the double creative step that is required in Abduction-2, and it requires the same kinds of skills (in framing and reframing, proposing of solutions, the seeking of inspiration from precedents) that design researchers have described as being part of the design ability.

6. CONCLUSION

This project involved a certain measure of 'classic' analytical thinking and 'hard' research methods in setting up the study around the logging of the stoves. And the research project itself was initially framed in the Induction-1 approach: this would lead to the creation of new specifications and development of a new stove design (through a subsequent Abduction-1 process). The designer-researcher might have done that, on the basis of the analysis of the empirical data. Yet that would not have worked, as the REAL problem in this project is connected to the framing of the issues. By analyzing the situation in detail – both through creating a basis of facts through the logging of the stove activity, and through looking for multiple stories and viewpoints in the problem arena — a rich complex picture emerged. This required a 'design thinking' approach that is closely related to abduction-2 (dealing with two unknowns in the left of the equation by proposing and thinking through different frames and possible solutions), but one that focused on analysis, rather than synthesis.

In this paper we hope to have demonstrated that there is an analytical side to the professional practice of some designers, that can be seen as part of the repertoire of design thinking. This paper, with its description of just a single case study, is only a first attempt at capturing the complexities of this field. Much more research is needed: a richer, deeper picture will only emerge through the creation of multiple models of this practice, based on a rich variety of cases.

REFERENCES

1. Australian Bureau of Statistics, A., 4704.0 - The Health and Welfare of Australia's Aboriginal and Torres Strait Islander Peoples, 2008 in A.I.f.H.a. Welfare (ed.) 2008 edn, Australian Bureau of Statistics, (ABS), Canberra, p. 32, 2010.
2. Australian Bureau Statistics, A., CHANGING DWELLING AND HOUSEHOLD SIZE Australian Bureau of Statistics, 2001.
3. Brown, T., 'Design Thinking', Harvard Business Review, p. 86, 2008.
4. Davidson, A., CEO, Goldstein Eswood, personal communication, 8/2/2010, 11 am, Meeting at Goldstein Factory Smithfield, Sydney, NSW, Sydney, 2010.
5. Department of Families, Community Services and Indigenous Affairs, National Indigenous Housing Guide, Third edn, Commonwealth of Australia, Canberra, 2007.
6. Dorst, K. Design Problems and Design Paradoxes, Design Issues, Volume 22, number 3 pp. 4–17, 2006.
7. Dorst, K., Describing Design - A Comparison of Paradigms, Thesis TUDelft, The Netherlands, 1997.
8. Hekkert, P., Mostert, M. & Stompff, G., 'Dancing with a machine: a case of experience-driven design', paper presented to the Proceedings of the 2003 international conference on Designing pleasurable products and interfaces, Pittsburgh, PA, USA, 2003.
9. Lawson, B. and Dorst, K., Design Expertise, Architectural Press, Oxford, 2009.
10. Northern Territory Housing Services, D., Management of Territory Housing Dwellings, in L.G.a.R.S. Department of Housing (ed.) no 18/9/2007, Northern Territory Government, Darwin, p. 5, 2007.
11. Paton, B. and Dorst, K., Briefing and Reframing, in: Dorst et al (eds) Intepreting Design Thinking – proceedings of the 8th Design Thinking Research Symposium, University of Technology Sydney, 2010.
12. Roozenburg, N.F.M. and Eekels J., Product Design: Fundamentals and Methods Wiley, Chichester, 1995.
13. Rowe, P, Design Thinking, Cambridge, Massachusetts, MIT Press, 1987
14. Schön, D.A., The Reflective Practitioner: How professionals think in action. Temple Smith, London, 1983.
15. Tietz, C., Stirring Appetites in design: A User Centred Product Design Approach to Improve Environmental Healh in Remote Indigenous Australia, Design Principles & Practices: An International Journal, vol. 3, no. 5, pp. 105–119, 2009.
16. Whitbeck C., Ethics in Engineering Practice and Research Cambridge University Press, Cambridge UK. 1998.