



Navigating Difference: A Framework to Support Understanding of Design Research

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Thesis Title: Navigating Difference: A Framework to Support Understanding of Design Research

Abstract:

The social practice of design and design research is continually evolving to meet the needs of society. Research has always been an integral part of the design process, yet as a profession which developed outside of the university, its methodologies are fundamentally different from more traditional academic models by incorporating elements of creativity, intuition and tacit knowledge. Increased collaboration with the wider academic research community combined with greater focus on public research assessment and accountability creates a clear need for design to develop, define and communicate its particular research methodologies.

The research was conducted in three phases. A documentary analysis of the UK Research Excellence Framework 2014 (UK REF 2014) captures an understanding of how research, and in particular design research, is represented, defined and evaluated within the wider discursive and social practice of research assessment. This was followed by a constructivist grounded theory study of practising design researchers to capture their approach and understanding of design research. Finally, building on the themes emerging from the documentary analysis and grounded theory study, a hermeneutical circle of interpretation is developed to explore the contextual social and historical structures, practices and cultures shaping the evolution of design research.

Based on the findings, a framework titled *Navigating Difference* has been created to support understanding of design research practice. *Navigating Difference* represents the experience of design researchers as they navigate the opposing values of design practice and academic research. Addressing research questions framed in terms of ‘what could be’, design research practice was found to be determined by the embodied interaction of the design researcher with the human situation, drawing on a combination of creativity, intuition and theoretical knowledge. The *Navigating Difference* framework maps and explicates the range of design research approaches as evidenced in the research interviews and the continued evolution of design research practice as it navigates and addresses design practice and academic research values.

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Publications List

Journal Publications

Maher, C., Hadfield, P., Hutchings, M. and de Eyto, A., (2018) Ensuring Rigor in Qualitative Data Analysis: A Design Research Approach to Coding Combining NVivo With Traditional Material Methods. *International Journal of Qualitative Methods*, 17: 1-13.

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International Conference Proceedings

de Eyto, A., Maher, C., Hadfield, M., Hutchings, M., (2016) Beautiful Nerds: Growing a rigorous design research dialogue in the Irish context. in: P. Lloyd & E. Bohemia eds., *Proceedings of DRS2016: Design + Research + Society – Future – Focused Thinking*, Volume 10, pp 2711 – 2723, DOI 10.21606/drs.2016

Maher, C., Hadfield, P., Hutchings, M., de Eyto, A., (2014), 'Representation and Evaluation of Product Design in Research Assessment: A Case Study of the UK REF 2014', in Bohemia, E., Egar, A., Eggink, W., Kovacevic, A., Parkinson, B., Wits W., eds., *Proceedings of the 16th International Conference on Engineering and Product Design Education*, 4 & 5 September 2014, University of Twente, The Netherlands

Professional Practice

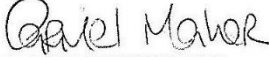
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Author's Declaration

This is to certify that this thesis is the original work of Carmel Maher. The author is solely responsible for the content. Neither the thesis nor the original work contained therein has previously submitted for a higher degree.



Carmel Maher B. Des. (Hons), MA

4 May 2020

Glossary

Art School.

In the context of this thesis, the term art school or art college refers to a third level university specialising in art and design education and research.

Design

In the context of this thesis, design refers primarily to industrial design, although in many instances the findings may have relevance for a broader range of design practices.

Design Research

The academisation of design is a relatively recent development, and without a long tradition in research and education, its theoretical development remains fragmented and contentious. Frayling's (1993-94) much cited paper on research in art and design categorises its research as being either, "research into art and design, research through art and design and research for art and design". For the purpose of this thesis, design research may encompass any one of these categories.

Industrial Design and Product Design

These terms have different meanings in different countries and contexts. Both are involved with the design of consumer products for mass production. The researcher's understanding, coming from an industrial design background, is that product design has a greater focus on engineering and materials science. In the context of this research and thesis, industrial design refers primarily to the design of industrially manufactured products and, more recently, services and systems. It considers not only the technical, manufacturing and engineering aspects but also the user and their physical and emotional needs, thereby requiring not only technical and engineering proficiency but also creativity, empathy and understanding.

Research

Research will be assumed to comprise the following features as outlined by Cross (Cross 2007c, p. 48), an investigation that is purposive, inquisitive, informed, methodological and communicable.

Scientific method

The meaning of the term ‘science’ has evolved over the years in response to the historical and cultural contexts of its use. While science has evolved, developed and expanded to include a range of methodological approaches and positions, strong links remain with its positivist origins and the words ‘science’ and ‘scientific’ still retain strong associations with a mainly objective, value-free, quantitative form of enquiry. Implicit connotations of fact, truth and reason make methodological rigour fundamental to its constitution. It is this understanding of science and associated scientific method that this researcher holds.

Institute of Technology

In the context of this thesis, an institute of technology refers to a third level institution of education which specializes in applied science, engineering, technology, art and design education and research.

University

In the context of this thesis, a university refers to a third level institution of education and research.

Abbreviations

The following provides the full term for any abbreviations used in the thesis. The page on which each abbreviation is first used is also given.

Abbreviation	Full Term	Page
BIS	Business, Innovation and Skills	p. 78
BU	Bournemouth University	p. 1
CAQDAS	Computer assisted qualitative data analysis software	p. 93
CDA	Critical Discourse Analysis	p. 21
DMM	Design Methods Movement	p. 34
EXP	Experimental Projects for MA students	p. 127
GT	Grounded Theory	p. 22
HEA	Higher Education Authority (Ireland)	p. 151
HEFCE	Higher Education Funding Council for England	p. 46
JACS	Joint Academic Coding System	p. 125
RAE	Research Assessment Exercise	p. 83
RAND	Research ANd Development	p. 43
REP	BU Research Ethics Panel	p. 69
SEP 2015–2021	Netherlands Standard Evaluation Protocol 2015–2021	p. 152
STEM	Science, Technology, Engineering and Mathematics	p. 114
UK REF 2014	UK Research Excellence Framework 2014	p. 3
UOA	Unit of Assessment	p. 79

Section One: Introduction

1. Introduction

1.1 Background to Problem

The ability to conduct research is essential to any discipline. This is also true for design as it is an integral part of the design process. It is important this research is credible and trustworthy, as it guides project specific decision-making and design practice. Formal research skills are largely developed in postgraduate educational programmes, although some tacit understanding may be acquired at undergraduate level. The research modules delivered in postgraduate programmes generally address the major theoretical and philosophical underpinnings of research, its purpose and context. These modules in the main compare the appropriateness of a range of qualitative and quantitative approaches and methods to different research questions depending on the researchers' disciplinary background. However, frequently the models and methods proposed originating from either the natural or social sciences are ill suited to the requirements of the design researcher. The design researcher then has to strive to make them 'fit' with their particular research needs (Institutes of Technology Ireland Research Alliance 2010). This can be challenging for the novice design researcher. Methods must be adapted in order to make them relevant to design research questions; however, this may impact the rigour of the process. Conversely, lack of confidence may direct the researcher to follow rigorously a particular research approach; where in their effort to maximise rigour, they fail to address the pertinent issues of the research question. There appears to be a deficit of widely recognised and established design research methodologies. This research aims to develop understanding of design research approach, methodologies and methods to support the theoretical development of a research practice which serves and advances design practice.

A study of peer reviewed literature on design research, its nature and methodologies revealed concerns coming from within and beyond the design community regarding this issue. They questioned the ability of other discipline approaches to serve design practice needs while expressing reservations regarding the coherent development of an explicit design approach to research. (Archer 1991; Buchanan 1992; Friedman 2000; Biggs and Buchler 2007; Bonseipe 2007; Cross 2007b; Almquist and Lupton 2010; Margolin 2010; Biggs and Buchler 2011b; van de Weijer et al. 2014). These authors advise that while classic research methods required modification to be used in a design context, there appeared to be little understanding of the nature, the type of knowledge created and the methodological procedures emerging from a design researcher's approach. Yet design methods, and by implication design research methods because they are an intrinsic element of the process, were considered to have productive application in a range of societal issues. As described by Norman:

“Modern design has grown from a focus on products and services to a robust set of methods that is applicable to a wide range of societal issues” (Norman 2014).

This lack of understanding combined with a wide range of possible applications justified further research. The following section provides a brief overview of design, identifying the origin of the deficit and its impact on research practice and development.

Industrial design is a relatively new profession with its origins in the Industrial Revolution. The development of formal industrial design education as we know it today followed in the early 1900s. Industrial design and indeed the creative processes of design in general, being of a more applied nature and favouring an apprenticeship model of teaching, have not had the benefit of a long historical tradition in academic research. Subsequently, it has progressed without the associated formalised development of research approaches and methodologies, despite the fact that research is an integral part of the design process and some tacit understanding is acquired through practice. This combined with the fact that design and its practice has its own distinct, though often poorly understood and articulated intellectual culture and ‘designerly’ ways of knowing (Cross 2007a), leaves a significant gap in understanding of design research methodologies. This is a deficit requiring attention as design takes a more active and often collaborative role in research. Projects frequently involve multi-disciplinary teams dealing with a range of social and environmental issues with design (due to their particular skill sets) taking a coordinating role. Stappers outlines the benefits of bringing a designer to a research team:

“They can communicate with all specialisms and specialists involved. They can integrate the (often mismatching) inputs from specialisms. They can act in the absence of complete information. They retain focus on realizing the product throughout the process” (Stappers 2006, p.83).

Stappers’ analysis underlines some of the benefits designers can bring to multi-disciplinary research projects. The need to communicate these benefits and others to the wider research community combined with an increased focus on public research assessment, accountability and pressure to generate research income through competitive funding application in academia creates a clear need for design to clarify, legitimise and articulate its research approach/methodologies both for those within and outside the community (Maher et al. 2014).

1.2 Definition of Terms

In the context of this thesis:

Design refers primarily to Industrial Design, although in many instances the findings may have relevance for a broader range of design practices.

Research will be assumed to comprise the following features as outlined by Cross (2007c, p.48): an investigation that is purposive, inquisitive, informed, methodological and communicable.

A more detailed consideration of the meaning of these terms in the context of this thesis and the positioning of design research in the social practice of research can be found in *Section 2.4 Positioning Design Practice and Research in the Social Practice of Research*.

1.3 Statement of Problem

A preliminary exploration of the literature relating to the development of design research practice finds that design research has historically focused on advancing the methods of design practice rather than design research practice. This has been with a view to raising the status of design by increasing its alignment with scientific ideals of rigour and rationality (Cross 1984). More recently, there has been a general consensus among designers that this is counterproductive and that the methods developed, which were significantly influenced by scientific practice, failed to address the complexity and situated nature of design practice and to incorporate the creative interpretation of the designer. The prescribed methods consequently had limited practical application.

Current research has focused on developing understanding of design methods by observation of and reflection on practice (Cross 1996, 2001; Lawson 2004, 2005; Lawson and Dorst 2009); however, there are few studies based on observation of design research practice, the focus of this project. Loughborough University, Design Practice Research (DPR) have put together a collection of PhDs which provide examples of visually creative design practice contributions to academic research which is a useful resource (Design Practice Research Group 2013). Generally, however, published literature and journal articles relating to design research practice do so in the context of its role in supporting design decisions in relation to a specific design project rather than as a contribution to the general theoretical development of design research practice (Keller et al. 2009). Kuhn's (1962) view of research paradigms as arising from the interpretations and self-understandings of a community of practice supports the expansion of research paradigm studies to include observation of design research practice. Other practice-based research disciplines with more established research traditions advocate that researchers must also consider the historical and cultural influences on practitioner's self-understandings when developing understanding of discipline specific research approaches (Usher et al. 1997, p. 181). These threads are expanded in *Section 3.2 Research Paradigm*. This is absent from the existing studies observing design practice (Cross 1996, 2001; Lawson 2004, 2005; Lawson and Dorst 2009) and constitutes a gap in knowledge relating to both design practice and design research practice.

To summarise, there is a significant lack of understanding of the research process of designers. While much has been written about the development of design research practice and its associated challenges (van de Weijer et al. 2014), there are few studies which focus on observation of and reflection on research practice as a means to its theoretical development. Design research has cross-disciplinary reach and application. Furthermore, it is recommended that when developing

understanding of research practice, researchers consider the historical and cultural contexts informing that research practice. (Usher et al. 1997, p.182). However, despite these observations, research which addresses design research practice tends to focus on it in isolation of its social and historical location. It is the view of this researcher that this constitutes a significant gap in knowledge and directs an approach to address it.

1.4 Purpose of Study

The researcher's theoretical perspective views design research practice as being shaped by the conventions of a particular community of practice and the "knowledge systems, social structures and social agents" (Smith 2010, p. 27) within which this practice is operating in. A hermeneutic/interpretative research approach considers both the details of a situation and the overall picture (Verganti and Oberg 2013). The focus of this research moved iteratively from developing understanding of the overall context and cultural influences to observation of the details of practice and back again in an iterative process. This is an inductive approach to research inquiry. The research aimed to develop and construct theory. Its objective is to develop understanding of: research definition and evaluation within the larger research community, research practice as experienced and understood by design researchers and the historical and social structures influencing this practice.

1.5 Research Aims

This research aims to develop a framework to support understanding of design research practice based on the self-understandings of design research practitioners while being cognisant of the historical and social structures influencing this practice.

1.6 Research Objectives

- a. Conduct a Critical Discourse Analysis (CDA) of the UK REF 2014 in order to understand and critique research assessment exercises in terms of the role they play in the definition, evaluation and continued evolution of research and in particular design research.
- b. Conduct an interview based, grounded theory study of practicing design researchers in order to uncover their understanding and experience of research, their approach, their research problems and methods.
- c. Review the literature relating to;
 - the historical and social structures influencing design research practice and to
 - the findings emerging from the critical discourse analysis of the UK REF 2014 and the grounded theory study of practicing design researchers.
- d. Compare, critique and integrate the literature with the research findings and analysis from objectives a and b in order to produce a framework which explicates and maps design research approach and evolution as evidenced in this study.

1.7 Research Design

A qualitative mixed method approach has been adopted, consisting of a Critical Discourse Analysis of the UK REF 2014 and a Constructivist Grounded Theory (GT) study of practising design researchers. This mixed method approach is directed by an interpretative, hermeneutical and critical approach to research enquiry. This approach considers not only the participants' self-understandings but the links between their understandings and the social and cultural practices they operate within.

Data sources included: the UK REF 2014 documentation, semi-structured interviews with practising design researchers, existing theoretical accounts of the biography of design research practice, in particular, the social and historical contexts of design research and its tacit and judgement-based processes.

Data analysis consisted of: a documentary analysis of the UK REF 2014 and a constructivist grounded theory study of practising design researchers. Visual affinity mapping of findings combined with a hermeneutical circle of interpretation supporting consideration of the whole in relation to its parts and vice versa completed the analysis. Analysis and critique were further supported by existing theoretical accounts of the research of other practice-based disciplines.

1.8 Contribution of Study

It is anticipated that this research may provide understanding and critique of research assessment practice as it impacts on design research practice, the historical and social values informing research assessment and current best practice in research as defined by the UK REF 2014. It will also provide understanding and critique of how designers conduct research, what they perceive as important and what is problematic and the actions they implement to achieve resolution (Stern and Porr 2011). On a conceptual level, this research may provide understanding of the extent to which design research practice is “embedded in larger and, often hidden positions, networks, situations, and relationships” (Charmaz 2006, p. 130). Furthermore, it may provide understanding of the freedoms/supports required for productive design research approach and practice.

It is hoped the findings will have relevant application for a range of users, for example, research students, research supervisors, government policymakers, higher education funding bodies, higher education institutions and the broader research community. It may assist in design methodological development, in cross-disciplinary communication and collaborative research projects, in higher education interdisciplinary development and in the development of more inclusive research funding mechanisms.

1.9 Structure of Thesis

The thesis follows a traditional PhD structure. The work is presented in the following order: Section One, Introduction; Section Two, Literature Review; Section Three, Methodology; Section

Four, Critical Discourse Analysis of the UK REF 2014; Section Five, Grounded Theory Study of Practicing Design Researchers; Section Six, Research Framework-Navigating Difference; Section Seven, Discussion; Section Eight, Conclusion.

Section Two: Literature Review

2. Literature Review

2.1 Introduction

This section explores the literature relating to design research practice. Conducted to identify gaps in knowledge and to provide dialogue with and contextualisation for the findings, it reflects on existing theoretical accounts of similar phenomena while taking into consideration contextual social and historical structures, practices and cultures.

2.2 Method

As is consistent with inductive approaches to research inquiry, the literature was explored in an iterative manner, before, during and after the fieldwork, that is the Critical Discourse Analysis of the UK REF 2014 and the Grounded Theory interviews with practising design researchers. This is because, when developing Grounded Theory, much of the relevant literature is not known until concepts start to emerge from the interview analysis (Daymon and Holloway 2002). More importantly, it is essential the literature does not constrain the emergent nature of the process or impose predetermined ideas and theories on the analysis. This approach adopted was recommended by Norton and Holloway (2013). They advocated consulting the literature in this way, when developing Grounded Theory, and differentiated between the uses of the three iterative stages of literature searching as outlined below.

- “Literature searched before the fieldwork commences, is used “to discover previous studies on similar topics, to ascertain the gaps in knowledge [and] to sensitise the researcher.”
- Ongoing literature searching throughout the project is used “to provide additional sources of data, to [permit findings] to have dialogue with the literature and integrate findings, to confirm, disconfirm or challenge the findings.”
- Literature searched towards the end of the project, is used “to query and discuss when findings contradict it, to integrate into the core category, to extend and refine knowledge [and] to set research into context of other studies.” (Norton and Holloway 2013)

The literature referred to in *Section 2 Literature Review*, *Section 3 Methodology* and *Section 7 Discussion* was explored in this manner and written up at the end of the study. In alignment with a hermeneutical/interpretative approach, the focus of the research moved iteratively from developing understanding of the overall context and cultural influences (informed by the literature and UK REF 2014 analysis) to observation of the details of research practice (informed by the GT study of design researchers) and back again in an iterative process. This iterative process led to the development of a framework which guided the second and third stages of the literature exploration (the first to a lesser extent), data analysis and the thematic literature presentation. See Figure 1 Literature Review Map of Thematic Sections. The selection of literature presented in

this *Section 2 Literature Review* was guided by this framework, in other words, much of it was consulted as a result of primary fieldwork analysis in an attempt to make more sense of it. However, it has been broadly structured in alignment with traditional thesis format and to reflect the requirements of a preliminary review of the literature by reporting on previous studies on similar topics to ascertain the gaps in knowledge and to sensitise the researcher to what might be happening in the data.

2.3 Structure and Content

This literature review explores the literature relating to design research practice. Design in the context of this thesis refers primarily to industrial design. However, this is an evolving discipline, where boundaries are continually being challenged and extended to meet the needs of society. Hernandez describes how;

“design has experienced a profound transformation from traditional definitions and uses strongly attached to product development and aesthetics to current perceptions where design is presented for example as a thinking process or as an integrator of people, spaces, knowledge, and functions. ...In many of these projects it is possible to see how design is no longer only attached to the definition of product properties or aesthetic features; it is much more even if it is not clearly defined”. (Hernandez et al. 2017)

Despite this diversification and lack of clear definition there are developments that are pertinent in defining the focus of this study. The first is “the idea of design being less a making and a styling discipline and more a thinking and research process” (Hernandez et al. 2017). Goatman and Moody (2014) also reference this change in the discipline outlining how words or “cognitive attributes referring to thought and emotion based activities” are increasingly used to describe industrial design. The definition and focus of design in the context of this study is informed by these observations. It is recognised that all designers (regardless of area of specialism) straddle the “two camps of rationality and free creativity” (Goatman and Moody 2014) in the context of their work, however, specialisms will differ in terms of where they locate themselves on a continuum between these positions. Industrial design, generally applied to the more intangible emotional, social and ill-defined questions of design may require technical and engineering proficiency but more importantly and in greater proportion, elements of social empathy, intuitive judgment and free creative exploration than for example, product design, design science or engineering design. This is because design science or engineering design are considered to address more the technical, material, functional and accountable requirements for design where problems may be (but are not always) more focused and defined requiring creative and intuitive insight, but also proportionally greater elements of objective and analytic, rational, proven, safe and executable response than the judgement based, project framing activities found at the “fuzzy front end” (Sanders and Stapers 2008) of industrial design practice. As it is particularly the intuitive, judgement based processes which are less clearly defined and understood, this was identified as the gap in knowledge to be addressed in this study. The literature reviewed therefore

relates mainly to industrial design, that is design which draws on the practitioners' creativity and judgement in order to inspire and improve the functional, aesthetic and also the more intangible emotional qualities of products, services or systems. Excepting the historical design methods movement, which sought to develop a scientific approach to design, current literature relating to the more rational and scientific disciplines of design such as design science and engineering design are not included in the review.

The literature review is divided into the following thematic segments, some of which emerged as a result of the Critical Discourse Analysis of the UK REF 2014 and the Grounded Theory interviews with practising design researchers.

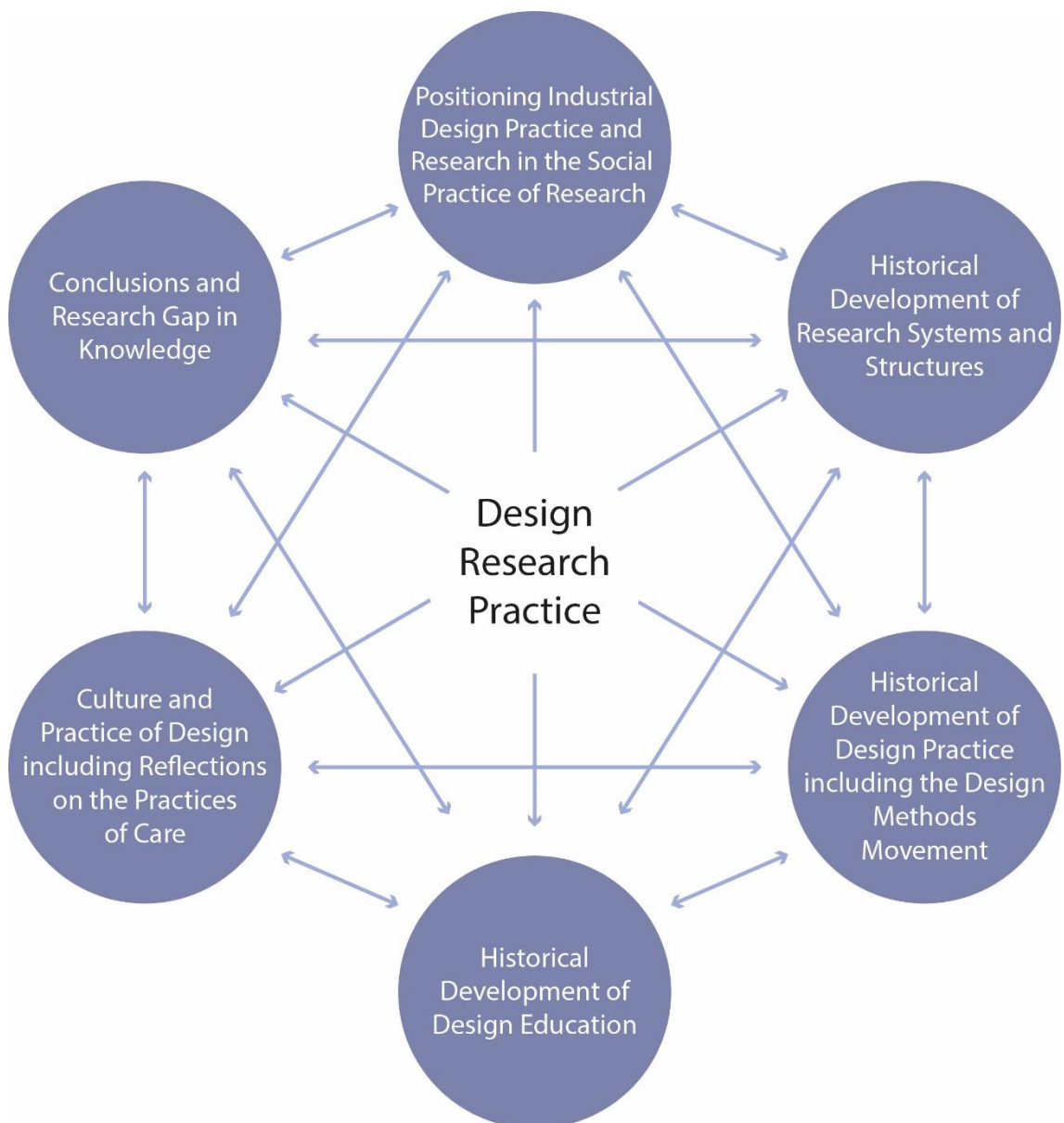


Figure 1 Literature Review Map of Thematic Sections

Positioning Industrial Design Practice and Research in the Social Practice of Research

The first section of the literature review positions industrial design practice and research in the social practice of research, while articulating the researcher's understanding of these phrases. This section defines "design research" in the context of this study.

Historical Development of Research Systems and Structures

Building on the assumption that all knowledge is historically and socially situated, the next section of the literature review focuses on the historical development of research systems and structures and the ascendance of associations of scientific method with truth, reason and progress for humanity.

Historical Development of Design Practice including the Design Methods Movement

This is followed by the historical development of industrial design practice within those systems and structures. This section includes a detailed study of the design methods movement outlining the difficulties aligning design methods with scientific ideals of rigour and rationality. It concluded that, despite the best efforts of the design methods movement to develop a scientific approach, design practitioners were achieving greater success applying tacit knowledge and methods learned through practice to address the largely unstructured and ill-defined aspects of industrial design problems.

Historical Development of Design Education

This section reviews the literature relating to the history of design education.

Culture and Practice of Design including Reflections on the Practices of Care

Noting the difficulties encountered by the design methods movement, regarding the application of scientific methods to the development of design practice and their subsequent recommendations to focus on observation of practice as the primary source for theoretical development, the final section focuses on developing understanding of the methods of design practice. This section reviews the literature emerging from studies based on observation of design practice, focusing especially on understanding the role of experiential learning, creativity, intuition and value judgement in design practice. This section also includes literature relating to other practice based disciplines which have more established research cultures, in particular the practices of care. Their experience which recognises Aristotle's,

“phronesis as a form of reflective practical wisdom that complements *techne*, technically oriented approaches, and *episteme*, scientifically oriented approaches, in considerations of what it might mean to develop and enact professional knowledge. (Kinsella 2012, p. 35)”

may provide a more sympathetic model for conceptual development of design research process.

Conclusions and Research Gap in Knowledge

This will be followed by a conclusion which identifies the research gap and defines and authorises the proposed study.

2.4 Positioning Industrial Design Practice and Research in the Social Practice of Research

In the context of this thesis, it is important to position design practice and research in the social practice of research. This is not an easy task as the meaning of words like *research*, *science as it relates to research*, *social research*, *design* and *design research* are fluid and open to differing interpretations depending on context of use and the discursive stance of the author and indeed the recipient. Furthermore, combined with the fluid and interpretative nature of the words and their use in discourse, the social practices themselves are also in a continuous process of evolution (Williams 1976). Despite the obvious challenge, in the context of this research it is important to articulate as clearly as possible the researcher's understanding of these words and associated practices.

Design in the context of this thesis refers primarily to Industrial Design, although in many instances the findings may have relevance for a broader range of design practices. As the lines are blurring between discrete design disciplines, these categorisations may have decreasing relevance for the identification of design practitioners and their practice.

A simple interpretation of the word 'research' would suggest it combines 're' with 'search', repeated searching to address a deficit or question. The performance of this process is dependent on the approach of the researcher and the nature of the goal of the search. The discussion of research in this thesis is generally occupied with different forms of or approaches to disciplinary, academic or practice based research. These are the subject of much debate, nuance and contestation. However, for the purpose of clarity of communication, Cross's general description of the characteristics of good research is a useful starting point and benchmark. He states that the following are "normal features of good research in any discipline":

“Purposive – based on 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
Communicable – generating and reporting results that are testable and accessible by others” (Cross 2007c, p. 48).

The general term 'research' in the context of this thesis will be assumed to comprise the features outlined by Cross.

The meaning of the term 'science' has evolved over the years in response to the historical and cultural contexts of its use. Williams (1976) in an essay tracking its evolution discusses its early association (C17) with "theoretical or, commonly, a demonstrative proof in an argument". He goes on to say, "Science was a kind of knowledge or argument, rather than a kind of subject" (Williams 1976, p. 277). Increasingly though, it came to be associated with the natural sciences (C19) where "a particular and highly successful model of neutral methodical observer and external object of study became generalised, not only as science, but as fact and truth and reason or rationality" (Williams 1976, p.279). Its approach was built and defended on the basis of "methodological rigor". While science has evolved, developed and expanded to include a range of methodological approaches and positions, strong links remain with its positivist origins and the words 'science' and 'scientific' still retain strong associations with a mainly objective, value-free, quantitative form of enquiry. Implicit connotations of fact, truth and reason make methodological rigour fundamental to its constitution. This raises the question: is it possible for research to be rigorous while acknowledging that it is not objective, factual or true? These questions are largely unresolved; however, many disciplines are justifying the use of scientific method by defining rigour in alignment with their own value positions. This may be something design researchers need to consider for the theoretical development of design research practice.

For example, historically, it became increasingly obvious that the application of natural scientific methods of inquiry to the 'human' or social sciences was problematic due to its primarily objective stance within this mainly subjective environment. Methodological rigour as aligned with the natural scientific approach (C19) was reductive and difficult to apply in a social research context.

Social or human science research communities responded by undertaking to define their own epistemology, methods and standards of evaluation. However, this is a complex field with multiple communities, perspectives and viewpoints. There is no single unified community or epistemological position. Denzin and Lincoln describe how "the field sprawls between and crosscuts all of the human disciplines, even including in some cases, the physical sciences" stating that because of this, "It has no theory or paradigm that is distinctly its own" (Denzin and Lincoln 2011, p. 6). 'Qualitative research' is the umbrella term which Denzin and Lincoln use to describe the research approach of the human disciplines. While acknowledging the tensions, contradictions and differences operating between alternate positions, they identify the common threads of a qualitative research approach and how they differ from quantitative research.

"Qualitative researchers stress the socially constructed nature of reality, the intimate relationship between the researcher and what is studied, and the situational constraints that shape inquiry. Such researchers emphasise the value-laden nature of enquiry. They

seek answers to questions that stress *how* social experience is created and given meaning. In contrast, quantitative studies emphasise the measurement and analysis of causal relationships between variables, not processes. Proponents claim that their work is done from within a value-free framework” (Denzin and Lincoln 2011, p. 8).

Despite its simplification of a complex field, the above description permits a basic positioning of design research within the quantitative and qualitative fields of research. Design which addresses human need through the physicality of materials and objects and increasingly actions and environments (Buchanan 2001) may benefit from both the qualitative social scientific and quantitative scientific research approaches depending on whether they are seeking understanding of the user or the materials and processes of an associated artefact. While the above may position design research in relation to its requirement for qualitative and quantitative methods and findings, it does not identify the research epistemology, approach/s and methods of designers. Frayling states with reference to art and design research relative to other research: “There *is* a lot of common ground. There is also a lot of private territory” (Frayling 1993-94). This research seeks to gain an understanding of both.

The academisation of design is a relatively recent development (Biggs and Buchler 2011a), and without a long tradition in research and education, its theoretical development remains fragmented and contentious. Frayling’s (1993-94) much cited paper on research in Art and Design categorises its research as being either, “research into art and design, research through art and design and research for art and design”.

“Research into art and design is the most straightforward” and most closely resembles other forms of research. The subject of the research is design and there are countless existing research models. The researcher may choose from a wide range of disciplines depending on the nature of the question. Issues regarding epistemology, approach, methods and evaluation criteria have essentially been addressed by the disciplines of origin.

Research for art and design is defined by Frayling as research with a small r, “the gathering of reference materials [for a design] rather than research proper”. He questions the motivation of considering this form of research as research with a capital R, when it does not attempt to add to “communicable knowledge”.

Research through art and design utilises design practice approaches as a methodology to answer research questions relevant to practice. In a design context, these questions may range from materials and manufacturing to user needs and emotional design. Referencing Cross (2007c), as long as it is “purposive, inquisitive, informed, methodological and communicable”, it is research. This category is more problematic as epistemological grounding, research approaches, methodologies and evaluation criteria are loosely defined at best, or where they are defined, they are often ignored by design researchers (Dorst 2008). Dorst goes on to suggest that this may be

because the *assumptions* behind the research methods and tools developed for designers are at fault; that they do not fully understand and consider design epistemology, its nature and approach.

The objective of this PhD research project is to develop understanding of design research approach grounded in designers' self-understandings, while addressing the whys of design research practice. Why do design researchers practise design research in the way that they do? The findings will support the development of a framework to communicate the nature of design research practice and its influences, which may enable or support the development of an epistemology of design research. It is only then, with grounding in an epistemology of design, that approaches, methodologies, methods and evaluation criteria can be developed.

2.5 Historical Development of Research Systems and Structures

Design research, as a social practice concerned with the production of knowledge, is shaped and influenced in many ways by prevailing historical traditions of research and knowledge production. This area historically has been largely dominated by the positivist/empiricist research model of the natural sciences. Smith (2010, p. 27) explains how the “the scientific method, as we understand it, emerged in the seventeenth century”. He goes on to describe the social processes which he identified as being central to the production and transmission of knowledge, and ultimately to the development and ascendance of the scientific approach. They are:

“Knowledge systems’, ... a complex series of assumptions and methodological rules about what counts as appropriate knowledge in a given time and place.

‘Social Structures’, ... relations and patterns of behaviour which have become so well established across time and space that they provide the (largely unquestioned) conditions for human action and thought.

‘Social agents’, involve the groupings and associations which are actively engaged in the development and transmission of knowledge” (Smith 2010, p. 27).

These processes as they impact on beliefs relating to knowledge and research have a subsequent impact on the development of design research. Smith's (2010) explanation highlights the impact of historical and social circumstances on knowledge production while confirming the role of knowledge systems, social structures and social agents in the development and representation of research. It also supports Kuhn's critique of the universal application of natural scientific thinking in 'The Structure of Scientific Revolutions' (Kuhn 1962). In this, he questions the foundations of natural scientific thinking by highlighting its situated nature and by proposing that the rules or truths on which it is based are merely the conventions of a particular community. These observations highlight the fluid and evolving nature of research practice, the prevailing influences on its development and its attendant relationship within a community of practice. Consideration of Kuhn's critique and Smith's observations guided the hermeneutical/interpretative research design of this project, further details of which can be found in *Section 3.2 Research Paradigm*.

From an historical perspective, the dominant ideology in the seventeenth century was one governed by religious beliefs. Early scientific approaches to knowledge production were successful only in so much as they were compatible with these embedded religious assumptions (Smith 2010). Bacon, one of the founding fathers of scientific approach:

“identified the key activity of science as one of demystifying existing false and irrational interpretations of the world around us, in order to establish the truth” (Smith 2010, p. 48).

This search for truth was achieved by direct observation, made possible through engaging the scientific experiment, described as empiricism. Great care had to be taken at this time not to directly challenge religious authority, in particular notions of truth, which could only be divinely inspired. Bacon’s emphasis on observation and experiment in the early stages of scientific development with a lesser focus on human reason (rationalism) as a source of truth softened the challenge to prevailing religious dogma. However, in time, and with further integration and development during the period of the enlightenment, truth, reason and experimental scientific method as a means of progress for humanity became a key feature of modern scientific thinking (Smith 2010).

The Enlightenment, which took place in the eighteenth century, consolidated the association of truth, reason and experimental scientific method with progress for humanity. This period which marks a change in society from premodern to modern was demarcated by significant social, economic and political upheaval. During this time there was a shift in knowledge and power structures from those decreed by religious values to belief in rational science and human reason to control and improve the human condition. This is evidenced in documents such as the *Encyclopédie*, several volumes of which were published in France between 1751 and 1772 by a group of intellectuals known as the *Philosophes* under the leadership of a man called Diderot. In the words of Diderot:

“All things must be examined, debated, investigated without exception and without regard for anyone’s feelings ... We must ride roughshod over all ancient puerilities, overturn the barriers that reason never erected, give back to the arts and sciences the liberty that is so precious to them” (Diderot, D. cited in Bartholomew et al. 1992, p.69).

Hollinger (1994) traces the philosophical concept of modernity back to Bacon, connecting Bacon’s notion of knowledge as power with modern philosophical ideas described by (Schon 1983) as technological rationality:

“For Bacon, knowledge is tantamount to control and prediction, ... thus, arguably, the beginning of modern instrumental or technological rationality” (Hollinger 1994, p.71).

The Enlightenment is the period when the application of scientific method to social questions was seen to be the answer to society’s ills and the means of human progress. Despite continued critique

and questioning of its fundamental assumptions and subsequent development of a range of competing epistemological positions, this one-dimensional view of scientific method and its associations with truth, development and progress continue to impact development of design research today. For example, the introduction to ‘Design Epistemology’ from the proceedings of the 50th Anniversary DRS2016 conference in Brighton in 2016 describes how:

“Our dominant logical tendencies were acquired through Enlightenment philosophy and at a time when truth was considered to be an absolute and achievable conclusion, as well as being bound to a deterministic version of progress bound to technical development rather than social justice” (Jones et al. 2016).

The impact of this Enlightenment vision on the development of design practice, as was played out in the Design Methods Movement (DMM) of the 1960s and 70s, is discussed in detail in *Section 2.6 Historical Development of Design Practice including the Design Methods Movement*, highlighting the challenges associated with simplistic transfer of scientific methods and approaches to practices of different traditions and requirements.

These challenges are not new and have already been identified by those in the social science tradition. Design, sharing many characteristics with social research, may benefit from following their journey in terms of research development. For example, the legacy issues of applying a natural scientific approach to addressing social issues is clearly articulated by Bernstein (1976) in *The Restructuring of Social and Political Theory*. Here he outlines the fact/value debate and the difficulties associated with removing values from social and political research:

“On the one hand we are told we cannot turn our back on the relentless progression of science, that our task as theorists is to interpret the world – that is, to give theoretical explanations of the facts that meet rigorous standards of scientific knowledge. Enlightenment ideals are still verbally endorsed, for we are constantly told that as we accumulate empirical knowledge, we can better engage in enlightened action and social reform. But on the other hand, the very possibility of rational discourse about what is enlightened and what is better is called into question. Such discourse, we are told, not only lies outside the domain of science, but outside any rational argument. Presumably in the final analysis, all value positions are subjective, arbitrary, and equally unjustifiable. There are no rational procedures that are sufficient for judging among competing value orientations” (Bernstein 1976, p. xxiii).

Hollinger also identifies these as the issues in applying scientific methods to social problems:

“The dualisms of facts and values, the objective and subjective, science and the rest of culture, and reason and emotion have persisted” (Hollinger 1994).

This brief account of research history illustrates the ascendance of associations of scientific method with truth, reason and progress for humanity; the origin of the instrumental or technical rational model of research; the role that social agents, social systems and knowledge structures have played in this development; while introducing critique of its fundamental assumptions. It raises questions regarding the appropriateness of natural scientific method for social questions or

indeed design research. A disciplinary-aligned definition of rigour may enable cross-disciplinary application of scientific approach but if rigour is defined relative to disciplinary and practice values, is it still scientific? Furthermore, this strong and long association with truth in the discourse of science is problematic in disciplines where the establishment of the truth of a proposition is unachievable and where values and interpretation are fundamental to knowledge construction.

Continued critique by Feyerabend of the perceived position of natural scientific method as “a single orthodox account of what constitutes authoritative knowledge” (Smith 2010, p. 206) advanced the idea of multiple approaches to knowledge construction and methodological pluralism. This has been played out in the continued evolution of both the natural and social sciences as they encapsulate, adopt and develop a range of nuanced research approaches and epistemological positions which are developed in alignment with their particular research values and requirements.

The dichotomy of requirements between research which aims to research ‘what is’ as opposed to ‘what might be’ or ‘what is desirable’ has significant implications for the identification and application of appropriate methodology. ‘What might be’ and ‘what is desirable’ necessitate an active requirement for ‘creativity’ and ‘value judgement’ in the research process. This is particularly relevant in design research where a more appropriate question might be framed as ‘what could be?’ This would be in alignment with the design researchers’ creative research approach (input) and designed product (output) bringing values (designers/users/stakeholders), creativity and possibilities together within constraints of resources, stakeholders’ needs and wants for ‘best’ situated contingent and contestable outcomes/solutions. Subsequently, in terms of design research, more appropriate procedures may need to be developed which consider the role and validity of value judgements and creativity in this practice. The following *Section 2.6 Historical Development of Design Practice including the Design Methods Movement* provides an historical overview of this social practice. In alignment with the findings from this section, a significant element of its historical development was directed towards the professionalisation of the practice and introducing more scientific procedures.

2.6 Historical Development of Design Practice including the Design Methods Movement

The previous section explored the historical development of research systems and structures and the ascendance of associations of scientific method with truth, reason and progress for humanity. This section guided by Kuhn’s (1962) critique and subsequent observations of research development, traces the historical development of design with a view to developing understanding of the foundational intentions and beliefs of design practitioners and how they might influence design research practice. Much of the focus in this section is on the development of design

methodologies rather than design research methodologies. While there is much overlap between the two and research forms a significant element of design practice, the development of more formal academic design research is a more recent phenomenon. Two sources were particularly useful in the preparation of this section. One was a collection of design research conference proceedings and research papers brought together in book form by Nigel Cross titled *Developments in Design Methodology* (Cross 1984). The papers span a period of twenty years beginning with the first ‘Conference on Design Methods’ held at Imperial College, London in 1962. A second reference source was the DRS2016 conference held in Brighton in 2016. This conference marked the 50th Anniversary of the Design Research Society which was founded to address some of the issues raised at the 1962 conference. (Lloyd 2016). As a commemorative conference, there was a strong historical thread among the conference themes, along with themes addressing design research epistemology and methodology providing a mix of historical and current reference material for this section.

The foundational intentions and beliefs of industrial design stem from a craft tradition as design, preceding the Industrial Revolution, was practised within the craft industry. Learning a craft was a practice-based process achieved through guild organisations and apprenticeships. Research, design and manufacture were combined in the crafting of the product which was often manufactured in the home or small workshops for a local clientele. This craft process had been perfected over centuries. During the Industrial Revolution (approximately 1760–1840), the introduction of semi-mechanised mass production, changes in distribution, and marketing created a distance between design, manufacture and market causing a subsequent skills deficit and decline in the quality of products. This, combined with the growth of cities and poor living and working conditions for these new industrial workers, created a need for reform of design and industry.

The Arts and Crafts Movement (approximately 1850–1920) was the most significant and influential reform movement to take place in the late nineteenth century. Inspired by the writings of John Ruskin and headed by the leadership of William Morris, the plea was to reinstate the practices and craftsmanship of the medieval guilds, both to improve the quality of design and craftsmanship and the nature of work and the environment. Despite its backward looking stance, its simple design principles, combined with its focus on the needs of the people (workers and the public) meant it had a significant influence on design development in the twentieth century. For example, the Bauhaus (1919–1933), probably the most influential design school of the twentieth century “organised its teaching curriculum around the traditional handcrafting of materials and defined its pedagogy through master classes” (Erlhoff and Marshall 2008). The Bauhaus retained the Arts and Crafts Movement socialist agenda, its apprenticeship model and its basic design principles but with a view to serving industry and mass manufacture. Its influence on design education, theory and practice can still be felt today. This is evidenced in education by a practice-based studio approach, emphasis on tacit knowledge and learning by doing, and if not a socialist

agenda a focus on fulfilling user and social needs. The influence of design education is covered in more detail in *Section 2.7 Historical Development of Design Education*.

2.6.1 The Interwar and Post-war Years

The interwar years saw designers becoming increasingly aware of the complexity of issues to be considered in the design of a product for mass manufacture. This was a time also when design came to be seen as a means of contributing to social and economic progress. Erlhoff and Marshall (2008, p. 107), exemplify Behrens and Lowey as two designers who illustrate a general move from an artistic or craftsman's approach to design to one to

“be understood as an immensely complex undertaking, as it attempts to optimize the psychological, social, cultural, and ergonomic aspects of people's interactions with the designed world”

for economic and social gain.

Due to an increased focus on the development of manufacturing and technology to support the war, technological achievements accelerated during this time, further reinforcing a “belief in science-based progress” (Langrish 2016). John Langrish reflecting on the post-war period at the DRS2016 conference describes how:

“following recovery from the depression of the 1930s and the world war of the 1940s, the Festival of Britain in 1951 was a celebration of optimism and belief in scientific progress Science was seen as producing antibiotics, synthetic fibres, thermoplastics, TV, computers etc. leading to a healthier and more colourful way of life” (Langrish 2016).

A strong belief in scientific method, increased professionalisation and specialisation in design and other disciplines was seen to be the way forward. This was common in many disciplines. Schon (1983) describes how the 1960s marked a period where “we are seeing the professionalization of nearly everyone” (Schon 1983, p. 4). There was what Everett Hughes cited in Schon described as the:

“the professions' claim to extraordinary knowledge in matters of great social importance” [making] “professional careers ... among the most coveted and remunerative, and there are few occupations that have failed to seek out professional status” (Schon 1983, p. 4).

This unquestioning belief in scientific knowledge and approach brought many benefits to design practice and outcome. For example, research in materials science, engineering, manufacturing processes and ergonomics have progressed design practice for the benefit of all. Scientific knowledge continued to influence the direction of design for many years, particularly in the activities of the Design Methods Movement. However, the intense focus on scientific methods underrepresented the role of values, judgement and creative thinking in the design process

generating a partial or incomplete account of design practice. The impact of this may be responsible for the somewhat incoherent development of design research practice.

2.6.2 Introduction to The Design Methods Movement

The academisation and professionalisation of design is exemplified by the Design Methods Movement (approximately 1960–1980). This is a movement which attempted to raise the status of design and the quality of its outputs by developing its methodological approach to have greater alignment with scientific ideals of rigour and rationality. Cross (1984, p. 10) describes how it was a:

“period of ‘systematic design’ in which attempts were made to restructure the design process on the basis of new methods and techniques of problem solving, management, and operational research which had been developed in World War 2 and in the 1950s”.

Langrish (2016) describes the optimism which inspired the Design Methods Movement as having three layers:

- “A general all-purpose optimistic zeitgeist that saw the world as getting better than it had been.
- A belief that the process of designing had an important part to play in this ‘getting better’.
- A belief that the design process could itself be made better through becoming more scientific.”

The Design Methods Movement can be attributed to Bruce Archer, John Chris Jones, Christopher Alexander and Horst Rittel along with the help of others. These men associated with the University of Manchester, (Jones), Royal College of Art London and Ulm School of Design, Germany (Archer), Ulm School of Design, Germany and College of Environmental Design Berkeley, California (Rittel) and University of Cambridge, UK and College of Environmental Design Berkeley (Alexander) brought together a range of international expertise to make design more ‘scientific’. The first formal event was the *Conference on Design Methods* held in Imperial College, London in 1962 (Langrish 2016).

“The proceedings were published as – Conference on Design Methods: papers presented at the conference on systematic and intuitive methods in engineering, industrial design, architecture and communications, London, September 1962”(Langrish 2016).

The Design Methods Movement is sometimes categorised as having three generations of development. These can be roughly mapped against the chronological sections in Cross’s (1984) collection of research papers providing it with an analytical and explanatory framework. Cross aligns the 1st generation with ‘prescription’ of a method for design process (approx. 1962–67)

where designers sought to develop a more systematic approach to address the increasing complexity of design problems. Lack of success in developing a useable approach led to the 2nd generation of design methods with a focus on ‘description’ of design problems (approx. 1966–73). It was hoped greater understanding of design problems would generate more useful methodologies. While the 2nd generation generated a much more nuanced understanding of design problems, it still failed to prescribe a unified approach to the solving of same problems. The 3rd generation gaining confidence in their practice recognised that the answer may in fact lie with practitioners and subsequently directed their focus on ‘observation’ and ‘reflection’ of design practice (approx. 1979)” Further detail of the Design Methods Movement is discussed in *Section 2.6.3 Design Methods Movement: 1st Generation of Development*, *Section 2.6.4 Design Methods Movement: 2nd Generation of Development*, and *Section 2.6.5 Design Methods Movement: 3rd Generation of Development*.

2.6.3 Design Methods Movement: 1st Generation of Development

The development of the 1st generation of design methods is associated with the previously mentioned first Conference on Design Methods held in London in 1962 to support the DMM. Victor Margolin, University of Illinois, founder of the journal *Design Issues* in 1982, reflects on this time and the aims of the movement at the DRS2016 conference. He outlines how the aims of the movement were several fold:

“First, it sought to investigate and theorize about the methodology of producing designs. Second, it attempted to devise theories that could be useful in understanding design more deeply. Third, it was a means to speculate on new possibilities for designers that challenged the limitations of product design up to that point and it introduced other options. Fourth, the movement became a forum where designers, architects, engineers, systems theorists and others with an interest in design could meet up and discuss the field. And fifth, it involved a number of people who were teaching in universities and contributed to the development of university programmes in aspects of design research” (Margolin 2016).

Overall, there was a clear feeling that design problems had become “too complex for humans to solve using traditional craft methods” (Ghassan 2016) and that a systems approach would be more appropriate:

“to consider the whole system of which the proposed product is part, instead of considering the product as a self-contained object” (Archer cited in Cross 1984).

Cross (1984) attributes the 1st generation of design methods to Jones (1984b), Alexander (1984), Archer (1984) and Luckman (1984). Their approaches share many common traits (Broadbent 1984; Cross 1984), namely a:

“Cartesian view of designing; breaking the problem down to fragments and solving each of these separately before attempting some grand synthesise” (Broadbent 1984, p. 337).

While this approach supported design in many ways, particularly in addressing and managing the increasing complexity of design problems, in its attempt to minimise human error and rationalise decision-making, it may have swung the pendulum too far in one direction by neglecting the role of creativity and intuition. It is important to note that Jones did not intend for this systematic approach to replace creativity and intuition, but to complement it, or in his own words, “to make possible more imaginative and advanced designs” (Jones 1984b, p. 9). This point according to Cross was often “ignored by the early critics of systematic design procedures” (Cross 1984, p. 1). Alexander, however, did express some concerns that the systematic approach might limit the potential of a creative mind. To address this concern, he placed emphasise on the primary analysis of the environment rather than the artefact or structure, as he felt that the systematic analysis of the components of a structure would limit the solution to a rearrangement of these existing components and therefore apply limits to prospective creative solutions (Cross 1984, pp. 2-3). The methods proposed in this 1st generation of design methods, while well intended, were tedious and time consuming to apply and did not align with the natural iterative practice of design. According to Broadbent, they had limited productive application (Broadbent 1984). In his reflection on these 1st generation methods, he states:

“Yet asked to catalogue its achievements, in terms of buildings built, cities designed, and so on, most of its advocates find themselves in difficulties. Of course, there are fragments of design – a transportation analysis here, an actual building plan there which do owe something to such an approach. But the most striking example of all is usually overlooked Disney World at Orlando, Florida” (Broadbent 1984).

This example is described by Broadbent as emphasising the “expert knows best” attitude which permeated so much design theory at this time” (Broadbent 1984). Jones reflecting on these early methods in 1977 outlines how they were met with:

“Psychological and social resistance ... resulting in design methods being neglected by professional designers but flourishing as a rational but useless academic game” (Jones 1984a).

Unfortunately, somewhere along the way, despite the concerns expressed by Jones and Alexander, some of the agency of design approach had been lost in the development of this 1st generation of design methods. The 2nd generation of design methods came about with this realisation that the 1st generation failed to address adequately the real problems of design and subsequently were neglected by design practitioners, even by those practitioners who were instrumental in their development. Jones articulates clearly his dissatisfaction with design methods below:

“In the seventies I reacted against design methods. I dislike the machine language, the behaviourism, the continual attempt to fix the whole of life into a logical framework. Also there is the information overload which swamps the user of design methods. I realize now that rational and scientific knowledge is essential for discovering the bodily limits and abilities we all share but that mental process, the mind, is destroyed if it is encased in a fixed frame of reference” (Jones 1984a).

Jones’s account goes on to question the ability of the Design Methods Movement to ever prescribe a method which addresses the intuitive mental act which occurs in the early stages of the design process. He outlines how this realisation emerged as he wrote his book on design methods:

“What’s striking is that each method begins with a first stage that is extremely difficult to do. Which has no description of how to do it. Which is intuitive. What emerged in writing the book was that to use design methods one needs to be able to identify the right variables, the important ones and to accept instability in the design problem itself. One has to transform the problem and the solution all in one mental act or process” (Jones 1984a, p. 332).

This first generation of the Design Methods Movement, with a focus on prescribing a systems or Cartesian approach to problem solving, neglected to consider fully the complexity of design problems and practitioners’ utilisation of intuition and judgement in their deliberation. This may be an important consideration in the development of a framework to support understanding of design research practice.

2.6.4 Design Methods Movement: 2nd Generation of Development

A lack of productive applicability of the 1st generation of design methods led to a loss of momentum of the Design Methods Movement with some of its contributors withdrawing from the field altogether (Broadbent 1984). Rittel was to propose a 2nd generation of design methods which reenergised the movement. Its foundational premise focused on a description of the design problem. Rittel saw the application of scientific method to social problems as being irreconcilable. He defends this position by describing social problems as “wicked problems” unlike the problems of the natural sciences which he describes as ‘tame’ or ‘benign’. He asserts that the paradigm of science which “has underlain modern professionalism – is not applicable to the problems of open societal systems” (Rittel and Webber 1984, p. 135). Citing Popper in his defence, he states that:

“it is a principle of science that solutions to problems are only hypotheses offered for refutation ... [and] consequently, the scientific community does not blame its members for postulating hypotheses that are later refuted In the world of planning and wicked problems no such immunity is tolerated. Here the aim is not to find the truth, but to improve some characteristics of the world where people live Solutions to wicked problems are not true-or-false, but good or bad” (Rittel and Webber 1984, pp. 143-144).

Rittel's assertion highlights the difficulties of direct transference of scientific approach to design questions. Without modification it is likely to fall short in fully addressing the value-based questions and "wicked problems" of design practice. Jones previous reference (Jones 1984a, p. 9) (Section 2.6.3) to using scientific approach to complement creativity and intuition may provide a more useful direction.

Rittel aligns himself away from the 'expert knows best' position. He discusses 'the symmetry of ignorance' claiming that no one has the authority to suggest s/he is more knowledgeable than anybody else. He proposes a participatory model of design using an argumentative structure where people accept or reject various positions or proposals put in front of them (Rittel 1984, pp. 325-326). While initially, this approach may have failed to provide cohesive solutions due to 'decision by committee' difficulties, it has gained currency and some success when managed carefully, with designers and users working together successfully in collaborative co-design approaches (Sanders 2005; Sanders and Stapers 2008).

Levin, Alexander and Poyner, and Simon (in a parallel project in the US) identified by Cross (1984) as the chief contributors to this 2nd generation of design methods also agreed that any proposed methodology must address the ill-defined nature of design problems. However, there are nuanced differences in their description of the design problems and subsequently in their proposed method for solving them. Here, a clear divide emerges between those proposing a rational, value-neutral, scientific approach to solving design problems and those suggesting that values cannot be removed from the design process.

Levin, in his paper on 'Decision-making in Urban Design' acknowledges that a designer must 'use his powers of conjecture and original thought' because of the nature of urban planning problems where complete information is unavailable and the complexity of the problems make them unsolvable in a systematic scientific way. He explains by showing that the complexity of urban design problems requires them to be broken down into sub problems for analysis and solution. He suggests that detailed scientific analysis of each would lead to impossible numbers of alternative solutions:

"Throughout the design process the designer is continually formulating alternative part-solutions: to each sub-problem there may be several such solutions. The total number of possible combinations can be very large indeed. If there are ten alternative solutions to each of ten sub-problems there will be ten thousand million" (Levin 1984, pp. 118-119).

What he does suggest is the addition of an 'ordering principle' to add structure and coherence to the data which the designer must then use his/her discretion to address.

Conversely, Alexander and Poyner continue to see merit in applying rational scientific principles to design problems and set about doing this by removing all value judgements from the process.

“We believe that it is possible to define design in such a way that the rightness or wrongness of a building is clearly a question of fact, not a question of value” (Alexander and Poyner 1984, p. 124).

In their analysis of the design problem, they suggest replacing an analysis of ‘user needs’ with ‘user tendencies’. This is a behaviourist approach where a tendency expresses an operational version of a need. As outlined by Alexander and Poyner:

“If someone says that a certain tendency exists, we can begin to test the statement” (Alexander and Poyner 1984, p. 125).

In this way, they say it is possible to remove all value judgements from design and “make it a cumulative scientific effort” (Alexander and Poyner 1984, p. 133). There has been considerable critique of the behaviourist approach. Critiques attest it is a one-dimensional approach focusing only on that which is observable and measurable. In this way it may fail to consider the complexity of the whole person and mistakenly attribute casual conditions with particular behaviours. Polkinghorne (2004, p. 8) attests that this type of scientifically validated approach has limitations when faced with the complexity of the human situation and that practitioner’s judgement may have greater resonance. This is also the belief of this researcher.

However, the apparent rigour and value-neutral nature of this approach meant it continued to maintain traction. Simon, author of *The Sciences of the Artificial* and an influential contributor to the application of decision-making theory and artificial intelligence to new professions, included design in his studies. He asserts that design is a profession which could apply his problem-solving theories and essentially remove the intellectually soft, intuitive aspects from the decision-making process (Huppatz 2015). Simon with an education based in maths and behavioural science believed strongly in the application of scientific objectivity and rigour to the social sciences. Simon was not directly involved in the Design Methods Movement in the UK, but his work has had considerable influence on design research and continues to do so (Huppatz 2015). His background was in US military research. An esteemed consultant and collaborator for the US Air Force, RAND (Research ANd Development) Corporation during the 1950s and 1960s, Simon’s problem solving and digital computing work was “seminal in developing the new field of artificial intelligence” (Huppatz 2015). He went on to win a Nobel Prize for his work on decision-making process in economic organisations.

Simon firmly believed that scientific method could solve problems of social research and design. Describing as ‘bounded rationality’ man’s limited computational capacities, Simon proposes the use of computer programmes to augment their research capacity and optimise solutions. His overall aim as described by Huppatz was to develop, “an objective, value-neutral, quantifiable and mathematical field of research centred on problem solving” (Huppatz 2015). Simon described

complex multidimensional problems as ill-structured and believed they could be broken down into well-structured problems and solved by human processing power supplemented by computers. A behaviourist approach focused on prediction and control of behaviour, Simon's work was critiqued by many in the counter culture movements of the 1960s as far from being ideologically neutral and being representative of a repressive political establishment (Huppatz 2015).

The legacy of the 2nd generation of design methods was an acknowledgement and detailed analysis of the complexity of design problems combined with some further disagreement as to the applicability of scientific rigour and value-neutral decision-making processes to these problems. In fact, some critics as outlined previously questioned the 'ideological neutrality' of these or any research models (Huppatz 2015). There was a proposal by some (Levin 1984; Rittel 1984) that value and judgement were a fundamental part of the design process. Rittel called for a participatory and argumentative method of design. However, the early application of this approach yielded poor results, as it was found on a practical level that a fully negotiated design process with the users essentially slowed down the design and planning process and produced a fragmented and unsatisfactory solution (Broadbent 1984).

Similar to the 1st generation of design methods, this 2nd generation failed to provide a cohesively approved and constructive methods model for generating successful design solutions. Design practitioners were achieving greater success applying tacit knowledge and methods learned through practice to these 'wicked problems'. Gaining confidence in a design led approach, theorists began to explore the idea of an epistemology of design "separate to and as credible as [that] of the scientific community" (Ghassan 2016).

2.6.5 Design Methods Movement: 3rd Generation of Development

The next wave of design methods saw theorists grounding their understanding of design methods in observation and reflection on practice. Cross (1984) attributes the most valuable of these early observations of practice to Darke, Akin, Lawson, and Thomas and Carroll. Polanyi (1966), Schon (1983) and Jarvis (1999) also made valuable contributions to an understanding of tacit knowledge gained in practice. Tacit knowledge gained in practice is a foundational element of design methods and subsequently design research methods and is considered in detail in *Section 2.8 Culture and Practice of Design including Reflections on the Practices of Care*.

2.7 Historical Development of Design Education

The historical structural development of research and education and the positioning of design within this evolving model have a significant impact on its epistemological development, its

values, structures and methods. Looking back to the origins of modern research models, design practice at this time, an artisan trade and associated with tacit knowledge and intuition, meant its position lay outside of the field of research, the emerging university and beyond its influence. Buchanan (2001) outlines how:

“Design was not one of the fields institutionalised in our universities following the work of Galileo, Bacon, Newton, Descartes, and others. ... Design as we have understood it in the twentieth century was then regarded as a servile activity, practiced by artisans who possessed practical knowledge and intuitive abilities but who did not possess the ability to explain the first principles that guided their work” (Buchanan 2001).

Pure rather than applied theoretical investigation was highly prized in these new universities. Specialisation was cultivated with a view to providing foundational knowledge to ‘command nature in action’ (Buchanan 2001). This is the origin of current disciplinary divisions in our universities. Art and design education took place in art schools and academies, which according to Buchanan “were first established in Europe in the sixteenth century, independent of universities”. Art enjoyed a superior role to design which was perceived to require artistic guidance from the fine arts of painting and sculpture in order to reach its ends” (Buchanan 2001). This positioning continued without change until the Industrial Revolution. Changing manufacturing methods and a subsequent fall in quality of manufactured goods, created a requirement for the specialist activity of the industrial designer, an activity now removed from the crafting process. Lack of precedent and experience in design for manufacture located early attempts at industrial design education in the art schools. The rather superficial focus of these early efforts of design education was applied decoration and historical referencing. A step removed from the manufacturing process, they failed to fully explore its potential. It would take the Bauhaus, taking influence from the ‘hands on’ approach of the Arts and Crafts Movement to reunite the designer with his materials. The Bauhaus reintroduced the master apprenticeship model of design education with a focus on workshop practice and exploring the fundamental elements of materials and design. Strickler (1999) proposes that the considerable influence of the Bauhaus school encouraged a model of design education antithetical to the university model.

“Implicit in the European trade school system of which the Bauhaus was a part is an education removed from the traditions of university scholarship with its concern for veracity and empiricism. At the centre of a craft or trade, workshop education is a master/apprentice pedagogy which does not involve questioning its sources of knowledge” (Strickler 1999).

The legacies of this theory/practice divide have been expounded in recent years as external forces compel design to engage with a more theoretical model of education. In a process of institutional reorganisation in the UK in 1992, polytechnics were redesignated as universities (O Cathain 2016). Design departments were now relocated in a university setting and expected to compete

for resources with traditional university based subjects. However, the evaluative metrics applied to award funding favour a theoretical university model of learning. These have, after all, “helped to shape the notion of what constitutes good academic research” (Biggs and Buchler 2011b). A similar process was happening in continental Europe with the introduction of Bologna. The Bologna process called for:

“a more transparent and uniform system of higher learning” giving rise to “former *Hochschulen* being transformed and integrated into the academic system; *Hochschulen* are thus expected to conduct research activities and to produce research output” (van de Weijer et al. 2014).

Additional to this restructuring of education is an increased commodification of knowledge. Research is a significant generator of income for universities. For example,

“The four UK higher education funding bodies allocate about two billion sterling per year of research funding to UK universities” (Higher Education Funding Council for England (HEFCE) 2014).

In response to funding mechanism like these, design departments are compelled to modify their practice in accordance with the values expressed by them. Biggs and Buchler assert that developments such as those outlined have created a dysfunctional relationship between design’s world view and its academic models.

“The relationship between a community’s worldview and the academic models that it adopts may be functional or dysfunctional. We claim that the relationship in areas of design practice is often dysfunctional. This is because the academic model has not developed authentically in relation to its functional beliefs, but has done so in response to external forces of academisation. When pushed into the academia, areas of design practice did not possess their own academic models that were effectively linked to its world view. We claim that, as a result, these areas simply co-opted research models from other disciplines” (Biggs and Buchler 2011b).

Van de Weijer supports their views stating that:

“A brief literature review reveals that many authors conceive of research and design as antithetical.... Some of them situate these differences mostly in terms of modalities, others in terms of finalities of both approaches” (van de Weijer et al. 2014).

Van de Weijer includes an overview table. See Table 1.

Table 1 Antitheses Between Academic and Professional Practice (van de Weijer et al. 2014)

Antitheses Between Academic and Professional Practice			
	Academic practice (scientific Research)	Professional practice (design)	
Mode of production	Objectivity, how things are, exchangeable facts	Subjectivity, how things ought to be, personal choices	Darke 1979, Simon 1969, Cross 2006
	Explicit knowledge as a basis	Tacit knowledge as a basis	Polanyi 1983, Schon 1983
	Analysis, rationality	Synthesis, mimesis	Cross 2006, Powers 2007, Heynen 1999
Finality	Convergence towards paradigms	Convergence towards application of paradigms in divergent situations	Schein 1973
	Problem defining	Problem solving	Gregory 1966, Cross 2001
	Applies to a general, representative concept	Applies to a singular particular case	Buchanan 1992, Powers 2007

Aside from design’s lack of alignment with academic practice values, critique of the traditional university model of research reveals a limitation of the model of specialisation which design may be in a position to add support to. To explain, Buchanan states that as a result of its historical development with a focus on specialised and fragmented theoretical development:

“We possess great knowledge, but the knowledge is fragmented into so great an array of specializations that we cannot find connections and integrations that serve human beings either in their desire to know and understand the world or in their ability to act knowledgeably and responsibly in practical life” (Buchanan 2001).

Prentice suggests that rather than design modifying its practice to align with a university model, it should embrace the opportunity presented by the recent restructuring of education to extend and “advance the mainstream debate about what counts as academic research in a university” (Prentice 2000). It is possible the research approach of designers may be able to make “the connections and integrations that serve human beings” that Buchanan refers. A more nuanced understanding of design research practice, the focus of this research project, may support its coherent development and in turn have application in the strategic development of academic research.

2.8 Culture and Practice of Design including Reflections on the Practices of Care

Section 2.5 of the literature review, *Historical Development of Research Systems and Structures* illustrates the ascendance of associations of scientific method with truth, reason and progress for

humanity and the legacy issues of applying a prevailing scientific approach to addressing social questions. These issues revolve around the fact/value debate and the difficulties of removing values from social and political research (Bernstein 1976). It also drew attention to the role “Knowledge Systems, Social Structures and Social Agents” (Smith 2010, p. 27) play in research development. *Section 2.6 Historical Development of Design Practice including the Design Methods Movement* concludes with a judgement that despite the best efforts of the Design Methods Movement (1962 to mid-1980s) to develop a scientific approach, design practitioners were achieving greater success applying tacit knowledge and methods learned through practice to the ‘wicked problems’ (Rittel and Webber 1984) of design. The third wave of the Design Methods Movement saw design theorists begin to explore the idea of an epistemology of design “separate to and as credible as [that] of the scientific community” (Ghassan 2016) grounding their understanding of design methods in observation and reflection on practice.

This section reviews the literature emerging from these and other studies. As there are many overlaps and dependencies between design practice and design research practice, findings from their observations will provide valuable insights to support this study design, ongoing sense making and analysis. This approach receives further endorsement from the ‘practices of care’. Much progress has been made in the ‘practices of care’ and ‘education’ which support the theoretical development of a practice reflecting the values/beliefs of the practitioners. Carr and Kemmis stipulate why this is important in an educational context:

“Since educational practitioners must already have some understanding of what they are doing and an elaborate, if not explicit, set of beliefs about why the practice makes sense, they must already possess some ‘theory’ that serves to explain and direct their conduct ... it is only within this [their theoretical] framework of intentions and beliefs can the value which he places on these practices be made intelligible and justifiable” (Carr and Kemmis 1986, p.111).

This is the theory that guides their practice. It is therefore crucial to reference this particular mode of understanding in any theoretical development of the discipline in order for it to have practical applicability. From a design perspective, this is not to say that the foundational intentions and beliefs of design always support best practice in design and design research. Much can be learned from the more established research practice of other disciplines. However, it does highlight the importance of acknowledging the foundational intentions and beliefs of design practitioners in the theoretical development of the discipline.

It is within the context of an historical background, emerging from an apprenticeship model that designers’ foundational intentions and beliefs have developed. Up until the Industrial Revolution, designers were essentially craftsmen and their learning was acquired through practice under the guidance of a master craftsman. The essence of this mode of learning in apprenticeship is beautifully described by Heidegger in the extract below, outlining how it is much more than mere copying or skills acquisition.

“His learning is not mere practice, to gain facility in the use of tools. Nor does he merely gather knowledge about the customary things he is to build. If he is to become a true cabinet maker, he makes himself answer and respond above all to the different kinds of wood and to the shapes slumbering in the wood – to wood as it enters into man’s dwelling with all the hidden riches of its nature. In fact, this relatedness to wood is what maintains the whole craft. Without that relatedness, this craft will never be anything but empty busywork, [and] any occupation with it will be determined exclusively by business concerns” (Heidegger 1968 cited in Jarvis 1999, p. 12).

The extract above is a useful starting point on which to build an understanding of an epistemology of design because it describes a form of learning and tacit knowledge acquisition which is intrinsic to the practice of apprenticeship, but which evades verbal articulation and subsequent knowledge transfer within current discursive frameworks. The challenge of preserving and evidencing the tacit elements of design and design research has continued to be central to its development. Bruce Archer (a leading figure in the Design Methods Movement) in a paper reflecting on developments in design methodology in the 1970s, outlined his concerns regarding the “judgement based values” which might be lost in the application of a logical framework to design methodologies.

“I was concerned to find ways of ensuring that the predominantly qualitative considerations such as comfort and convenience, ethics and beauty, should be carefully taken into account and as doggedly defensible under attack as predominantly quantitative considerations such as strength, cost, and durability” (Archer 1979).

Archer’s citation highlights the concerns of design practitioners/methodologists of the application of scientific method to the design process in the 1970s. To address these concerns, there was an effort to make explicit the implicit and unarticulated processes of practice (mentioned above) in design and other similar professions. As Schon stated, “We are in need of inquiry into the epistemology of practice” (1983, p. viiii). Design practice has evolved from its craft and apprenticeship origins in response to a developing world; however, tacit understandings gained through practice still remain fundamental to its problem-solving approach. The concern is that their lack of visibility within current discursive frameworks relating to design and research may impact negatively on their continuation and progressive development. In a world with increasing focus on accountability, methods and approaches which are (1) visible, (2) articulate and (3) can demonstrate accountable and measurable impact using current metrics are rewarded and continue to progress. Those which remain undetectable struggle to do so.

2.8.1 Evolution of Design Practice

The evolution of design practice, its changing remit and ensuing modification of approach has been well documented. Buchanan (2001) attributes the changing meaning of ‘product’ to be central to these developments. In his evaluation, he defines design as:

“the human power of conceiving, planning, and making products that serve human beings in the accomplishment of their individual and collective purposes” (Buchanan 2001).

He then goes on to describe how designers' understanding and conception of product has evolved from a focus on symbols and material things to action and environment. To frame this perspective, he employs his concept of the "four orders of design in the twentieth century" (Buchanan 2001). He attributes the establishment of symbolic and visual communication to the first order of design and material objects and artefacts to the second order of design. It is in the third and fourth order where the greatest change has taken place. He states that:

"Instead of focusing on symbols and things, designers have turned to two quite different places to create new products and to reflect on the values of design in our lives. They have turned to action and environment And the products are more than physical objects. They are experiences or activities or services, all of which are integrated into a new understanding of what a product is or could be " (Buchanan 2001).

The fourth order is associated with 'environments and systems'.

"The focus is no longer on material systems – systems of 'things' – but on human systems, the integration of information, physical artefacts, and interactions in environments of living, working, playing and learning" (Buchanan 2001).

This conception of product locates design practice firmly in the social realm, where designers try to understand products from "inside the experience of the human beings that make and use them in situated social and cultural environments" (Buchanan 2001). Design practice therefore increasingly shares many of the concerns of social and cultural research relating to issues around the fact/value debate and the difficulties of removing judgement-based values from its practice.

There have been many attempts made to capture and document the design process, to abstract it from its particular and contextual environment and disseminate its methods for the benefit of the discipline, some of which were documented in the previous section, *Section 2.6 Historical Development of Design Practice*. However, through the process of abstraction, it seems to lose its fundamental qualities. Kees Dorst suggests that this is because:

"The art of design is linked to the designer, the design problem and the design situation, not just the process of designing" (Dorst 2006, p. 75).

An evaluation of the role of these three domains in the design process may support a more nuanced understanding of design practice and subsequently design research practice as it relates to this process. The following discussion will focus first on the nature of design problems, then the designer and the design situation. Design research forms part of this discussion in so far as it has been mentioned by the selected authors. In most cases the authors are referring to research in support of decision-making in relation to a particular design project or problem. Notwithstanding, it provides valuable insight into methods and approaches which may have relevance for design research, grounded in design understanding and practice.

2.8.2 Design Problems and their impact on the Design Process

Analysis of the literature suggests that it is the ill-defined nature of design problems which is dictating design process and methods of practice. Without standard strategies to follow, problem/solution strategies are trialled in an iterative manner until a satisfactory resolution has been achieved (Rittel and Webber 1984; Dorst and Dijkhuis 1995). As previously noted, the evolution of design practice has impacted substantially on the complexity of design problems. Buchanan (2001) outlined how a changing perception of 'product' has had a significant impact on the nature of design problems. The problem space has evolved from a focus on material things to a focus on user experiences, environments and systems, moving design increasingly into a social space. Rittel and Webber's (1984) much cited paper on the 'wicked' nature of design problems provides further understanding of this problem space. They describe how problems that scientists and engineers face are "mostly 'tame' or 'benign' ones" (Rittel and Webber 1984, p. 136). They "are definable and separable" with "solutions that are findable", whereas wicked problems are "ill-defined", and in fact "the information needed to understand the problem depends upon one's idea for solving it" (Rittel and Webber 1984, pp. 136-137) ... "problem understanding and problem resolution are concomitant to each other" (Rittel and Webber 1984, p. 137). They describe how "solutions to wicked problems are not true-or-false, but good or bad", that "every wicked problem is essentially unique" and that "the planner has no right to be wrong" highlighting that unlike scientific problems, the "aim is not to find the truth, but to improve some characteristics of the world where people live" (Rittel and Webber 1984, p. 144). Cross asserts that it is the particular nature of design problems, as described by Rittel and Webber, that drives how they are resolved.

"A central feature of design activity, then, its reliance on generating fairly quickly a satisfactory solution, rather than on any prolonged analysis of the problem. ... Why it should be such a recognisably 'designerly' way of proceeding is ... likely to be a reflection on the nature of the task and of the nature of the kind of problems designers tackle" (Cross 2007a, p. 23).

Dorst and Dijkhuis (1995) support this view outlining how different paradigms for describing design activities align with particular design problem areas.

"Describing design as a rational problem solving process is particularly apt in situations where the problem is fairly clear cut, and the designer has strategies that he/she can follow while solving them..... Describing design as a process of reflection-in-action works particularly well in the conceptual stage of the design process, here the designer has no standard strategies to follow and is proposing to try out problem/solution strategies" (Dorst and Dijkhuis 1995).

This conception of design approach and its concomitant relationship with the design problem is further substantiated by Lawson. Lawson conducted a number of experimental studies to learn more about designers' problem-solving approach. In the first one, he observed groups of science

students and architectural students solving design-like problems under laboratory like conditions.

He found:

“the scientists focused their attention on understanding the underlying rules, the architects were obsessed with achieving the desired result. Thus we might describe the scientists as having a problem-focused strategy and the architects as having a solution focused strategy” (Lawson 2005, p. 43).

He went on to explain, after conducting some further experiments with final year second level students and first year third level students, that:

”it is the educational experience of their respective degree courses which makes the science and architecture students think the way they do, rather than some inherent cognitive style ... The architects are taught through a series of design studies and receive criticism about the solution they come up with rather than the method As in the real professional world the solution is everything, and the process is not examined! By comparison scientists are taught theoretically. They are taught that science proceeds through a method which is made explicit and which can be replicated by others” (Lawson 2005, p. 44).

This differs slightly from Cross’s assertion that it is the nature of the problem which governs the process; however, regardless of where this process originated from (Lawson qualifies his statement by saying that this may be too simplistic an explanation) Lawson, asserts, based on further studies of practising designers, that the more experienced designers “learned about the problem through attempts to create solutions rather than through deliberate and separate studies of the problem itself” (Lawson 2005, p. 44). These findings echo Rittel and Webber’s assertion that “problem understanding and problem resolution are concomitant to each other” (Rittel and Webber 1984, p. 137). Analysis and synthesis occur simultaneously during the problem-solving process and evaluation of same is a subjective value-laden process driven by the varying requirements of a diverse group of stakeholders.

2.8.3 The Designer’s Role in the Design Process

The designer’s role in this process is interactive. Embodied in this interaction are the designer’s past experiences, values, intuition and creativity. Having conducted empirical studies of expert practitioners in engineering, architecture, management, psychotherapy, and town planning, Schon, building on Polanyi’s theoretical development of tacit knowledge (Polanyi 1966), proposed “reflection-in-action” as an appropriate model for the theoretical development of design practice. In this he presents the designer/practitioner as:

“a researcher in the practice context [constructing] a new theory of the unique case” (Schon 1983, p. 68) ... [where by engaging in the design process] “the unique and uncertain situation comes to be understood through the attempt to change it, and changed through the attempt to understand it” (Schon 1983, p. 132).

In this Schon is describing the interactive relationship between the designer/practitioner and the problem to be solved, where constant reframing occurs as “the situation talks back” As previously

mentioned, embodied in this interaction are the designer's past experiences, accumulated theoretical knowledge, values, intuition and creativity. This particular knowledge base has been formed through a process of experiential learning in design practice and education and is underpinned by the accumulated theoretical knowledge, habits, conventions and traditions of the design community and the community at large. Polanyi referred to the cultural impact on tacit knowledge acquisition maintaining that:

“In the last few thousand years human beings have enormously increased the range of comprehension by equipping our tacit powers with a cultural machinery of language and writing. Immersed in this cultural milieu we now respond to a much increased range of potential thought” (Polanyi 1966, p. 91).

Polanyi's reflection proposes a co-dependency between tacit knowledge and cultural values supporting the view that they are influential in tacit knowledge acquisition and expression. This position is supported by Mareis stating:

“that tacit knowledge, rather than just presenting a “natural” circumstance, also includes the effects of social habituation, which always are manifested in it. Tacit knowledge can thus first be understood as a complex of certain incorporated cultural capital. It comprises practical and semantic knowledge, schemes, rules, and scripts, as well as values and standards, abilities, competencies, and skills” (Mareis 2012).

Jarvis work underpins this view of experiential learning and tacit knowledge acquisition stating that:

“People carry all their learning from their previous experiences (their biography) into every situation, and these are employed in coping with their current situation and in creating new individual experiences for themselves from which they learn. Learning is therefore the process of creating and transforming experiences into knowledge, skills, attitudes, values, emotions, senses and beliefs” (Jarvis 1999, p. 40).

In a design context, Lawson (2004, p. 100) describes how designers draw on precedents learned by experience, and stored in episodic memory, to help address complex design problems. The accumulation of a wealth of such experience leads to a level of expertise in the practitioner (Dreyfus and Dreyfus 1980).

Fundamental to this process is the embodied nature of the interactions which occur during problem understanding and idea generation (Rust 2004; Chamberlain et al. 2007; Keller et al. 2009; Poulsen and Thøgersen 2011; Mareis 2012). Gedenyrd in a study of how designers work concluded that:

“cognition is not organised around a mind working in isolation...“Interactive cognition relies on mind, action and world working together, its superior performance depends on the immediate presence of those physical materials that is concerned with” (Gedenyrd cited in Poulsen and Thøgersen 2011).

Gedenyrd's reference to the 'world' is the physical manipulation of the materials in design. Poulsen and Thøgersen in a study of the role of the body in design interaction and generation of ideas also found that:

“embodied engagement of the designers plays a fundamental role in both understanding the problem at hand and in opening up new ideas leading to a new design solution” (Poulsen and Thøgersen 2011).

By means of a case study of three designers working on a collaborative project, observed from a phenomenological perspective, they made the following observations relating to the role of the body in understanding the problem, collaborative work and idea generation:

“Human thinking is situated in this being-in, not as something parallel taking place in an inner world, but as something which occurs during our engagement. ...The first two situations in the case [developing and understanding the problem] we have presented show us that we navigate in the world as it is through the embodied engagement, but the reframe situation [idea generation] tells us that the body likewise supports us in understanding the world as it might be – as we can project an imaginary world around us by our embodied movements and envision how things could be” (Poulsen and Thøgersen 2011).

Not only does embodied engagement support the processes of design practice, Rust found that:

“a designer's ability to embody ideas and knowledge in artefacts can give us access to tacit knowledge, and stimulate [other] people to employ their tacit knowledge to form new ideas” (Rust 2004).

He demonstrated this by observing designers collaborating with scientists on research projects where the designers augmented the research process with a “number of practical contributions” which supported the scientists in viewing the data from fresh perspectives and imaging new concepts not thought of before. Designers supported the process in a number of ways, for example, with their skills of visualising data in novel ways. Rust illustrates how although:

“Clearly, the scientist had the data and the knowledge (tacit and explicit) to carry the research forward, but the designer's ability to work and reframe representations provided a valuable catalyst” (Rust 2004).

And with model making he found that in one observed case:

“The most important value of the cardboard computer process was the way it allowed participants to enter into an imaginary world (which they would not have been able to envision by other means), explore it, and, most important, manipulate it to further their exploration” (Rust 2004).

And in another:

“The model arm allowed them to mobilize their tacit knowledge of anatomy, gained from many years of regularly manipulating people's limbs” (Rust 2004).

Rust's study reminds us of the value of engaging our tacit embodied understandings along with our logical reasoning and theoretical knowledge when addressing complex tasks which require creativity and innovative thinking. These are the roots of design intuition and inspired guesswork which inform a productive and successful design process (Swann 2002). This understanding may help underpin the framework developed in this research project.

Krippendorff (2007, p. 70) states that the design process is further stimulated and directed by designers' motivations, again highlighting the interactive role the designer plays in the process and the role of personal motivations and values in the design process. Krippendorff deduces that:

“designers, including myself, are motivated in at least three ways by,

- Challenges, troublesome conditions, problems or conflicts that have escaped (re)-solution....
- Opportunities not seen by others to do something, to improve one own or other people lives.
- Possibilities of introducing variations into the world that others may not realise or do not dare to consider....” (Krippendorff 2007, p. 70).

Design intuition and creativity is further supported by the acquisition of research data. Sanders (2005) in her exploration of the design development process states that two types of research data are required to support design development. She describes these as “research that informs the design development process and research that inspires the design development process”. Research that informs the design development process is the scientific factual information necessary for the technical development of a material artefact, product service or system. However, it is the acknowledgement of the existence of research that inspires the design development process that goes some way to validate that a designer's intuition and creativity are fundamental to the process and that ‘non scientific’ forms of research have productive application. Her description outlines that:

“Research that informs the design development process has been evolving for many years and is now well established.... [it]

- tends to be conducted by people who are trained in research and/or the applied social sciences,
- has borrowed heavily from the scientific model of research with its adherence to the tenets of good research: reliability, validity and rigor,
- is built upon the results of investigation, analysis and planning, and
- relies primarily on extrapolation from past events as a way to improve the future” (Sanders 2005).

On the other hand, research that inspires the design development process:

- “tends to be explored and applied by designers,
- is discovering its own tenets of good research such as relevance, generativity and evocativeness,
- is built through experimentation, ambiguity and surprise, and

- draws primarily from the future and the unknown, using imagination as the basis for expression.” (Sanders 2005).

The designer input is fundamental to this process. This embodied input is guided by his/her personal and cultural biography and combines logical reasoning, theoretical knowledge and inspirational resources with personal motivations, intuitive insights and creativity.

2.8.4 The Design Situation and its impact on the Design Process

Unlike scientific research, design research problems cannot be abstracted and objectively removed from the design situation for problem-solving purposes. In fact, the situation is an intrinsic element of the design problem and the process must address it. Dorst (2006) states that:

“The purpose of design is to develop something for the wider world, and that wider world is intimately woven into any design project. Design not only takes place in a context, it is permeated by it” (Dorst 2006, p. 146).

Lawson and Dorst (2009, p. 70) state that “the very essence of design is that it is a ‘situated’ activity”, explaining how:

“it is often the very special and sometimes unique circumstances of a situation that, in the hands of an expert designer, can help to create very special solutions. The famous opera house in Sydney, for example, was an extraordinary response to a very special site. Frank Lloyd Wright’s much-admired house at Falling Water owes a huge amount to his enormous skill but the waterfall it sits over must have triggered much of his thinking” (Lawson and Dorst 2009, p. 70).

This view suggests that the unique situated nature of the design problem not only requires diligent consideration but that it can also act as a catalyst for creative and novel solutions. This supports Krippendorff’s view of designers as being motivated by “opportunities not seen by others to do something” (Krippendorff 2007, p. 70).

A fundamental characteristic of the ‘design situation’ is its future oriented solution space. Simon outlines how:

“Everyone designs who devises courses of action aimed at changing existing situations into preferred ones” (Simon 1969, p. 55).

Krippendorff states that:

“Design articulates constructions that might work in the future – but not without human intervention” (Krippendorff 2007, p. 79).

It is this future oriented problem space which not only directs the process but may direct it in opposition to the traditional methods and values of scientific research for operational reasons. Krippendorff (2007) describes some of the difficulties aligning the conflicting values and processes of research with design research and practice. The contradictions outlined below specifically relate to the situated and futuristic nature of design practice and its impact on process:

“Whereas scientists celebrate generalisations, abstract theories or general laws, supported by evidence in the form of observational data, designers suggest courses of action that must ultimately work in all of their necessary details and in the future. Artefacts never work in the abstract” (Krippendorff 2007, pp. 72-73).

It is the situated nature of design problems combined with the hypothetical deliberation of researching for ‘what could be’ in a practical applied format that makes the unmodified scientific approach problematic when applied in isolation of other more intuitive and judgement-based design approaches.

“Whereas researchers are concerned with the truth of their propositions, established by observational evidence, designers are concerned with the plausibility and compellingness of their proposals, which reside in stakeholders’ ability to rearticulate them in the context of the futures they desire and various paths to reach them” (Krippendorff 2007, pp. 72-73).

The consequential impact the situated and futuristic problem space has on the design process is one which values possibility, what can be done, with human intervention (Krippendorff 2007). This is an interesting space. It has been observed that design process is evaluated on the success of the outcome and this outcome is developed through a process of research and development. However, designers have been identified as having an unorthodox approach to research. Krippendorff describes this as “undisciplined” suggesting that designers need to be “undisciplined” in their approach to research to allow for new and unforeseen possibilities.

“Blindly accepting scientific authority means surrendering to what existed in the past. ...In effect, designers need to question prevailing ontological beliefs. Being afraid of undermining common convictions makes for timid designs. Proposing what everyone knows or already uses is not design at all. Unable to rely on data from a desirable future and without real experience of what is being proposed, designers need to know what makes their proposal compelling” (Krippendorff 2007, pp. 74-75).

To develop a compelling design proposal in a complex and future oriented problem draws upon the designer’s judgement and creativity. To optimise and support judgement and creativity, design seeks research support in a diverse range of disciplines and approaches. The *Munich Design Charter*, a charter developed in 1990 by experts and designers from different European countries to “promote the development of more wide-scale cultural and civic cooperation” in design describes the reach of the problem space. They outline how:

“design has always been deeply concerned with all parts of contemporary life: with the economy as well as ecology, with traffic and communication, with products and services, with technology and innovation, with culture and civilization, with sociological, psychological, medical, physical, environmental, and political issues, and with all form of social organisation. Given its complexity, design has thus meant working on history, on the present, and on the future” (Rams et al. 1991, p. 75).

This describes the multi-disciplinary perspectives of design (Bremner and Rodgers 2013) and the complexity of the problem space. It is for this reason that designers have become accustomed to working with a wide range of specialisms and specialists while also having to act with incomplete appreciation of the entirety of the problem space (Stappers 2006). By combining specialist disciplinary knowledge with design led experiential knowledge, the designer addresses the particulars of the problem.

2.8.5 Culture and Practice of Design Conclusion

Dorst claimed that:

“the art of design is linked to the designer, the design problem and the design situation, not just the process of designing” (Dorst 2006, p. 75).

The literature supports his claim. A short summary of the exploration of the three domains reveals a migration of the design problem, over time, from a narrowly defined material object space to a future oriented, situated, social and cultural space (Buchanan 2001). It is suggested that the ‘wicked’ nature of design problems has led to a practice where “problem understanding and problem resolution are concomitant to each other” (Rittel and Webber 1984, p. 137) and the “information needed to understand the problem depends on ones idea for solving it” (Rittel and Webber 1984, pp. 136-137). The designer is also ‘situated’ in the problem space, whereby the unique and uncertain situation is changed by the designer through attempts to understand and resolve it (Schon 1983). The embodied nature of the problem-solving process involves multi-modality modes of interaction with the problem particulars, which include, for example, model making and visualisation tools to encourage fresh and intuitive insights. The designer brings to this interactive problem-solving activity, accumulated theoretical knowledge and logical reasoning combined with intuitive insight and creativity, which is informed and inspired by past experiences, cultural values and personal motivations, particular ones which value challenges, opportunities and creative possibilities. Fundamental to the productive implementation of the design process is design research. As previously indicated, two types of research data are required, research that informs the design process and research that inspires the design process (Sanders 2005). It is in this space that this research project is located. It aims to uncover how designers do research with a view to providing a framework which supports understanding of its approaches and methods.

2.9 Conclusions and Research Gap in Knowledge

Exploration of the literature identified the research gap, considered the causation of its occurrence and directed a research approach to address it.

The gap relates to understanding and consensus regarding the nature of design research practice, in particular design research practice, undertaken by design practitioners which may draw on design practice methods as a methodological approach. This form of research described by Frayling as “research through design” (Frayling 1993-94) is poorly understood. For example, there is little understanding or consensus around its epistemological grounding, its methods or its evaluation criteria. Questions were raised around the role of judgment, creativity, intuition and the challenge of evidencing the tacit elements of design practice in these research approaches. Furthermore, there are few studies based on a grounded theory approach to design research practice, that is research studies grounded in the practices, processes and self-understandings of the design researcher. Due consideration of social and historical influences on design research practice were also absent.

Framed by these observations, this research aims to address this gap in knowledge. Its primary aim is to develop a framework to support understanding of design research practice based on the self-understandings of design research practitioners while being cognisant of the historical and social structures influencing this practice.

Section Three: Methodology

3. Methodology

3.1 Introduction

A review of the literature relating to the historical development of research revealed the ascendance of associations of scientific method with truth, reason and progress for humanity and the role “knowledge systems, social structures and social agents” had on this development (Smith 2010, p. 27). It also highlighted the difficulties of applying a scientific approach to a value-laden social and political research where the focus is on the future; ‘what is desirable’ or ‘what might be’ rather than ‘what is’. It can be deduced that design research would have similar difficulties, as value judgements and, furthermore, creativity are seen to be fundamental to a process where the research questions are framed in terms of ‘what could be’.

This deduction is supported by a review of the science inspired Design Methods Movement of the 1960s which failed to address the real problems of design, were tedious and time consuming to apply and did not align with the natural iterative practice of design. The outcome was recognition among design theorists that observation and reflection on practice was fundamental to its theoretical development. Preliminary review of the literature relating to design practice highlighted the situated and ‘wicked’ nature of design problems and the interactive role of the designer in the problem space.

While there are a number of studies which are based on observations of design practice (Cross 1996, 2001; Lawson 2004, 2005; Keller et al. 2009; Lawson and Dorst 2009) and studies which consider the theoretical development of design research, (Laurel 2003; Michel 2007; Koskinen et al. 2011; Malpass 2017) there was a notable lack of consensus on the role, the methods and the strategic direction of design research. Additionally, there were few studies based on a grounded theory approach to design *research* practice, that is research studies grounded in the practices, processes and self-understandings of the design researcher. Due consideration of social and historical influences on design research practice was also absent.

Framed by these observations, this research aims to address this gap in knowledge. Its primary aim is to develop a framework to support understanding of design research practice based on the self-understandings of design research practitioners while being cognisant of the historical and social structures influencing this practice.

3.2 Research Paradigm

To frame this project and to identify the most appropriate research approach, it is necessary to locate design and its research requirements in the historical and methodological context of research and discovery. This area historically has been largely dominated by the positivist/empiricist research model of the natural sciences. This model continues to remain

influential despite the continued development of a range of epistemological positions and research approaches. In modern society:

“Scientific or technical knowledge” is “highly valued” Modelled on the natural sciences, technical rationality aspires to a world that is orderly and knowable, where the benefits of promoting knowledge that is secure, reliable and applicable have become institutionalised, through policies for assuring greater accountability ...” (Hutchings and Jarvis 2012, pp. 180-181).

This view continues to govern public opinion of research despite critique of scientific thinking. One of the leaders of this critique, Kuhn (1962) questions the very foundations of natural scientific thinking by highlighting its situated nature and by proposing that the rules or truths on which it is based are merely the conventions of a particular community. By doing so he casts doubt on the idea of scientific truth, objectivity and the linear progression of knowledge while also creating a space for other approaches to knowledge construction which may work alongside scientific approaches. By contesting the foundations of natural scientific thinking, Kuhn has created opportunities for the development of research enquiry based on diverse beliefs and traditions. By showing that objectivity, closure and scientific method are the interpretations of a community rather than universal truths, he creates an obligation for us to develop understanding of the research approach of other communities. Based on Kuhn’s evaluation, to have real explanatory value, it is important theoretical development of design research is built on the interpretations and self-understandings of the design community. Epistemologically, this is an interpretive research approach. However, Carr and Kemmis (1986, p. 117) caution against a singular dependence on this approach questioning its ability to support progressive understanding and critique of research practice.

“By limiting its task to the explication of the practitioner’s own interpretations and by rejecting explanations incompatible with them, the interpretative approach offers no way of critically examining any defects that they many possess” (Carr and Kemmis 1986, p. 117).

Their caution suggests that “explication of the practitioner’s own interpretations” is not enough and that more is required for complete understanding.

A study of other practice-based research disciplines with more established research traditions advocate that researchers must also consider social and historical influences on practitioner’s self-understandings. This is described by Usher et al. (1997, p.181) as a hermeneutic/interpretative research approach.

“Interpretation is meaning-giving (or hermeneutic), a representing of the world through signficatory systems such as language and culture. This has to assume the prior existence of a social order and social interaction which is a ‘given’ background to all human actions. We are ‘immersed’ in the historical and cultural contexts of this given world” (Usher et al. 1997, p. 181).

Meanings are constructed and re-constructed in an ongoing process in society and culture. Hermeneutic theory suggests that action can only be understood within context and the context can only be understood if one understands the actions/parts. Verganti and Oberg describe how:

“This duality is represented by the ‘reflective circle’ consisting of an understanding of both the details of a situation and the overall picture. Reflection implies to move iteratively between the two” (Verganti and Oberg 2013).

To fully appreciate a practitioner’s self-understanding, it is important therefore to be cognisant of the historical and cultural contexts of his/her practice. This condition also applies to the researcher. This is described by Usher et al as the “double hermeneutic”

“an important characteristic, ...of the hermeneutic circularity of interpretation is that it always takes place against a background of assumptions and presuppositions, beliefs and practices, of which both the subjects and objects of the research are never fully aware and which can never be fully specified” (Usher et al. 1997, p. 182).

Their proposition is not to avoid the circle but “to recognise its existence and get into it properly” [by]

“being aware of one’s pre-understandings, recognising that they cannot be transcended but, at the same time, putting them to work” (Usher et al. 1997, p. 184).

A critical theory research approach brings this process a step further by taking measures to try and uncover and expose our taken for granted beliefs and assumptions. It is a political process in that the term “critical’ “in this context refers to detecting and unmasking of beliefs and practices that limit human freedom, justice and democracy” (Usher et al. 1997, p. 156). Insights gained from a critical theory approach may help further expose historical, social and cultural influences on the representation and evaluation of research in general and its subsequent impact on the evolution of design research.

Bernstein supports this hermeneutical and critical approach to research inquiry when he outlines that any “adequate social and political theory must be empirical, interpretative, and critical” (Bernstein 1976, p. 235), highlighting the importance of uncovering the ways participants “understand themselves and interpret what they are doing” while also attending to the possibility of “systematic distortions or ideological mystifications in the agents’ understanding of what they are doing” (Bernstein 1976, p. 231). The research approach undertaken in this study was developed in alignment with the findings from the literature review and this understanding and perception of research inquiry.

3.3 Research Approach and Design

Positioned in a hermeneutical/interpretative and critical paradigm this research aims to develop and construct theory. This is an inductive approach to research inquiry. This research aims to develop a framework to support understanding of design research practice based on the self-understandings of design research practitioners while being cognisant of the historical and social structures influencing this practice. To address these aims this research seeks to understand:

- a) How research is defined and evaluated within the larger research community and design research position within it.
- b) Design research practice as experienced and understood by design researchers and
- c) The historical and social structures influencing this practice.

To address the individual elements of the questions and in alignment with a hermeneutical/interpretative approach, the focus of the research moved iteratively from developing understanding of the overall context and cultural influences to observation of the details of research practice and back again in an iterative process. This is represented visually by a hermeneutical ‘reflective circle/spiral’ supporting understanding of the details of a situation and the overall context, cumulatively leading, as the process is repeated, to a more nuanced understanding of design research practice. See *Figure 2 Hermeneutical ‘reflective spiral’*.

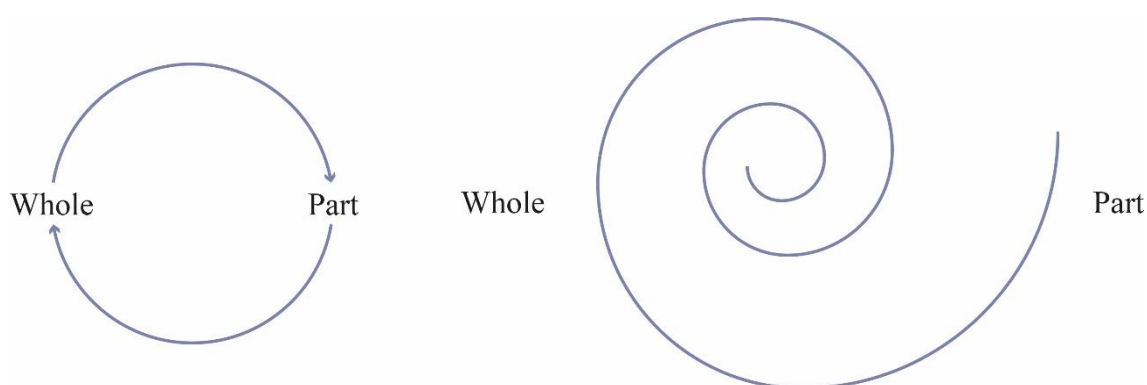


Figure 2 Hermeneutical ‘reflective spiral’

The research was broken down into three operational elements outlined below, interspersed with three rounds of literature searching conducted before, during and after the field research.

Stage 1: A Documentary Analysis of the UK REF 2014 in order to understand and critique research assessment exercises in terms of the role they play in the definition, evaluation and continued evolution of research and in particular design research.

Stage 2: A constructivist grounded theory study (qualitative semi-structured interviews) of practising design researchers in order to uncover their understanding and experience of research, their approach, their research problems and methods.

Stage 3: A critical hermeneutical lens/circle of interpretation developed from synthesis of the literature with the themes emerging from the documentary analysis and the grounded theory study supporting a deep holistic understanding of the social processes at work in this realm.

This triadic methodological approach, developed by the researcher, to address the research requirements of this project and represented by *Figure 3. Triadic Research Approach* scaffolds a reflexive interpretation of the findings, strengthened by a critical evaluation of the literature. The three elements are essential to each other, each one informing the analysis with fresh perspectives and insights supporting a deeper and more nuanced understanding of what is going on in design research practice. Reflection and synthesise of all the elements enabled the research questions to be answered.

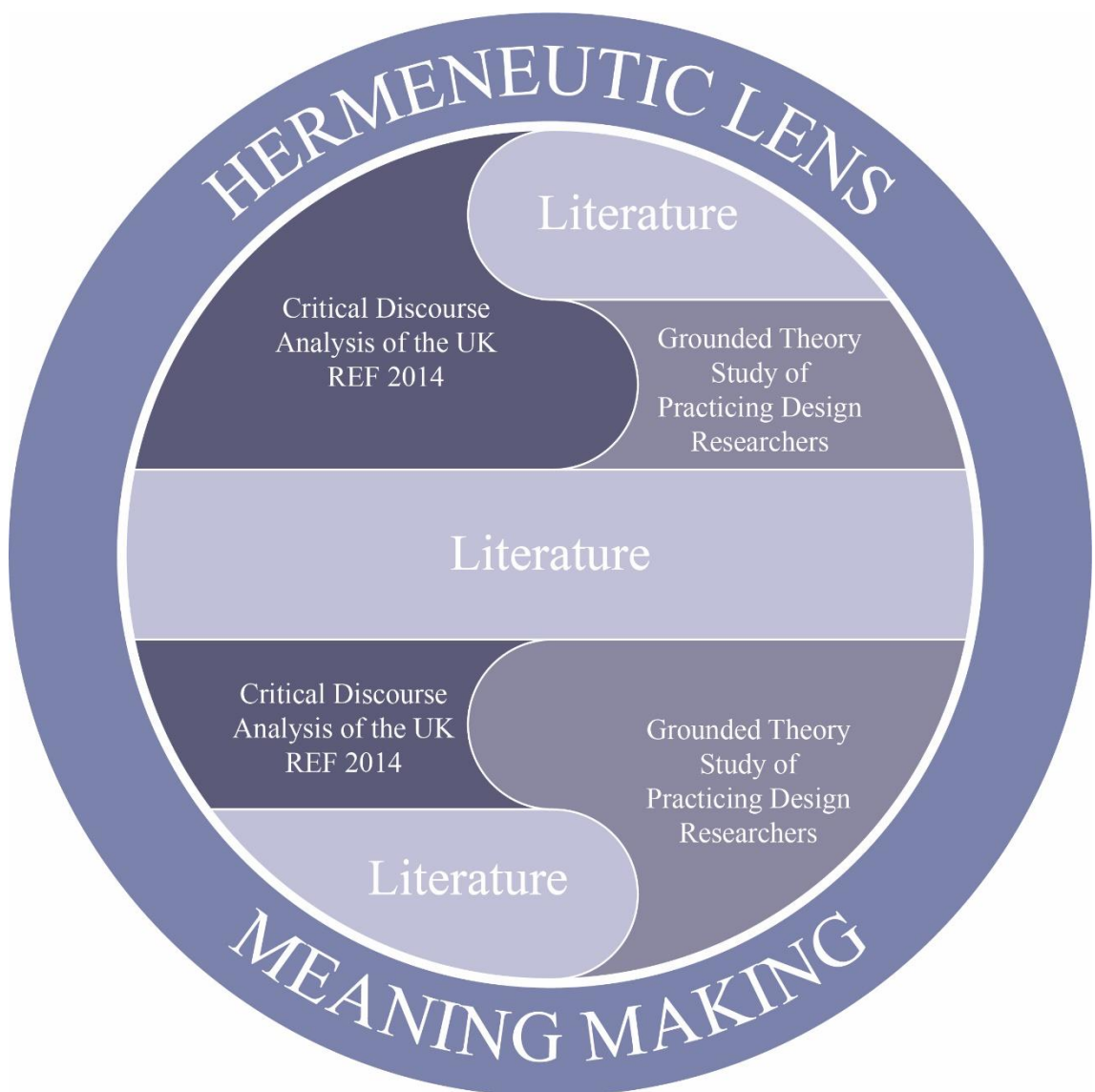


Figure 3 Triadic Research Approach

3.4 Research Methodologies

The three research methodologies, Critical Discourse Analysis, Constructivist Grounded Theory and Hermeneutics, were interdependent in this project. Contextualisation is an integral component of interpretative qualitative analysis and to support contextualisation, it is important to visualise the data from a range of perspectives. The combination of methods rendered design research practice visible in different ways, thereby adding depth and breadth and more importantly context and criticality to the inquiry. This approach which is compatible with a constructivist epistemology supported conceptualising the often hidden positions, relationships and social influences.

3.4.1 Literature Review One

This study began with a short literature review to discover previous studies on the topic and to identify any gaps in knowledge. The findings of this initial review identified a lack of understanding of design research practice and supported methodologically a critical hermeneutic/interpretative inquiry. The preliminary review of the literature also guided the researcher to consider the social and historical construction of knowledge and research practice as it was evident that “knowledge systems, social structures and social agents” (Smith 2010, p. 27) had a role to play in the development of design research practice. See *Figure 4*. This line of enquiry was further pursued with a Critical Discourse Analysis of the UK REF 2014. Visual maps were created of these early connections and relationships and this mapping process continued throughout the iterative research journey.

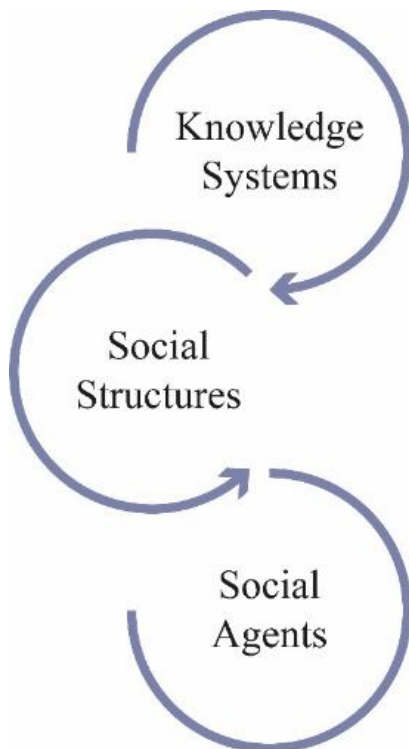


Figure 4 Knowledge Systems, Social Structures and Social Agents

3.4.2 Critical Discourse Analysis of the UK REF 2014

In alignment with the teaching of Charmaz, (Charmaz 2006; Charmaz 2011) some understanding of the social structures and associated cultural influences impacting on design research practice, in particular those which provided definition and evaluation of research, were considered valuable to this study. Therefore, following on from the initial literature review, a documentary analysis of the UK REF 2014 was conducted to examine the practice of funding evaluation exercises, to describe how they work and to provide a critique of those practices as they relate to design research. See *Section 4 Critical Discourse Analysis of the UK REF 2014*.

3.4.3 Constructivist Grounded Theory Study of Practising Design Researchers

This was followed by a grounded theory study of practising design researchers. The grounded theory study aimed to explore the research process of designers, their understanding of and approach to research and to develop a grounded theory to explain this process.

“Grounded theory contains tools for analysing and situating processes ... [leading to] ... defining relevant processes, demonstrating their contexts, specifying the conditions in which these processes occur, conceptualizing their phases, explicating what contributes to their stability and/or change and outlining their consequences” (Charmaz 2011, p. 361).

Constructivist grounded theory supports researchers attending to contexts, positions, discourses, and meanings and actions providing tools to make links between concrete experiences and social structure, culture and social practices or policy (Charmaz 2011). A constructivist grounded theory approach supports consideration of the role ‘social agents’, ‘social systems’ and ‘knowledge structures’ play in social processes, in data collection and analysis. This is in alignment with the findings of *Section 2.5 Historical Development of Research Systems and Structures* where historical and social structures were found to be influential in the continued evolution of research. In this study data was collected mainly by means of semi-structured interviews with practising design researchers. See *Section 5 Grounded Theory Study of Practising Design Researchers*. Supplementary data supporting extension and refining of core categories, context and critique was provided by the literature and the Critical Discourse Analysis of the UK REF 2014 and a hermeneutic circle of interpretation.

3.4.4 Hermeneutic Circle of Interpretation framed by Literature Review Two

Building on the themes emerging from the Critical Discourse Analysis of the UK REF 2014 and the Grounded Theory study of practising design researchers, a Hermeneutical Circle of Interpretation was developed supporting consideration of the whole in relation to its parts and vice versa. It guided exploration and reflection on existing theoretical accounts in the literature of similar phenomena while taking into consideration contextual social and historical structures, practices and cultures. See Figure 5 for the Hermeneutical Circle of Interpretation. This informed additional literature selection and critique which may be found in the literature review and

discussion sections. Areas explored in the literature guided by this Hermeneutical Circle of Interpretation included *Section 2.5 Historical Development of Research Systems and Structures*, *Section 2.6 Historical Development of Design Practice including the Design Methods Movement*, and *Section 2.8 Culture and Practice of Design including Reflections on the Practices of Care*. Additionally, it assisted the development of a framework to support understanding of design research practice. See *Section Six Research Framework – Navigating Difference*

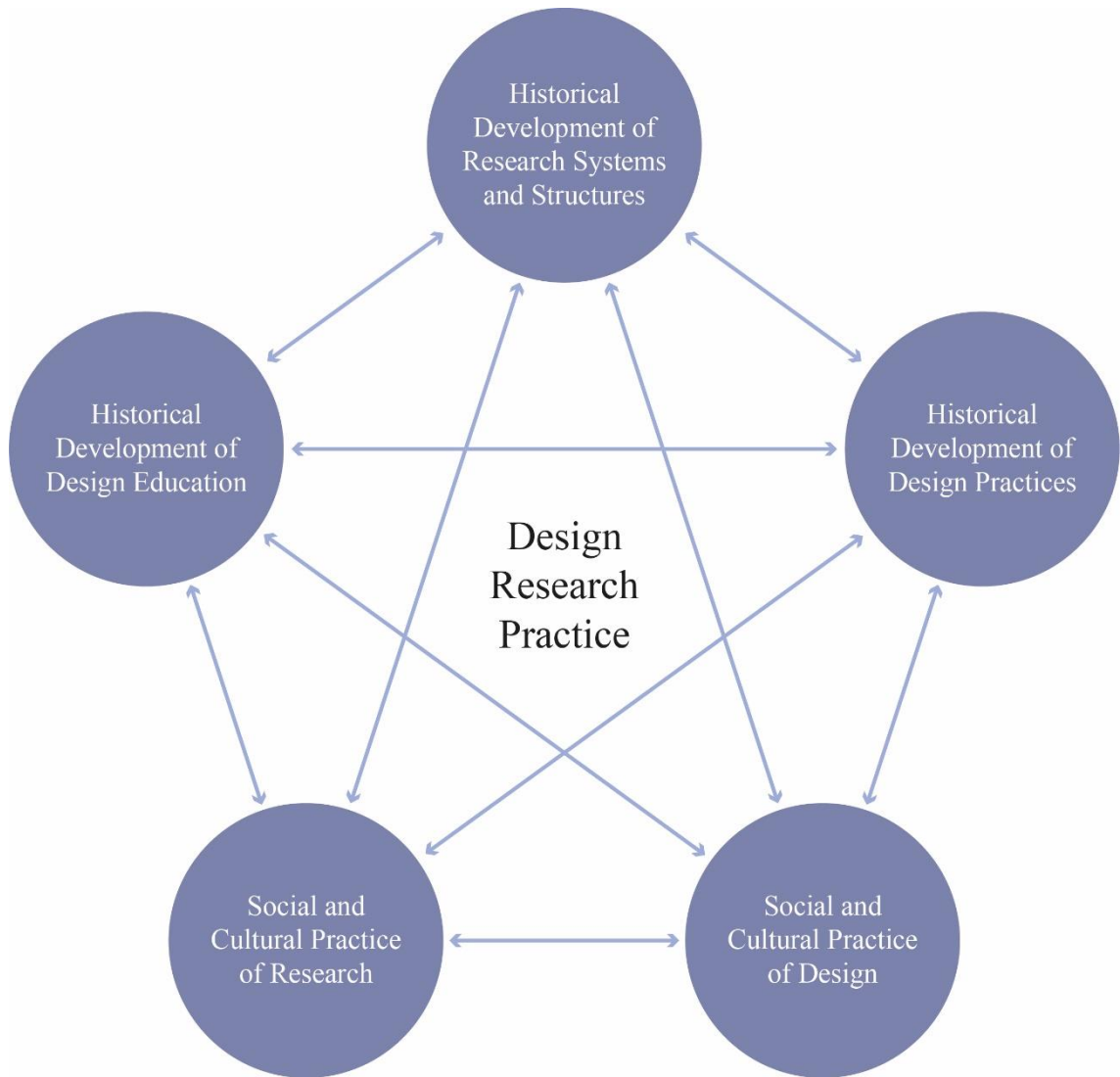


Figure 5 Hermeneutic Circle of Interpretation

3.4.5 Literature Review Three

The final review of the literature was framed by the research findings, situating them in the context of similar studies in other practice-based disciplines and in the historical development of research and discovery. This final review of the literature is threaded through *Section 6 Research Framework – Navigating Difference* and *Section 7 Discussion*.

3.5 Research Ethics

In good research practice ethical consideration is an integral component of the decision-making process from ideation to theory generation and dissemination. The European Code of Conduct for Research Integrity (Academies 2017) specifies four principles which when adhered to support good ethical research practice. They are:

- “Reliability in ensuring the quality of research, reflected in the design, the methodology, the analysis and the use of resources.
- Honesty in developing, undertaking, reviewing, reporting and communicating research in a transparent, fair, full and unbiased way.
- Respect for colleagues, research participants, society, ecosystems, cultural heritage and the environment.
- Accountability for the research from idea to publication, for its management and organisation, for training, supervision and mentoring, and for its wider impacts.”

This research was conducted primarily for the continued professional development of the researcher in support of their role as design research supervisor. The research which aimed to develop a framework to inform the theoretical and practical development of design research may also prove to be of use to research practitioners, educators and students. The four principles outlined by the European Code of Conduct for Research Integrity guided the decision-making process from ideation to publication. At all times, the researcher endeavoured to conduct honest and reliable research with respect for the research participants, colleagues and other stakeholders. For accountability, a transparent audit trail of decision-making process was maintained throughout. More specific ethical issues related to ensuring participants were fully informed, had provided voluntary consent and that their personal data remained confidential and was securely stored.

Ethical considerations were assessed by the Bournemouth University Research Ethics Panel (REP) and received approval on 28 November 2014. See *Appendix A* for a copy of the *Ethical Application Approved by the Bournemouth University Research Ethics Panel (REP)* and *Appendix B* for a copy of the *Participant Information Sheet and Consent Form*. The following is a brief summary of the project and principal ethical considerations outlined for the review process.

The research methodology is a qualitative hermeneutic mixed method approach incorporating critical discourse analysis and grounded theory. This involves collecting data from a range of sources, but most significantly from:

- Academic literature search relating to practice-based research methodologies
- Critical Discourse Analysis (CDA) of the UK REF 2014 documents
- Qualitative semi-structured interviews with practising design researchers.

The first two data sources are publically available and ethical issues relate mainly to correct citation and accurate representation.

The third data source is the recorded audio material from the interviews. The interviews are necessary to retrieve a designer's reflection and understanding of design research, its methodologies and approaches. The collected audio material was used solely for the purposes of developing an explanatory theory/conceptual framework of design research practice grounded in the practices and understanding of design researchers. The ethical issues of this research relate to:

- Making sure participants are fully informed about the purpose, methods and intended possible use of the research. This was achieved by means of a participant information sheet which they were supplied with prior to participation and interviewing. See Appendix B.
- Ensuring participants are aware that participation is voluntary and they may choose at any stage throughout the research and writing up process to withdraw this consent. This was communicated to the participant in the participant information sheet. The participants, who choose to participate in the research, signed a consent form. They were free to withdraw at any time if they so wished. See Appendix B.
- Ensuring confidentiality of information supplied. Care was and continues to be taken to ensure that the participants and the educational institutions they are associated with are not disclosed in any of the outputs from the research. This is achieved by using gender neutral pseudonyms for the participants and by removing other possible identifiers such as detailed project descriptions, institution names and location details. Due to the small postdoctorate design research community in Ireland, where all are known to each other, achieving confidentiality in analysis and reporting has been challenging. It has been achieved by careful selection of textual examples to ensure phrases or expressions which may identify the participant are omitted.
- Ensuring all data and study information collected is stored securely and retained/destroyed in accordance with the Data Protection Act 1998 and the eight Data Protection Principles. Interview audio data was transcribed. Only anonymised data was included in the transcription and then all audio tapes were destroyed. Transcriptions, study information and consent forms are stored on the researcher's password protected personal computer and/or in a secure cupboard. It is not possible to link the personal data to any particular transcription. All the above research data is backed up on a password protected external hard drive. In keeping with Principle 5 of the Data Protection Act 1998, data will be retained for five years after the award of degree. After this period, all personal data will be securely destroyed.

- Ensuring participants are informed of the research outcomes. As a thank you for their participation, all participants will receive a short summary of the research in writing when it is complete.

3.6 Positionality and Reflexivity

Positionality recognises the intended/unintended impact the researcher may have on the research process, from research design to analysis and theory generation. It is generally accepted that little research in a social context is value-free and that the researcher needs to be open and transparent regarding their position and location in the research. Charmaz (2006, p. 149) outlines how in grounded theory generation:

“We are part of our constructed theory and this theory reflects the vantage points inherent in our varied experiences, whether we are aware of them or not”.

It impacts the “relationship between the researcher and the data, how it is collected and generated, what it consists of and how it is analysed” (Birks and Mills 2011, p. 52). The text in italics in this section refers particularly to the positionality of this researcher.

These perspectives on the role of the researcher in the research resonate with the researchers’ ontology on an individual and disciplinary (Industrial Design) level while echoing Kuhn’s (1962) account of research paradigms, on a community level. This is where he describes research paradigms as being reflective of the conventions of a particular research community. In both cases, there is recognition of the role ‘taken for granted’, sometimes hidden, assumptions play in the research process.

In the case of this research project, the researcher is an industrial design lecturer and research supervisor researching industrial design research practice. Building on Kuhn’s position, the research aims to develop understanding of the research approach of industrial designers. This understanding will be based primarily on the interpretations and self-understandings of this community. Here the “double hermeneutic” (Usher et al. 1997) has additional significance as the researcher may hold many of the values and ‘taken for granted’ assumptions as the industrial design community being researched. To attend to these challenges and provide additional critique, the research referenced the literature addressing the historical and cultural influences on design research practice with the inclusion of a critical discourse analysis of the documents relating to research assessment (Maher et al. 2014).

Industrial Design shares some ontological and epistemological assumptions with constructivist grounded theory generation making it a natural process to follow. Grounded theory is greatly influenced by the pragmatic philosophy of Pierce (Stern and Porr 2011) along with symbolic interactionism which looks at the meaning people place on things and actions in social interaction.

Pragmatic concepts underpin much of design research practice. For example, design foregrounds practice as a test bed for theory. Other pragmatic concepts design adheres to are a view of “the world as emergent and never fully finalised”, where we as humans make sense of it by acting within it, that “all human activity is situated”, that research/inquiry involves transformation of an existing situation into a preferred one and that resolution “is an ongoing iterative process that cycles between problem framing and articulation, hypothesis generation and practical evaluation” (Dalsgaard 2014). *On a practical level this meant the researcher was particularly comfortable in this constructivist interpretative research space where the process included constant interaction and immersion in the data, numerous iterations of data collection and analysis, with ongoing analysis guiding the next stage of data collection, and the necessity of creative interpretative insights grounded in the data. Moreover, the researcher coming from a creative background brought additional creative interpretive research experience to the process (Maher et al. 2018). To add criticality to the process, the researcher engaged in a critical discourse analysis of the UK REF 2014. While this was an altogether more uncomfortable methodological journey for the researcher, it did challenge their underlying research assumptions and extend their methodological experience to include critical discourse analysis and their knowledge of the research expectations of the community of practice involved in research assessment as represented by the REF 2014 documentation.*

Theoretical sensitivity is defined in grounded theory “as the ability to recognize and extract from the data elements that have relevance for your emerging theory. [It is influenced by] the sum of your personal, professional and experiential history” (Birks and Mills 2011, p. 59). *The researcher undertaking this project, as previously stated, is an industrial design lecturer and research supervisor. They have many years’ experience working in design education, particularly in the area of design history, theory and culture. This role has developed in the researcher particular understanding and sensitivity to the cultural processes at work in the creation of meaning in society and has shaped an approach which includes social, cultural and hermeneutical elements. The researcher also has tacit understanding of the design research process, its approach to data collection and analysis and the associated challenges and opportunities for the discipline. This position has influenced the research. From an ethical perspective, it aims to be mutually beneficial, providing additional self-understanding for the design community. As a member of this community, participant voice is particularly important to the researcher. In support of participant voice, the researcher foregrounded the role of the semi-structured interview in the data collection process providing opportunity for the participant to direct and lead the interaction. This approach acknowledges the interview as a space for the co-construction of knowledge, where data is negotiated and contextual (Birks and Mills 2011, p. 55). In the analysis process the research combined the use of In Vivo codes (participants’ actual words) with gerunds (coding for action and process) to further ground the analysis in the participant understanding.*

The researcher is aware of the impact of her positionality on the research process and by acknowledging and articulating her position and by taking the measures outlined above hopes to produce an open and transparent account of her work and minimise its distortive influence. A limitation of the research is criticality of design researcher understanding. While the hermeneutic and constructivist grounded theory approach did address that in some way, it would require a researcher from a different background to provide additional criticality. Peer review at conference and publication has provided some additional criticality and the researcher has plans for additional publication of the research findings and analysis to further address this issue.

3.7 Research Validity

It is important to clarify that the requirements for demonstrating rigour in design research and in grounded theory qualitative analysis vary from those required in quantitative studies. The requirements of reliability, replication and validity generally associated with demonstrating rigour in quantitative studies are less applicable to qualitative studies. This is because they were initially developed for quantitative studies and their focus is mainly on measurement and the adequacy of the measures.

Trustworthiness is considered a more appropriate criterion for evaluating qualitative studies. In order to ensure the process is trustworthy, Guba and Lincoln (1989) propose the research should satisfy four criteria. They are credibility, transferability, dependability and confirmability. In the context of grounded theory development, Charmaz, (2006, p. 182) proposes a modified version of these criteria which accounts for the epistemological and ontological underpinnings of grounded theory generation. They are credibility, originality, resonance and usefulness. Speaking from a constructivist position, they acknowledge the existence of multiple perspectives, a co-constructed view of data generation and view analysis and theory generation as partial, conditional and situated (Charmaz 2009).

Credibility ensures the study describes what is intended and is a fair and balanced reflection of the social reality of the participants. For the research to be credible, it needs to achieve “intimate familiarity with the setting or topic”. There needs to be “enough evidence for your claims to allow the reader to form an independent assessment – and agree with your claims” (Charmaz 2006, p. 182).

In the case of this research, the researcher is an active member of the community being researched. This ensured an intimate familiarity with the design research process; however, the researcher also shares many of the values and ‘taken for granted’ assumptions of the design research community. To address this issue, the researcher chose to adopt Charmaz constructivist methodological approach. This approach acknowledges the influence of the researcher on the analytic process and an ensuing reflective position is adopted throughout the research. This was achieved through recording the researcher’s interpretations and constructions through a process of

reflective journaling. The researcher's positionality, as a practising design researcher in an Institute of Technology, was also noted. Frequent debriefing sessions with research supervisors and peer review at conference further challenged underlying assumptions. Furthermore, as stated in *Section 3.6 Positionality and Reflexivity*, participant voice is particularly important to the researcher. In support of participant voice, the researcher foregrounded the role of the semi-structured interview in the data collection process providing opportunity for the participant to direct and lead the interaction. In the analysis process the research combined the use of In Vivo codes (participants' actual words) with gerunds (coding for action and process) to further ground the analysis in the participants' understanding. This was combined with the use of Corbin and Strauss's (1990, p. 13) coding paradigm to structure the affinity mapping process and provide a frame for focused coding. This process helped bring the fractured data together into a coherent whole and by providing a different arrangement of data, supported additional and novel understanding of the relationships between categories. See *Section 5.3 Grounded Theory Study: Analysis and Coding Approaches* for a description of the process. During the analysis process, annotations and memos were created recording the researcher's developing interpretations of the data. These were recorded in a number of A4 hard-backed notebooks and in the NVivo software. Throughout the analysis procedure, manual and digital approaches to analysis were trialled and evaluated (Maher et al. 2018) before finally setting on a combined approach. This further supported prolonged interaction with the data from a range of positions.

To provide critique and to question the underlying assumptions of the design community and the broader research community, two further measures were taken. These were a Critical Discourse Analysis of the UK REF 2014 and a study of the literature relating to the social and historical development of design research practice. The Critical Discourse Analysis of the UK REF 2014 provided a critique of the evaluation and subsequent funding of UK higher education research and the wider social practices shaping it, providing critique of the 'knowledge systems' and 'social structures' at work in this process. The review of the literature relating to the historical, social and cultural development of design research practice provided contextual critique and understanding of the origins of some of the design community's 'taken for granted' assumptions. Also, a comprehensive audit trail of all strategic decision-making, data gathering and analysis was maintained.

Originality requires the research to develop new insights, to "challenge, extend, or refine current ideas, concepts and practices" (Charmaz 2006, p182). A clear gap in knowledge was tacitly experienced in the design research practice of the researcher. This was reaffirmed in a review of the associated literature. The triadic research approach, developed specifically for the research requirements of this project, (See Figure 3) generated new understanding of design research practice. Here, the three elements, the critical discourse analysis, the grounded theory study and the hermeneutic lens, were essential to each other, each informing the analysis with fresh

perspectives and insights supporting and extending understanding of design research practice. Reflection and synthesis of all the elements thereby supported the development of a framework for design research.

Resonance asks if the research has resonance for the participants involved. Does it reflect the fullness and reality of their lived experiences? “Does it offer them deeper insights about their lives and worlds?” (Charmaz 2006, p. 183). The research design supports visualising data from a range of perspectives and standpoints. It further situates this understanding in the ‘knowledge systems’ and ‘social structures’ of design research practice. This in turn supports contextualisation, and deep and nuanced interpretation and analysis. Because qualitative research is specific to a particular context, it is important a ‘thick description’ of the particular research context is provided allowing the reader to assess its relevance. Feedback received from dissemination of the findings in a design research journal/conference further supports resonance.

Usefulness asks if the research is useful for its intended audience. How does it contribute to knowledge and contribute to design practice? A study of the literature revealed a deficit in terms of a widely accepted and cohesive account of design research approach and methodology. This can be problematic when searching for appropriate models for academic research. The researcher’s initial impetus for undertaking this project stemmed from this problem. It is hoped that the framework developed from this research augments understanding of design research practice and the factors influencing its evolution for academic design research practice and supervision.

Section Four: Critical Discourse Analysis of the UK REF 2014

4. Critical Discourse Analysis of the UK REF 2014

4.1 Introduction

Providing a contextual starting point for the research, a documentary analysis of the UK REF 2014 documents was conducted to address the first research objective. That was, to conduct a critical discourse analysis of the UK REF 2014 in order to understand and critique research assessment exercises in terms of the role they play in the definition, evaluation and continued evolution of research and in particular design research. Combining linguistic analysis with consideration of how “texts are produced, distributed and consumed” (Boreus and Bergstrom 2017, p. 223), CDA supports understanding of the practice of research assessment, the social and cultural values informing research development and the representation and evaluation of design research.

4.2 CDA Method Description

Critical Discourse Analysis is trans-disciplinary, connecting linguistic and social analysis. By examining text in its social context, it focuses on the part language and discourse play in social maintenance and change. A Critical Discourse Analysis of the UK REF 2014 can increase understanding of how research is defined and evaluated in research assessment and provide a critique of that practice. Furthermore, it will provide a benchmark from which to compare and critique design researchers’ self-understandings which emerge from the GT study. The Critical Discourse Analysis adopted here is based on Fairclough’s three-dimensional framework for analysing discursive events (Fairclough 2010). It aims to:

“explore often opaque relationships of causality and determination between (a) discursive practices, events and texts, and (b) wider social and cultural structures, relations and processes; to investigate how such practices, events and texts arise out of and are ideologically shaped by relations of power and struggles over power; and to explore how the opacity of these relationships between discourse and society is itself a factor securing power and hegemony” (Fairclough 2010).

Social practices such as design are fluid and evolving. It is important to understand the mechanisms and processes that influence this evolution, if we are to influence change.

“This accords with the critical intent of this approach, the production of knowledge which can lead to emancipatory change” (Wetherell et al. 2001).

While the aim of this research is not emancipatory change, a critical approach directs the researcher to question the underlying assumptions which drive research representation and evaluation. Fairclough outlines how:

“each discursive event has three dimensions or facets: it is a spoken or written language or text, it is an instance of discourse practice involving the production and interpretation of text, and it is a piece of social practice” (Fairclough 2010).

These are three complementary “ways of reading a complex social event”(Fairclough 2010).

“The connection between text and social practice is seen as being mediated by discourse practice: on the one hand, processes of text production and interpretation are shaped by (and help shape) the nature of social practice, and on the other hand the production process shapes (and leaves ‘traces’ in) the text, and the interpretative process operates upon ‘cues’ in the text” (Fairclough 2010).

For the purpose of this study, the text is the UK REF 2014; the discursive practice is the evaluation and subsequent funding of UK higher education research by the Higher Education Funding Council for England (HEFCE). An outline of the wider social practice would include a neo-liberal political background, a public sector and a university system which is increasingly being subjected to the forces of marketisation and commodification, a dominant positivist/empirical research discourse and a weakly defined design research discourse.

“Discourses, frequently based on the norms of a group, exclude and devalue the norms and practices of other groups and, therefore, dominant discourses wield power” (Lai and Vadeboncoeur 2012).

In the case of the UK REF 2014 this has very real implications in terms of gaining access to funding, public esteem, and also its potential influence on the development of research, in particular niche areas such as design, as researchers modify their ideal practice to attain funding. A Critical Discourse Analysis of the UK REF 2014 may illustrate how research is represented and evaluated by the UK higher education funding bodies and whether this representation and evaluation of research is capable of identifying and fostering research excellence in design and other niche areas.

Other groups such as the research users, industry, Business, Innovation & Skills (BIS) research councils, UK government local health and hospital authorities and UK charities also conduct practices which shape the representation and evaluation of research in the public sphere but these will not be considered in this particular study.

4.2.1 Data Collection – Document Selection

As there are many long documents explaining the REF 2014, it was necessary to select a representative and appropriate sample for analysis. The REF 2014 website home page was selected for CDA as it is the first point of contact for all stakeholders and provides an overview of the assessment framework.

A study of two documents:

- REF 02.2011 Assessment framework and guidance on submissions (July 2011) and
- REF 01.2012 Panel Criteria and working methods (January 2012)

was necessary to understand the evaluation process, the generic assessment criteria and the assessment criteria for the Unit of Assessment (UOA) 34: Art and Design: History, Practice and Theory. As both are long documents (63 and 106 pages respectively), the sections concerning the evaluation of design research were selected for analysis, that is generic criteria and criteria specific to (UOA) 34. These were dispersed throughout both documents. Page locations will be referred to in the analysis.

Further data was provided by literature and research publications relating to research assessment.

4.2.2 Data Analysis

Critical Discourse Analysis (CDA) analyses text in its social context. Therefore, the analysis comprised of a discourse analysis of the REF 2014 texts (See *Text Analysis* for description) and further included identification of the network of practices involved in research assessment and consideration of the role research assessment played in their interaction and continuity (See *Institutional Interaction* for description). It also considered the broader social context of research assessment operates within (See *Social Context* for description).

Text Analysis

This element describes and analyses the UK REF 2014 text in detail and considers the representation and evaluation of product design (closest reference to term industrial design) within this text. Its purpose is to uncover ‘the taken for granted’ or ‘common sense assumptions’ made by the text, to identify what these assumptions might be and how they are communicated. A careful analysis of structure, vocabulary and grammatical constructions may reveal connotations and assumptions within the text and discursive constructs supporting them. In the case of this study, an ‘ordinary reading’ (Boreus and Bergstrom 2017, p.170) of the text is conducted initially to take in the explicit meaning of the text. This was followed by a discourse analysis of the text entailing the following actions. (Kelly-Holmes 2013):

- Identifying the genre of the documents
- Analysis of the vocabulary, taking into consideration, the dominant lexical fields, the use of repetition and of metaphor. The selected documents were printed out, the metaphors and associated lexical fields identified and highlighted and recorded in tabular format. See *Table 2 Metaphors used in the document*.
- Analysis of the grammar. Fairclough’s approach was taken which focuses on analysis of “transitivity, nominalisation and modality” (Boreus and Bergstrom 2017, p. 223). Transitivity focuses on grammar and how its use determines “choice of perspectives when

events or situations are described” (Boreus and Bergstrom 2017, p. 156). Nominalisation is when a more complete description of an event is replaced by a briefer description which removes the social actors and their role, thereby decreasing visibility of that element of the process. This is achieved by replacing a verb or adjective with a noun. For example; on the home page of the REF 2014, (HEFCE 2014) the process of planning and designing the assessment is absent when it is referred to as “the assessment”. “Modality refers to the degree of certainty with which a text producer, ...expresses themselves” (Boreus and Bergstrom 2017, p. 223). Texts may be tentative or authoritative and unquestionable in their modality. The selected documents were printed out, and examined noting grammatical perspectives, in particular the use of nominalisations and the modality of the text, a summary of which are recorded in *Section 4.3 Findings*.

- Analysis of reference to other texts.
- Analysis of who is included and excluded in the text
- Analysis of the representation and evaluation of product design research

Institutional Interaction

This element describes and analyses the discursive practice of research assessment and the network of practices involved, looking at both the production and interpretation of the text. It identifies the network of practices which either inform or draw from the REF documents. Its main focus is on the REF 2014 text addressing the following:

- A description of the practice of research assessment.
- A description of the network of practices involved in research assessment.
- The role research assessment plays in their interactions and continuity.

The REF website and associated documents were examined (ordinary reading) to obtain a description of the practice of research assessment. Their documents also provided an indication of the network of practices involved in research assessment, as government bodies, UK higher education funding bodies and UK higher education institutions. Documentation produced by these organisations referencing research assessment were then identified and examined, thus providing evidence of their involvement and indication of the role research assessment played in their interactions and continuity. As the media, newspapers, reports etc. also comment on research assessment, these documents were also evaluated in the analysis.

Social Context:

This element describes and analyses the wider social and cultural practices influencing research development. This was informed mainly by REF 2014 documents and supplementary literature relating to research development in the UK where further understanding was required.

4.3 Findings

This was the first stage of the research providing contextual background and benchmarking particulars for the grounded theory study. Its focus was on developing an understanding of current best practice in research as defined in public sphere discourse while providing a critique of research assessment process. The Critical Discourse Analysis of the UK REF 2014 supported understanding of the:

- Practice of research assessment, identifying, the network of practices involved and the role research assessment plays in their interactions and continuity
- Social and cultural values informing research development as represented in the
 - Discursive practice of research assessment
 - UK REF 2014 Text
 - Wider social and cultural practices influencing research development
- Representation and Evaluation of Design Research.

4.3.1 Practice of Research Assessment and Network of Practices Involved in Research Assessment

The network of practices which shape the ‘representation and evaluation of research in the public sphere’ include the following:

- Government and party politics, political manifestos, speeches, public information documents and public relations documents
- UK higher education funding bodies, public information and public relation documents
- UK universities public information, public relation documents, academic papers and lectures.
- Media: television, newspapers and academic journals

The REF 2014 documents inform and provide evidence for claims made by government, funding bodies, UK universities and the media regarding the nature and quality of research in the UK. It is a resource for producing further reports. By referring to the UK REF 2014, these stakeholders can demonstrate the benefits of public investment in research, account for their position and the quality of their work and, in the case of UK universities, benchmark their research relative to that of others. The flow chart *Figure 6 Influence of the UK REF 2014 on the Discourses of Other Stakeholders* illustrates the influence and the importance of the REF 2014 documents for the discourses of the other stakeholders.

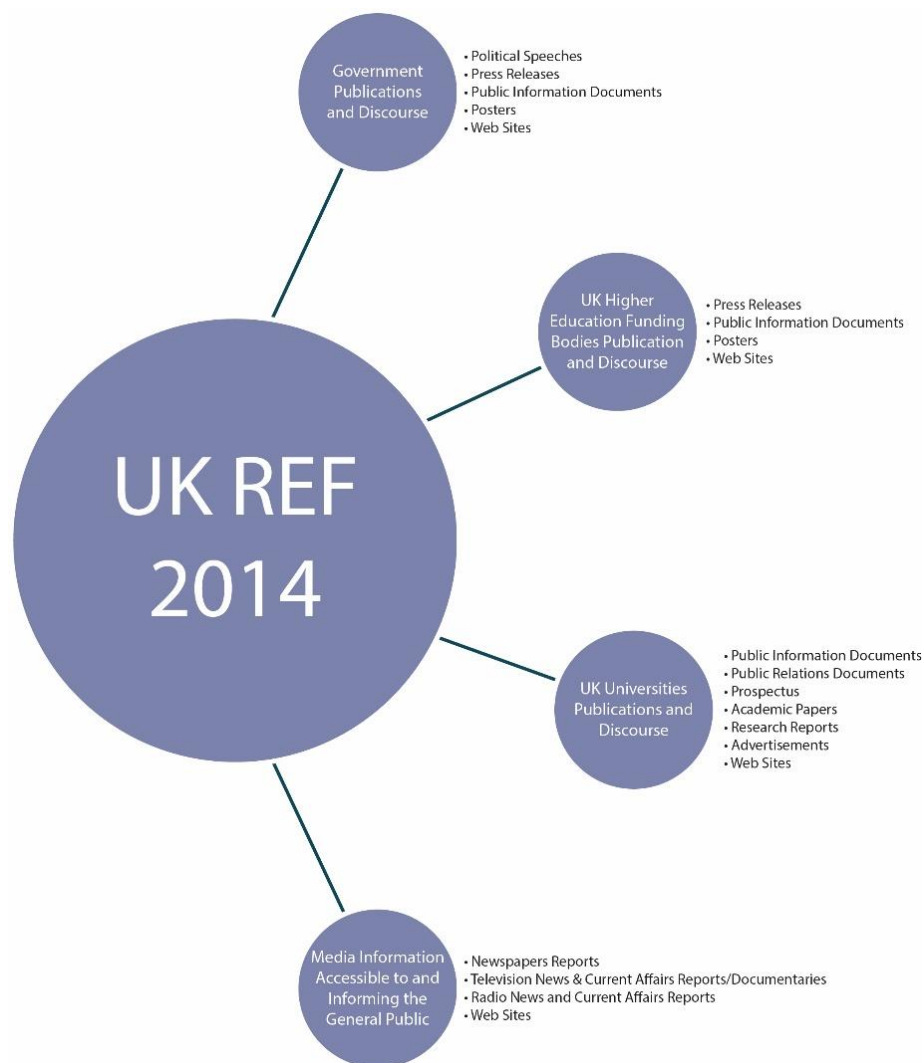


Figure 6 Influence of the UK REF 2014 on the Discourses of Other Stakeholders

The explicit and implicit values in the REF 2014 will be reflected in many of the documents outlined in *Figure 6*. This illustrates the relative power of research assessment exercises to influence research development and perception.

4.3.2 Social and Cultural Values as represented in; the Discursive Practice of Research Assessment, the UK REF 2014 Text and the Wider Social and Cultural Practices influencing Research Development

Discursive Practice of Research Assessment

Accountability and public relations are important in many of the practices which influence how research is represented. The Higher Education Funding Council for England (HEFCE) also operates within this realm as is indicated by the following statement on the home page of REF 2014. It states that “the funding bodies intend to use the assessment outcomes to ... provide accountability for public investment” (Higher Education Funding Council for England (HEFCE) 2014).

There is a presupposition within the documents that the configuration and funding of research should mirror the organisation of a **market system**. For example, research in this document assimilates the characteristics of a commodity in a market or a competitor in a competition. The research that can best prove its worth within the given framework wins. Academic freedom to select and manage research agendas is being restrained by these market values. The home page of the REF 2014 (Higher Education Funding Council for England (HEFCE) 2014) outlines how “The REF is a process of expert review ... the funding bodies intend to use the assessment outcomes to inform the selective allocation of their research funding.” Within the REF 2014, “quality research” as defined by the REF is awarded greater funding. **Competitive language** is a significant property of this discourse. There is competition between government parties for votes, funding bodies for validation, UK universities for funding and students, even the media for readership. To compete, it is necessary to compare like with like, to **quantify the outputs**. There is an element of cost benefit analysis. This process is referred to on the home page: “Sub-panels will apply a set of generic assessment criteria and level definitions, to produce an overall quality profile for each submission” (Higher Education Funding Council for England (HEFCE) 2014). The complexity of funding evaluation exercises and the necessity of producing metrics to evaluate research for the purposes of funding can lead to the use of a more quantitative metric (for example citations or research income) which may fail to identify/value more qualitative and contextual research. Traditional research approaches are easier to quantify and compare than the more interpretative research approaches. Given the breadth and diversity of the research submitted, it is questionable whether it is possible to evaluate, compare and subsequently award research in a fair and equitable manner. It is probable also that the evaluation criteria will have an influence on how future research is conducted if the researcher hopes to avail of funding from this source. This may not be the intention of research assessment exercises but it may well be an effect.

UK REF 2014 Text

The primary genre is that of public information document. The REF is a complex system for assessing the quality of research in the UK, by the four UK higher education funding bodies, in order to allocate research funding to universities, from 2015–16.

The home page of the REF 2014 (HEFCE 2014) takes the form of a public information leaflet outlining the purpose and form of the REF. While factual in nature it also has promotional elements. The change of title from “Research Assessment Exercise” (RAE) (HEFCE 2008) to “Research Excellence Framework” REF may be indicative of the commercial and subsequent promotional requirements of these organisations. It clearly indicates that it will be used for “allocation of funding, accountability for public investment in research and to establish reputational yardsticks” (HEFCE 2008). The home page also implicitly promotes and provides evidence for the continued existence of these public bodies. The continued use of the words ‘excellence’, ‘quality’ and ‘expert’ imply that the document, the assessment framework, the

funding bodies and those allocated funding all value and share these characteristics. In terms of vocabulary, the metaphors used on the home page and throughout the document are chosen from the lexical fields of accounting and bookkeeping “accountability” (HEFCE 2014) and engineering and land surveying “benchmarking, reputational yard sticks” (HEFCE 2014) reinforcing the themes of quantification within the document . See *Table 2 Metaphors used in the document*

Table 2 Metaphors used in the document

	Competition and Awards	Accountability, Public Relations and Market System	Engineering and Land Surveying
Vocabulary in Document	Awarded	Starred quality levels	Evidence
	Assessment criteria	Accountability	Percentage weightings
	Expert review	Investment	Rigour
	Professional judgement	Reputational yardsticks	System
	Originality	Quality profiles	Generic criteria
		International quality standards	Yardsticks
		Reach	Benchmarking

Grammatically, the document is authoritative and unquestionable in its modality, demonstrated by the use of declarative statements such as “will replace”, “will apply” and “will be assessed” (HEFCE 2014). The implicit message in the documentation is that this is the ‘common sense’ and ‘expert’ process of publically funding research. Contributing to altering and possibly fixing this common-sense understanding of how research could be funded and evaluated is the process of nominalisation. Fairclough cited in Lim (Lim 2014) outlines how:

“nominalisations work to obscure important elements of processes. By expressing a process as a noun, as if it were an entity, crucial aspects of the process may be left unspecified, but tacitly assumed as self-evident and straightforwardly commonsensical” (Lim 2014).

For example, on the home page of the REF 2014, (HEFCE 2014) the process of planning and designing the assessment is absent when it is referred to as “the assessment”. This is evident again on the home page where the people involved in making decisions about research quality are nominalised. “The REF is a process of ‘expert review’” (HEFCE 2014). Here the agent is removed. The process is depersonalised. This has the dual effect of removing both the decision-making process, its rationale and the personalities involved from our reading of the document. The implicit message in the document is that a diverse range of academic research should and can be assessed fairly, and that this is the ‘common sense’ and ‘expert’ process of publically funding

research. References to other mechanisms for funding research which may value more intuitive or empathic forms of research are absent.

The REF 2014 assessment exercise is essentially a reducing process. For the purpose of evaluation, each research submission is reduced to an “assessment outcome” and “a starred quality profile” (HEFCE 2011b, p.43). This is to enable selective allocation of research funding and to provide “benchmarking information and establish reputational yardsticks” (HEFCE 2014). It follows a quantitative procedure of breaking the research down into discrete parts, assessing them individually and calculating the results. These are artificial divisions which decontextualise and fragment the research process and may fail to recognise and value more applied contextual research (HEFCE 2011b, p.43).

The most significant change in the development of the REF 2014 from the RAE 2008 (HEFCE 2008) has been the introduction of an explicit element to assess the impact of research (HEFCE 2011b, p.44). As outlined in REF 01. 2011, this:

“reflects policy aims across the four UK funding bodies to maintain and improve the achievements of the higher education sector, both in undertaking excellent research and in building on this research to achieve demonstrable benefits to the wider economy and society” (HEFCE 2011a, p.3).

This is a valuable research outcome worthy of recognition and one which has particular resonance for design researchers. However, it is assessed via a “case study” which imposes a particular research framework. This may increase the pressure on academics to address external prerequisites to gaining research funding and subsequently reduces agency freedom in their research methodologies.

Wider Social and Cultural Practices influencing Research Development

Research assessment exercises such as the REF 2014 are part of a broader neo-liberal project in higher education where, following the argument of Bourdieu in Fairclough, social practice and discourse is being restructured “in accord with the demands of unrestrained global capitalism” (Fairclough 2010). This is changing research and educational practice in universities. Researchers are required to be increasingly strategic, organising their research and educational practice to align favourably with the assessment criteria of research evaluation exercises.

For product design research, the impact may be particularly significant as CDA reveals that the discourse and research values of product design have minimal representation in the REF 2014. This may impact product designers’ success in attaining research funding or place pressure on them to modify their research practice in accordance with the values expressed in the REF 2014. The Grounded Theory study of practising design researchers will reveal how this impacts their research practice.

4.3.3 Representation and Evaluation of Product Design Research

The representation of product design research is limited; there is mention of “product design” and “interdisciplinary research” in the Unit of Assessment (UOA) 34 discipline listings along with a mention of “designs and exhibitions”, but these are only listings and representation is defined by association with the other creative disciplines listed (HEFCE 2012, p.82). In terms of evaluation, product design research is evaluated by main panel D and its sub panel UOA 34 according to the generic criteria for assessing submissions, as long as it adheres to the generic definition of research as defined in Annex C “as a process of investigation leading to new insights, effectively shared” (HEFCE 2011b, p.48). This is an open and inclusive definition of research. The document does not at any point attempt to define product design research. It does give examples of possible outputs, “designs and exhibitions” (HEFCE 2012, p.85) being one of them and it provides an overall interpretation of the assessment criteria for the panel D which again seems quite flexible and based on expert review. The document states that panels will “aim to identify excellence wherever they can find it” (HEFCE 2012, p.79). It is a system of expert review which affords an element of flexibility within the system but also requires a ‘leap of faith’ to be made by design researchers when submitting their research. On reflection, product design research has a very small voice in the REF 2014 and its assessment is dependent upon the interpretation of the reviewers, within a quantitative assessment framework.

4.4 Summary of Findings, and Conclusions informing the Grounded Theory Study

The Critical Discourse Analysis of the UK REF 2014 identified the **network of practices** involved in research assessment as being government and political bodies, UK higher education funding bodies and UK universities. It further revealed the considerable power of research assessment and its importance to their interaction and continuity. This is due in part to research funding but also indirectly through associated discourse and media documents which inform the public and other stakeholders about the nature and quality of research in the UK. Providing a contextual background to the grounded theory study, these findings led the researcher to further explore in the grounded theory analysis the relative importance of research assessment to design research practitioners.

The CDA of the UK REF 2014 further revealed **social and cultural values** pertaining to market systems, accountability and public relations, quantification and competition. This raised questions for the researcher around the impact of these values, if any, on design research practice, the alignment (or lack of alignment) of research assessment values with design research practice values and furthermore the experience of design researchers in their engagement with and subsequent evaluation in this competitive exercise.

Finally, the CDA of the UK REF 2014 revealed a **lack of definition of design research** within the document. It was important to further explore the question of design research definition among design research practitioners in the grounded theory study. Due to the nature of grounded theory research approach and methodology, it is important the themes emerge from an open ended interview and questioning format. However, the CDA findings did sensitise the researcher to the aforementioned issues, both in the analysis and critical reflection of the findings, extending the grounded theory research reach beyond the isolated and limited understandings of its participants, to include the complexities of their world, views and actions.

Section Five: Grounded Theory Study of Practicing Design Researchers

5. Grounded Theory Study of Practicing Design Researchers

5.1 Introduction

Grounded theory is a research approach developed by Glaser and Strauss which they developed during a collaborative research project in the 1960s. They disagreed with the extreme positivism of the time, the belief that “scientific truth reflects an independent reality” and the ensuing focus on verifying existing theory in social research (Suddaby 2006). They proposed that an interpretive framework was more appropriate to the study of social situations. Strauss, one of the founding members, was greatly influenced by the pragmatic philosophy of Pierce and used it as a basis for the development of grounded theory along with symbolic interactionism which looks at the meaning people place on things and actions in social interaction.

“Pragmatism combined with symbolic interactionism underpins the whole thrust of grounded theory: in short, to figure out what is important to people, what is problematic, and what is the process of events or action schemes implemented to achieve resolution” (Stern and Porr 2011).

Grounded theory is a research methodology used to understand and explain a phenomenon where theory is developed from the data collected. This data which may come from a variety of sources will aid the building of theory grounded in the interpretations and actions of the participants in their particular daily reality. Data sources may include, for example, interviews and focus groups, field notes and memos, research literature and policy documents. It is important data that provides rich detail and captures a range of perspectives to aid the development of theory. In grounded theory, the literature is also considered a source of data which may challenge the findings. Grounded theory was chosen because design research is a research area where little formal theory has already been generated, and to have real explanatory value, it is important the theory comes from the practices and processes of the designer, along with their reflection and understanding.

Grounded theory approach has evolved and developed since its conception in the 1960s resulting in the development of a range of approaches from an objectivist approach which is in alignment with a more positivist tradition to a constructivist approach reflecting the values of the interpretative tradition. Kathy Charmaz (2006) is associated with the development of constructivist grounded theory and this is the approach adopted in this study. This approach has been selected because it extends the grounded theory research *reach* outlined above beyond the isolated and limited understandings of its participants, to include the complexities of their world, views and actions.

“A contextualized grounded theory study can start with sensitizing concepts that address such concepts as power, global reach, and difference and end with inductive analyses that

theorize connections between local worlds and larger social structures” (Charmaz 2006, p. 133).

The triadic research approach adopted and outlined in *Section 3.3 Research Approach and Design* draws from Charmaz’s grounded theory development.

5.2 Grounded Theory Study: Sampling Strategy, Participant Profile and Interview Format and Questions

The grounded theory study aimed to explore the research process of designers to uncover their understanding and experience of research, their approach, their research problems and methods. Data was collected mainly by means of qualitative semi-structured interviews with practising design researchers. Ongoing analysis and critical reflection was supported by the findings from the discourse analysis of the UK REF 2014 and continuing review of the literature.

5.2.1 Sampling Strategy

The researcher conducted interviews with eleven practising design researchers. Grounded theory data collection is guided by a theoretical approach to sampling. This sampling approach is unique to grounded theory research “and is the essential method responsible for making the process emergent” (Birks and Mills 2011, p 69). It is different from other sampling strategies because decisions regarding where and who to collect the data from (apart from the initial interview/s) are purposely not made in the planning stage, but made in association with and guided by subsequent rounds of data analysis. This is an iterative process of data collection and analysis

“whereby the analyst jointly collects, codes, and analyses his data and decides what data to collect next and where to find them, in order to develop his theory as it emerges.” (Glaser and Strauss 1967; Birks and Mills 2011, p.45).

“Application of theoretical sampling in its purest form would see [the researcher] undertake a single data collection event [interview] followed by analysis of that data” which would guide the next round of data collection (Birks and Mills 2011, p. 71). Generalisability in this case is considered less important than the gathering of rich data in order to develop deep understanding of the phenomenon under observation.

In order to start the process, the first interview participants were selected on the basis of relevance to the study. In the case of this study, relevance was defined as a ‘practicing design researcher in Ireland and/or the UK with a minimum of a PhD qualification’. However, engaging participants in this bracket proved challenging, particularly in an Irish context, where the study was geographically based. This was because of the limited number of practicing design researchers in

Ireland with a PhD qualification. There were possibly ten to fifteen people in Ireland in 2015 matching this profile, although the numbers are increasing on a yearly basis. Because the numbers were so small, they were almost all known to each other and the researcher. This rendered fulfilling the selection criteria and protecting participant anonymity particularly challenging. Of the small Irish cohort, three potential participants, matching the ‘relevance criteria’ were contacted by email inviting them to take part in the study. All three agreed to participate. The first three interviews were conducted and the data analysed which directed the selection of the next round of interviewees.

A theoretical approach to sampling followed, that is, the ‘relevance criteria’ was informed by the analysis of the first three interviews. Once the ‘relevance criteria’ were identified and met the participants were selected in a snowball or chain referral sampling approach, that is, participants identified other suitable participants.

The first interviews focused on academic design researchers in Ireland. Preliminary analysis found that their research approaches varied and appeared to be influenced by their educational background. The next two rounds of interviews selected participant design researchers from a range of educational institutions, art schools and universities in the UK and Ireland and Irish Institutes of Technology revealing further alignment between professional backgrounds and research approaches. To further explore this relationship and the range of variation in research approaches, the final round of interviews was conducted with research active practitioners working inside and outside of education.

5.2.2 Participant Profile

Full details of the participant profiles can be found in *Table 3. Participant Profile – Practising Design Researchers*. The profile overview includes the Participant Pseudonym, Coding Analysis Round Number, Academic and Practice Experience and the nature of the two highest educational awards received. Gender neutral pseudonyms were selected to protect the anonymity of the participants in the small close community of practicing design researchers. This issue was particularly important in an Irish context. One significant factor which impacted on the participant profile sample were lack of PhDs with practising design researchers in Ireland. This was also experienced in a leading UK art school research environment and among the fully practice-based researchers. Complete capture of the four rounds of coding analysis can be found in the Appendices, C, D, E, F, G, H, I, J, K, and L.

Table 3 Participant Profile – Practicing Design Researchers

	Participant Pseudonym & Coding Round No.		Art School	University/ Institute of Technology	Practitioner	Academic	PhD	MA MPhil MSc	Post PhD Research Experience in years
	Pseudonym	C. R. No.							
1	Lee	1&4		✓	✓	✓	✓		3
2	Frankie	1&4	✓		✓	✓	✓		11
3	Kelly	4		✓	✓				0
4	Jules	2&4		✓		✓	✓	✓	3
5	Sam	1,2&4		✓				✓	0
6	Ashley	2&4	✓		✓	✓			0
7	Alex	3&4	✓	✓	✓	✓		✓	?
8	Val	3&4		✓	✓	✓	✓	✓	13
9	Sydney	4		✓	✓	✓	✓		7
10	Ali	4		✓		✓	✓	✓	11
11	Drew	3&4	✓		✓				0

Note: In this table, the term art school refers to a third level university specialising in art and design education and research, an Institute of Technology refers to an Irish third level institution of education which specializes in applied science, engineering, technology, art and design education and research and a university refers to a third level institution of education and research.

5.2.3 Interview and Analysis Timeframe

The interviews took place between the months of February and December 2015. Eleven practicing design researchers were interviewed. Analysis consisted of Grounded Theory iterative, constant comparative coding. Four rounds of coding were conducted in an iterative process of data collection interspersed with data analysis. Approximately three interviews were coded in each consecutive coding round.

- Coding Round One: First three interviews were coded.
- Coding Round Two: One interview re-coded and two further interviews coded.
- Coding Round Three: Three further interviews coded.
- Coding Round Four: Final three interviews coded and codes and categories developed integrated with the first three coding rounds.

5.2.4 Interview Format and Questions

Participants completed a short questionnaire creating a participant profile education and career history. However, these were omitted in later interviews as some of the profile questions created awkwardness and impacted negatively on the interview process.

This was followed by a semi-structured interview lasting approximately one hour. Design researchers were encouraged to describe their day-to-day activities through the vehicle of a research project they were particularly happy with. The interview explored the ‘insider perspective’, where participants’ experience and understanding were the focus. Open ended questions such as, “Tell me about Tell me more about” were posed in relation to the key

concept areas outlined in the bullets below. However, the focus was on the participants' experience and understanding of design research and what they saw as important. This took precedence over the questions which were not always required during the course of the interview.

- Your role and responsibilities as a design researcher (This question seeks to provide some background contextual data and allow possible unforeseen issues relating to conducting design research to emerge which may be important for the study.)
- An exemplary research project you worked on (This question seeks to obtain data relating to the interviewee's personal approach to design research, use of research methodologies, dissemination, outcomes, etc.)
- An exemplary funding proposal you worked on (This question seeks to obtain data relating to the challenges and opportunities for design researchers seeking funding.)
- Your experience of research assessment (This question seeks to obtain data relating to a design researcher's experience and understanding of research assessment.)
- Design research methodologies (This question seeks to obtain data relating to a design researcher's use and understanding of research methodologies.)

Each interview was recorded and the audio material transcribed for analysis.

5.3 Grounded Theory Study: Analysis and Coding Approaches

The researcher undertaking this study learned to code using a mixture of theoretical and practical guide books, masterclasses, workshops and experiential learning. The experience of undertaking data analysis was where the greatest learning took place. During this process, the researcher coded the data using a variety of approaches. Continued reflection on, evaluation and comparison of these approaches informed the adaptation of a dual approach to qualitative analysis which combines the Computer Assisted Qualitative Data Analysis Software (CAQDAS), NVivo with traditional materials (coloured pens, paper, display boards, etc.) for coding. This was found to generate greater insights during the analysis process. Further visual analysis and mapping of modes of interaction and cognition afforded by the different coding approaches, highlighted that the approaches which afforded greater modes of interaction and cognition increased the opportunity for interpretative insight leading to a more rigorous analysis procedure (Maher et al. 2018).

5.3.1 Grounded Theory Study: Coding Methods

The researcher trialled coding with and without the use of CAQDAS software before finally settling on a combined approach. This resulted in a number of interviews being coded more than once, encouraged reflection and comparison of emerging codes, particularly codes which differed because of the coding approach adopted, and ultimately increased the modes of interaction with

the data. There were four coding rounds capturing four coding approaches in total with approximately three interviews being coded in each round. The final/fourth round of coding brought together all the previous interview codes and categories with the final three interviews coded.

A detailed description of each coding process along with examples are presented in Tables 4 to 9. The four coding approaches are described in the coding descriptions, which also include a coding reflection discussing their ability to support visualising the data from a range of perspectives and contextual settings, as well as opportunities for imaginative exploration and reflection. It is important to note that auditory interaction with the data is beneficial. This occurred during the interview and by listening to the interview recording a number of times afterwards to listen for meaning, review memos and field notes and prepare the transcriptions.

Coding Round One - First Approach (Sticky Note Approach)

The first three interviews with Lee, Frankie and Sam were coded in the first round. Coding was conducted using A4 sheets of paper, coloured markers, sticky notes and large format display boards. The results were recorded in photographs and captured in a Microsoft Excel Matrix. See *Figure 10* for a sample page of the Matrix. See *Table 4 Coding Round One - First Approach – Coding Description* and *Table 5 Coding Round One - First Approach – Coding Example* and *Figures 7, 8, and 9* for photographic capture of the coding process for this first round.

Table 4 Coding Round One – First Approach – Coding Description

Coding Round One - First Approach – Coding Description (Sticky Note Approach)

Printed out the interview transcript on A4 sheets of paper leaving plenty of space between the lines of text and a wide margin for coding. Line by line coding was conducted manually with pens, markers and sticky notes. The researcher highlighted in the text lines/phrases relating to the unit of analysis (designers doing research), and ascribed fledgling codes in the margins. See *Figure 7* for a photographic capture of the analysis process and *Table 5* for a coding example. This process of coding continued until the entire interview was coded. During the process emerging codes were compared with previous codes and amended if necessary to capture process and understanding. Memos continued to be written in a hard-backed notebook to record relationships between codes, ideas and insights.

Focused or Axial Coding

At this point all the fledgling codes from the three interviews were transferred to sticky notes and placed on a number of A1 sheets of paper. See *Figure 8* for a photographic capture of the analysis. This facilitated seeing relationships between codes within interviews and between

interviews. Codes that seemed to be saying the same thing were grouped together with a pithy code from that group reflective of the core content being selected as a group heading. Memos continued to be written recording analytical reflections and decisions.

To add structure to this process, Corbin and Strauss's (1990, p. 13) coding paradigm was used. Here codes were grouped under the following headings:

1. Conditions/Context (Why, Where, How and What happens),
2. Actions/Interactions, Emotions and
3. Consequences (of Actions / Interactions / Emotions).

The process allowed for imaginative exploration and reflection. The result was four A1 sheets of paper with codes on sticky notes for each interview. See *Figure 8* for a photographic capture of the analysis. All twelve sheets were laid out on the table and floor in the room so all could be viewed at the same time. The method of 'constant comparison' was practised as the researcher compared codes with codes and categories with categories within interviews and between interviews. Memos were written to describe the relationship between codes and categories. Further rearranging was done until the researcher was content that the categories and codes best reflected the participants understanding and experience of doing research. Sticky tape was then used to fix the sticky notes to the sheets in the order they were arranged in. See *Figure 9* for photographic capture. This would provide a visual record of the first round of analysis. A matrix was also created in Microsoft Excel recording the categories and codes created. See *Figure 10* for sample page of matrix.

Coding Reflection

The ability to see all the codes at once, to move them freely from one group to another and back again, on large sheets of paper on a table, allowed free interaction with the data. Like a children's card memory game, the researcher becomes familiar with all the codes, their actual and possible positions in relation to their properties relative to their physical position on the sheets of paper. The physical layout also allows the researcher to reflect on the process as a whole and zoom in on smaller groupings, while in a reflective mode. With the addition of further interviews in this large viewing format, it was possible to compare codes with codes, categories with categories within interviews and between interviews. Furthermore, the large format sheets can be taken out, reflected upon, and compared with future coding and analysis.

Table 5 Coding Round One - First Approach – Coding Example

Coding Round One - First Approach – Coding Example (Sticky Note Approach)

This coding and memo example is taken from an interview with Frankie, an art school lecturer, research supervisor and industrial design practitioner. In this interview excerpt Frankie is describing the PhD research process and the issues associated with not having a design research model to work from. Frankie goes on to question the possibility of creating a model for design research given the intuitive/creative nature of the process and describes how, when supervising design research students, they are encouraged to break the rules.

Interview Transcript Excerpt

“I would have modelled my approach very much on a scientific approach to PhD research rather than a design approach and more because I didn’t have a model to work from ... I’m still unsure about how How possible it is to model the creative process because so much of it relies on intuition and that kind of intuitive spark of energy that you know leads to creation and all the methodology in the world won’t necessarily bring you to that point, you know, it may allow you to understand it in hindsight but you know I think a straight jacket of any kind, of any kind, in a creative process could be a hindrance more than an aid you know and part of the, the kind of glory of creativity is freedom. Freedom to break the rules, to be able to work outside, to break new ground in a creative way.”

Fledging Codes

Questioning Methodology: Noting a lack of design research models, Questioning the possibility of “modelling the creative process”, Viewing research methodology as being powerless to bring about creativity, Equating methodology with a “straight jacket”, a “hindrance”,

Valuing Creativity: Seeing creativity as being reliant on “that kind of intuitive spark of energy”, Equating creativity with “glory” and “freedom”, Equating creativity with “breaking the rules, working outside”, Equating creativity with “breaking new ground in a creative way”

Questioning methodology in its ability to support creativity:

Memo Title – Fundamental Conflicts

Frankie is reflecting on design research process in this excerpt. Noting the lack of design research models while questioning the possibility of modelling the creative process required for “breaking new ground in a creative way”. Seeing a fundamental conflict between research methodology and the “kind of intuitive spark of energy” required “to break new ground in a creative way”. Frankie’s use of language is emphatic on this point, for example “all the methodology in the world won’t necessarily bring you to that point”. Frankie’s reservations continue with equating research methodology with a “straight jacket” and a “hindrance” to the creative process. In contrast, creativity is associated with “glory” and “freedom”, “freedom to break the rules, to be able to work outside, to break new ground in a creative way”. The use of language is very strong in this excerpt reflecting fundamental beliefs/values and conflicts relating to the requirement for creative freedom in design research process and perceived methodological constraints.

Conflicts appear to occur between (design research) process and (research methodological) structure. They are expressed in terms of: freedom and constraint, glory and dullness, spark and deaden, energy and powerlessness. There are clear value and process differences and concerns regarding methodological structure.

Are all design researcher values/processes similar? How do other design researchers relate to methodology and structure?

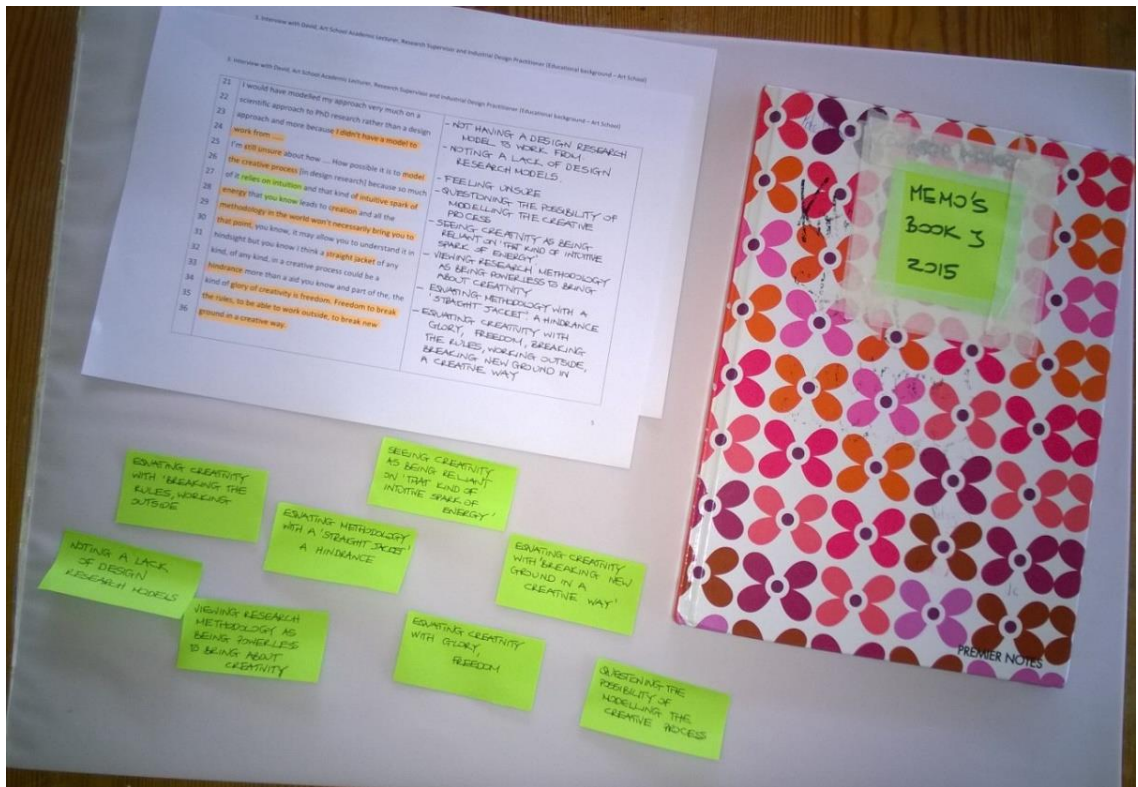


Figure 7 Coding Round One - First Approach – Open Coding. Photograph shows A4 coding sheets with interview excerpt and hand written codes, sticky notes and memo notebooks



Figure 8 Coding Round One - First Approach – Focused or Axial Coding. Affinity Mapping Process. Photograph shows sticky notes placed on large format display boards

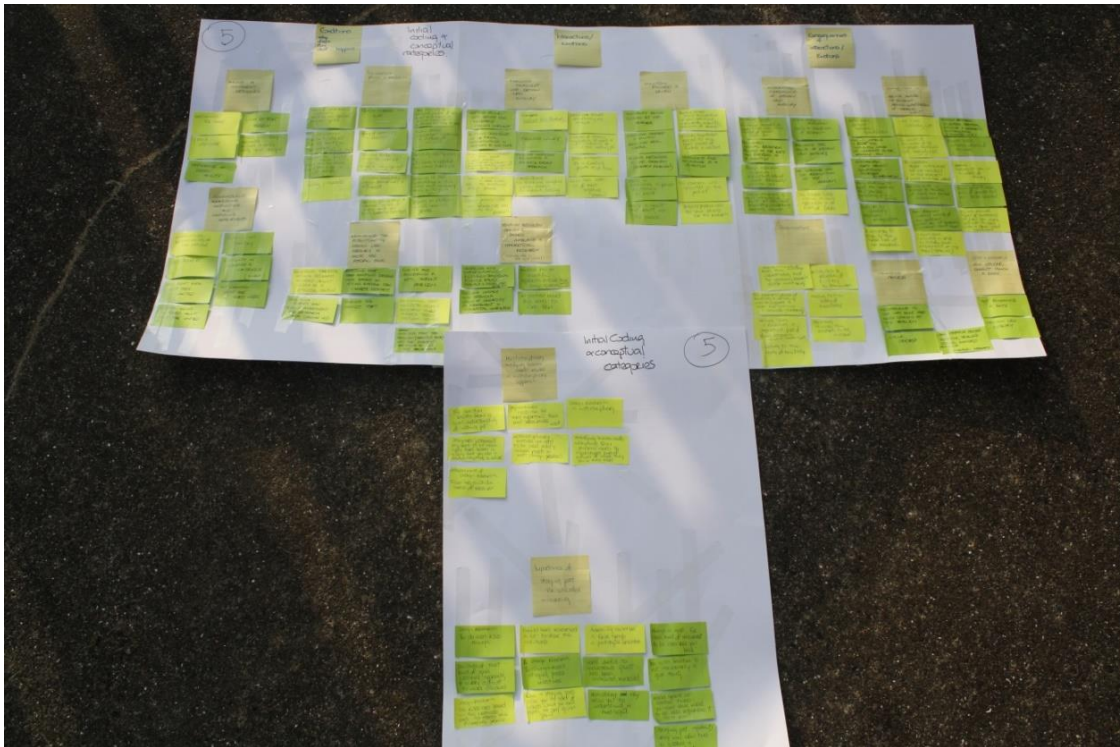


Figure 9 Coding Round One - First Approach – Focused or Axial Coding. Affinity Mapping Process Continued. Photograph shows sticky notes arranged on large format display sheets using Corbin and Strauss’s (Corbin and Strauss 1990, p.13) coding paradigm for one of the interviews.

Unit of Analysis - Designers Doing Research (Post Graduate/Post Doctorate Academics and Practitioners engaged in Research), with a focus on their approach and understanding. Note: Initial Code Titles are derived from direct quotations from interviews.			
Coding paradigm Strauss & Corbin 1990 & 1998. In this paradigm, data analysis is structured by the following headings; 1. Conditions/Context (Why, Where, How and What happens), 2. Actions/Interactions, Emotions, 3. Consequences (of Actions / Interactions / Emotions)			
2. Actions / Interactions / Emotions			
	Category Code/Concept	Coding Paradigm Classification	Description
Category A (Focused Code)	Seeing it Differently	2. Action / Interaction	Design researchers see research differently
Code 1 (Initial code)	"Designers do see things differently"		The researcher outlines how in terms of research 'designers do see things differently, they see patterns differently and opportunities emerging.'
Code 2	"a word like research is fundamentally boring"		This design practitioner speaks about a perception of research as 'fundamentally boring'
Category B	Doing it Differently	2. Action / Interaction	Design researchers do research differently

Figure 10 Example of a page of coding results captured in Microsoft Excel. Figure shows aggregate of focused codes developed from the affinity mapping process

Coding Round Two – Second Approach (NVivo Only)

The second round of coding was digital only, using NVivo software. The interview with Sam was recoded and two further interviews with Jules and Ashley were coded in this way. The NVivo only approach was found to be restrictive for data analysis and it was decided to combine it with the sticky note approach in subsequent coding rounds. See *Table 6 Coding Round Two – Second Approach – Coding Description*.

Table 6 Coding Round Two - Second Approach – Coding Description

Second Approach – Coding Description (NVivo Only)

The researcher recoded one previously coded interview and coded two further interviews in sequence using NVivo software on the personal computer. This involves reading the interview text on the screen, highlighting key sections of text, ascribing codes to these text sections in a sequential manner. Analytic questions and reflections related to text segments were captured during this process by using NVivo annotations. This function proved useful as the annotation and the text segment remained digitally connected and easily retrievable. Code memos written in NVivo during this process were also digitally linked with the code and the associated data. On completion of the three interviews, the researcher progressed to focused coding. This involved reviewing all the codes developed and grouping those that were reflecting similar actions and processes. A heading was selected to represent each of these core categories.

Coding Reflection

The researcher found NVivo to be useful for data storage, for recording connections, annotations and memos, but found it restrictive for data analysis, imaginative exploration and reflection. The researcher's design background supports more visual and kinaesthetic work practices and felt limited by the computer work process format. For example, the computer screen size determines and limits how much of the interview and the emerging codes the researcher can see at any one time. This renders the process of constant comparison difficult and fails to encourage reflection. As a result, the researcher moved relatively quickly through the data, completed 'open coding' and moved on to developing 'core categories' working at a more abstract level prematurely and without having fully considered the complexities of the participants' stories. After some reflection, it was decided to combine both the coloured pen and 'sticky note' method of analysis with NVivo to optimise the researcher's interaction with the data, while maintaining a digital audit trail. It is important to note that NVivo was the only CAQDAS software trialled. Other packages may support a different experience.

Coding Round Three – Third Combined Approach

The third round of coding combined digital coding with NVivo with the sticky note method. The participant interviews coded in this round were with Alex, Val and Drew. See *Table 7* for Coding

Description, *Table 8* for Coding Example, *Figure 11* for visual exploration of analysis findings and *Figure 12* for photograph of Affinity Mapping Process.

Table 7 Coding Round Three - Third Approach – Coding Description

*Third Approach – Coding Description
(NVivo and Sticky note Combined)*

This was the most satisfactory and fruitful analysis procedure. First a new NVivo project was created with a new title. This was to limit the influence of the previous analysis and code names on this third round of analysis. It was important for the research that the researcher looks at the data with fresh eyes and from a fresh perspective. NVivo was then used to create codes for three further interviews in a number of sequential coding sessions. To look at the interviews with fresh eyes, to ensure coding was grounded in the data and that the researcher did not move too quickly into developing core categories or higher level abstractions, the researcher concentrated on developing codes which, where possible, reflected both the words of the participants and individual and collective processes. This strategy combines the use of In Vivo codes (participants' actual words) with gerunds (coding for action and process). In Vivo codes help capture participants' implicit meanings and understandings, while the use of gerunds keeps the analysis active while supporting understanding of the relationships between meaning and action/process. See *Table 8 Third Approach – Coding Example* for further details.

In Vivo coding was facilitated by the software package NVivo, as the exact text from the interview could be highlighted and made into a code. Annotations and Memos were created in NVivo during the process to record the analysis process and the rationale behind the decisions made. This also encouraged the researcher to stop and reflect.

All the In Vivo codes developed in these coding sessions were then printed out and cut into strips and glued onto sticky notes. These sticky notes were then arranged, compared with each other, compared with earlier interview codes and transcripts, and rearranged using, as in round one, Corbin and Strauss's coding paradigm and a large format display board. This is primarily where the focused or axial coding took place. As mentioned previously, the higher level codes were expressed where possible as gerunds derived from the In Vivo codes. Memos continued to be written developing the analytic process and reflecting on decisions made. A number of conceptual and visual maps were also used to support the analytic process. They further extend data interaction modes and provide a useful approach to exploring relationships within the study. For example, 'doing it differently' became a core category. These 'differences' were manifest in the design researchers' values, processes, and situations/problems. The relationship between these and other variables were explored visually with paper and coloured pencils. See *Figure 11* for example of a typical visualisation and *Figure 12* for a photograph of the affinity mapping process. Once the researcher was satisfied the codes developed reflected the participants' views, a digital matrix was created in Microsoft Excel to reflect the findings. See *Figure 10* for a sample page of a digital matrix. The process facilitated and encouraged constant comparison, imaginative exploration and reflection.

Coding Reflection

The advantages of the combined process were: the codes were initiated and recorded in NVivo along with their associated annotations and memos. This encouraged the researcher to stay close to the actual interview transcript as it is quick and easy to retrieve and it also helped maintain a clear data trail, while the interpretation, reflection, constant comparison, etc. were then further supported by the more interactive coloured pens, paper, sticky notes, visual mapping and large format display boards approach.

Table 8 Coding Round Three - Third Approach – Coding Example

***Coding Round Three - Third Approach – Coding Example
(Nvivo and Sticky Note Combined)***

Coding example illustrating the use of In Vivo codes (participants’ actual words) with gerunds (coding for action and process).

The In Vivo code ‘designers do see things differently’ was initially selected from an interview excerpt. This code had strong conceptual ‘grab’ and could be linked with other text segments in the same and following interviews using the NVivo software, some of which are listed in the selection of interview quotations below. It was subsequently elevated to a focused code (this happened at a later stage of analysis) and changed slightly to the gerund ‘seeing it differently’. It also had strong links and a co-dependency with another focused code ‘doing it differently’ as can be seen in the interview excerpts. This code could also be linked with codes relating to creativity in research where the addition of creative approaches led to novel or creative insights for the research.

Origin of In Vivo code ‘designers do see things differently’

“I would argue potentially that as a designer and a researcher I think designers do see things differently, they see patterns differently and opportunities emerging.” Val

“I think designers, just the way they are and it’s the way they operate, so I think they see the world differently and they’ll make patterns in relationships that maybe others wouldn’t.” Val

“Maybe an engineer is looking for an optimum solution whereas designers are looking for something that’s a bit different you know to express themselves so yeah designers have something distinctive to offer.” Val

“Again it’s seeing these opportunities... as a designer I could see things coming out of this and I could see how we could create some panels and plinths and exhibit it as cool stuff. So yeah and for me personally something coming out the end of it rather than a report you know.” Val

“In that research methodology record, we are different, we wouldn’t record endless notes in a lab unless it was particularly breakthrough, unless it was worth writing down.” Alex

“the conversations between ***** from this designer-ly angle and ***** who’s the head of program from Industrial Design Engineering, from ***** College so more of an engineering approach to research and a kind of really fundamentally different thinking you know both passionate supporters of design but very different attitudes.” Alex

“I felt reluctant to say I’m really creative and I can explore this. I would rather not state it. I would let it be observed so if my employers line managers or whatever, noticed me doing things differently and commented on it,” Sam

“I have supervised a number of people, of course everybody is different as well and their approach is different and it depends on the subject, you know, some, even within design, there are some subjects that would lend themselves to being explored in a scientific way if that’s the word, you know, but once you step in to the world of innovation and creativity, breaking new ground, in that way. ...I think you have to allow space, I know I would always have said to students you know, to forget the boundaries, forget about the rules and just explore, just be free and be creative, you know see what turns out” Frankie

“so it’s kind of a slightly different approach and it requires a different mind-set” Jules

“but when I present it to them it’s very different and actually that’s probably a design sensitivity to how you represent your research.” Jules

“what that might mean in terms of the designerly way of thinking if I can put it like that or even an artist’s way of thinking which is quite different, it has a different intended outcome and all that kind of stuff.” Jules



Figure 11 Coding Round Three - Third Approach – Focused Coding: photograph of visual exploring the relationship between the core category ‘doing it differently’ and the manifestations of these differences.

Note: This is an exploratory visual illustrative of the analysis process rather than a theoretical conclusion.

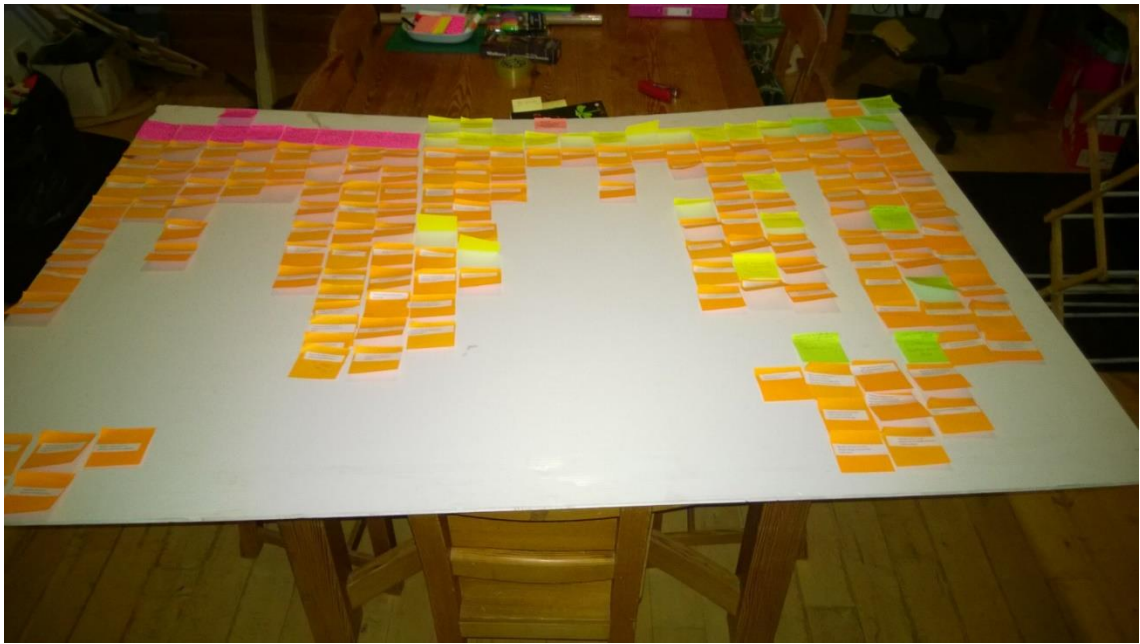


Figure 12 Coding Round Three - Third Approach – Axial Coding. Photograph shows the In Vivo codes attached to the sticky notes and the Affinity Mapping Process

Coding Round Four – Bringing it all together

The final three interviews with Kelly, Sydney and Ali were coded in this round and then focused codes and categories from all the interviews were brought to together for comparison and further analysis. See *Table 9 Coding Round Four – Bringing it all together - Coding Description* for a detailed description and *Figure 13* for a photograph of the coding process using Dorst’s “art of design” (Dorst 2006, p.75) overview as a framework to structure the ‘difference domains’ as expressed by the participants in one of the coding categories *Recognising Difference*.

Table 9 Coding Round Four – Bringing it all together- Coding Description

Fourth Approach – Coding Description - Bringing it all together

This final round of coding added another three participants to the analysis process, Kelly, Sydney and Ali and then brought together all the codes and categories from the first three rounds of coding for comparison and further analysis. All the categories and associated codes developed in the four coding rounds were printed out. The printed sheets were cut with scissors so categories and associated codes could be displayed individually and rearranged on a large format display board. See *Figure 13 Coding Round Four – Bringing it all together*. During the process categories and codes were compared with previous categories and codes and amended to capture combined and evolving process and understanding. This was further informed by ongoing literature searching and the CDA of the UK REF 2014. Memos continued to be written in a hard-backed notebook to record relationships between codes, ideas and insights.

Advanced Coding

Rearranging continued over a number of days until the researcher was content that the categories and codes best reflected the participants’ understanding and experience of doing research. Corbin and Strauss’s (1990, p. 13) coding paradigm was not used in this fourth round of analysis. While useful in the previous rounds of coding to bring together and support the creation of a coherent narrative for the fractured data, it was now found to constrain the analysis

process and theory development. Additional consultation of the literature, in this instance the writing of Dorst, considered in tandem with the ongoing grounded theory analysis, provided an insightful interpretative frame for one of the categories in the fourth round of coding. Ongoing literature searching guided by findings from the grounded theory analysis directed the researcher to look more closely at existing studies of design practice. This was because early analysis of the interviews indicated that design researchers were framing and undertaking their research using a design led approach, that is, a methodological approach used to generate design solutions which they had experiential and tacit knowledge of. Dorst's insight stating that:

“the art of design is linked to the designer, the design problem and the design situation, not just the process of designing” (Dorst 2006, p. 75).

was used as a frame to structure the ‘difference domains’ as expressed by the participants in the one of the three main Coding Categories, titled *Recognising Difference*. See *Section 5.6 Grounded Theory: Navigating Difference* for further details.

Coding Matrix

A matrix was created in Microsoft Word to record the grounded theory categories and codes created. For the purpose of traceability, the researcher has retained the initial Focused Coding blocks in this final round of coding. For this reason, some of the focused code names appear similar or repetitive in the Coding Matrix for Round 4. This is because similar codes emerged from the individual coding rounds. It is indicated in the Coding Matrix in which round they were developed and the pseudonyms of the contributing participants. See Appendix H, I, J, K and L for full Coding Analysis Matrix for Round 4 and Tables 11 to 15 in the thesis for summarised versions.

Coding Reflection

As in the previous rounds of coding with sticky notes and large format display boards, the ability to see all the codes at once, to move them freely from one group to another and back again, on large sheets of paper on a table, allowed free interaction with the data. The physical layout allowed the researcher to reflect on the process as a whole and zoom in on smaller groupings, while considering similarities with findings from the literature. The use of NVivo proved valuable at this time as a quick and easy method to retrieve exact quotations and links to full interviews and previously written memos.



Figure 13 Coding Round Four – Bringing it all together

5.4 Findings

The reoccurring theme appearing in this grounded theory study of ‘designers doing research’ was *Navigating Difference*. This became the core category of the study. *Navigating Difference* was made up of three categories: *Recognising Difference*, *Experiencing Tension* and *Seeking Recognition*. See Table 10 Concept map detailing constituent Categories and Focused Codes for the Grounded Theory, *Navigating Difference* for further information. The core category and sub-categories are drawn from the categories and codes created during the grounded theory analysis. The detail of the initial codes and categories captured and developed through four rounds of coding are contained in the appendices. See Appendix C, D, E, F, G, H, I, J, K, and L. A summary of the codes developed, their participant sources and the concept map recording the final research themes/categories developed in the fourth round of coding can be found in Section 5.5 *Initial and Focused Coding*. These and the emerging grounded theory are discussed in Section 5.6 *Grounded Theory: Navigating Difference*.

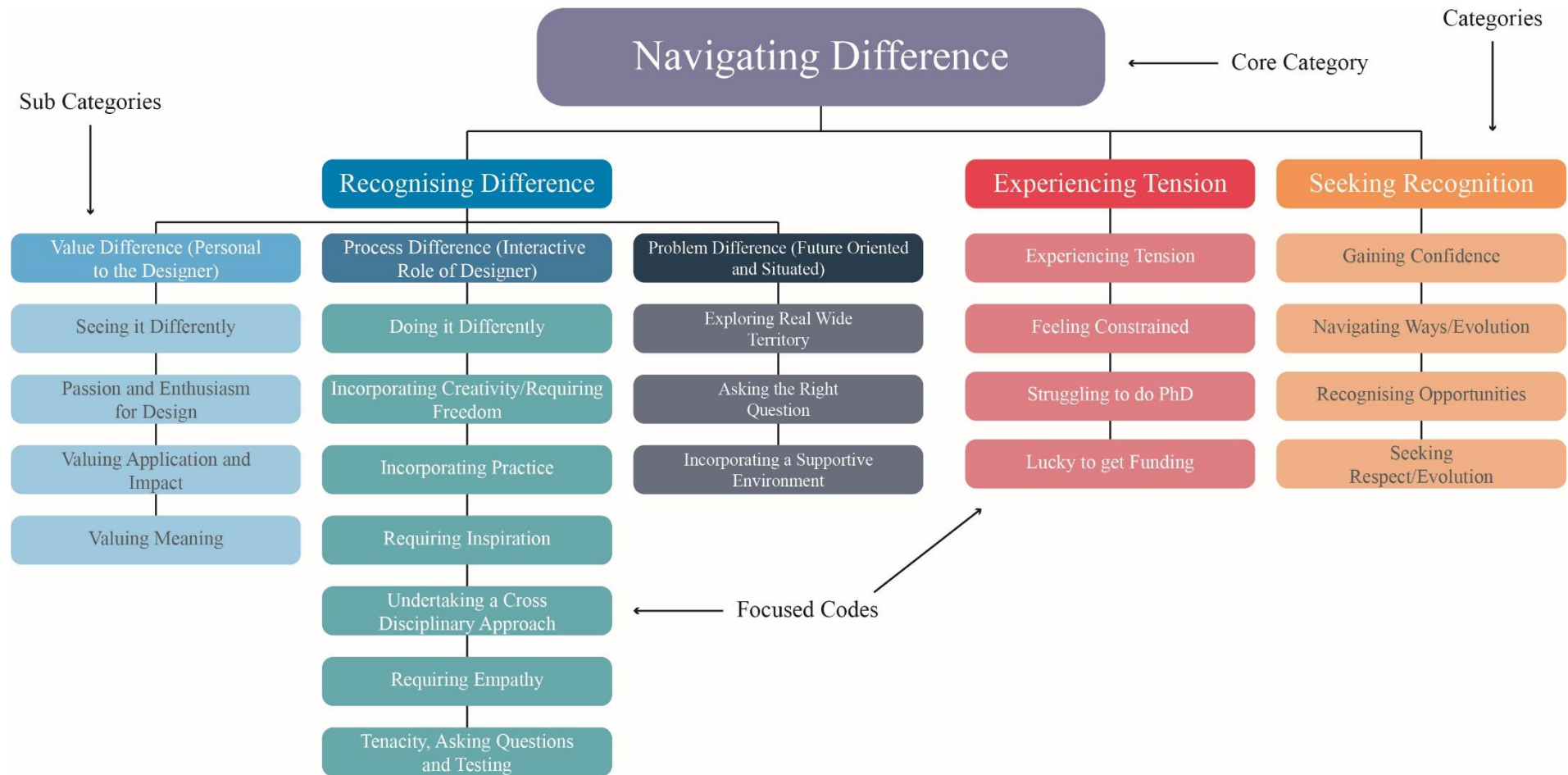
5.5 Initial and Focused Coding

A detailed description of the coding process can be found in Tables 4, 6, 7 and 9 in Section 5.3 *Grounded Theory Study: Analysis and Coding Approaches*. Once the researcher was satisfied the codes developed reflected the participants’ views, digital matrices were created in Microsoft Excel to capture the initial codes and their aggregate focused codes.

Navigating Difference became the core category of the grounded theory. This was made up of three categories: *Recognising Difference*, *Experiencing Tension* and *Seeking Recognition*. *Recognising Difference* had three further sub-categories *Value Difference*, *Process Difference* and *Problem Difference*. See *Table 10 Concept map detailing constituent Categories and Focused Codes for the Grounded Theory, Navigating Difference* for further information. Each category and sub-category is derived directly from aggregates of the initial interview codes. Tables 11 to 15 summarise the constituent aggregate and focused codes for each of the five categories making up the grounded theory *Navigating Difference*. For the purpose of traceability, the researcher has retained the initial focused coding blocks developed in iterative rounds of coding in this final round of coding. For this reason, some of the focused code names appear similar or repetitive in Tables 11 to 15. This is because similar codes emerged from the individual coding rounds. It is indicated in the Full Coding Matrices in the appendix which round they were developed and the pseudonyms of the contributing participants. See Appendix H, I, J, K and L for full Coding Analysis Matrix for Round 4 and Tables 11 to 15 for summarised versions.

The grounded theory *Navigating Difference* and its constituent categories are discussed with contributing quotations in *Section 5.6 Grounded Theory: Navigating Difference*.

Table 10 Concept map detailing constituent Categories and Focused Codes for the Grounded Theory, Navigating Difference



Each category and sub-category in *Table 10* is derived directly from aggregates of the initial interview codes. *Table 11* summarises the constituent aggregate and focused codes for the sub-category *Value Difference*. These are *Seeing it Differently*, *Passion & Enthusiasm for Design*, *Valuing Application and Impact* and *Valuing Meaning*. Both tables can be cross referenced with each other. The thumbnail sketch of *Table 10* below indicates the position of Coding Sub-category *Value Difference* on that table. Appendix H contains the full Coding Analysis Matrix complete with participant pseudonyms, code description and coding round number for *Value Difference*.

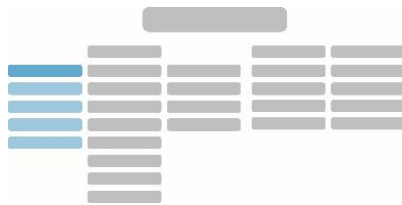


Table 11 Coding Category: Recognising Difference, Coding Sub category: Value Difference, Focused Code with Aggregate Initial Codes

<i>Coding Category: Recognising Difference</i>			
<i>Coding Sub category: Value Difference</i>			
	<i>Focused Code with Aggregate Initial Codes</i>	<i>No. of Interviews</i>	<i>No. of times code cited</i>
A	Seeing it Differently		
1	"Designers do see things differently" Val (Alex, Ali, Sydney)	4	21
2	"a word like research is fundamentally boring" Drew (Sydney)	2	2
3	"Every design researchers approach is different as well" Frankie	1	14
4	"Every design research subject is different, to be explored in different ways" Frankie	1	14
5	"do we know we're going to get value for data type rigour" Ali	1	1
B	Passion & Enthusiasm for Design		
1	"really pleased" with the outcome, Val (Alex, Sydney)	3	18
2	"making it more fun" Drew (Sydney)	2	4
3	"the fuel that is required is enthusiasm" Drew (Kelly)	2	3
4	Having "that enthusiasm to gather the data" Drew (Sydney, Kelly)	3	11
5	"enthusiasm"... "distill(ing) a sense of empowerment" Drew	1	3
6	"without enthusiasm you cannot do a good job" Drew (Sydney)	2	9
7	"being passionate for practice" Val (Alex, Drew, Sydney)	4	22
8	"that's where the magic is" Drew (Sydney)	2	3
9	"magic of design is when design starts telling you what to do rather than you telling it" Alex	1	1
10	Enthusiasm for the project (Jules, Sam & Ashley)	3	14
11	Loving Design (Sam & Ashley)	2	16
12	Loving Design (Lee, Frankie & Sam)	3	19
13	"certainly a creative spirit" Kelly	1	1
C	Valuing application & Impact		
1	Research Purpose "to give you a result you can use" Drew (Alex)	2	16
2	"take this process and product-ise it" Alex (Sydney)	2	11
3	"potential to come up with cool stuff" Val (Alex, Sydney)	3	17

4	"the impact of design is very, very powerful for the economy, important for society" Alex (Sydney)	2	3
5	"kind of project makes really exciting breakthroughs" Alex (Sydney)	2	7
6	"much of the REF able material has been partly generated by practitioning work" Alex	1	2
7	"the really exciting part was you know engaging the industry" "you got the sense of great it's not just about writing a paper and ticking I've got this many papers written, it's like I did create something that had an impact" Alex (Sydney)	2	4
8	Noting how PhDs "just get stuck on a shelf" Val	1	2
9	Noting "researchers identifying there was a need for this" Val (Alex)	2	12
10	Continual focus on the outcome (Jules, Sam & Ashley)	3	43
11	Design research methodologies can produce successful outcomes in policy development (Jules)	1	3
12	Design has application in non-traditional contexts (Jules)	1	4
13	"Realising that existing designs were based on notions rather than concrete research" Frankie	1	7
14	"cross overs in methodology...[between] research to inform developing a product and research to generate new knowledge" Ali (Sydney, Kelly)	3	12
15	"looking for novel applications and designs"... "Seeing novel applications for technology" Sydney	1	5
16	"it's still very tangible research that something comes out of it" Kelly	1	1
D	Valuing Meaning		
1	"Making more sense" of the research. Val (Alex, Drew, Sydney)	4	18
2	"designers can add value I think" Val (Alex, Sydney)	3	8
3	design research "fundamental game changer in new knowledge and development in research terms" Alex (Sydney)	2	3
4	"solving the world's problems through design thinking" Val (Alex Sydney)	3	5
5	Acknowledging the value of design and design research methodologies in developing policy (Jules)	1	8
6	Utilising design research methodologies to understand why policy development research methodologies don't work (Jules)	1	2
7	Utilizing design methods and design research in policy (Jules)	1	12
8	Valuing design research (Jules & Ashley)	2	12
9	"They didn't know what they wanted" Frankie	1	14
10	"looking at meaning driven innovation" Sydney	1	2

Tables 12 summarises the constituent aggregate and focused codes for the sub-category *Process Difference*. The thumbnail sketch of *Table 10* indicates the position of Coding Sub-Category *Process Difference* on that table. Appendix I contains the full Coding Analysis Matrix complete with participant pseudonyms, code description and coding round number for *Process Difference*.

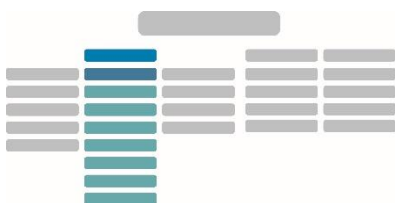


Table 12 Coding Category: Recognising Difference, Coding Sub category: Process Difference, Focused Code with Aggregate Initial Codes

<i>Coding Category: Recognising Difference</i>			
<i>Coding Sub category: Process Difference</i>			
	<i>Focused Code with Aggregate Initial Codes</i>	<i>No. of Interviews</i>	<i>No. of times code cited</i>
A	Doing it Differently		
1	"designers don't work like that" Val (Alex)	2	6
2	"in that research methodology, we are very different" Alex	1	1
3	"researching or generating new knowledge in their own ways" Alex (Sydney)	2	3
4	"fundamental difference....the point (role) of you in the research" Alex (Ali)	2	2
5	"as a designer you can't really take yourself out of it" (the research) Alex (Ali, Sydney)	3	3
6	Engineering "all their research was defined at the start" Alex	1	2
7	"feeling at sea in a world of theory" Frankie	1	6
8	"Feeling unsure how to model the creative PhD process" Frankie	1	9
9	"very used to quite a chaotic design process." Ali	1	1
B	Incorporating Creativity/Requiring Freedom		
1	"What if you made" Alex (Sydney)	2	4
2	"there's a real lack of creativity with a product like that" Drew	1	3
3	"so the project became" Alex (Ali, Sydney)	3	5
4	"beautiful" through creativity Drew (Alex, Sydney)	3	5
5	Being a confident designer (Lee, Frankie, Sam)	3	15
6	Being free to break the rules (Lee, Frankie & Sam)	3	23
7	"Being Creative" (Lee, Frankie & Sam)	3	39
8	Making Judgements (Lee, Frankie & Sam)	3	16
9	Relying on Intuition (Lee, Frankie & Sam)	3	23
10	Loving Design (Lee, Frankie & Sam)	3	19
11	Adding Creativity (Jules, Sam & Ashley)	3	27
12	Design Researchers – "Dreamers that do" Ashley	1	9
13	Encouraging creativity and freedom (Jules & Ashley)	2	18
14	Importance of free exploration (Sam & Ashley)	2	39
15	Methodologies for creativity and research (Jules & Ashley)	2	16
16	Trusting the creative process (Jules, Sam & Ashley)	3	26
17	Utilising the iterative creative process (Jules, Sam & Ashley)	3	12
18	Working fanatically hard while exploring in a random fashion (Ashley & Jules)	2	4
19	"looking for novel applications and designs" Sydney	1	3
C	Incorporating Practice		
1	design research "doing the practice to try and find the theory" Alex cites a colleague (Ali)	2	4
2	"practitioners coming to teach with some research" Alex	1	1
3	"still born of a kind of practicing spirit" Alex (Ali)	2	16
4	"heritage around practicing" Alex	1	1
5	"as a baby you act in order to understand" Alex	1	3
6	"designs are wilful, they take you where they want to go and not where you want to go" Alex cites a colleague.	1	1
7	"cybernetics like design 'feedback' loops and observers being able to feed into feedback loops" Alex	1	1
8	"needing a real problem" Val (Alex)	2	3

9	Utilising iterative design process (Lee, Frankie & Sam)	3	11
10	Trusting the process (Lee, Frankie & Sam)	3	66
11	Utilising staging posts (Frankie & Sam)	2	23
12	Not following a path (Lee, Frankie & Sam)	3	27
13	Feeling comfortable addressing conflicting and confusing requirements (Lee, Frankie & Sam)	3	14
14	Exploring new territory (Lee, Frankie & Sam)	3	25
15	Always returning to the problem (Frankie & Sam)	2	18
16	Going deep very quickly (Lee)	1	6
17	Using design and design research words interchangeably (Sam)	1	1
18	Empathic design (Jules, Sam & Ashley)	3	33
19	Exploring how design research and methods can inform policy development (Jules)	1	12
20	Framing the problem (Jules, Sam & Ashley)	3	33
21	Importance of being reflexive and reflective in design research (Sam)	1	2
22	Noting a lack of success with other policy research approaches (Jules)	1	11
23	Participatory design or co design methodology (Jules, Sam & Ashley)	3	22
24	trailing design research and design methods in policy (Jules)	1	9
25	User centred design approach (Jules)	1	5
26	Using narrative to communicate, share and explore in research (Ashley)	1	6
27	Utilising abstract representation as a communication and development tool (Ashley)	1	4
28	Utilising staging posts, milestones, reflection (Jules & Sam)	2	9
29	Utilising a design user centred approach for policy research (Jules)	1	11
30	"there has to be some kind of flexibility. But still there's deadlines" (Kelly)	1	1
D	Requiring Inspiration (Some overlap with creativity)		
1	"Enough kind of inspirational and sort of application focus to be relevant as a design project" Alex	1	2
2	"inspiring and intriguing " ... "start point" Alex (Kelly)	2	3
3	"more conceptual lateral thinking" ... "the start of a research project" Alex	1	7
4	"works at a Masters level to kind of clash (different disciplines) people together" Alex	1	2
5	"masters level stuff is intuitive and inspirational" Alex	1	1
6	"Relying on intuition in the creative process" Frankie	1	9
7	"We would start a project almost like a discovery phase or a research phase where we're looking at competition and even inspiration around that kind of subject" Kelly	1	1
E	Undertaking a cross disciplinary approach		
1	Satisfying human needs requires a cross disciplinary approach (Lee & Frankie)	2	12
2	Going back to the thought leaders in a methodological approach. (Lee, Sam, Sydney)	3	15
3	Being careful how you blend methodologies (Lee, Sydney)	2	18
4	Being cognisant also of your own design ability (Lee, Frankie & Sam)	3	24
5	Engaging with design theory and methodologies (Jules)	1	1
6	Engaging with other discipline theory and methodologies (Jules, Sam & Ashley, Sydney)	4	22
7	Grounded qualitative methodology (Jules, Sam & Ashley)	3	28
8	Methodologies are useful tools for communicating and mapping when the project is chaotic (Ashley & Frankie)	2	5
9	"that is a form of an ethnographic approach" Ali (Kelly)	2	8
10	"Design for me is multidisciplinary" Ali (Sydney, Kelly)	3	7

11	"the wider sense of institutions have not grappled with multidisciplinary" Ali	1	1
12	"polymaths make the best designers" Sydney	1	3
F	Requiring Empathy		
1	"being able to be empathise enables you to ask the questions" Drew (Alex, Kelly)	3	32
2	"abstract empathy is absolutely critical" Drew (Kelly)	2	4
3	"asking the right questions" Drew (Alex)	2	28
4	Considering the user at all times (Sam)	1	35
5	"good designers have a natural empathy for the consumer" Kelly	1	5
6	"the skill to identify the right questions to get the right information I think is huge because not everybody has that" ... "be really open so they can really absorb information".. "It's almost like a therapist, a design therapist" Kelly	1	3
7	"to really listen and let the information come out" Kelly	1	1
8	"it's all about the usability and experience" Kelly	1	1
G	Tenacity, Asking Questions and Testing		
1	"a billion whys" and "never stop asking questions" Drew (Kelly)	2	27
2	"test, test, test" and "you have to user test" Drew (Kelly)	2	15
3	"Tenacity is king" Drew	1	7
4	"Importance of being thorough in your research" Drew	1	17
5	"there is no compromise" Drew (Kelly)	2	5
6	"always returning to the problem" Frankie	1	4
7	"asking yourself why at every stage" Kelly	1	3

Table 13 summarises the constituent aggregate and focused codes for the sub-category *Problem Difference*. The thumbnail sketch of Table 10 indicates the position of Coding Sub-Category *Problem Difference* on that table. Appendix J contains the full Coding Analysis Matrix complete with participant pseudonyms, code description and coding round number for *Problem Difference*.

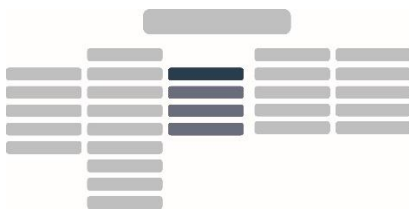


Table 13 Coding Category: Recognising Difference, Coding Sub category: Problem Difference, Focused Code with Aggregate Initial Codes

Coding Category: Recognising Difference			
Coding Sub category: Problem Difference			
	Focused Code with Aggregate Initial Codes	No. of Interviews	No. of times code cited
A	Exploring a Real Wide Territory		
1	"Exploring a real wide territory" Alex, (Sydney)	2	6
2	"broadening of what design research is" Val (Alex, Ali, Sydney)	4	10

3	"I suppose now it's much broader" Alex	1	3
4	"Design is now... it reaches into all kinds of different spaces" Alex (Ali, Sydney)	3	5
5	"So many research methods" Val (Ali, Sydney, Kelly)	4	7
6	having "a very flexible approach" Alex	1	1
7	"aren't necessarily form a design background" Alex (Ali)	2	4
8	"it was a material science piece of research" Alex	1	3
9	"building your team is a milestone" Drew (Alex)	2	2
10	"passionate supporters of design but very different attitudes" Alex	1	1
11	Acknowledging the unpredictable nature of design research (Ashley)	1	5
12	"the word design is such a broad label" Ashley (Jules)	2	22
13	Design Research for Policy (Jules)	1	13
14	Describing Design Research in a University Ashley	1	5
15	Describing Design Research in an Art College (Ashley)	1	36
16	Difficulty with Ethical considerations (Jules, Sam & Ashley)	3	19
17	Interdisciplinary nature (Jules & Ashley)	2	18
18	Noting unanticipated outcomes and directions of research (Ashley)	1	4
B	Asking the Right Question		
1	"framing and reframing what the question was" Alex (Ali)	2	6
2	Comfortable addressing conflicting and confusing requirements. (Frankie)	1	7
C	Requiring a Supportive Environment		
1	needing "an environment that supports that kind of vaguely 'framed' research" Alex	1	3
2	having "the freedom of design" Drew	1	1
3	"Just be free and creative" Frankie	1	5

Table 14 summarises the constituent aggregate and focused codes for the category *Experiencing Tension*. The thumbnail sketch of Table 10 indicates the position of Coding Category *Experiencing Tension* on that table. Appendix K contains the full Coding Analysis Matrix complete with participant pseudonyms, code description and coding round number for *Experiencing Tension*.

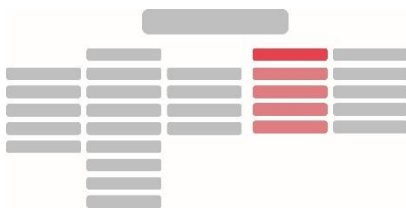


Table 14 Coding Category: Experiencing Tension, Focused Code with Aggregate Initial Codes

Coding Category: Experiencing Tension			
	Focused Code with Aggregate Initial Codes	No. of Interviews	No. of times code cited
A	Experiencing Tension		

1	"trying to get over that fundamental difference" (between practice and academic research) Alex	1	5
2	noting "tension between industrial design and engineering design" Val (Alex)	2	6
3	"trying to be a designer in a research world" Alex	1	7
4	"the system tries to beat that out of them" creativity Val	1	3
5	"it's frustrating for us" Alex	1	5
6	Feeling "like a straight jacket" Frankie	1	4
7	Being aware of tensions around quantification of creative output. (Frankie)	1	17
8	Grappling with the theory/practice relationship (Frankie & Lee)	2	20
9	Feeling uneasy following a design led model (Frankie & Lee)	2	12
10	Dealing with a lack of design led role models (Frankie & Lee)	2	9
11	Dealing with a lack of understanding of design research. (Frankie & Lee)	2	19
12	Questioning academic models (Frankie)	1	6
13	Adapting the process to suit academia (Frankie & Lee)	2	15
14	Noting the limitations of some methodologies mapping tools (Jules & Ashley)	2	10
15	Reflecting on the fact that the policy makers didn't seek out design research methodology. (Jules)	1	1
16	Tension between creative exploration and compliance relating to ethics application. (Ashley & Sam)	2	2
17	"industrial design and research is still very adolescent" Sydney	1	1
18	"if you look at the big hitters or perceived big hitters, very few of them are designers are they" Sydney	1	1
B	Feeling Constrained		
1	"Research can be very constraining for a creative person" Val (Alex, Sydney)	3	9
2	"being forced down that route" Val (Sydney)	2	2
3	"Cutting the leash" constraining work practice of PhDs. Val (Alex)	2	4
4	Feeling "like a straight jacket" Frankie	1	4
5	"the robustness of their methodology which probably does stifle a certain amount of creativity" Ali	1	1
6	"didn't have a PhD and in this world of research led universities that was going to be a hindrance" Sydney	1	1
C	Struggling to do PhDs		
1	"hard core practitioners struggle to do PhDs" Val (Alex, Lee & Frankie)	4	7
2	"it takes a different attitude" Alex (Sydney)	2	2
3	"research as in PhD research has grown slower" Alex	1	1
4	"High age profile of Industrial Designers undertaking PhDs" Val	1	2
5	Noting lack of practitioner expertise in PhD research. (Val)	1	2
6	not seeing "where the research is in this" Alex (Sydney)	2	2
7	"how is this helping you answer it or explore it" Alex (Ali)	2	3
8	"when does it actually become research" Alex (Ali, Sydney)	3	10
9	taking "a long time to really know what the research is about" Alex (Sydney)	2	2
10	"having a humungous struggle" understanding the design process and the research process Ali (Sydney)	2	6
11	"struggling to fit into what she feels is a shoe horn" Ali (Sydney)	2	4
12	"Risk with not using classic academic methods" Sydney	1	1
D	Lucky to get funding		
1	"REF 2014" Design case study can demonstrate impact. Val (Alex)	2	15
2	"it's not part of STEM subjects, it's not funded, it's part of humanities" Alex	1	1
3	"lucky to get funding" Val (Alex, Sydney)	3	4
4	REF "someone who we might respect is completely irrelevant to ----- College" Alex	1	2

5	funding difficulties "funding 'applications' as part of research" Alex	1	4
6	"the level of funding is that much different" Alex	1	2
7	REF targets "they're very different sort of ultimate measurable targets" Alex	1	1
8	design research "it's not really funding it" Alex	1	1
9	"you know R and D, the D of design is not what they want to fund" Alex	1	4
10	"Funding model in UK beginning to change to more applied research" Alex	1	2
11	"Impact strategy REF 2015" Val (Alex)	2	10
12	"Slightly looser interpretation" of the REF Val (Alex)	2	2
13	"much more emphasis on grant wins" Alex	1	4
14	REF "benefits design because the' impact 'measurement of it" Alex	1	4
15	"getting a little bit cynical" re-funding process Val	1	2
16	"design does not fit the ref particularly" Ali	1	1
17	"shoe horn it in" design into the REF Ali	1	1

Table 15 summarises the constituent aggregate and focused codes for the category *Seeking Recognition*. The thumbnail sketch of Table 10 indicates the position of Coding Category *Seeking Recognition* on that table. Appendix L contains the full Coding Analysis Matrix complete with participant pseudonyms, code description and coding round number for *Seeking Recognition*.

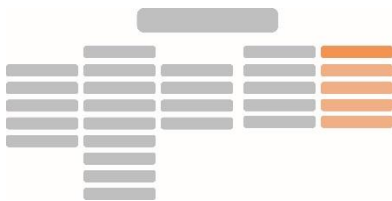


Table 15 Coding Category: Seeking Recognition, Focused Code with Aggregate Initial Codes

Coding Category: Seeking Recognition			
	Focused Code with Aggregate Initial Codes	No. of Interviews	No. of times code cited
A	Gaining Confidence		
1	Bringing tacit knowledge to the research of the disciplinary area frees the researcher to focus on methodologies (Jules & Lee)	2	3
2	Drawing on previous experiences in design research. (Jules & Ashley)	2	7
3	Identifying and being motivated by the success of previous applications of design to policy. (Jules)	1	1
4	Increasing ambition with experience (Jules & Sam)	2	2
5	Increasing confidence with experience of exploring (Jules, Sam & Ashley)	3	14
6	Initial lack of confidence (Sam)	1	3
7	Utilising previous research experience and knowledge gave policy makers confidence in my approach. (Jules)	1	1

8	Realising the potential of design led inquiry to solve the problem (Lee, Frankie)	2	11
9	Gaining increased confidence in design led inquiry (Lee, Frankie & Sam)	3	29
10	Feeling confident with design led inquiry (Lee, Frankie & Sam)	3	45
B	Navigating Ways to incorporate Practice - Evolution		
1	navigating ways" Val	1	10
2	Noting move to practice based PhDs (Val)	1	4
3	"ideal PhD is design practice so design project but builds on a strong theoretical base" Alex	1	1
C	Recognising opportunities		
1	"perhaps there's a real opportunity for design research to grow respect" Alex	1	1
2	figuring "out what we were doing in design research that made sense" Alex	1	4
3	"ordinarily a design is just building on something rather than doing that fundamental research" Alex	1	1
4	"launch point for some more serious research" Alex	1	3
5	design research "lots of great work in exploring new processes, methodology". Alex	1	3
6	"work at the same level of rigour and quality at embodiment and application and understanding of science" Alex	1	1
7	"huge opportunity for design to get into technology led innovation" Alex (Sydney)	2	2
8	"realising nobody had really addressed this research area" with a design led approach Frankie	1	5
D	Seeking Respect - Evolution		
1	"do it with enough rigour for it to be a respectful piece of research" Alex	1	5
2	"engage with a bit of responsibility" Val (Drew)	2	4
3	"the academia wouldn't respect that much" Alex (Sydney)	2	3
4	"change to a more normal university style model" Alex	1	2
5	"bring that up to a more, kind of normal university approach" Alex	1	1
6	"we always team supervise our students" Alex	1	1
7	opting "for the classic" PhD research route Val	1	6
8	"culture shift in training" Alex	1	1
9	"much more emphasis on research" Alex	1	4
10	always making sure "there is a PhD research theory" supervisor Alex (Ali, Sydney)	3	4
11	"exploring classic design PhD" Alex	1	2
12	"the methodologies section can be quite weak" Val (Alex)	2	3
13	"harder to imagine it (cross disciplinary collaboration) working at PhD (the Industrial Design/Engineering collaboration)" Alex	1	2
14	"Accounting for 'classic' PhD route" Val	1	7
15	"If you want to base it and like stretch your intellect then a PhD is the model" Alex	1	1
16	"Using 'standard' academic PhD research methods" Val (Ali, Sydney)	3	9
17	"Getting people into that mind of academic research" Alex (Sydney)	2	3
18	"Using 'rigorous and metric based' methods" Val (Sydney)	2	6
19	"Just to make sure everything is recorded in an academic process" Alex	1	2
20	"needing 'classic research training" Val (Alex, Ali)	3	9
21	"it's not focused on how to capture that new knowledge" Alex	1	2
22	"Evolution of Design" Sydney (Jules, Val, Alex)	4	5
23	"little awareness of design research in the community" Kelly	1	1
24	"there is very little appreciation" or understanding of design research from the general public or SMEs" Kelly	1	1

5.6 Grounded Theory: Navigating Difference

The reoccurring theme appearing in this grounded theory study of ‘designers doing research’ was *Navigating Difference*. This became the core theme of the study. *Navigating Difference* had three categories, *Recognising Difference*, *Experiencing Tension* and *Seeking Recognition*, and they in turn had a number of sub categories. See *Table 10 Concept map detailing constituent Categories and Focused Codes for the Grounded Theory, Navigating Difference* for details. In all the interviews, design researchers, when asked to describe their day-to-day research activities through the vehicle of a research project they were particularly happy with, spoke of difference, associated tensions and frustrations and a desire for understanding and recognition of their particular approach. An expanded description of each of the three categories illustrated with pertinent quotations taken from the interviews with design research practitioners follows.

Recognising Difference

Recognising Difference is made up of three ‘difference’ domains or sub categories: *Value Difference*, *Process Difference* and *Problem Difference*. These ‘difference’ domains are clearly evidenced in the grounded theory analysis and mirror Dorst’s explication of design practice where he states that:

“the art of design is linked to the designer, the design problem and the design situation, not just the process of designing” (Dorst 2006, p75).

Dorst’s insight was considered in the light of the grounded theory analysis and used as a frame to structure the ‘difference domains’ as expressed by the participants in the coding category *Recognising Difference*. There is a vital co-dependency and conceptual alignment existing between the *value*, *process* and *problem* domains and this is found to be fundamental to the functioning of a productive design research process.

Furthermore, analysis of the interviews revealed some design researchers adopting a more structured academic research approach and others a less structured approach with greater emphasis on facilitating creative exploration and intuitive insights. While these positions appeared to be loosely aligned with the educational context of their research, they may also be influenced by participant background and positionality. See *Figure 14 Participant Differences in Design Research Approach*.

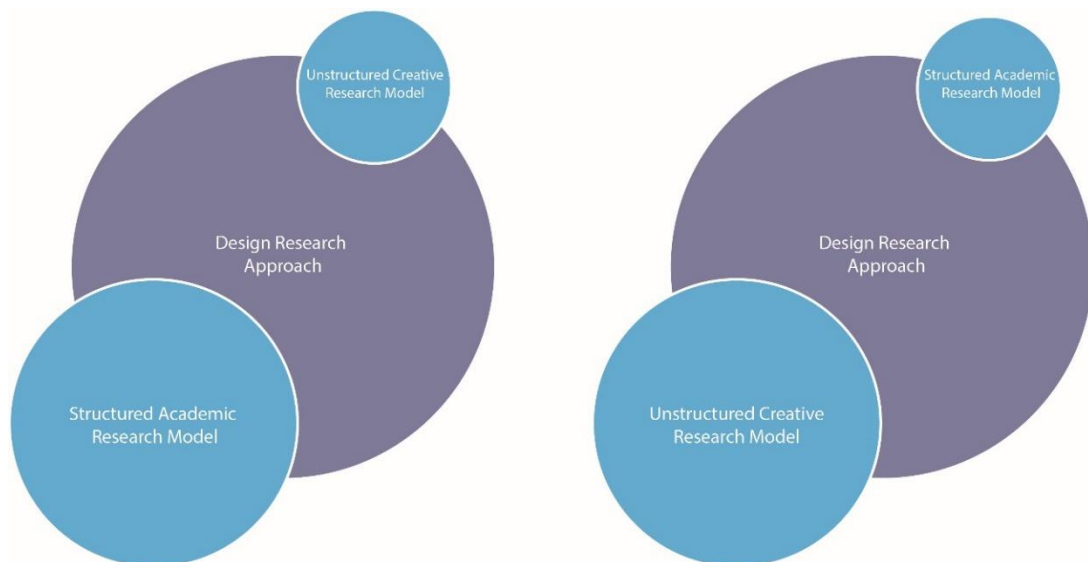


Figure 14 Participant Differences in Design Research Approach

Value Difference (Personal to the Designer)

The conceptual category *Value Difference* is made up of the following focused codes: *Seeing it Differently*, *Passion and Enthusiasm for Design*, *Valuing Application and Impact* and *Valuing Meaning*. See Table 11 Coding Category: *Recognising Difference*, Coding Sub category: *Value Difference*, Focused Code with Aggregate Initial Codes. As already stated there is a vital co-dependency between the difference domains with *value* and *problem* differences impacting research *process* differences. To explain, the design research *process* is a judgement-based *process* and the judgements made reflect the *values* of the designer.

In terms of *value* difference, Val, a design researcher spoke of “see[ing] things differently”. This concept was reflected in many of the interviews making it a focused code. When speaking of “see[ing] things differently” design researchers interviewed were referring to both their research values and their ‘way of seeing’ or their methodological approach. It is also clear from the analysis that values impact on the judgements made in the design research process. Design researchers spoke of the requirement for passion and enthusiasm for design and designers’ propensity to value in particular meaning and application and how this impacted the direction and outcome of their research. They spoke emotively about this and it was found to drive and direct their process. Alex, an art school researcher, referred to designers in research as:

“people coming along and showing them how it would come alive, that’s where design comes in”.

Here the reference to “com[ing] alive” is referring to the ability of design researchers to see unique or unanticipated applications for research. Alex clarifies this, stating that “design [research] addresses application rather than theoretical science”. Sydney, a researcher and supervisor in a technological university, describes his/her PhD student “who is based in the design school will

be kind of looking for novel applications and designs” as part of their PhD. Val, a researcher in a technological university, also referred to this outcome:

“Again it’s seeing these opportunities ... as a designer I could see things coming out of this and I could see how we could create some panels and plinths and exhibit it as cool stuff. So yeah and for me personally something coming out the end of it rather than a report you know.”

Val went on to explain why this might be, proposing that designers “see things differently”. This excerpt also illustrates the role personal and creative judgement play in the research process and the importance assigned to that creativity in order to provide a unique and inspired solution:

“I would argue potentially that as a designer and a researcher I think designers do see things differently, they see patterns differently and opportunities emerging ... I think they see the world differently and they’ll make patterns in relationships that maybe others wouldn’t, ... maybe an engineer is looking for an optimum solution whereas designers are looking for something that’s a bit different you know to express themselves so yeah designers have something distinctive to offer.”

Alex, discussing the different approaches of practitioners, in this case an industrial designer and an engineer, in a multi-disciplinary supervisory team outlined how:

“we were aware of that tension because two different professions, common goal, great product but tapping it in different ways. The industrial designer is visual, emotional, qualitative. The engineer is scientific, rigorous; you know you have got two different approaches.”

Both Alex and Val believe that “designers can add value” to research but they see this value in terms of meaning and application. The importance of product meaning is reflected in the title of one of the participants PhD student projects looking at “meaning driven innovation”. To achieve this goal of adding value and application, design researchers spoke of the need for design researchers to have passion and enthusiasm for design, tenacity in their work practice and empathy for their user. Drew, a practitioner researcher, spoke of “putting in the work and showing enthusiasm always opens doors and gets results”. He goes on to say “tenacity is king”, outlining how it is important to “test, test, test” and to “never stop asking questions”. These sentiments were echoed in many of the interviews, placing particular emphasis on the personality and researcher value profile required for making advances in design research. Rather than seeing the design researcher outside of the research process, the researcher was seen to be a fundamental part of it, bringing his/her creativity, enthusiasm and experience to the practice and influencing its direction.

Alex makes this point when saying:

“That’s one of the fundamental differences though isn’t it, the point of 'you' in the research, you’re doing it and observing it and creating it and that’s a classic design perspective. You don’t see that in science, you might be doing the experiment but you’re not in the experiment. ... And as a designer you can’t really take yourself out of it, some of the process you could pass on to someone else but the results would be different because they’re a different person.”

The high regard and enthusiasm for design and creativity was conveyed by the researchers through the employment of words like ‘king, glory, freedom, magic, life,’ when describing design expertise. These words illustrate the passion and enthusiasm design researchers have for the creative process and the value they place on it.

Process Difference (Interactive Role of the Designer)

Design research process is cross-disciplinary in nature. Designers utilise and adapt research methods from a wide range of disciplines adapting and merging them with their own practice-based methods to address their particular requirements. Intuition and creativity play a fundamental role in the more practice-based methods which is in alignment with design values but was seen to be in opposition to mainstream research discourse. Process differences are evidenced among the focused codes, *Doing it Differently*, *Incorporating Creativity/Requiring Freedom*, *Incorporating Practice*, *Requiring Inspiration*, *Undertaking a cross-disciplinary approach*, *Requiring Empathy and Tenacity*, *Asking Questions and Testing*. See Table 12 Coding Category: *Recognising Difference*, Coding Sub category: *Process Difference*, Focused Code with Aggregate Initial Codes for focused and initial codes.

The theme ‘*doing it differently*’ came up frequently. Design researchers were vocal in outlining that their research process had differences from what they perceived to be traditional academic research approaches. Val comparing PhD work practice and methodology to design research practice asserts that “designers don’t work like that”. Alex states that “in that research methodology, we are very different”, while Frankie, an advocate for the use of academic models in design research, questioned their ability to fully support design research process. Seeing creativity and its requirement for freedom as an intrinsic element of design research methodology, but lying somewhere outside of academic models, Frankie questioned the value of trying to model or formalise it.

“I still. I’m unsure about how how.... How possible it is to model the creative process because ahh so much of it relies on intuition and and that kind of intuitive spark of energy that you know leads to creation and all the methodology in the world won’t necessarily bring you to that point, you know, it may allow you to understand it in hindsight but I you know I think a straight jacket of any kind, of any kind, in a creative process amm could be a hindrance more than a aid you know and part of the, the kind of glory of creativity is freedom. Freedom to break the rules, to be able to work outside, to break new ground in a creative way.”

Incorporating Creativity/Requiring Freedom was an intrinsic element of the research process and was seen as a key determinant of the success of the outcome for each design researcher. They used creative thinking, for example, to frame the research problem or to adapt known research methodologies to their particular research requirements. All expressed the need for “freedom” to “break new ground” (Frankie) in design research. Ashley, an art school academic, outlined how they incorporated creative exploration in the early stages of the research process to encourage fresh and inspired thinking. This was achieved by getting students to create an abstract piece:

“and then I get them to create an abstract piece for me of their project and then I can discuss with them something that isn’t yet born ... and that really works.”

Others (Alex) used it to make sense of the findings or to identify novel and unforeseen applications.

“it’s one that demands a kind of design input like what do you do with it and actually you could create a need by imagining different applications of the future?”

Frankie reflected on the contradictions and lack of alignment between creative exploration with traditional positivist research methodologies, both of which Frankie used in his/her design PhD.

“But I was, as I said, I was lucky in that I was able to put it to one side a lot of the time because a lot of work I was doing was as a practice-based research project was about the practice so I could get stuck into doing.... To doing the measurements, scientifically, you know, adding up the numbers, and doing the graphs and producing the statistics and making observations and assumptions and conclusions based on that but ... alongside it ran the whole, the whole sort of ... haaaa ... nebulous kind of notion of ... of creativity, how you manage that, how you assess it, how you judge it, how you extract ... sort of theory from it. You know, I don’t know if I ever got to that. I didn’t get to the bottom of that. *But it is there.*”

The focused code *Incorporating Practice* referred to modelling the research approach on the design process and/or utilising design methodology to undertake discrete elements of the research process; for example, Ashley described using abstract representation as a communication, analysis or development tool. Of those design researchers interviewed, all spoke of modelling the overall research approach on an iterative design methodological approach which they have tacit knowledge of and feel very comfortable with, while borrowing and adapting suitable research methodologies from other disciplines to use within this design methodological framework. Frankie stated that “design process was the framework used to guide the research”. Alex compared the use of practice in design research to human development.

“traditionally you study theory and carry out practice so that’s a kind of engineering model ... sometimes you know you do the practice to try and find the theory ... you know as a baby you act in order to understand you know that actually that’s kind of more of a designer-ly approach.”

Design practice was also used as a means of testing and evaluating ideas and/or making sense of data. Frankie spoke of “realising that concrete design research [meaning design practice] could address these issues” and outlined how “the traditional [design process] conceptual, explore, design development and detailing” were utilised to address the research questions. With reference to *Incorporating Practice* Alex described how “design researchers” strengths lie in “embodiment and application”. Tacit creative abilities acquired in practice support design researchers in seeing creative and unique approaches, methods and applications for research others might not.

Requiring Inspiration is evidenced by quotes from Ashley, Alex and Frankie where Ashley talks about design researchers as “dreamers that can do”, Alex outlines the importance of research

having “inspiring and intriguing start points” and Frankie speaks of “relying on intuition in the creative process”.

Undertaking a cross-disciplinary approach was referred to in all the interviews. This was considered necessary to address the diverse range of research questions where methodological approaches drawn from associated disciplines with some adaptation were utilised in the research process. Lee, while stating that “there are lots of research methodologies in different disciplines that we can borrow from”, also advised caution noting the importance of being “cognisant the research methods that you are using are quite rigorous” and “going back to the thought leaders on a methodological approach” for direction. It was also noted that researchers undertaking a design PhD or postdoctorate research were coming from a diverse range of disciplinary backgrounds and combining their particular methods with design methods. Sydney went on to question the fact that “very few” of “the big hitters or perceived big hitters [in design research], are designers”. He notes that they come from backgrounds such as cognitive psychology or science, raising questions around why this might be so.

Requiring Empathy has been taken out from the *Incorporating Practice* focused code to highlight its particular importance in design research. A research practice which supports design decisions which impact people in their everyday lives increases the role of empathy in the process. Sam spoke of users being stakeholders in the research process and highlighted the importance of “considering the user at all times”. Drew states that “being able to empathise enables you to ask the right questions” and extends the empathic role to empathising with the environment, stating that “abstract empathy is absolutely critical”.

Requiring empathy leads on to *Tenacity*, *Asking Questions and Testing* because real empathy can only be achieved by deep and meaningful research, asking many, many questions, continual testing and having the tenacity not to give up.

Problem Difference (Future oriented and situated)

Problem difference had three focused codes: *Exploring a real wide territory*, *Asking the right question and Requiring a Supportive Environment*. See Table 13 Coding Category: *Recognising Difference*, Coding Sub category: *Problem Difference*, Focused Code with Aggregate Initial Codes for a breakdown of codes.

Design problems were described as interdisciplinary and unpredictable with unanticipated outcomes and directions. Alex spoke of how design research problems are “vaguely framed” and that design researchers are “exploring a real wide territory” noting that:

“Design is now ... it could go to the roots of science you know to the level of business strategy, it reaches into all kinds of different spaces.” Alex

Researchers described how a problem might begin in one disciplinary space and end in another. Ashley's statement below describes the 'wicked' nature of design research problems while asserting frustration with the lack of recognition this work receives:

“Yeah and I really can't bear it because I think that it debases the wonderful things an industrial design researcher does which is to go through the logical and the illogical and experiment and then have a very informed, well researched mind for areas that are wider than the project.”

Frequently, design researchers found the application of traditional scientific research approaches fail to address the situated and contextual nature of their research problems. More creative and intuitive approaches were required to address them. These approaches, some of which are outlined below, support creative insight and discovery.

“It's also ... you cross fertilise all the time and that's why I believe in interdisciplinary thinking and learning ... at the moment because there are people working with materials, there are people working with medical, there are people working with So my methodology is to tell stories, narrative. And to place it in real life so that there's always a sort of launch pad to go to the next stage and then inhabit the further stage with more realism to enable that jump between the two.” Ashley

Alex spoke of the importance of framing the right question and Frankie spoke of being comfortable addressing conflicting and confusing requirements. Frankie, Drew and Alex spoke of the importance of having a supportive research environment, for in Alex's words “that kind of vaguely framed research”, where Frankie states a researcher can “just be free and creative”.

Experiencing Tension (link with CDA of UK REF 2014)

Experiencing Tension incorporates the focused codes *Experiencing Tension*, *Feeling Constrained*, *Struggling to do PhDs* and *Lucky to get Funding*. See Table 14 Coding Category: *Experiencing Tension*, Focused Code with Aggregate Initial Codes. A designer's experience of research reveals a struggle to address the oppositional values of academia and design practice where, as described by Val, much energy and creative thinking is applied to “navigating ways” to satisfy both. Alex, an art school lecturer and researcher, describing master's students' work speaks of them making “exciting breakthroughs” which were highly valued in design that “the academia wouldn't respect that much” and the associated “frustration” with that. Val, a university lecturer and researcher, describes their PhD in terms of “kind of navigating ways in which I could use my own practice to answer research questions”. Here Val was striving to align personal research values and requirements with those of academia in a bid to address the diverging requirements of both. Design researchers spoke of the challenge of aligning the design research with a traditional academic theoretical research approach. Lee spoke of there being a lack of “many practice-based PhDs” and because of a lack of role models, feeling

“it is safer in a way to go down a theoretical route, to create a framework rather than creating three-dimensional objects”

but if they were to do it again

“would be a little bit more confident or vocal about the fact that it was a practice-based PhD... and would start designing or creating prototypes earlier on.” Lee

This shows increasing confidence in practice-based design research where the findings are supported by design methods and/or embodied in the product. The lack of research models was reiterated by Frankie who stated:

“So I modelled. I would have modelled my approach very much on a scientific approach to PhD research rather than a design approach and more because I didn’t have a model to work from.”

On reflection Frankie said:

“That was always the thing I grappled with, you know, how do you differentiate between, the traditional kind of science-based approach or methodology to research and the more abstract, design led enquiry, which is not linear and not, you know, doesn’t always follow a path.” Frankie

These quotations reflect a very real sense of conflict and uncertainty among those interviewed about what they felt was expected of them and what they felt was the most appropriate way to achieve results in terms of methodological approach. Some design researchers spoke of how the tacit knowledge gained through experience of undertaking design research increased their confidence in a design led approach despite its lack of alignment with traditional academic research approaches. However, their confidence in a practice-based approach was not necessarily reciprocated in funding evaluation exercises and this was referred to in the interviews.

Feeling Constrained was another reoccurring theme which had links with *Incorporating Creativity* and its *Requirement for Freedom*. Freedom was seen as a fundamental requirement for creative expression and attempts to introduce academic research models or frameworks for design research practice was seen to be counterproductive and restrictive. This point was made by both Val and Frankie.

“So I think PhD’s can be restrictive for really creative types and I think they can be forced, they’re almost being forced into this approach ... I wonder if you get the creative people and then the system tries to beat that out of them because you must be rigorous, you must be methodological ... rigorous methodology. Every move you make needs to be cited, designers don’t work like that you need to cut the leash and let them get on with it.” Val

“I still. I’m unsure about how how.... How possible it is to model the creative process because ahh so much of it relies on intuition and that kind of intuitive spark of energy that you know leads to creation and all the methodology in the world won’t necessarily bring you to that point, you know, it may allow you to understand it in hindsight but I I you know I think a straight jacket of any kind, of any kind, in a creative process could be a hindrance more than a aid you know and part of the the kind of glory of creativity is freedom. Freedom to break the rules, to be able to work outside, to break new ground in a creative way.” Frankie

Lucky to get Funding was selected as focused code to reflect the ambiguous classification of design research in funding mechanisms, design researchers' navigation of this space and their perception that there was a significant element of providence in the process. In the UK, the REF was the main funding source spoken about. Ali stating that "I don't fit" when asked about the UK REF, linked the difficulties with the REF with the general classification of academic disciplines and subjects, referring to the Joint Academic Coding System (JACS), a system used in the UK to classify academic subjects. Ali said that "design does not fit the REF particularly or it doesn't fit the REF as far as this university is concerned" noting that 'design' doesn't fit in 'engineering' or 'art design' and noting at the same time that "arguably it could go into either depending on your impact studies and your environment". Both Alex, Val and Sydney made similar observations, stating that while design could fit in a number of classifications, it did not fit easily in to any. Sydney felt that for design applications, because of this ambiguity, providence was involved in selecting the most appropriate category for your research and because the assessment criteria were relatively open, researchers felt they were dependent on the individual judgement of the panel. Furthermore, codes developed in this category related to an acknowledgement of how funding mechanisms are changing design practice and research culture. Some of this is seen in a positive way. Researchers describe how their processes are becoming more rigorous and that design education is becoming more research active.

"That's caused a major culture change here...because we used to be...practitioners coming to teach with some research ..., some really high class research happening but it wasn't in every program right throughout the college like you'd expect in a research driven university so now that's changed with much more emphasis on research, much more emphasis on you know grant wins." Alex

Others, however, expressed concerns about the impact that this is having on research direction, where they see more general/social design research projects being pursued rather than product-based because of the bigger impact they can demonstrate.

"so I'm not sure if I'm being a bit cynical and [noting] a move from the visually creative end of design to a more holistic generalist view of design thinking to solve problems, any problems which I guess opens up funding opportunities because you can use design thinking to create a mental health support structure and if you're lucky to get funding that kind of thing is probably going to have greater merit than new approaches to design products. The social impact is potentially greater." Val

There was also frustration regarding the lack of funding and/or comparative level of funding for research application or, as this design researcher put it, "the D (Design) of R (Research) & D (Design)".

"one of the challenges was when we were looking for funded research is that you know R&D the D of design is not what they want to fund, they want to fund the research and we are like actually what we do is research plus you know a really good job of showing how it might be implemented." Alex

In Ireland, no particular funding stream was mentioned, but similar difficulties were recognised.

Seeking Recognition

The final process this grounded theory study identified was a desire for recognition of the methods and outcomes of design research practice, to make visible and seek academic acknowledgement for the intangible methods of practice. It was also observed in the analysis that design research was evolving. Repeatedly it appeared this evolution was in polarised directions as design researchers *seeking recognition* were aligning with sometimes conflicting research values and positions causing a lack of coherence in terms of research identity. This raises questions around the need for a coherent unified identity for a diversified practice or how indeed that identity might reflect a coherent identity while incorporating the values and approaches of its many configurations. These observations are captured in the focused codes *Navigating Ways/Evolution and Seeking Respect/Evolution*. Seeking Recognition also incorporates the focused codes *Gaining Confidence* and, *Recognising Opportunities*. See *Table 15 Coding Category: Seeking Recognition, Focused Code with Aggregate Initial Codes*.

Many of the researchers interviewed spoke of their PhD as being their first experience of a major academic research project. Because of a distinct lack of models to work from, particularly in an Irish context, but this was also evident to a lesser extent in the UK, they struggled with the conflicting requirements/values of academic research and design practice. This led to a lack of confidence and hesitancy to fully utilise a design approach to research. However, these same researchers all spoke of gaining increased confidence in a design led approach as a result of this first experience of formal academic research practice. As a result of this experience, they spoke of “trusting the process” (Sam), of “feeling comfortable addressing conflicting and confusing requirements” (Frankie), of “realising the potential of design led enquiry to solve the problem” (Frankie) and “feeling confident with design- led enquiry” (Lee). Jules reflected on the positive outcomes and increasing application of design research methodology and approach in policy research.

“But there’s been an emergence over the last I’d say 10 years of the use of design [research] in policy and public sector ... there’s a policy lab who sits within the cabinet office which is a small team of designers and design practitioners and researchers who are looking in at different areas of government policies, anything from criminal justice to social care and different things and saying actually thinking about that services how could we use design methods to make them better.”

Jules’s observation extends the reach of design research approaches illustrating its value and applicability to a range of research areas.

They all spoke of “navigating ways” to address the conflicting requirements of design practice and positivist research discourse. Lee reflecting on this issue stated:

“understand methodologies ... understand [the] rigorous ways of doing research but also be cognisant of your own design abilities and start adapting And just start making early and testing early. I suppose its confidence in design ability, but also be cognisant of ... the research methods that you use are quite rigorous.” Lee

Alex spoke of experimental type projects being set up for MA students to support the creative process and contribute to innovative idea exploration. S/He felt this was unachievable at PhD level due to the constraints of academic research models.

“experimental design was sort of set up as a way of well allowing more conceptual lateral thinking but you would often describe an Experimental (EXP) project as the start of a research project. You know it could fundamentally allow further research later.”

By creating the dual stream approach, it allowed the research to draw from both methodological approaches. Alex felt there was more flexibility at MA level to incorporate “more conceptual lateral thinking”. Alex went on to outline “opportunities” for the particular or unique approach of design researchers. Expressing that collaborative projects with engineers would bring the strengths of pure and applied research together, where design researchers would imagine and identify innovative applications for science.

“I think what’s really interesting ... find the people who are at the forefront of science and technology and have a passion for design ... they get excited about people coming along and showing them how it would come alive, that’s where design comes in ... I think the future of [design research] is that you know put the normal technical aside ... and get back into the space where you can’t make the technology work yet because it’s still in the lab and you’ve got proof of principal but not prototype though.” Alex

In this way, design researchers are drawing on their particular strengths and abilities for innovative research applications.

Increased confidence fuelled a desire for respect and recognition for a design led approach. Ashley referred to design researchers as “dreamers that can do” illustrating admiration for the particular combination of creative and practical aptitudes. Another researcher spoke of “knowing that design led enquiry was the perfect vehicle to do the research” (Frankie).

5.7 Conclusion

To summarise, the reoccurring theme appearing in this grounded theory study of ‘designers doing research’ was *Navigating Difference*. Practicing design researchers spoke of navigating difference in the course of their research journey. The differences they were navigating was caused by difficulties aligning their design values and processes with academic research values and processes and was manifest in their research values, research processes and the types of research questions they were addressing. Subject to the pushes and pulls of both practices, design researchers aligned themselves more closely to one or the other depending on the context of their work and their own positionality. All researchers interviewed expressed feelings of associated tensions and a desire for recognition of their design values and processes.

The following characteristics of design research were identified by the study. Design researchers were found to be situated in the research process. They shaped and framed the problem as they interacted with it. To the research process, they brought their goals, their values and emotions, their accumulated fund of disciplinary knowledge and tacit embodied experiential knowledge, their creativity, their empathy, enthusiasm and tenacity. They acted on and interacted with the research situation in a fluid, iterative and evolving process. Design research was generally found to reside in the future, in ‘what could be’. Problems tended to be initially vaguely framed, cross disciplinary and occurring in a wide range of social and physical spaces. Design research practice was also found to be evolving as it addressed the developing and sometimes conflicting requirements of design and research practice.

By providing another lens to view research practice, the grounded theory study of practising design researchers clarified and confirmed the findings of the CDA of the UK REF 2014. The Critical Discourse Analysis of the UK REF 2014 revealed the considerable power of research assessment and its importance to the interaction and continuity of government and political bodies, UK higher education funding bodies and UK universities and faculties. These sentiments were echoed by practicing design researchers. The CDA of the UK REF 2014 revealed social and cultural values pertaining to market systems, accountability and public relations, quantification and competition. Design researchers also noted the increasing pressure to be research active and the need to address external competitive and quantitative evaluations. Finally, the CDA of the UK REF 2014 revealed a lack of definition of design research within the document. While design research practice was found to share common characteristics previously outlined, the differences were equally prominent. The researchers interviewed noted the ambiguous nature of design research practice and the lack of consensus around its methods both within and outside the community.

Synthesising the findings with the literature provided understanding as to the extent design research practice is “embedded in larger and, often hidden positions, networks, situations, and relationships” (Charmaz 2006, p130). It also supported the development of a framework to construct new understandings of the continued evolution of design research practice and the historical and social mechanisms, both internal and external, informing this evolution. See *Section Six Research Framework – Navigating Difference*.

Section Six: Research Framework - Navigating Difference

6. Research Framework - Navigating Difference

6.1 Introduction

Based on the findings and analysis, a framework was created to support understanding of design research practice. The framework describes the structural elements of design research practice. It maps the possible range of design research approaches as evidenced in the research interviews and the continued evolution of design research practice as it addresses these opposing requirements of design practice and academic research practice. For explication, the framework has three descriptive components illustrated by three infographics; Research Framework Elements (Figure 15), Mapping Research Approach (Figure 16) and Positions and Pathways (Figure 19). The framework was informed primarily by the grounded theory study of design researchers' reflections of their research experience of a project they were particularly happy with. It is an ideal depiction of researcher attributes and processes based on what they felt was important for a successful research outcome. It also considers social and cultural influences on design research practice, in particular the opposing values systems, approaches and methodologies of design practice and academic research.

The purpose of this framework is to support the progressive development of design research practice by informing those practices and policies which impact the evolution of design research practice. It is important the theoretical development of design research practice reflects the values and beliefs of its practitioners. This framework achieves this by providing foundational understanding of design research practice grounded in their self-understandings. It will have explanatory value for a range of users, for example, research students, research supervisors, government policymakers, higher education funding bodies, higher education institutions and the broader research community. It may inform and assist design methodological development, cross-disciplinary communication and collaborative research projects, in higher education interdisciplinary development and in the development of more inclusive research funding mechanisms.

Central to its purpose is the communication of the research methods and approaches of design research practice which are drawn from practice, such as design approach, project framing and reflection, drawing and model making, testing etc. It underlines the role values, intuition etc. play in design research practice while illustrating the central function of tacit knowledge in the practice of design research and the need to acknowledge its presence. It recognizes the power of research assessment exercises to define and influence research practice and it may raise awareness of the sometimes fragmented and partial explication of design research practice as it actually occurs.

This framework is built on the core category of the grounded theory study, Navigating Difference. Navigating Difference represents the experience of design researchers as they navigate the

opposing values of design practice and academic research. See 6.2 *Navigating Difference: Research Framework Elements*, 6.3 *Navigating Difference: Mapping Research Approach* and 6.4 *Navigating Difference: Positions and Pathways* for further details.

6.2 Navigating Difference: Research Framework Elements

Figure 15 Navigating Difference: Research Framework Elements illustrates the underlying structural elements for design research approach and methodology as evidenced in this study. *Design research approach and methodology* is determined by the *values, knowledge and creative potential of the design researcher* as they interact with and act on a *particular human situation* which is likely to be but is not limited to a *future based scenario* where *research* is conducted.

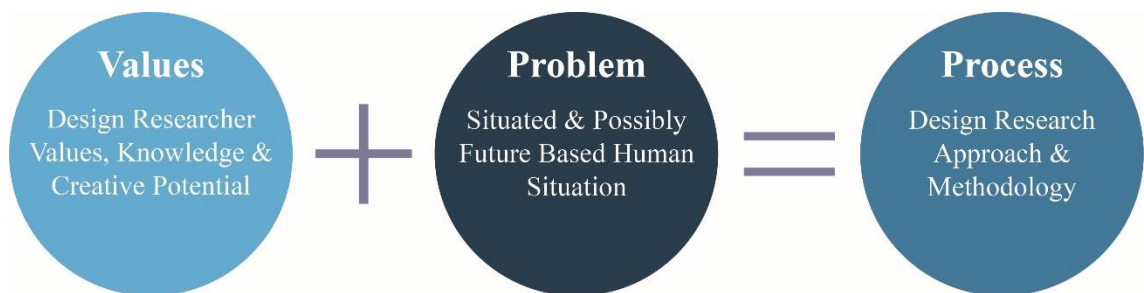


Figure 15 Navigating Difference: Research Framework Elements

Design researchers are situated in the research process. They cannot take themselves out of it. In the early stages, they shape and frame the problem as they interact with a particular human situation combining their particular experience and values with the particulars of the situation, which acts as a catalyst to create a problem space rich with potential for creative exploration. This early stage is fundamental to a productive outcome. To the research process, they bring their goals, their values and emotions, their accumulated fund of disciplinary knowledge and tacit embodied experiential knowledge, their creativity, their empathy, enthusiasm and tenacity. They act on and interact with the research situation in a fluid, iterative and evolving process.

Design research generally resides in the future, in ‘what could be’. Problems tend to be initially vaguely framed, cross disciplinary and occurring in a wide range of social and physical spaces. The research problem/question is permeated by the situated and possibly future based human situation. The unique characteristics of this space combined with the researcher’s creative interpretation act as a catalyst for framing an innovative and possibly unforeseen research approach or application.

Design research approach and methodology is determined by the interaction of the researcher with the human situation. The deeply personal and embodied interaction of the design researcher with the human situation determines the research approach, methodology and outcome as the design researcher interacts with and acts on the human situation.

6.3 Navigating Difference: Mapping Research Approach

It is because this interaction is deeply personal that design research practice exhibits so many flavours. Jarvis (1999, p.40) states that “people carry all their learning from their previous experiences (their biography) into every situation”. The nature of the future based problem space necessitates this personal, interactive and creative research approach in order to maximise innovative and creative potential. Design research practice, combining creativity and intuition with accumulated theoretical and tacit knowledge, exhibits a spectrum of approaches reflective of the attributes, influences and backgrounds of the individuals involved. This was verified in the interviews. While participants exhibited common methodological elements in their research approach, their preferences for and use of these elements varied significantly. For example, some participants followed closely a theoretical or academic model and others a more unstructured creative model. Analysis of the interviews uncovered the following common characteristics of design research practice, which were evident to a greater or lesser extent dependent on the identity, and positionality of the participant.

This was *an iterative design methodological research approach, which* incorporated;

- Cross disciplinary academic research methods
- Design practice methods
- Visual, kinaesthetic and embodied modes of data interaction and systems of representation
- Value judgements
- Creativity and intuition
- Empathy

This approach was supported by the design researchers;

- Accumulated design knowledge
- Accumulated cross disciplinary theoretical knowledge
- Accumulated precedent, tacit, embodied and experiential knowledge
- Emotions, goals and values

All the above would have drawn influence from a design and an academic community of practice depending on the working context of the researcher. The success of the approach was also dependent upon an environment; which valued and was supportive of both cross-disciplinary academic research approaches and unstructured creative research approaches and outcomes, permitted freedom to explore and break the rules if necessary and which facilitated the use of a rich supply of inspirational source material. *Figure 16 Navigating Difference: Mapping Research Approach* illustrates these common characteristic of design research practice as evidenced in this research project.

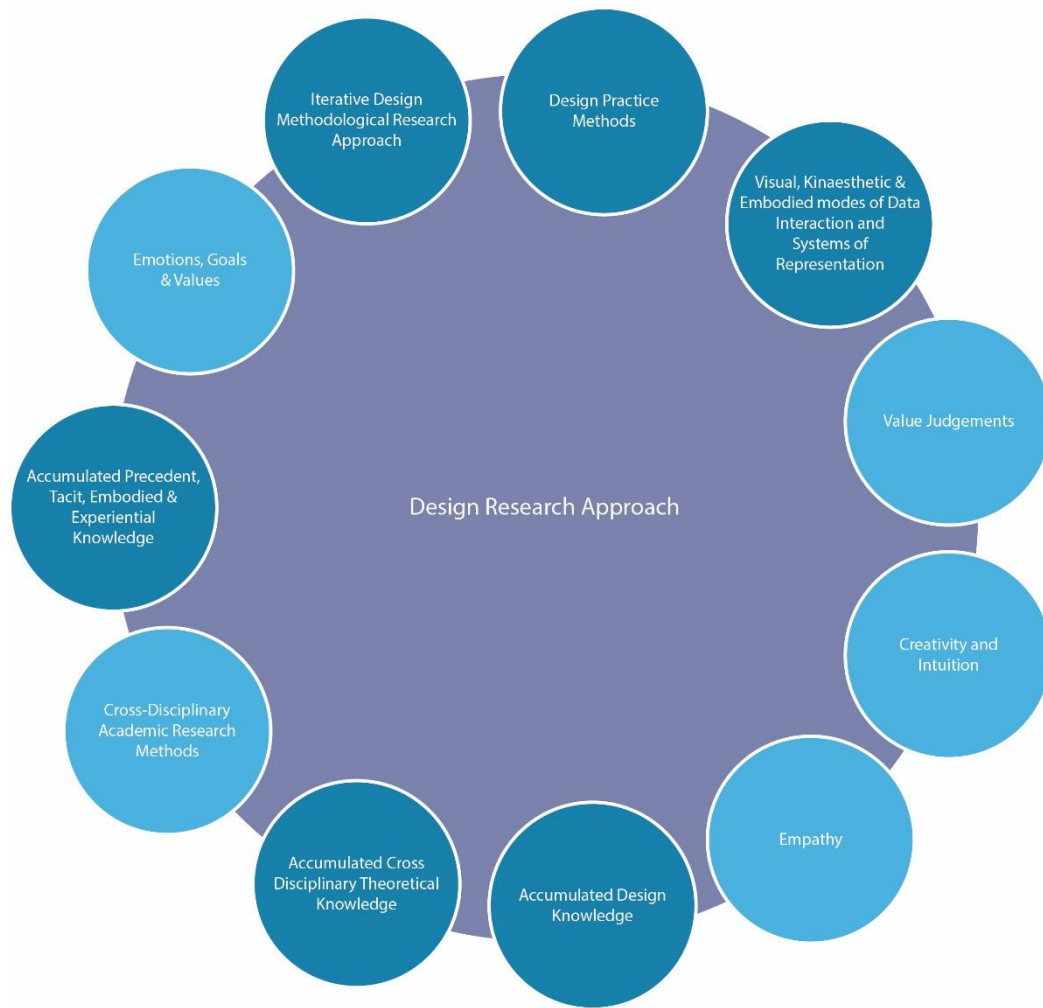


Figure 16 Navigating Difference: Mapping Research Approach

These characteristics were evident to a greater or lesser degree dependent on the identity, the positionality and working context of the research participants of this study. See *Figure 17* and *Figure 18* for comparative maps of Ali’s and Ashley’s research approaches.

Ali is based in a university and his/her approach is influenced by a background in engineering, art, education and ethnography. Conducting research and research supervision in product design now, Ali values a rigorous academic approach and methodology which has academically proven, valid and demonstrable methods which are recognised by academia. He/she feels this is important to prove the rigor and validity of their approach. In this way Ali is aligning more closely with academic research values than design practice values. While agreeing that value judgements and

intuition are required when developing a research question and hypothesis, Ali felt that they had minimal application in the general research process.

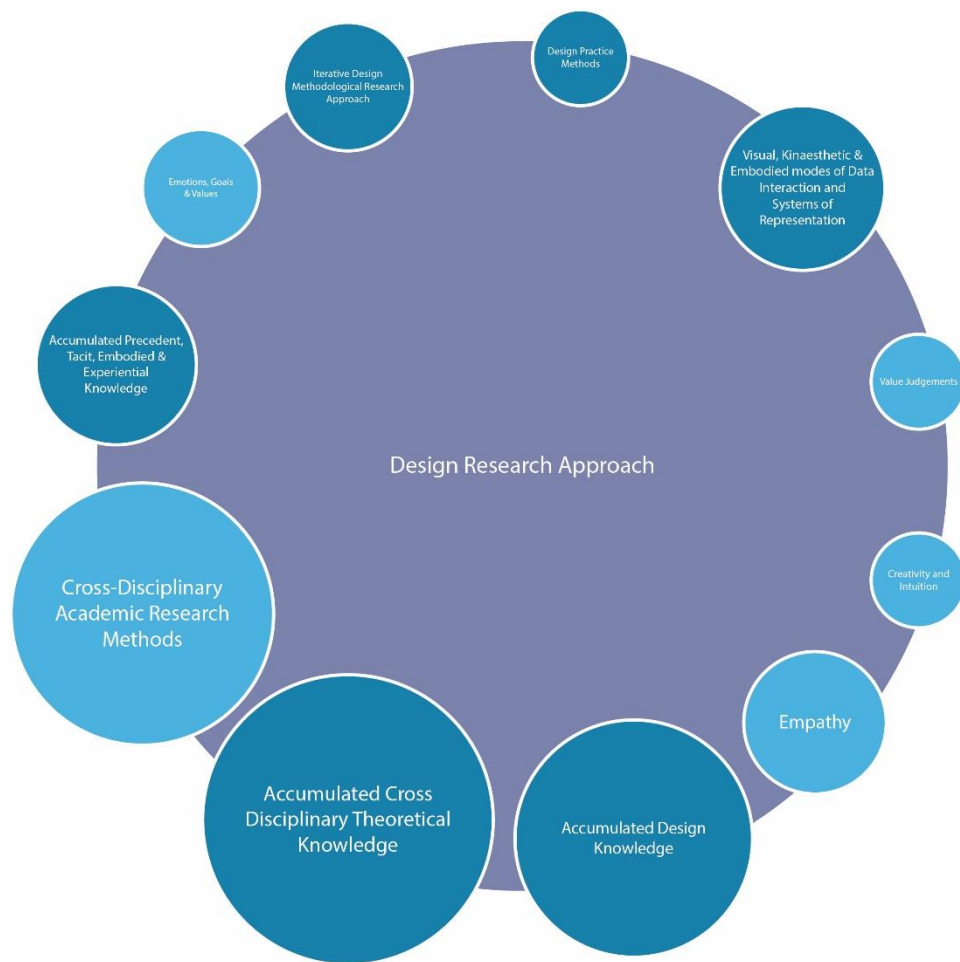


Figure 17 Navigating Difference: Mapping Research Approach - Ali

Ashley is based in an art college and his/her approach is influenced by a background in design practice, fashion and industrial design. Conducting research and research supervision in industrial design now, Ashley values an unstructured creative approach to research. His/her research approach is framed by an iterative design practice model, incorporating significant elements of creativity, intuition, visual, kinaesthetic and embodied modes of data interaction and systems of representation. His/her main focus is on meaning and outcome and their approach is guided by their personal values and goals. Ashley's approach is driven by design practice values and outcomes. The research process is evaluated on the merit of the outcome rather than the rigor of the approach.

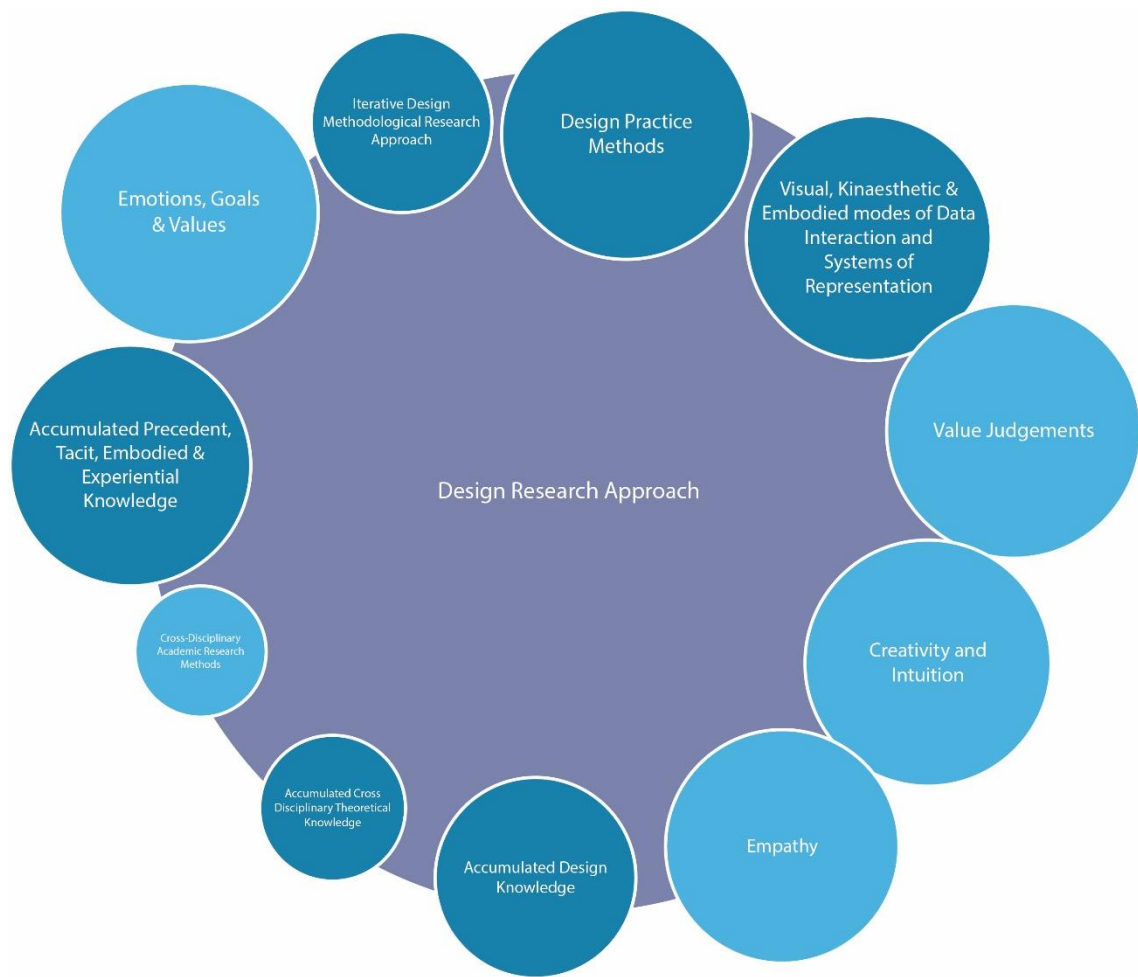


Figure 18 Navigating Difference: Mapping Research Approach - Ashley

6.4 Navigating Difference: Positions and Pathways

Design research is not static. It is constantly evolving as was evidenced in the research interviews. The theme *Navigating Difference* describes the factors influencing this evolution. *Figure 19 Navigating Difference: Positions and Pathways* illustrates the forces at work both in practitioners' personal research journeys and in the general evolution of design research practice. In Figure 19, positions and pathways for the general evolution of design research practice is represented by the large circular infographic with the word 'Design Research' in the centre. The range of possible individual design research positions on this spectrum is represented by the smaller circular infographics. Design researchers in the course of their research practice journey spoke of *Navigating Difference*. The visual represents their journey. Time moves from left to right and as they engage with research, they *Recognise Difference*, *Experience Tension* and *Seek Recognition* all the time oscillating between trying to address the conflicting values, processes and problems of their design research practice preferences and what they perceived as academic research requirements.

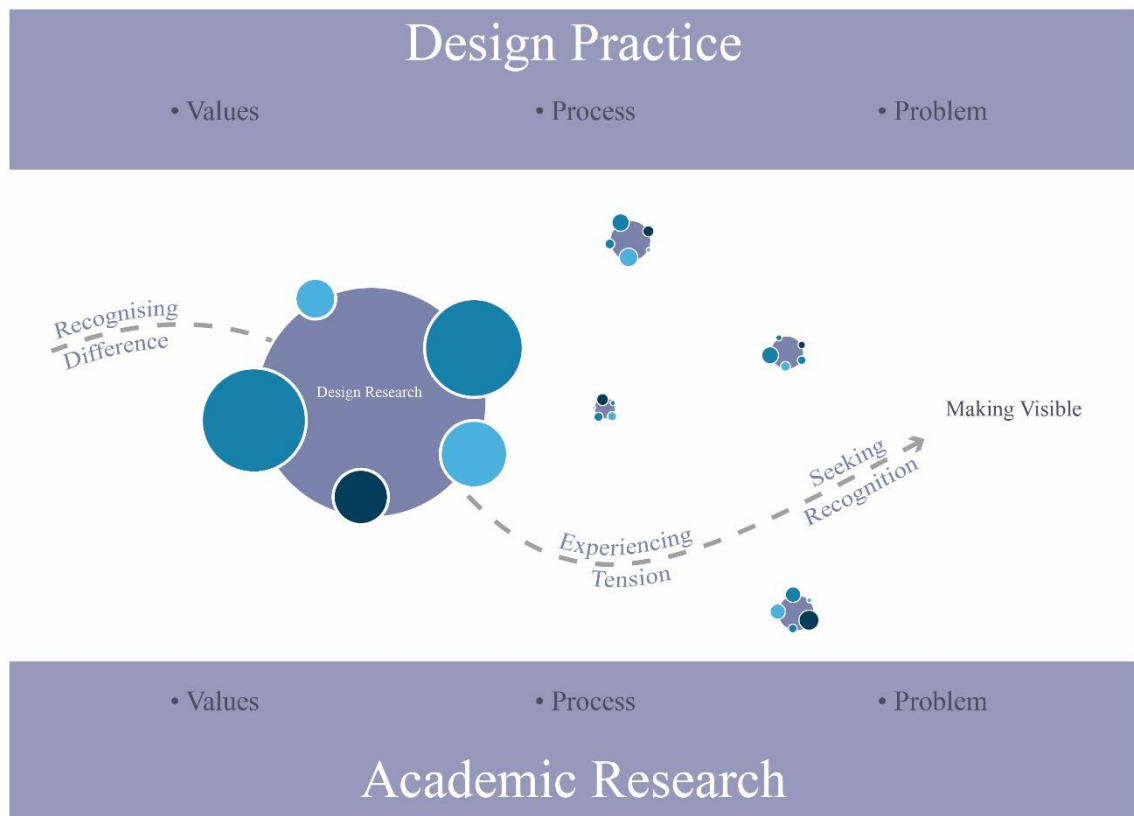


Figure 19 Navigating Difference: Positions and Pathways

Practising design researchers describe the developments and challenges they have witnessed in the course of their research journey, represented by the dashed line. They ‘*recognised difference*’ between design research practice and what they perceived as academic research requirements as represented in research evaluation models. These differences are found in the domains of *research values*, *research processes* and *research problems* and relate primarily to the prominence of tacit knowledge construction and creativity found in design research practice. This poses challenges in their day-to-day practice and causes *tension* as they *navigate ways* to address the diverging *values* and evaluation criteria of *design practice* and *academic requirements*. However, in alignment with an apprenticeship model of design education, tacit understanding of design research gained through research practice brings about *confidence* in a design led approach to research and a desire for public *recognition* of this approach. In order for this to happen, a design led approach to research must be articulated and made visible outside the confines of the design community.

6.5 Conclusion

This framework embodies and illustrates the experience of design researchers as they navigate the opposing values of design practice and academic research. It describes the structural elements of design research practice. It maps the possible range of design research approaches as evidenced in the research interviews and the continued evolution of design research practice as it addresses these opposing requirements of design practice and academic research practice. Its contribution to knowledge is in the provision of a map of design research practice as experienced and

understood by design researchers, which is further informed by critical hermeneutic enquiry. While it identifies and describes the common methodological elements, it also illustrates how preferences for and use of these elements varies significantly. Furthermore, it identifies and describes factors which may be causing this variation and are instrumental in guiding the continued evolution of design research practice. This knowledge may have application in a range of domains but in particular the theoretical and practical development of design research practice. For example, it may have application in research methodological development, development of dissemination and reporting templates, of evaluation metrics and processes to maximise rigor and reliability. It may also support cross disciplinary research and communication.

Section Seven: Discussion

7. Discussion

7.1 Introduction

The research aimed to develop a framework to support understanding of design research practice based on the self-understandings of design research practitioners while being cognisant of the historical and social structures influencing this practice. To achieve this, the following objectives were realised.

- a. Conduct a critical discourse analysis of the UK REF 2014 in order to understand and critique research assessment exercises in terms of the role they play in the definition, evaluation and continued evolution of research and in particular design research.
- b. Conduct an interview based, grounded theory study of practicing design researchers in order to uncover their understanding and experience of research, their approach, their research problems and methods.
- c. Review the literature relating to;
 - the historical and social structures influencing design research practice and to
 - the findings emerging from the critical discourse analysis of the UK REF 2014 and the grounded theory study of practicing design researchers.
- d. Compare, critique and integrate the literature with the research findings and analysis from objectives a and b in order to produce a framework which explicates and maps design research approach and evolution as evidenced in this study.

The research framework described in *Section 6 Research Framework – Navigating Difference* draws from all the objectives outlined, a, b, c and d. The three components, *Research Framework Elements* (See Figure 15), *Mapping Research Approach* (See Figure 16) and *Positions and Pathways* (See Figure 19) draw directly from *Table 10 Concept map detailing constituent Categories and Focused Codes for the Grounded Theory Navigating Difference* which is presented in *Section 5.5 Initial and Focused Coding*. The reoccurring themes, taken from *Table 10*, which informed the framework development were *Recognising Difference*, *Experiencing Tension* and *Seeking Recognition*. The following discussion will expand on these themes, which are integrated into the research framework, in the context of existing literature and the CDA of the REF 2014. This will be followed by a brief discussion of the research framework and its contribution to knowledge.

7.2 Recognising Difference

The first category *Recognising Difference* is made up of three sub-categories, *Value Difference*, *Process Difference* and *Problem Difference*. The close alliance of design research practice with design practice led the researcher to explore existing studies of design practice to support interpretation of the research findings. This was found to be fruitful, in particular Dorst's depiction of the "art of design" as being:

"linked to the designer, the design problem and the design situation, not just the process of designing" (Dorst 2006, p75).

Dorst's insight was used as a frame to structure the 'difference domains' as expressed by the participants in the Coding Category *Recognising Difference*.

7.2.1 Value Difference (Personal to the Designer; Having Different Values, Making Value Judgements, Adding Value)

The theme *Recognising Difference* has resonance with much of the discussions in the literature regarding the difficulty of applying a positivist scientific research approach to social issues where value judgements are fundamental to the process. See Literature Review *Section 2.5 Historical Development of Research Systems and Structures*. In a domain where, historically, value judgements were deemed to be outside of research practice (Bernstein 1976, p. xxiii), value judgements in design research practice are fundamental to its productive application and were referred to by the research participants in a variety of contexts from the need for the researcher to have particular values to the use of value judgement in research approach and method. Frankie in the context of a PhD research project spoke of the kind of value judgements made in the course of design research and its multi-disciplinary requirements.

"Yeah, its multi-disciplinary that's for sure. Yeah, and that's the nature of it because and it has to be that way in order to be able to satisfy. You know human needs are in most design problems, and that involves you know, everything from their physical needs to their aspirational kind of notions of what their, what they think they need as well and you know, often they can be more important than their real measurable needs, you know. But that's the nature of design. It's about capturing all of those and you know that hard and soft, you know, have to be sort of put in the melting pot ...the solution results from a good, a good understanding of all of that, to be able mesh all of that together."

Drew from a practice-based perspective also refers to the judgements required in the course of research and the ensuing requirement for enthusiasm for the process itself.

"So to have that enthusiasm to gather that data I went much deeper than that so I'd look at colour palettes and relationships between palettes and then look at the contrasts. I would look at photographs of how luxury brands photograph their products and what worked and what not and then I'd do some very loose user group testing ... show

[examples] for comment to a group of people that I respected their opinions and knew that I could analyse it.”

These examples illustrate that value judgements are made not only in design practice but also extend to design research process and methodology. The fundamental difference between design research and a positivist research position has been noted by Krippendorff. He describes how scientific research aspires to remain value-free where design research is a value-driven activity:

“Researchers are concerned with the truth of their propositions, established by observational evidence; designers are concerned with the plausibility and compellingness of their proposals, which reside in stakeholders’ ability to rearticulate them in the context of the futures they desire and various paths to reach them. Whereas scientific researchers seek knowledge for its own sake, value-free, and without regard to utility, designers value knowledge that improves the world, at least in the dimensions related to their designs” (Krippendorff 2007, pp. 72-75).

While Krippendorff takes a polarised position on research disciplinary positions which are becoming increasingly blurred, his observations identify the nature of the differences between pure scientific research (rather than applied) and design research. This can be useful in understanding their basic epistemological origins. Design research is undertaken in a creative space where the predominant focus for the researcher is on ‘what could be’ in a particular context. Design theorist Hakan Edeholt maintains “that the innovation potential in design is to propose how things might be” (Jahnke 2012). Design research needs to support this process. The focus is both future based and situated. The design researcher is not so concerned with universal application, transferability or universal laws.

Value judgements are also made in a social research context and therefore a useful model to look at for comparison. Polkinghorne supports their application by identifying social research as a practice which addresses “what ought to be accomplished”. He maintains that research decisions made in this realm should be governed by the “goals and values of a person”.

“Although the technical – rational method can be used to decide how something can be accomplished, it cannot determine what ought to be accomplished. Decisions made through this method should be governed by the goals and values of a society and person” (Polkinghorne 2004, p34). “...Accomplishing goals in the human realm depends on the motivation, imagination and awareness of the practitioner” (Polkinghorne 2004, p90).

This echoes Drew’s statement regarding the need for “enthusiasm to gather that data” for a deeper, more meaningful research outcome. ‘What ought to be accomplished’ or more specifically ‘what could be accomplished’ is the domain of designers and the study found that design researchers have particular value sets which guide the research decisions made in this space. These values relate to application, impact, meaning, design, the visual and the emotional. See *Section 5.6*

Grounded Theory: Navigating Difference in particular the sub-heading *Value Difference*. Value judgements were made during the research process to support the application of the research, to support deep and meaningful analysis and to ensure its relevance to design.

The theme *Value Difference* also found that design researchers felt that the values driving their research were different than those that they perceived in mainstream research discourse as understood in research assessment. As previously mentioned design researchers outlined how they valued meaning, application and outcomes while they perceived research evaluation exercises to value pure research, or in Krippendorff's (2007) words "knowledge for its own sake". They spoke passionately about these perceived value differences and outlined their approaches to managing them in the context of research dissemination and evaluation exercises. Alex, an art school academic, speaks of "exciting breakthroughs" in master's students' research projects, "that the academia wouldn't respect that much", going on to say that their mechanism for managing this was to use the master's students' research as launching pads for a more focused study at PhD level where the academic requirements are more clearly defined. By aligning their research streams in this way, they could merge the free exploration required for "exciting breakthroughs" with the rigorous academic requirements for PhD research. Val also alluded to the difference in values and approaches to addressing them which included "navigating ways in which I could use my own practice to answer research questions". However, most spoke of adopting a classic PhD model in their first significant research project because of a lack of design research models and because it was seen as the safer route (Val, Frankie and Lee). Some of these interventions may fragment their research approach and/or disseminate an incomplete story, which may subsequently undermine the coherent development of design research practice, thus highlighting the power of main stream discourse to influence research development. This area will be further developed in *Section 7.3 Experiencing Tension*.

7.2.2 Process Difference and Problem Difference

Design research appropriates and adapts research methods from many disciplines but the approach is guided by a design practice model. This model is best suited to the 'wicked' and unstructured nature of design research problems. There are many parallels and some differences between design research and research in the human sciences or practices of care. This is an area with a more established research culture and some comparison may support deeper understanding and provide a more sympathetic model for conceptual development of some of the more social aspects of design research process. Polkinghorne (2004) in the context of the practice of psychotherapy, makes a case for a "judgement-based approach" rather than a "technological approach" for this profession. He begins his discussion by outlining how psychotherapists are bound by ethics not to use "an experimental therapy that does not have empirically demonstrated efficacy" without first telling their patients. He goes on to state that he believes this "move to limit psychotherapy to empirically demonstrated technical sequences was mistaken". He also

notes how “the pressure to adopt a technical approach ... is occurring in ... many practices such as education, nursing, social work and occupational therapy” which he links with increasing dominance of a technical position underpinned by scientifically validated knowledge (Polkinghorne 2004, p. ix-x).

“Thus, when the task is significant, it is thought that one should rely on instructions that have been validated scientifically. The practitioner’s experientially accumulated fund of knowledge is considered less trustworthy.” (Polkinghorne 2004, p.8).

Polkinghorne made this observation in 2004 and qualitative research models have become more established; nonetheless, this continues to be a pressure that design researchers interviewed drew attention to. See *Section 5.6 Grounded Theory: Navigating Difference*, particularly the section *Experiencing Tension*. However, in design research practice, the pressure appeared to stem from not having established design research models to inform their process combined with the predominance of more traditional ‘technical rational’ criteria and metrics in research discourse, particularly in discourse associated with funding and research evaluation where accountability and quantification are important. This raises questions around the influence of a commercial agenda in research evaluation and the importance of ongoing vigorous public debate around development and encouragement of research practice. Should there be greater consultation when reviewing research funding mechanisms? Would the social order be threatened by a more qualitative, contextual representation of research? Perhaps the development of a universally accepted design research model which included these qualitative judgement based aspects might have greater resonance for design researchers and balance the influence of the ‘technical rational’ elements of practice. It may also be that the deficit of recognised and established design research models is partly responsible for the lack of visibility of design research practice approach in research evaluation metrics. See *Section 4.3.3 Representation and Evaluation of Product Design Research* for evidence of deficit.

Polkinghorne’s justification of why a “judgement based approach” to research in the human sciences is appropriate may also have resonance for the “human interaction” elements of design research. He makes the case that there is “a significant distinction between practices aimed at transforming physical materials into useful objects and practices involving human interaction” (Polkinghorne 2004, p. 5) and it is because of the complex and case specific nature of human interaction that a “judgement based approach” is required. The research finds that these practices (those aimed at transforming physical materials into useful objects and those involving human interaction) are not mutually exclusive and that design practice involves both domains. The model he advocates for in the human sciences is based on Aristotle’s model of practical wisdom or *phronesis*. This model draws on all the human sensitivities, including emotions (Polkinghorne 2004, p. 107). He goes on to explain why all the human sensitivities are required.

“(a) Human beings are committed to multiple values, and therefore multiple consequences must be considered in deliberation. (b) In the human realm, particular instances have priority over general rules, so in deliberation the unique and special requirements of each situation must be taken into account. (c) Emotions provide guidance to and motivation for action, so deliberation must include felt understanding ... Aristotle viewed the emotions as a form of rich intentional awareness” (Polkinghorne 2004, p. 107, p. 109).

Design decisions are made to address human needs and desires and these human choice characteristics fall within the ‘wicked’ design problem remit. Design researchers interviewed reflected on addressing many similar considerations and complexities outlined by Polkinghorne. Therefore, Aristotle’s model of practical wisdom or *phronesis* may have application and relevance for theory of design research practice. *Phronetic* deliberation as described by Polkinghorne:

produces knowledge about practical choices by integrating background understandings, felt meanings of a situation, imaginative scenarios, prior experiences, and perceptive awareness (Polkinghorne 2004, p. 116).

Jahnke goes on to question the concept of solving the “wicked problem” in design practice, stating that it is an insufficient representation of what design practice undertakes.

“It neglects the fact that what is deliberated in design is often not so much a problem, but rather is a typical human situation where inspiration can be found in almost anything that is intriguing” (Jahnke 2012).

Jahnke proposes a:

“meaning-oriented understanding of design situations [which] implies that the interpreter is inevitably situated in such complex assemblages of meanings”.

This representation is supported by the grounded theory study where researchers speak of valuing meaning in particular and also the unbounded nature of the ‘problem’ space or of it being up to the researcher/designer to frame or imagine the problem. Alex makes this point when describing how their MA students are encouraged to propose new and innovative applications for technologies.

“experimental design was sort of set up as a way of well allowing more conceptual lateral thinking but you would often describe an Experimental (EXP) project as the start of a research project. You know it could fundamentally allow further research later.”

Design decisions also address the physicality of materials and objects, a decision-making process described as *techné* which is more closely aligned with a technical rational or scientific mode of thinking. The findings indicate that the design research decision-making process contains

elements of *phronesis* and *techne*; that is, the “judgement based practice” model and “technical rational model” of practice and research. The analysis revealed that researchers tended to align themselves more closely with one or the other position depending on historical and cultural alignments associated with their territory education. See *Section 5.6 Grounded Theory: Navigating Difference* in particular the section *Recognising Difference* for details.

Design research reasoning draws from *phronesis* and *techne*. However, the methods or tools employed in the process of analysis and sense making draw from its distinct craft/apprenticeship origins and encompass visual, kinaesthetic and embodied modes of data interaction. These data interaction modes have particular and significant relevance and application in design research practice. For example, designers will use drawing as a way to explore ideas and ask questions of the data (Maher et al. 2018). A number of studies by Cross on the work practices of exceptional designers verify this process:

“The architects also use their drawing as a means of thinking “aloud” or “talking to themselves” ... The architect Richard MacCormac [is quoted] as saying “ I use drawing as a process of criticism and discovery” (Cross 1996).

The design researchers interviewed in this study also reflected on using model making, prototyping, etc. as a means of making sense of the data. Frankie outlined how:

“the process by which that was arrived at was quite scientific in the sense that there was a series of prototypes that were a, that were trialled, tested, results, analysed, refined, you know and cycled ...”

Lee reflected on the value of many practice-based research methods which might be utilised in design research to develop theory:

“I think an artefact or anything practice-based in research can ... you know ... [for example] use a sketch book ... to inform the theory ... use a prototype ... it doesn't have to be ... am fully formed or pretty looking ... in fact probably, the less pretty, the better. You know, using any kind of design methodology to inform theory.”

These practice-based research and analysis methods combined with *phronetic* deliberation as described by Polkinghorne have been acquired in design practice over a period of time and could be described as a form of tacit knowledge. The topic of tacit knowledge acquisition and its role in knowledge creation has been explored by Polanyi and may support deeper understanding of their particular relevance in design research practice. Polanyi states “we can know more than we can tell” (Polanyi 1966, p. 4) in his exploration of the tacit element of human knowledge. Polanyi placed great importance on the role of tacit knowing in all knowledge construction, so much so that he proposes that a “strictly detached, objective knowledge” is unattainable. By illustrating

how “tacit knowledge forms an indispensable part of all knowledge”, he shows that “the process of formalizing all knowledge to the exclusion of any tacit knowing is self-defeating” (Polanyi 1966, p. 20). This supports the value of the experiential and tacit elements of design research approach and the need for design research practitioners to communicate these tacit elements of knowledge construction when disseminating their findings, if this is possible.

Polanyi by evidencing the deeply personal embodied elements of tacit knowing illustrates why it can only be acquired through experience. This has implications for the process of acquiring design research capacity, expertise and education. He begins his lecture, which the book is based on, with an example of tacit knowing.

“We know a person’s face, and recognize it among a thousand, indeed among a million. Yet we usually cannot tell how we recognize a face we know. So most of this knowledge cannot be put into words” (Polanyi 1966, p. 4).

This is followed by a summary of examples of where tacit knowing is active.

“The things that we know in this way included problems and hunches, physiognomies and skills, the use of tools, probes, and denotative language....” (Polanyi 1966, p. 29).

His description of tacit knowing and how it is attained is quite lengthy for inclusion in this discussion. However, in summary, he describes it as being made up of two parts, one he describes as proximal and the other distal. He suggests that our focus on the distal (what the meaning is, as interpreted by the knower) relies upon placing the proximal (actual features of human physiognomy in the above example) in the subconscious, that which we are not ‘attending’.

“In the case of human physiognomy, I would say that we rely on our awareness of its features [proximal] for attending to the characteristics appearance [distal] of a face. We are attending *from* the features *to* the face, and thus may be unable to specify the features” (Polanyi 1966, p. 10).

He goes on to show how we have a range of such proximal tacit understandings of “particulars” or “interiorized bits of the universe” acquired by our physical, embodied interaction with the world, similar to those described by the design research participants, and stored in our subconscious which go on to inform our skill sets, hunches and creative endeavours. He uses the example of scientific discovery to show how tacit understanding is fundamental to all knowledge construction processes, even those of a more detached, objective, scientific nature. It is included here as paradoxically the process of scientific discovery, as described by Polanyi, closely resembles the design process, which further highlights the multiple narrative positions available and selected to represent our different social practices:

“It is a commonplace that all research must start from a problem. But how can one see a problem, any problem, let alone a good and original problem? For to see a problem is to see something that is hidden. **It is to have an intimation of the coherence of hitherto not comprehended particulars.** ...To see a problem that will lead to a great discovery is not just to see something hidden, but to see something that the rest of humanity cannot have even an inkling. **To hold such knowledge is an act deeply committed to the conviction that there is something there to be discovered.** It is personal, in the sense of involving the personality of him who holds it....” (Polanyi 1966, pp. 21-25).

It is this deeply personal and embodied experiential form of knowing that evades description and knowledge transfer in a theoretical sense, that is fundamental to the intuitive understanding and creativity employed in the design and research process, which defines tacit knowledge. It is what Alex was referring to when speaking of “exciting breakthroughs” in master’s students’ research projects, “that the academia wouldn’t respect that much” and therefore considered inadmissible in PhD research process. It is a quality communicated by Ashley’s description of design researchers as “dreamers that do” or Frankie’s as “relying on intuition in the creative [research] process”. Despite accepted difficulties associated with description and demonstration of rigour, it is important this aspect of design research is acknowledged and visible in research outputs.

This form of tacit knowing has received some recognition and consideration in practice, but less so in research applications. However, research in the area of practice may support understanding of how tacit and experiential knowledge is acquired, perfected and articulated/disseminated which may contribute to the progressive development of design research practice. Schon, having conducted empirical studies of expert practitioners in engineering, architecture, management, psychotherapy, and town planning, and building on Polanyi’s theoretical development of tacit knowledge (Polanyi 1966), proposed “reflection-in-action” as a lens from which to view and theoretically develop practice.

“It is this entire process of reflection-in-action which is central to the ‘art’ by which practitioners sometimes deal well with situations of uncertainty, instability, uniqueness, and value conflict” (Schon 1983, p. 50).

Schon’s “reflection-in-action” describes how practitioners bring tacit knowledge gained through experience to their decision-making process. He proposes that “the practitioner has built up a repertoire of examples, images, understandings, and actions,” [and when he] “makes sense of a situation he perceives to be unique, he sees it as something already present in his repertoire” (Schon 1983, p. 138). This repertoire of example or precedent and its particular value was mentioned by Ashley in the context of design research.

“It’s a lovely thing if you don’t know why you keep noticing something and you haven’t thought about it before and you keep and lo and behold you end up working with that

thing at some point and yet why at that time didn't you do something then but it's sort of storing itself in the back of your head so it's really good."

The acquisition of this form of experiential knowledge takes time and can only be acquired by experience. Lawson, building on the Dreyfus Model of Skill Acquisition, explored the design process through empirical observation of designers in practice. His findings relating to the attainment of expertise in design may also have relevance for design research practice. He emphasises the prerequisite for a type of experiential or episodic knowledge (tacit) as opposed to theoretical or semantic knowledge in the attainment of expertise in design which he breaks down into five stages of cognitive development. They are:

"The acquisition of design domain schemata ... the development of a growing pool of precedent ... the identification of some guiding principle which develops over time and further structures and filters the continued acquisition of precedent ... the ability to recognise situations with little or no analysis ... and the building of a 'repertoire of tricks' or design gambits which are integrated into the schemata used to recognise the problem situations" (Lawson 2004, p. 118).

The final two steps of Lawson's cognitive framework for attaining expertise in design mirrors closely Benner's assessment of expertise in nursing, also derived from the Dreyfus Model of Skill Acquisition. Like the designer's 'repertoire of tricks' the expert nurse:

"With her/his enormous background of experience, has an intuitive grasp of the situation and zeros in on the accurate region of the problem without wasteful consideration of a large range of unfruitful possible problem situations They are no longer using rules and formulas to guide their practice. They are now using past concrete experiences much like the researcher uses paradigms" (Benner 1982).

There may be some correlation between this research projects grounded theory code "*Gaining increased confidence in design led inquiry*" and "*the attainment of expertise*" outlined by Lawson. This might inform the theoretical development of design research practice in education.

To achieve expertise takes time and practice. "A common estimate is that it takes about 10 years in total to become recognised as an expert" (Lawson and Dorst 2009, p. 83). It must be recognised also that 'attaining expertise' and 'defining expertise' is not an exclusively 'natural' and 'personal' phenomenon. It is also socially constructed through a process of "uncritical imitation of existing (local) traditions and of authorities in a field" (Mareis 2012). Mareis advises design researchers "to critically question the "'often declared as natural' apriorism of design" and to be cognisant of the fact that "expertise and connoisseurship are related to the habituation and perpetuation of social standards, values, and traditions" (Mareis 2012). Much of this has relevance for the productive development of design research practice in terms of recognising the skill sets required and being cognisant of the impact of prevailing trends and influences.

Another significant element of design research practice which raises many questions is the application of creativity. Rust suggests that creative thinking exists in all research, particularly in the project initiation and framing phase, but this fundamental element is not widely reported upon.

“It is conventional, in reporting scientific findings, to emphasize the rigorous process of ‘proof’, and pay very little attention to the genesis of the enquiry... [However] There must also be some kind of ‘illumination’ by which the scientist imagines a new concept and proposes it as a worthwhile subject for investigation” (Rust 2004).

Alex highlighted the significant value of the project framing element of the research process when referring to master’s students’ research and went on to identify the particular skill set of design researchers to maximise the potential of this process and subsequently increase the innovative value and application of the research project outcomes. In the excerpt below Alex is describing how designers can add value to the project framing and application element of research in science and engineering.

“I think what’s really interesting which probably has a bigger impact on a sort of PhD level is unlock the labs in [names prominent engineering university], find the people who are at the forefront of science and technology and have a passion for design, we don’t want to disturb their normal work, they’ve still got to write their papers, that’s how their jobs work but they get excited about people coming along and showing them how it would come alive, that’s where design comes in.”

Alex goes on to describe work as an academic project coordinator and the benefit of collaborative projects where design researchers work with engineering researchers to support this early project framing phase. Ashley also speaks of this area Rust describes as “the genesis of enquiry” and outlines a process used to support design research students in this early phase of enquiry.

“and then I get them to create an abstract piece for me of their project and then I can discuss with them something that isn’t yet born ... and that really works.”

These design researchers place great importance on the productive value of this early stage project framing and give it considerable time and attention, yet it lacks positive identification and therefore goes unreported in many research evaluation exercises. See *Section 4.3.3 Representation and Evaluation of Product Design Research* for further details of the representation of design research values/discourse in research assessment.

The findings suggest that while creative exploration exists in all research, it has proportionally greater relevance and value in design research practice, not only at the project framing stage but throughout the research process. Creative exploration supports sense making throughout the research journey. Lee describes the use of creative generative design tools to support research enquiry and theory generation:

“I think an artefact or anything practice-based research can ... you know ... use a sketch book ... to inform ... em ... to inform the theory ... em ... use a prototype ... it doesn't have to be ... em ... fully formed or pretty looking ... in fact it probably, the less pretty, the better. You know, using any kind of design methodology to inform theory.”

Rust refers to this process as the use of “systems of representation” to support the “development of thought” (Rust 2004). By providing concrete examples of the use of “systems of representation”, he illustrates how the process unlocks participants’ and researchers’ “tacit knowledge gained through years of practical experience”.

“However, it may be profitable to consider how different forms of representation, including complex, very specific artefacts, can support our efforts to employ tacit knowledge in our enquiries, whether we are seeking to engage our own tacit processes or those of our audience (Rust 2004).

Creative exploration in design research raises many questions relating to its lack of alignment with positivist research values. For example, not only do design researchers use generative tools outlined above, but also surround themselves with inspirational sources of material, drawings, models, etc. They recognise this process as a valuable research tool. It is utilised but may go unreported in dissemination. Perceived lack of alignment with positivist research approach combined with an acknowledged difficulty generating and following formal design research models was clearly articulated by a Frankie.

“I still. I'm unsure about how how How possible it is to model the creative process because ... ahh ... so much of it relies on intuition and that kind of intuitive spark of energy that you know leads to creation and all the methodology in the world won't necessarily bring you to that point, you know, it may allow you to understand it in hindsight but I... I, you know, I think a straight jacket of any kind, of any kind, in a creative process ... amm ... could be a hindrance more than a aid you know and part of the the kind of glory of creativity is freedom. Freedom to break the rules, to be able to work outside, to break new ground in a creative way.”

This leads to the specific requirement for freedom in research and particularly in design research. Most notably it requires freedom to explore without disciplinary or methodological constraint. These sentiments are echoed by Koskinen et al. (2011) in their book on constructivist design research.

“To flourish in this environment, constructive design researchers need methodological and theoretical flexibility” (Koskinen et al. 2011, p30).

And by Janoszka and Buzoianu with reference to management research:

“Despite a growing number of studies pertaining to the interpretative approach, there are no universal standards for conducting qualitative inquiry. Moreover, advocates of

qualitative research have been arguing against development of such standards because it could put at risk the fluid and emergent nature of qualitative research. Hence the enduring dilemma relates to the balance between the creative, inherent messiness of qualitative research and methodological rigor. We agree with the standpoint of Symon-Cassell & Johnson that evaluation criteria should not marginalise alternative perspectives nor impose unified normative practice” (Janoszka and Buzoianu 2018).

Research assessment exercises such as the UK REF 2014 are part of a broader neo-liberal project in higher education where researchers are required to be increasingly strategic, organising their research and educational practice to align favourably with the assessment criteria of research evaluation exercises. Concerns have been expressed by a number of authors on the impact this has on academic freedom and original research (Higher Education Authority (HEA) 2013). Marginson puts it very well when he states that:

“The argument is not that neo-liberalism suppresses academic freedoms, but that it channels and limits academic freedoms. We are not robbed of agency per se, but we are robbed of certain forms of agency that arguably are vital to creators of academic knowledge in universities” (Marginson 2007).

7.3 Experiencing Tension

Experiencing tension is a theme which ripples throughout this research project. From the beginning, a study of the literature identified it might be a problem. Historically, the journey of the design science movement illustrated the challenges of and frustrations with applying a scientific framework to a creative discipline. Jahnke (2012) proposes that the use of scientific or problem solving metaphors for understanding design practice risks abstracting away the “*experience of designing*”. Similar challenges were identified by the interviewees in a design research context when applying recognised qualitative and quantitative research approaches adopted from other disciplines. These challenges were reflected in the themes ‘value difference’, ‘process difference’ and ‘problem difference’. A further impact is lack of consensus within the design community regarding the theoretical development of design research and subsequent delay in the development of formal design research models, if indeed the development of such is possible without restricting creative exploration. The effect has been to cause tension as design researchers try to navigate opposing values and requirements without a validated recognised model to work from. This impacts on research coherence in terms of approach and dissemination. It impacts negatively on design research moral, support, recognition and funding. The additional difficulty of evidencing and communicating tacit understandings, fundamental to design research practice, compounds this lack of visibility in public research discourse. Furthermore, the application of interdisciplinary, creative generative research approaches with their associated requirement for freedom does not align well with rigid quantitative evaluation frameworks. These findings raise questions around cause and effect. What might be sustaining these challenges and how can its impact be minimised?

Public social practice and discourse have a powerful influence on how ‘design research’ is understood, defined and evaluated and subsequently on how it evolves. The Critical Discourse Analysis of the UK REF 2014 illustrates the wider social and cultural structures which are influencing the representation, evaluation and continued evolution of research. The critical element supports reflection on the taken for granted assumptions, conventions, social processes and structures that underlie a particular social process, in this case research assessment, and seeks to uncover their “role in producing or reinforcing particular understandings” (Phillips and Brown 1993).

Findings from this exercise reflect the considerable influence of the REF 2014 in the discourses of other stakeholders and the dominance within those discourses of market systems structures where accountability, public relations and intense competition are fundamental to their operation. Research assessment exercises, such as the UK REF 2014, allocate research funding based on its assessment. They also provide benchmarking information for universities and accountability for public investment in research. The UK REF 2014 documents inform and provide evidence for claims made by government, funding bodies, universities and the media regarding the nature and quality of research in the UK, hence the significance of the explicit and implicit values contained within.

Discursively, the implicit message in the document is that a diverse range of academic research should and can be assessed fairly, and that this is the ‘common sense’ and ‘expert’ process of publically funding research. References to other mechanisms for funding research which may value more intuitive or empathic forms of research are absent (Maher et al. 2014). See for an example of a different approach the Standard Evaluation Protocol 2015-2021 (SEP) in the Netherlands. As product design is not part of the dominant discourse within the document, it may impact on its positive recognition and subsequent evaluation.

“Discourses, frequently based on the norms of a group, exclude and devalue the norms and practices of other groups and, therefore, dominant discourses wield power” (Lai and Vadeboncoeur 2012).

The problem is the representation and evaluation of research in the public sphere (mainly from a positivist/empiricist tradition) and its subsequent impact on those research areas, such as design, which have developed outside and challenge this tradition. This problem is exacerbated by a lack of a clear linear research tradition in design research, the diverse and interdisciplinary nature of design research, a divergent thinking style which is at odds with a positivist/empiricist tradition and which prefers not to follow fixed methodologies (Durling 1996) and a general consensus that design (research) is a category beyond categories (Lunefield in Laurel 2003, p.10). Krippendorff articulates his concerns for the theoretical development of design within the confines of dominant

opposing discursive structures by reflecting on ill-considered responses from the design community.

“Words are far from neutral bystanders of what happens in the world. They can shape their users’ perceptions and direct their actions. For this very reason, and to enhance its academic respectability, the design community has begun to adopt vocabularies from the more established disciplines, without noticing, I suggest, the implicit importation of paradigms that are essentially alien to it” (Krippendorff 2007, p. 67).

Design discourse is not part of the discourse surrounding the UK REF 2014 exercise and has a very small influence on it, if any. However, due to the nature of this research project, it may be useful to look at how *design* and *design research* is represented in the discourse of the design community as this may be part of the problem. Foucault’s work supports and questions the underlying assumptions in discursive frameworks and illuminates how they are manifest. These could operate from an external perspective such as a dominant scientific discursive framework but can also be manifest through the process of social habituation within the community of practice itself, where the conventions of practice are perpetuated through discourse without question or criticality. Research (Gulari 2013), (Julier 2000), (Durling 1996) identifies a range of contradictions and ambiguities in the representation of design within the design community.

For example, Julier highlights the essentially fragmented nature of the design tradition explaining how “fluctuating client demand and the design industry’s own lack of institutional cohesion have meant that it has been largely unable to establish its own professional norms” (Julier 2000). He goes on to explain how this difficulty is compounded by a rather skewed history of design where design historians in recording the history of design have foregrounded the product and minimised the essential “interdisciplinary research” which informs their work.

“There is a manifest contradiction between the realpolitik of the design profession and some of the discourses which are mustered to explain and legitimate itself. On the one hand, there is the complex, multi-disciplinary industry, accustomed to teamwork, stylistic and operational flexibility and active in a broad range of domains of use and exchange. On the other hand, individual biography focusing on the designer’s creativity and the modernist canon as a benchmark of ethical and formal development pre-dominate in the articulation of historical experience” (Julier 2000).

Buchanan, (1988) quoted in (Julier 2000), supports this view emphasising that:

“the history of design in the twentieth century is not merely the history of products or of personal styles of expression or even of broad cultural ideas. It is also the history of the character and disciplines of design thinking as they are formed through encounters with new problems.”

However, these aspects of design thinking receive less attention in the history of design.

Gulari (2013) outlines how contradictions and ambiguities are further compounded by the metaphors used to represent design expertise. She explains how:

“mystified metaphors lead to an unresolved and informal design process in which solutions are often built on personal skills of the designer or simply on serendipity Acting like a magician and being wilfully obscure about the process may create a sense of curiosity and help protect the design knowledge partially but it may inhibit them from successfully collaborating with others” (Gulari 2013).

This is important because design is an interdisciplinary activity, and successful collaboration and communication of its methodologies is necessary for its development. It is also important when seeking funding from the UK REF 2014 to be able to communicate the validity of its approach. The discourse surrounding the REF 2014 and the design process have very different values. Whereas the UK REF 2014 values accountability, clarity, metrics, benchmarking and quantifiable data, design discourse is contextual, ambiguous and sometimes contradictory. This creates tension as design researchers attempt to address the requirements of both domains.

7.4 Seeking Recognition

Seeking Recognition, a category of the core category *Navigating Difference*, describes an action design researchers aspired to; however, the described actions to achieve recognition sometimes appeared to be driven more by satisfying the ideals of the intended audience of the output than the intrinsic value and approach of the research. Evidence of this can be found in *Section 5.6 Grounded Theory: Navigating Difference*, particularly the section heading *Seeking Recognition*. *Seeking Recognition* incorporates the focused codes of *Gaining Confidence*, *Navigating Ways/Evolution*, *Recognising Opportunities* and *Seeking Respect/Evolution*. The grounded theory study identified a desire for recognition of the methods and outcomes of design research practice, to make visible and seek academic acknowledgement for the intangible methods of practice. This observation raises further questions. What are the tangible and intangible methods and outcomes of design research practice? Who are the benefactors of design research practice? What are the values of design research practice? Where are design researchers seeking recognition; in what social processes and activities? Why are designers seeking recognition?

This study identified methods and approaches born out of design practice which have particular resonance in design research practice. These relate to the use of imagination to identify unforeseen potential and possibility, the use of drawing and model making to imagine, make sense of, explore, communicate and test ideas; more recently, cultural probes and models questioning traditional values and social processes. There has been some success in particular institutions in achieving recognition in these areas; however, it is not the general experience as evidenced by the interviews. Koskinen et al (2011) in their publication *Design Research Through Practice* provide an overview of some successes in leading research institutions.

An observation arising from the CDA of the UK REF 2014 is that the lack of visibility in the REF discourse may provide opportunity for design researcher practitioners to be proactive in defining that space. See *Section 4.3.3 Representation and Evaluation of Design Research*. This requires design researchers to identify the qualities of their process and outputs for which they are seeking recognition for. Due to the previously highlighted difficulties communicating and evidencing tacit understandings, this will require deep reflection on process as well as output. Furthermore, it will require the development of a productive communication and dissemination strategy. The above strategy should increase the reach and design relevance of exercises like the UK REF and may cause less unintentional outcomes.

The benefits of identifying and communicating the values, processes and methods of design research would have application and relevance in the following domains: design research practice, multi-disciplinary research projects and education.

In terms of multi-disciplinary research projects and education, the literature review revealed some limitations of the traditional university model of education. It was noted that as a result of its historical development with a focus on specialised and fragmented theoretical development, great knowledge was possessed:

“but the knowledge is fragmented into so great an array of specializations that we cannot find connections and integrations that serve human beings either in their desire to know and understand the world or in their ability to act knowledgeably and responsibly in practical life” (Buchanan 2001).

Design, traditionally placed outside of university disciplinary boundaries, may now be proposed as a unifying force, offering a holistic way of seeing, in education and in multi-disciplinary research projects.

7.5 Research Framework – Navigating Difference

This research aimed to develop a framework to support understanding of design research practice based on the self-understandings of design research practitioners while being cognisant of the historical and social structures influencing this practice. The research framework developed, and described in See *Section 6 Research Framework – Navigating Difference*, addresses this primary aim. The constituent elements of this framework have been discussed in *Sections 7.2, 7.3 and 7.4*. In line with the hermeneutical approach taken, this section will conclude with a discussion of the complete framework and its significance in the light of what was already known.

The literature identified a gap related to understanding and consensus regarding the nature of design research practice, in particular design research practice, undertaken by design practitioners which draws on design practice methods as a methodological approach. Questions were raised in the literature review around the role of judgment, creativity, intuition and the challenge of

evidencing the tacit elements of design practice in these research approaches. This framework supports understanding of this type of research. It may inform progressive development of those practices and policies which impact the evolution of design research practice while making visible the tacit elements of design research. Understanding of the research approach of designers and the prevailing influences on this approach, based on their own self understandings, provides a sound foundation on which to develop design research practice. Issues identified by the research which may impact design negatively are adopting research approaches which are not aligned with their practice or minimizing the tacit and creative elements of design research in dissemination because of its perceived lack of rigor and objectivity. It is important that design community addresses the need to make all the methods and approaches of design research practice visible and develop appropriate evaluation criteria. These observations are verified by the lack of design research definition in the literature search, and a similar lack of robust design research models were noted by the design researchers interviewed and identified as an obstacle to undertaking that first design research project. This is both a challenge and an opportunity for the design community to address, that is, to define the approaches, the methods and appropriate evaluation criteria for design research practice. It is hoped this research provides some support for this process.

7.6 Conclusion

Early research activity in the course of this PhD journey revealed the social complexity of the practices driving the evolution of design research practice, the power struggles involved, the role of discourse etc. and the difficulties in communicating the tacit elements of design research practice. Awareness of these issues, in particular, signified that the contribution to knowledge of this research is placed more in mapping this complexity, the variables involved, their impact on design research practice and the measures taken to address them, rather than describing the particular methods of design research practice. This mapping expressed as a framework titled *Navigating Difference* will inform progressive development of those practices and policies which impact the evolution of design research practice while making visible the tacit elements of design research practice. The onus is on the design community to address the issues outlined and to gain recognition for their research practice. It is important they report and disseminate a more comprehensive reflection of design research practice which includes its judgement based, creativity and tacit elements. Reporting structures need to be developed which provide guidance on communicating the more difficult to articulate judgement and tacit elements. Furthermore, it's important appropriate evaluation criteria are developed for design research practice.

Section Eight: Conclusion

8. Conclusion

8.1 Motivation, Aims and the Triadic Research Approach

The initial impetus for selecting this topic was driven by the researcher's personal aspiration to develop a deeper understanding of design research practice. Preliminary critique of the literature revealed a deficit of established, recognised and agreed upon design research approaches, methodologies and methods. This represented a compelling gap in knowledge, and without published sources to adequately address this initial query, directed the researcher to extend the question to consider why this lack of cohesive development was occurring. To acquire understanding of research development and to support the selection of an appropriate research approach and methodology, the researcher explored literature relating to the historical and methodological development of research. In the historical and methodological context of research and discovery, the dominant research model has been the positivist/empiricist research model of the natural sciences. Kuhn's (1962) critique of natural scientific thinking which highlighted its situated nature and proposing that the truths on which it is based are the conventions of a particular community directed the research approach to focus on the self-understandings of the design research community. This approach has been adopted to some extent in studies of designers; however, these studies tended to focus on design practice only, and on design practice in isolation of the broader social and cultural practices it operated within (Cross 1996, 2001; Lawson 2004, 2005; Keller et al. 2009; Lawson and Dorst 2009). The focus of this study is design research practice. In design research practice, the researcher must respond to both design practice values and academic research practice values, generating a more complex and problematic remit. The theoretical perspective of Bernstein (1976) directed the research approach to consider not only design researchers' self-understandings but also to attend to the possibility of systematic distortions caused by social and historical influences on that practice. The research therefore aimed to develop a framework to support understanding of design research practice based on the self-understandings of design research practitioners while being cognisant of the historical and social structures influencing this practice. To address these aims this research looked to understand:

- a) How research is defined and evaluated within the larger research community and design research position within it
- b) Design research practice as experienced and understood by design researchers and
- c) The historical and social structures influencing this practice.

Applying a critical hermeneutical lens, the focus of the research moved iteratively from developing understanding of the overall context and cultural influences to observation of the details of research practice and back again in an iterative process.

The research was broken down into three operational elements outlined below, interspersed with three rounds of literature searching conducted before, during and after the field research.

Stage 1: A Documentary Analysis of the UK REF 2014 documents in order to understand and critique research assessment exercises in terms of the role they play in the definition, evaluation and continued evolution of research and in particular design research.

Stage 2: A constructivist grounded theory study (qualitative semi-structured interviews) of practising design researchers in order to uncover their understanding and experience of research, their approach, their research problems and methods.

Stage 3: A critical hermeneutical lens/circle of interpretation developed from synthesis of the literature with the themes emerging from the documentary analysis and the grounded theory study supporting a deep holistic understanding of the social processes at work in this realm.

The triadic research approach, developed by the researcher specifically for the research requirements of this project, generated new understanding of design research practice. See *Figure 3 Triadic Research Approach*. The three elements were essential to each other, each informing the analysis with fresh perspectives and insights supporting a deeper and more nuanced understanding of what was going on in design research practice. Reflection and synthesis of all the elements thereby supported the development of a framework which explicated and mapped design research approach and evolution as evidenced in this study. See *Section 8.2*. The limitations of this approach are the size of the study and the positionality of the researcher. To provide additional criticality, it might be beneficial to conduct a similar study in another country and perhaps for the study to be undertaken by a researcher from a different disciplinary background.

8.2 Navigating Difference: A Framework to Support Understanding of Design Research

The framework is built on the core category of the grounded theory study, *Navigating Difference*. *Navigating Difference* represents the experience of design researchers as they navigate the opposing values of design practice and academic research. It describes the structural elements of design research practice. It maps the possible range of design research approaches as evidenced in the research interviews and the continued evolution of design research practice as it addresses these opposing requirements of design practice and academic research practice. For explication, the framework has three descriptive components illustrated by three infographics;

- *Navigating Difference: Research Framework Elements (Figure 15)*
- *Navigating Difference: Mapping Research Approach (Figure 16)*

- *Navigating Difference: Positions and Pathways (Figure 19)*

8.2.1 Navigating Difference: Research Framework Elements

Design research approach and methodology is determined by the interaction of the researcher with the human situation, where the problem is framed in terms of ‘what could be’. A productive outcome generally involves the deeply personal and embodied interaction of the design researcher with the human situation. This determines the research approach, methodology and outcome as the design researcher interacts with and acts on the human situation.

8.2.2 Navigating Difference: Mapping Research Approach

Due to the embodied interaction of the researcher with the problem space, his or her personal and professional biography have relevance for the research approach. That is, their personal motivations, intuitive and creative insights combined with their logical reasoning and accumulated body of research precedent, theoretical and tacit knowledge. This is further influenced by the pushes and pulls of design research practice and academic research values and may be informed by the context of their work. Due to the interactive role of the design researcher with the research and the ‘wicked’ nature of the future based problem space, design research practice, exhibits a spectrum of approaches reflective of the attributes, influences and backgrounds of the individuals involved as they interact with the particulars of the situated problem space.

8.2.3 Navigating Difference: Positions and Pathways

The research found that design research practice is continually evolving both at an individual level and at a community of practice level. This evolution is being informed by the opposing values of design practice and academic research. The range of positions held by the design researchers interviewed illustrated the pushes and pulls of these divergent value systems. This has impeded to some extent the expedient and coherent development of design research practice. This was evidenced in the grounded theory category *Experiencing Tension*. However, as individual design researchers and the design community acquire precedent and grow in confidence through research practice, they are *Seeking Recognition* for research approaches which have academic credibility and are in alignment with their practice values. This can only be achieved by coherent dissemination of all the aspects of design research process, including the intuitive and creative elements and the development of evaluation criteria in alignment with these practice values.

8.3 Contribution to Knowledge

This research was driven by a knowledge gap identified in the literature and experienced directly as an academic design research supervisor. This gap was a lack of established and agreed upon design research methodological approaches. The initial goal was to uncover by means of a

grounded theory study of practicing design researchers, supported by a CDA of the UK REF 2014 and hermeneutical enquiry, a framework to explicate the nature of design methodological approach as undertaken and understood by design researchers. The initial partially incorrect assumption made by the researcher was that consensus would be found by concentrating on design research practitioners experience and understanding. However, the findings revealed a different story. While participants exhibited common methodological elements in their research approach, their preferences for and use of these elements varied significantly. There was increasing awareness as analysis continued that this was a complex research area which required understanding at a structural and evolutionary level, and that consensus on approach among the design community was not evident and therefore could not be described. The contribution to knowledge of the framework subsequently resided more in the mapping of this complexity, and the variables involved, rather than describing the particular methods of design research practice. The research framework *Navigating Difference* achieves this by describing the structural elements of design research practice. It maps the possible range of design research approaches providing explanation for their difference. It also identifies the diverging values, processes and problems informing the evolution of design research practice.

This framework may provide foundational understanding for the theoretical development of design research practice and its methodologies. It may support early stage design researchers and dialogue in interdisciplinary research projects. It is hoped it will encourage the development of dissemination templates, evaluation metrics and more rigorous approaches and methodologies in line with design research practice models. Furthermore, it is hoped that it will encourage the reporting of all the aspects of design research process, including the intuitive and creative elements.

8.4 Concluding Remarks and Future Work

Design research practice is guided by traditions with historically opposing values; design practice and research practice. While design research matures and traditional research practice broadens in scope and definition, breaking down some of the oppositional discourses between them, there are still considerable challenges in developing a research approach, which supports design practice and capitalises on its methods while demonstrating academic research rigour and credibility in the process. This is a question which can only be addressed by design research practitioners in the dissemination of their work. It is important that dissemination includes the tacit and judgement based elements, the creative exploration along with the more traditional academic research methods which lend themselves to existing research reporting structures. This will necessitate further research in the area of dissemination reporting models which support and encourage the inclusion of tacit and judgement based elements and also the development of evaluation criteria appropriate for and in alignment with design practice values which demonstrate academic rigor and credibility.

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Appendices

Appendix A: Ethical Application Approved by the Bournemouth University Research Ethics Panel (REP)

Research Ethics Checklist

Reference Id	1264
Status	Approved
Date Approved	28/11/2014

Researcher Details

Name	Carmel Maher
School	Faculty of Science & Technology
Status	Postgraduate Research (PhD, MPhil, DProf, DEng)
Course	Postgraduate Research
Have you received external funding to support this research project?	No

Project Details

Title	Design Research Methodologies - A framework to understand and guide academic design research methodologies.
Proposed Start Date	12/10/2014
Proposed End Date	01/09/2017

Summary (including detail on background methodology, sample, outcomes, etc.)

Background Industrial design is a relatively new profession with its origins in the industrial revolution and has not the benefit of a long tradition in research and education. The craft tradition has had a considerable influence on the industry and its research methodologies where intuition and tacit knowledge are combined with interdisciplinary skills and approaches. It can be difficult to define design research or indeed to separate design research (theory) from the design process (practice). Currently there is much debate within the industry regarding the nature of design research, its methodologies and how best to communicate them to the wider community. The goal of my research is to increase understanding and knowledge of the design researchers approach to research and of making explicit what is often implicit in their approach with a view to developing and articulating this distinct design research model. The anticipated outcome is a framework to understand and guide academic design research. Methodology The primary research methodology is grounded theory. This is a research methodology used to understand and explain a phenomenon where theory is developed from the data collected; in this case data will be collected from established researchers with proven success in their field. Grounded theory was chosen because design research is a research area where little formal theory has already been generated and to have real explanatory value, it is important the theory comes from the practices and processes of the designer, along with their reflection and understanding. Interviewees will be selected based on their relevance to the area of study, in the case of this research project, participants will have made a significant contribution to design research and will have identified themselves as design researchers either in past or present employment. Each interviewee will be sent a participant information sheet and consent form. If they choose to participate, they will be sent a short questionnaire to gain a profile career history. This will be followed by an interview to gain understanding of their perception, understanding and experiences of design research. The interview will take approximately one hour and will be recorded. Interpretation of the data to build theory/conceptual framework will be an ongoing process and will take place in tandem with data collection. The grounded theory methods of substantive and theoretical coding, constant comparison and memoing will be used to analyse the data. Interview and observation will be the primary source of data. Other sources which will be used are literature searching and documentary analysis. The documents selected for analysis will be publicly available. Outcomes A framework to understand and guide academic design research methodologies.

External Ethics Review

Does your research require external review through the NHS National Research Ethics Service (NRES) or through another external Ethics Committee?	No
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Research Literature

Is your research solely literature based?	No
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Human Participants

Will your research project involve interaction with human participants as primary sources of data (e.g. interview, observation, original survey)?	Yes
Does your research specifically involve participants who are considered vulnerable (i.e. children, those with cognitive impairment, those in unequal relationships—such as your own students, prison inmates, etc.)?	No
Does the study involve participants age 16 or over who are unable to give informed consent (i.e. people with learning disabilities)? NOTE: All research that falls under the auspices of the Mental Capacity Act 2005 must be reviewed by NHS NRES.	No

Will the study require the co-operation of a gatekeeper for initial access to the groups or individuals to be recruited? (i.e. students at school, members of self-help group, residents of Nursing home?)	No
Will it be necessary for participants to take part in your study without their knowledge and consent at the time (i.e. covert observation of people in non-public places)?	No
Will the study involve discussion of sensitive topics (i.e. sexual activity, drug use, criminal activity)?	No

Are drugs, placebos or other substances (i.e. food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind?	No
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Will tissue samples (including blood) be obtained from participants? Note: If the answer to this question is 'yes' you will need to be aware of obligations under the Human Tissue Act 2004.	No
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Could your research induce psychological stress or anxiety, cause harm or have negative consequences for the participant or researcher (beyond the risks encountered in normal life)?	No
Will your research involve prolonged or repetitive testing?	No
Will the research involve the collection of audio materials?	Yes
Is this audio collection solely for the purposes of transcribing/summarising and will not be used in any outputs (publication, dissemination, etc.) and will not be made publicly available?	Yes
Will your research involve the collection of photographic or video materials?	No
Will financial or other inducements (other than reasonable expenses and compensation for time) be offered to participants?	No

Please explain below why your research project involves the above mentioned criteria (be sure to explain why the sensitive criterion is essential to your project's success). Give a summary of the ethical issues and any action that will be taken to address these. Explain how you will obtain informed consent (and from whom) and how you will inform the participant(s) about the research project (i.e. participant information sheet). A sample consent form and participant information sheet can be found on the Research Ethics website.

The primary research methodology is grounded theory. Grounded theory was chosen because design research is a research area where little formal theory has already been generated and to have real explanatory value, it is important the theory comes from the practices and processes of the designer, along with their reflection and understanding. The interviews and the recorded audio material from the interviews are necessary to retrieve a designer's reflection and understanding of design research, its methodologies and approaches. The collected audio material will be used solely for the purposes of developing an explanatory theory/conceptual framework of design research practice grounded in the practices and understanding of design researchers. Interpretation of the data will be an ongoing process and will take place in tandem with data collection. The grounded theory methods of substantive and theoretical coding, constant comparison and memoing will be used to analyse the data. The ethical issues of this research relate to; •Making sure participants are fully informed about the purpose, methods and intended possible use of the research. This will be achieved by means of a participant information sheet which they will be supplied with prior to participation and interviewing. •Ensuring participants are aware that participation is voluntary and that they may choose at any stage throughout the research and writing up process to withdraw this consent. This will be communicated to the participant in the participant information sheet. Should the participant wish to participate in the research, they will sign a consent form from which they may withdraw at any time if they wish. •Ensuring confidentiality of information supplied. Care will be taken to ensure that the participants and the educational institutions they are associated with are not disclosed in any of the outputs from the research. This will be achieved by using pseudonyms for the participants and by removing other possible identifiers such as detailed project descriptions, institution names and location details. •Ensuring all data and study information collected is stored securely and retained/destroyed in accordance with the Data Protection Act 1998 and the eight Data Protection Principles. Interview audio data will be transcribed. Only anonymised data will be included in the transcription and then all audio tapes will be destroyed. Transcriptions, study information and consent forms will be stored on the researcher's password protected personal computer and/or in a secure cupboard. It will not be possible to link the personal data to any particular transcription. All the above research data will be backed up on a password protected external hard drive. In keeping with Principle 5 of the Data Protection Act 1998, data will be retained for five years after the award of degree. After this period, all personal data will be securely destroyed. . Ensuring participants are informed of the research outcomes. As a thank you for their participation, all participants will receive a short summary of the research in writing when it is complete.

Final Review

Will you have access to personal data that allows you to identify individuals OR access to confidential corporate or company data (that is not covered by confidentiality terms within an agreement or by a separate confidentiality agreement)?

Yes

Please explain below why your research requires the collection of personal data. Describe how you will anonymize the personal data (if applicable). Describe how you will collect, manage and store the personal data (taking into consideration the Data Protection Act and the 8 Data Protection Principles). Explain how you will obtain informed consent (and from whom) and how you will inform the participant about the research project (i.e. participant information sheet).

During the interview process which includes a short questionnaire (attached), personal data about participants will be obtained which will allow an individual to be identified. However, this data will be anonymized in all of the research outputs. This will be achieved by using a coding system and/or pseudonyms and by altering the age slightly. The name and general location of the associated institution will be changed or removed also. Data collection, management and storage. Interview audio data will be transcribed. Only anonymised data will be included in the transcription and then all audio tapes will be destroyed. Transcriptions, study information, consent forms, will be stored on the researcher's password protected personal computer and/or in a secure cupboard. It will not be possible to link the personal data to any particular transcription. All the above research data will be backed up on a password protected external hard drive. In keeping with Principle 5 of the Data Protection Act 1998, data will be retained for five years after the award of degree. After this period, all personal data will be securely destroyed. Informed consent will be obtained from each participant by means of a participant information sheet and consent form. Where possible memos, fieldnotes, will be devoid of personal identifiers and participants and their associated institutions will be given numbers or pseudonyms in the research account. Stored audio material descriptors and linked profile questionnaires will also use pseudonyms or numbers and the researcher will be the only person who will be able to match real names and identifiers with the records kept. To obtain informed consent prospective participants will be sent a participant information sheet and consent form prior to participation in the research.

Will your research involve experimentation on any of the following: animals, animal tissue, genetically modified organisms?	No
Will your research take place outside the UK (including any and all stages of research: collection, storage, analysis, etc.)?	Yes
Does the country in which you are conducting research require that you obtain internal ethical approval (i.e. beyond that required by Bournemouth University)?	No

Please use the below text box to highlight any other ethical concerns or risks that may arise during your research that have not been covered in this form.

The countries where the research will be conducted are Ireland, United Kingdom, Netherlands and Australia. Everything has been covered.

Appendix B: Participant Information Sheet and Consent Form

Participant Information Sheet

Research Project Title: Articulating a Design Research Framework based on a Grounded Theory Approach.

Project researcher: Carmel Maher, Industrial Design Lecturer, designcore, Institute of Technology, Carlow, Ireland

Contact details: carmel.maher@itcarlow.ie

Project supervisor: Prof. Mark Hadfield, Faculty of Science and Technology, Bournemouth University, England

Contact details: mhadfield@bournemouth.ac.uk

You are being invited to take part in a research project. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information. Ask me if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Research Project Purpose

I am a post graduate research student at Bournemouth University and am currently undertaking a PhD in design research methodologies. The research is jointly funded by my employer, the Institute of Technology, Carlow, Ireland and Bournemouth University, England.

The aim of this research study is to increase understanding and knowledge of a design researchers approach to research. I am inviting designers/design researchers to participate in this study because to gain true insight into design research, it is important the data comes from the practices and processes of design researchers, along with their reflection and understanding. The anticipated outcome is a framework to understand, guide and articulate the nature of design research enquiry.

Participation is entirely voluntary. If you do decide to take part you will be given a copy of this information sheet and a consent form, which you will be asked to sign. You can still withdraw at any time should you wish to. You do not have to give a reason.

What Participation Involves

Participation involves filling in a short questionnaire followed by an interview.

Questionnaire

This is to create a profile history and will take approximately five minutes to complete.

Interview

This will last approximately one hour and will be audio recorded. It will take place at a time and location agreeable to both the participant and the researcher. The interview questions will be open ended in order to gain your personal understanding and experiences of design research.

Follow up interviews

It may be useful to return to participants to clarify or explore in more detail some of the research findings. If this is necessary, there may be a second interview with the agreement of the participant at a time and location which suits both researcher and participant.

Benefits/risks of taking part

While there are no immediate benefits for those people participating in this project, it is hoped that this work will help increase understanding and knowledge of a design researchers approach to research. Your participation will also facilitate the learning required to complete my PhD. There are no risks in taking part in this study.

Confidentiality

Research Publications

To ensure confidentiality, your name, associated research institution and any personal information revealed during the research study will be anonymised in all of the research outputs, reports and publications.

Data Storage

Audio recordings will be transcribed and only anonymised data will be included in the transcription and then all audio recordings will be destroyed. Transcribed audio recordings, study information and consent forms will be securely stored on a password protected computer and/or a secure cupboard. It will not be possible to link the personal data to any particular transcriptions. This will be backed up on a password protected external hard drive.

Consent Form

Thank you for taking time to read this information sheet. Your participation is entirely voluntary. If you decide to participate in this study, please sign the attached consent form. Of course, you are free to withdraw at any time.

Contact for further Information

If you require any further information, please do not hesitate to contact me at carmel.maher@itcarlow.ie

Consent Form

Research Project Title: Articulating a Design Research Framework based on a Grounded Theory Approach.

Project researcher: Carmel Maher, Industrial Design Lecturer, designcore, Institute of Technology, Carlow, Ireland

Contact details: carmel.maher@itcarlow.ie

Project supervisor: Prof. Mark Hadfield, Faculty of Science and Technology, Bournemouth University, England

Contact details: mhadfield@bournemouth.ac.uk

Please Initial Here

I confirm that I have read and understood the participant information sheet for the above research project and have had the opportunity to ask questions.	
I understand that my participation is voluntary and that I am free to withdraw at any time up to the point when transcripts are anonymised, without giving reason and without there being any negative consequences. In addition, should I not wish to answer any particular question(s), I am free to decline.	
I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research.	
I agree to take part in the above research project.	

 Name of Participant Date Signature

 Name of Researcher Date Signature

Appendix C: Coding Round One - Matrix

Initial coding of preliminary purposive sample interviews with post graduate and post doctorate academic design researchers (Irish sample)
27 March 2015

Unit of Analysis - Designers Engaged in Research (Post Graduate/Post Doctorate Academic Research), with a focus on their research approach and understanding.			
	Category Code/Concept	Definitional Statement	Property/Dimension
Category A	Being Creative		
Code 1	Being a confident designer	To be a good design researcher, it is necessary to be a confident designer.	Design experience and practice.
Code 2	Being free to break the rules	Breaking new ground in research requires space and freedom to break the rules	Autonomy.
Code 3	Being Creative	For designers creativity is a fundamental part of the research process	Creative in research design and implementation
Code 4	Making judgements	Making judgments is an integral part of the design research process	Research approach, research method, adapting the research method to suit the problem.
Code 5	Relying on intuition	Designers bring skills of intuition to the research process	Intuition based on past design and research experience.
Code 6	Loving design	To be a good design researcher, it is necessary to love design, to care about the outcome.	
Category B	Modeling the research approach on the design process	The basic design process or utilising any design methodology in the process.	Sketching, prototyping, etc.
Code 7	Utilising iterative design process	Design process was the framework which guided the research	Length of time. Number of iterations.
Code 8	Trusting the process	Having confidence in the design process to solve the problem/research question	Design practice experience. Research Experience. Length of experience. Type of experience.
Code 9	Utilising staging posts	Utilising staging posts/milestones to reflect/question/assess the research at any given point	Explore, wide scattering, explore, reflect, narrow, weed out, narrow focus and start again. Funneling process.

**Initial coding of preliminary purposive sample interviews with post graduate and post doctorate academic design researchers (Irish sample)
27 March 2015**

Code 10	Not following a path	The research process evolves with time and exploration-non linear (similar to Grounded theory) inductive/abductive logic.	Re framing process. Research results continually inform and develop the process.
Code 11	Feeling comfortable addressing conflicting and confusing requirements	The design process is suited to these 'wicked problems'	Physical, Social, Environmental, Commercial,
Code 12	Exploring new territory	Designers are accustomed to clients not knowing what they require.	
Code 13	Always returning to the problem	Design research is constantly guided by the problem	The research was grounded in the product.
Code 14	Going deep very quickly	Because design researchers are solution focused, they need to 'fail fast', and move on.	Prototype- test - prototype -test- cycle
Code 15	Using design and design research words interchangeably	The words and processes are intrinsically linked.	Doing research as part of design Doing design as part of research
Category C	Undertaking a cross disciplinary approach		
Code 16	Satisfying human needs requires a cross disciplinary approach	Design research is cross disciplinary borrowing methods from the natural and social sciences.	Physical needs, hard sciences, ergonomics, engineering, etc Aspirational needs, psychology, anthropology, etc.
Code 17	Going back to the thought leaders in a methodological approach	It is important to rigerously understanding the other dicipline methodology before attempting to adapt it.	Ethnography, Grounded theory, etc.
Code 18	Being careful how you blend methodologies	Other discipline methodologies need to be adapted to suit academic requirements.	They are often not designed to suit the requirements of design research.
Code 19	Being cognisant also of your own design ability	Understanding other discipline methodologies but also being cognisant of your own design ability to adapt them for design research purposes.	

Initial coding of preliminary purposive sample interviews with post graduate and post doctorate academic design researchers (Irish sample)
27 March 2015

Category D	Grappling with the tension between design led approach and traditional theoretical research approaches		
Code 19	Feeling like a straight jacket	Fixed nature of academia felt like a straight jacket	Academic evaluation, funding evaluation, publication requirements, etc.
Code 20	Being aware of tensions around quantification of creative input	Contending with the difficulty of assessing/quantifying the creative input/aesthetic encapsulation	Form, detailing, colour, etc. Always in development, no right or wrong solution.
Code 21	Grappling with the theory/practice relationship		The output of theoretical research is theory. The output of design research is product/solution and theory.
Code 22	Feeling uneasy following a design led model	With no role models to follow, there were no guidelines.	
Code 23	Dealing with a lack of design led role models	Design research is emerging and there is a distinct lack of role models.	
Code 24	Dealing with a lack of understanding of design research	Feeling restricted by academic models	Within design community. Outside design community
Code 25	Questioning academic models	Academic models often hindered the research process, weren't relevant.	
Code 26	Adapting the process to suit academia	In the absence of design led role models, research was adapted to suit academia.	
Category E	Gaining increased confidence in design led enquiry	Gaining increased confidence in design led enquiry as a result of doing design research	
Code 27	Adding to the body of knowledge		
Code 28	Having applications in all kinds of fields		
Code 29	Realising the potential of design led enquiry to solve the problem		
Category F	Knowing that design led enquiry was the perfect vehicle to do the research	On reflection a favorable result in the project justified the methodology used.	

Initial coding of preliminary purposive sample interviews with post graduate and post doctorate academic design researchers (Irish sample)
27 March 2015

Code 30	Feeling confident with design led enquiry	Undertaking design research increases confidence in design led inquiry and in the use of design methodologies in the research process.	
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Appendix D: Coding Round Two - Matrix (NVivo Focused Codes with Aggregate Initial Codes)

Adding Creativity and Freedom

Adding creativity

Design Researchers - Dreamers that can do

Encouraging creativity and freedom

Importance of Free Exploration

Methodologies for creativity and research

Trusting the creative process

Utilising the iterative creative process

Working fanatically hard while exploring in a random fashion

Engaging with theory and methodologies

Engaging with design theory and methodologies

Empathic design

Exploring how design research and methods can inform policy development

Framing the problem

Importance of being reflexive and reflective in design research

Noting a lack of success with other policy research approaches

Participatory design or co design methodology

Trialling design research and design methods in policy
User centred design approach
Using narrative to communicate, share and explore in research
Utilising abstract representation as a communication and development tool
Utilising staging posts, milestones, reflection
Utilizing a design user centred approach for policy research
Engaging with other discipline theory and methodologies
Engaging with other discipline theory
Grounded qualitative methodology
Methodologies are useful tools for communicating and mapping when the project is chaotic
Noting tension between free exploration and formal theory and methodology
Noting the limitations of some methodologies mapping tools
Recording something can kill the creativity.
Reflecting on the fact that the policy makers didn't seek out design research methodology, Jules had to suggest it
Tension between creative exploration and compliance
Enthusiasm
Enthusiasm for the project
Loving design

Gaining Experience Through Practice
Bringing tacit knowledge to the research frees the researcher to focus on methodologies
Drawing on previous experiences in design research
Identifying and being motivated by the success of previous applications of design to policy.
Increasing ambition with experience
Increasing confidence with experience of exploring
Initial lack of confidence,
Utilising previous research experience and knowledge gave policy makers confidence in my approach
Outcome Focused
Continual focus on the outcome
Design research methodologies can produce successful outcomes in policy development
Paradigmatic
UK REF
Value Acknowledging value
Acknowledging the value of design and design research methodologies in developing policy
Utilising design research methodologies to understand why policy development research methodologies don't work
Utilizing design methods and design research in policy
Valuing design research

Wicked Problems and diversity

Acknowledging the unpredictable nature of design research

Design is a broad label

Design Research for Policy

Design Research in a University

Design Research in an Art College

Ethical considerations

Interdisciplinary nature

Noting also lack of Western design coolness or credibility.

Noting differences in focus between East and Western approaches to design

Noting high levels of technical expertise in design research in japan

Noting unanticipated outcomes and directions of research

Appendix E: Coding Round Three Matrix: Part 1. Conditions/Context (Why, Where, How and What happens)

Unit of Analysis - Designers Doing Research (Post Graduate/Post Doctorate Academics and Practitioners engaged in Research), with a focus on their approach and understanding. Note: Initial Code Titles are derived from direct quotations from interviews.

Coding paradigm Strauss & Corbin 1990 & 1998. In this paradigm, data analysis is structured by the following headings; 1. Conditions/Context (Why, Where, How and What happens), 2. Actions/Interactions, Emotions, 3. Consequences (of Actions / Interactions / Emotions)

1. Conditions / Context (Why, Where, How and What Happens)

	Category Code/Concept	Coding Paradigm Classification	Description
Category A (Focused Code)	Incorporating Practice	Conditions / Context (What Happens)	Design researchers incorporate practice in their research.
Code 1 (Initial code)	design research "doing the practice to try and find the theory"		This art school academic quotes a colleague who says this about design research as opposed to engineering research where 'traditionally you study theory and carry out practice'
Code 2			

	"practitioners coming to teach with some research"		This art school academic talks of 'practitioners coming to teach with some research' and how that model is
Code 3	"still born of a kind of practtitioning spirit"		This academic in an art school is speaking of his research masters students, saying that their work is approaching formal research but because they do not support methodology teaching, it is not quite there.
Code 4	"heritage around practtitioning"		This art school academic speaks of their heritage around practtitioning.
Code 5	"as a baby you act in order to understand"		Comparing design research to human development.
Code 6	"designs are wilful, they take you where they want to go and not where you want to go"		Ranulph Glanville cited by Tom
Code 7	"cybermetics like design 'feedback' loops and observers being able to feed into feedback loops"		This art school academic describes how cybermetics is quite similar to design practice.
Code 8	"needing a real problem"		the researcher outlines how for good research 'you need a real problem, a real problem that is valued and identified by all' Could also be grouped with category 'outcome focused'

Category B	Incorporating Creativity ("beautiful through creativity")	Conditions / Context (What Happens)	Design researchers incorporate creativity in their research
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Code 1	"What if you made"		this art school academic speaks of the process of his masters students exploring the 'what ifs' in their research and design work.
Code 2	"there's a real lack of creativity with a product like that"		This practitioner speaks of poor quality of design and highlights 'lack of creativity as being a contributing factor.
Code 3	"so the project became"		this art school academic describes how 'the project became' ...'suddenly flipping into a material science resesarch' The node is about the unexpected route of design research.
Code 4	"beautiful through creativity"		This practitioner discusses the role and importance of creativity in addressing the constraints of design.

Category C	Engaging with Academic conventions	Conditions / Context (Why it/What Happens)	Formal research practice was established in academia and its process has set the norms in research practice.
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Code 1	"Accounting for 'classic' PhD route"		The researcher links completing the classic PhD with now being able to supervise PhDs.
Code 2	"If you want to base it and like stretch your intellect then a PhD is the model"		This art school academic outlines the difference between a masters and a PhD.
Code 3	"Using 'standard academic PhD research methods'		The researcher describes using 'research methods which were standard academic PhD research methods'. Why is he doing this? There is a suggestion that their might be other ways, that it is up for debate (my interpretation)
Code 4	"Getting people into that mind of academic research"		this art school academic speaks of the need to 'getting people into that mind of academic research' as there is 'much more emphasis on research'
Code 5	"Using 'rigorous and metric based' methods"		the researcher describes their research methods as 'particularly rigorous and metric based'

Code 6	"Just to make sure everything is recorded in an academic process"		here this art school academic talks of 'churning those out' academic papers but that 'the really exciting part was you know engaging the industry'
Code 7	"needing 'classic research training"		the researcher outlines the importance of receiving 'classic research training'

Category D	"Exploring a real wide territory"	Conditions / Context (What Happens)	Design researchers 'explore a real wide territory'
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Code 1	"Exploring a real wide territory"		This art school academic describes his masters students projects as 'broad lateral design research' 'exploring a real wide territory' with 'very vague start points' . There is much 'what if you made' and 'framing and reframing what the research question was'
Code 2	"broadening of what design research is"		researcher outlining that 'there's a broadening of what design research is and I'm just wondering is a service designer really a designer, a problem solver a designer?'
Code 3	"I suppose now it's much broader"		

			this academic is saying how the range and nature of industrial design Masters student projects are much broader.
Code 4	"Design is now... it reaches into all kinds of different spaces"		this art school academic describes how design is changing and 'reaching into all kinds of different spaces...it could go to the roots of science you know to the levels of business strategy'.
Code 5	"So many research methods"		The researcher indicates that 'there are so many research methods out there' but that you 'need to engage with a bit of responsibility'
Code 6	having "a very flexible approach"		This art school academic describes their approach to PhD supervision as being very flexible to support all their PhDs.
Code 7	"aren't necessarily form a design background"		This art school academic describes how their PhD students come from diverse educational backgrounds and the challenges associated with that.
Code 8	"it was a material science piece of research"		here this art school academic talks of how a masters student project became 'a material science piece of research' highlighting both the unexpected outcome of some projects and the cross disciplinary nature of design research.

Code 9	"building your team is a milestone"		This practitioner emphasises the importance of building a good team in design (referring to the broad range of expertise required).
Code 10	"passionate supporters of design but very different attitudes"		This art school academic describes how two people one cybermetitian, one engineer had very differernt attitudes but both supporters of design.

Category E	Engaging with Funding Mechanisms	Conditions / Context (What Happens / Why it Happens)	Much research funding is regulated by the use of research evaluation metrics.
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Code 1	"REF 2014"		This project was used as a case study of the REF to demonstrate impact.
Code 2	"it's not part of STEM subjects, it's not funded, it's part of humanities"		This art school academic describes how because design is not part of stem, it receives less funding.
Code 3	"lucky to get funding"		The researcher describes how luck is involved in the funding process.

Code 4	REF "someone who we might respect is completely irrelevant to Imperial College"		This art school academic talks about the ref and how collaborative projects/teaching can work with design and engineering because the outputs are non competitive, for example journal publications. (This could also fit with category 'navigating ways')
Code 5	funding difficulties "funding 'applications' as part of research"		this art school academic speaks of the frustrations with existing UK funding models. He describes how they are prepared to fund pure research but it is much more difficult to get funding for the applied design aspect. He does say it is changing now.
Code 6	"the level of funding is that much different"		This art school academic describes how 'the level of funding is that much different' and that much greater sums of money are available for engineering research compared to design research.
Code 7	REF targets "they're very different sort of ultimate measurable targets"		This art school academic speaks how the targets for REF are so different for different disciplines, collaborative projects can work because each discipline will be looking for different impacts and outcomes.
Code 8	design research "its not really funding it"		This art school academic describes how the government is not really funding design research.
Code 9	"you know R and D, the D of design is not what they want to fund"		This art school academic speaks about research funding and the difficulty of getting funding for the design part 'or showing how it might be implemented' This is changing slightly with the REF impact criteria.
Code 10	"Funding model in UK beginning to change to more applied research"		This could also be used in 'Evolution' category.
Code 11	Impact strategy REF 2015		

			The researcher outlines how design research can demonstrate a different kind of practitioner impact than typical citation type journal publication impact.
Code 12	"Slightly looser interpretation" of the REF		The university researcher notes that 'more visually creative institutions that maybe have slightly looser interpretation'

Category F	Being enthusiastic about the outcome	Conditions / Context (What Happens) Character Trait	Design researchers are enthusiastic about the outcome in terms of an application or applicable solution.
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Code 1	"feeling pleased with outcome" outcome focused		The researcher expresses 'I'm really pleased...another cool tool that's needed' his pleasure regarding the outcome of the PhD.
Code 2	"making it more fun"		This practitioner speaks of the importance of enthusiasm and fun for the success of the project.
Code 3	"the fuel that is required is enthusiasm"		this practitioner highlights the importance of enthusiasm in design and research for successful outcomes.

Code 4	having "that enthusiasm to gather the data"		This practitioner speaks of the necessity of having 'enthusiasm' for the project, the design and the research.
Code 5	"enthusiasm"... "distill(ing) a sense of empowerment"		This practitioner talks about enthusiasm and how it empowers people to good design and research.
Code 6	"without enthusiasm you cannot do a good job"		This practitioner speaks about the importance of passion and enthusiasm for 'getting results'

Category G	"Being passionate for practice" / design	Conditions / Context (What Happens) Character Trait	Design researchers feel passionate about design
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Code 1	"being passionate for practice"		The researcher defines himself as having "a practitioner mindset, passionate for practice, I wasn't a classic academic profile" Could also be placed in 'practice' category.
Code 2	"that's where the magic is"		This practitioner speaks of, passion, enthusiasm and magic as important elements in design and research.

Code 3	"magic of design is when design starts telling you what to do rather than you telling it"		Ranulph Glanville cited by Tom
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Category H	Having Tenacity	Conditions / Context (What Happens) Character Trait	Designers/Design researchers require tenacity to find the solution.
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Code 1	"Tenacity is king"		This practitioner speaks of the importance of tenacity in design and research.
Code 2	"Importance of being thorough in your research"		This practitioner talks of the fundamental importance of research as a decision making tool in design.
Code 3	"there is no compromise"		This practitioners " belief is that there is no compromise that when designing a beautiful object there is no half way house, it's all or nothing job and you do whatever it takes to get that job done properly, to get the job done to the best it can be."

Appendix F: Coding Round Three Matrix: Part 2. Actions / Interactions / Emotions

Unit of Analysis - Designers Doing Research (Post Graduate/Post Doctorate Academics and Practitioners engaged in Research), with a focus on their approach and understanding. Note: Initial Code Titles are derived from direct quotations from interviews.

Coding paradigm Strauss & Corbin 1990 & 1998. In this paradigm, data analysis is structured by the following headings; 1. Conditions/Context (Why, Where, How and What happens), 2. Actions/Interactions, Emotions, 3. Consequences (of Actions / Interactions / Emotions)

2. Actions / Interactions / Emotions

	Category Code/Concept	Coding Paradigm Classification	Description
Category A (Focused Code)	Seeing it Differently	2. Action / Interaction	Design researchers see research differently
Code 1 (Initial code)	"Designers do see things differently"		The researcher outlines how in terms of research 'designers do see things differently, they see patterns differently and opportunities emerging.'
Code 2			

	"a word like research is fundamentally boring"		This design practitioner speaks about a perception of research as 'fundamentally boring'
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Category B	Doing it Differently	2. Action / Interaction	Design researchers do research differently
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Code 1	"designers don't work like that"		Researcher outlining how PhD work practice/methodology is not the way designers work.
Code 2	"in that research methodology, we are very different"		this art school academic talks about the very different approach of design researchers and they don't necessarily record' endless notes in a lab unless it was particularly breakthrough'
Code 3	researching or generating new knowledge in their own ways		this art school practitioner speaks of practitioners in the school 'researching or generating new knowledge in their own ways' not like a university model.

Code 4	"fundamental difference....the point (role) of you in the research"		This art school academic describes one of the fundamental differences with design research, the role of the designer in the research and his influence on the research outcome. Perhaps this is why it is so important that the design researcher is passionate, etc, because his influence is relevant and the type of person he is has an impact on the research. he is not removed from it.
Code 5	"as a designer you can't really take yourself out of it" (the research)		This art school academic talks about one of the fundamental differences of design research and scientific research .The position of the researchers as actively involved in the research or remaining outside of it.
Code 6	Engineering "all their research was defined at the start"		This art school academic describes an engineering approach to research where 'all their research was defined at the start'

Category C	Acting Intuitively	2. Action / Interaction	Design researchers (Masters level) act intuitively
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Code 1	"masters level stuff is intuitive and inspirational"		this art school academic outlines the difference between masters and PhD research in this art school. The PhD includes philosophical thinking, a stronger base, drilling down, understanding what the world is doing, what has
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			been done. Is this because of more formal evaluation criteria?
Category D	Having inspiration	2. Action / Interaction	Design researchers include inspiration as a formal process in their work/research (note: this does not work so well at PhD level because of specific research requirements.)
Code 1	"Enough kind of inspirational and sort of application focus to be relevant as a design project"		this art school academic speaks of the academic requirements of a masters design project, namely inspiration and application focus.
Code 2	"inspiring and intriguing " ... "start point"		This art school academic speaks of masters students research having 'inspiring and intriguing ' start points'
Code 3	"more conceptual lateral thinking" ... "the start of a research project"		this academic in an art school is speaking about 'experimental design project' strand at masters level allowing for more conceptual lateral thinking which may form the start of a research project.
Code 4			

	"works at a Masters level to kind of clash (different disciplines) people together"		This art school academic describes different disciplines can mix at masters level but it is more difficult at PhD level because the requirements are more specific.
Category E	Experiencing Tension	2. Emotion	Experiencing tension between creative freedom and academic constraints
Code 1	"trying to get over that fundamental difference (between practice and academic research)"		this art school academic speaks of 'much more emphasis on research' and practitioners 'trying to get over that fundamental difference' , 'getting people into that mind of academic research'
Code 2	noting "tension between industrial design and engineering design"		The researcher describes an interest in researching the tension between 'industrial design and engineering designers as they negotiate new product development.
Code 3	"trying to be a designer in a research world"		This art school academic outlines the difficulties of 'trying to be a designer in a research world' highlighting their differing requirements and values.

Code 4	"the system tries to beat that out of them" creativity		The researcher outlines how 'the system' tries to beat that (creativity) out of them' . The tension between creative freedom and system (PhD) constraints.

Category F	Feeling Constrained	2. Emotion	Design researchers feel constrained by academic research process.
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Code 1	"Research can be very contraining for a creative person"		The researchers reflects on the contraining nature of research for creatives and practitioners.
Code 2	"being forced down that route"		Researcher discussing how some PhD design research students might feel they are being forced down a route.
Code 3	"Cutting the leash" contraining work practice of PhDs		Researcher speaking of the difficulties designers experience doing PhDs becасue it is a different way of working and indicating that 'you need to cut the leash and let them get on with it.

Category G	Feeling Frustrated	2. Emotion	Design researcher feels frustrated that academia doesn't respect research breakthroughs made by his Masters students.
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Code 1	"it's frustrating for us"		this art school academic, in describing his masters student work speaks of them making 'exciting breakthroughs' that 'the academia wouldn't respect that much' and the associated 'frustration' with that.
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Category H	Feeling Cynical	2. Emotion	Design researcher feels cynical regarding the influence of funding metrics on 'research agenda'.
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Code 1	"getting a little bit cynical" re funding process		The researcher outlines how maybe he is 'getting a little bit cynical' about funding metrics and the researchers seeking funding, chasing the money as it were to the detriment of 'hard core' design research.
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Category I	Struggling to do PhDs	2. Action / Interaction / Emotion	Designers struggle to do PhDs
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Code 1	"hard core practitioners struggle to do PhDs"		constraining nature of research and how hard core practitioners struggle to do PhDs because it is so 'rigorous, its about methodology, its all about citing' rule following (my words)
Code 2	"it takes a different attitude"		this art school academic speaks how 'greater emphasis on research' 'it takes a different attitude'
Code 3	"research as in PhD research has grown slower"		This art school academic speaks of the slow growth of PhD research in design.
Code 4	"High age profile of Industrial Designers undertaking PhDs"		The researcher reflects on the difficulty for industrial design practitioners to do PhDs and notes the advanced age of those undertaking PhDs.
Code 5	Noting lack of practitioner expertise in PhD research.		The researcher notes the general lack of applied or practical design expertise in PhD research "it was a classic PhD tool, it was a little bit crude"

Category J	Seeking Respect (Defining research in terms of its academic respectability)	2. Action / Interaction / Emotion	Design researchers seek respect from academia/other design researchers?
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Code 1	"do it with enough rigour for it to be a respectful piece of research"		Here this art school academic speaks of the requirements of academic research.
Code 2	"engage with a bit of responsibility"		The researcher indicates that 'there are so many research methods out there' but that you 'need to engage with a bit of responsibility'
Code 3	"the academia wouldn't respect that much"		this art school academic speaks of 'exciting breakthroughs' in masters student research projects, 'that the academia wouldn't respect that much'

Category K	Navigating Ways		Design researchers seek respect from academia/other design researchers?
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		2. Action / Interaction / Emotion	
Code 1	"navigating ways"		The participant describes his PhD as "kind of navigating ways in which I could use my own practice to answer research questions'
Category L	Struggling to find the research in design	2. Action / Interaction / Emotion	Other discipline/people struggle to find the research in design and designers are so application/outcome focused they sometimes neglect to capture and disseminate the new knowledge
Code 1	not seeing "where the research is in this"		This art school academic describes an engineering students response to a design research method of unstructured people observation and how he struggled to see 'where the research is in this'
Code 2	"how is this helping you answer it or explore it"		This art school academic describes the difference of approach between design and engineering research. This engineering students supervisors were questioning the

			ability of his excellent engineering design solution to answer or explore questions.
Code 3	"when does it actually become research"		This art school academic questions when a design project becomes research in the context of design PhDs.
Code 4	taking "a long time to really know what the research is about"		This art school academic contrasts design research approach to an engineering research approach noting how it takes a long time for the design 'researcher to really know what the research is about. (This is a little like grounded theory, it emerges as a result of the research.

Category M	Not focused on capturing new knowledge	2. Action / Interaction / Emotion	Designers are not focused on capturing the new knowledge generated in their research. They are more concerned with its application.
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Code 1	"it's not focused on how to capture that new knowledge"		this art school academic speaks of practitioners 'researching or generating new knowledge in their own ways..(.but) its not focused on how to capture that new
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			knowledge' He is talking about how more thought needs to go into capturing that new knowledge and making it visible.
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Category N	Asking the right questions	2. Action / Interaction / Emotion	Designers stress the importance of asking the right questions to find an applicable solution
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Code 1	"framing and reframing what the question was"		this art school academic speaks of his masters students research and design projects and how in the early stages they are 'framing and reframing what the question was'. This reminds me of schon.
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Category O	Being able to empathise	2. Action / Interaction / Emotion	
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Code 1	"being able to empathetic enables you to ask the questions"		This practitioner outlines the importance of asking many questions and the right questions, He says how being
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			able to be empathetic is important to asking the right questions.
Code 2	"abstract empathy is absolutely critical"		This practitioner talks about the importance of empathy and extends this to empathising with the product, the environment etc.
Code 3	"asking the right questions"		This practitioner highlights the importance of asking the right questions and never stopping asking questions to have design success.

Category P	"A billion whys"	2. Action / Interaction / Emotion	Designers never stop asking questions
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Code 1	"a billion whys"		This practitioner stresses the importance of asking questions 'a billion questions' for a successful outcome.
Code 2	"never stop asking questions"		This practitioner highlights the importance of continually asking questions for a successful design.

Category Q	"Test, text, test"	2. Action / Interaction / Emotion	This practitioner outlines the importance of user testing in design.
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Code 1	"test, test, test"		This practitioner emphasises the importance of user testing.
Code 2	"you have to user test"		This practitioner outlines the importance of user testing in design.

Appendix G: Coding Round Three Matrix: Part 3 Consequences of Actions / Interactions / Emotions

Unit of Analysis - Designers Doing Research (Post Graduate/Post Doctorate Academics and Practitioners engaged in Research), with a focus on their approach and understanding. Note: Initial Code Titles are derived from direct quotations from interviews.

Coding paradigm Strauss & Corbin 1990 & 1998. In this paradigm, data analysis is structured by the following headings; 1. Conditions/Context (Why, Where, How and What happens), 2. Actions/Interactions, Emotions, 3. Consequences (of Actions / Interactions / Emotions)

3. Consequences of Actions / Interactions / Emotions

	Category Code/Concept	Coding Paradigm Classification	Description
Category A (Focused Code)	Having a Measurable Impact	3. Consequences of Actions / Interactions / Emotions	
Code 1 (Initial code)	Research Purpose "to give you a result you can use"		This practitioner outlines the fundamental importance of research, as a means of making decisions, 'otherwise it is fundamentally useless'

Code 2	"take this process and productise it"		This academic is talking about experiemental masters research projects in an art school where they might take some breakthrough in research and 'productise' it or look for a novel and useful product application. (Is this research?)
Code 3	"potential to come up with cool stuff"		Researcher indicating that 'because they really understand the details of the academic bit and they are creative, there's the potential to come up with cool stuff'
Code 4	"the impact of design is very, very powerful for the economy, important for society"		This art school academic describes how important design and design research is., yet it struggles to get significant funding.
Code 5	"kind of project makes really exciting breakthroughs"		This art school academic talks of expereimental conceptual research projects which make 'really exciting breakthroughs' but do not necessarily 'the academic world respect'
Code 6			

	"much of the REF able material has been partly generated by practicing work"		This art school academic speaks of practicing work being put in the ref.
Code 7	"the really exciting part was you know engaging the industry"		this art school academic talks of publication as almost 'auditing exercise' but the 'really exciting part was engaging with the industry' highlighting the different value systems between art school practice and academia.
Code 8	Noting how PhDs "just get stuck on a shelf"		The researcher notes how PhD research gets lost "they tend to come and go and then they just get stuck on a shelf and they're all down there"
Code 9	Noting "researchers identifying there was a need for this"		The researcher comments on researchers insight. He describes how this comes from practice experience.

Category B	Adding Value		
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		3. Consequences of Actions / Interactions / Emotions	Designers researchers add value by "making more sense" of the research.
Code 1	"Making more sense" of the research		The researcher indicates that by being engaged in the research, designers can then make more sense of it for practical application.
Code 2	"designers can add value I think"		the researcher outlines how 'designers can add value' to research.
Code 3	design research "fundamental game changer in new knowledge and development in research terms"		this art school academic highlights the value of design research in terms of 'new knowledge and development' and suggests design should build on that and 'grow respect through rigour and discovery'
Code 4			

	"solving the world's problems through design thinking"		Cynical statement re evolution of design to design thinking as a way of saving the world. 'Hard core' design is getting devalued. Could move to 'feeling cynical'
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Category C	EVOLUTION of design research to a more academic model	3. Consequences of Actions / Interactions / Emotions	"change to a more normal university style model"
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Code 1	"change to a more normal university style model"		Here this art school academic speaks how their engagement with the ref is changing to a more normal university style model.
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Code 2	"bring that up to a more, kind of normal university approach"		this art school academic talks about the move to 'much more emphasis on research' and the ref and that their approach 'bring that up to a much, kind of normal university approach' in terms of doing more formal type university research rather than practice.
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Code 3	"we always team supervise our students"		This art school academic speaks of the necessity of team supervision in PhDs in design, because the student backgrounds are diverse with varying approaches and also it is important to have 'research theory' support.
Code 4	opting "for the classic" PhD research route		The researcher describes a practice based approach and then outlines how he went for the 'classic 70,000 word thesis' despite his interest in a practice based route, but doesn't say why. Suggestion, an obligation or greater recognition?
Code 5	"culture shift in training"		This art school academic speaks of 'greater emphasis on research' and how there is a 'culture shift in training... of getting people into the mind of academic research'
Code 6	"much more emphasis on research"		This art school academic speaks of 'much more emphasis on research now in the school than there used to be.

Code 7	always making sure "there is a PhD research theory" supervisor		Here this art school academic notes the need for PhD research theory' expertise to support the project.
Code 8	"exploring classic design PhD"		This art school academic speaks of a student exploring a 'classic PhD design'
Code 9	"the methodologies section can be quite weak"		researcher noting that some practice based PhDs methodologies section can be weak.
Code 10	"harder to imagine it (cross disciplinary collaboration) working at PhD (the ID/Engineering collaboration)"		This art school academic describes how collaborative projects can work at masters level but it is more difficult at PhD level because the academic requirements are more clearly defined and different.

Category D	EVOLUTION of design research to a more practice based PhDs	3. Consequences of Actions / Interactions / Emotions	
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Code 1	Noting move to practice based PhDs		The researcher indicates that 'there are PhDs now with reduced word count 40,000 and you design some stuff, the stuff is part of the thesis'
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Code 2	"ideal PhD is design practice so design project but builds on a strong theoretical base"		This art school academic describes their ideal PhD.

Category E	EVOLUTION of design research to more focus on winning funding	3. Consequences of Actions / Interactions / Emotions	
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Code 1	"much more emphasis on grant wins"		this art school academic speaks of much more emphasis on 'grant wins' in the school
Code 2	REF "benefits design because the ' impact 'measurement of it"		this art school academic speaks of the increased focus on impact of the ref benefits design.

Category F	Creating an Opportunity for Design Research	3. Consequences of Actions / Interactions / Emotions	

Code 1	"perhaps there's a real opportunity for design research to grow respect"		this art school academic discusses how 'perhaps there's a real opportunity for design research to grow respect' ...'as being an important you know fundamental game changer in new knowledge and development and research terms'
Code 2	figuring "out what we were doing in design research that made sense"		This art school academic talk of the journey figuring out what they were doing in design research that made sense to them.

Code 3	"ordinarily a design is just building on something rather than doing that fundamental research"		This art school academic speaks of the struggles with getting funding for design research because design focuses more on the applications rather than the fundamental research .
Code 4	"launch point for some more serious research"		this academic speaks of his masters students work as being a launch point for more serious research. Its like they are the creative spark for research ideas with potential.
Code 5	design research "lots of great work in exploring new processes, methodology.		This art school academic says it is easier to get funding for this type of design research than the applied type because it is more close to pure research.
Code 6	"work at the same level of rigour and quality at embodiment and application and understanding of science"		This art school academic discusses how design researchers strengths lie in 'embodiment and application' and he talks about how exciting it might be if they worked with scientists, but focused on 'embodiment and application' at the same level of rigour.

Code 7	"huge opportunity for design to get into technology led innovation"		This art school academic discusses the difference between 'technology led innovation' and 'design led innovation' indicating that collaborating would greatly improve the research.
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Category G	Requiring a Supportive Environment	3. Consequences of Actions / Interactions / Emotions	
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Code 1	needing "an environment that supports that kind of vaguely 'framed' research"		This art school academic speaks of how design researchers need an 'environment that supports that kind of vaguely framed' research.
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Code 2	having "the freedom of design"		This practitioner outlines how it was good and important for him to have 'freedom of design' to be 'allowed to run away with your own ideas'. He got this with small business clients as opposed to more inflexible large corporations.
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Appendix H: Coding Round Four Matrix: Value Difference

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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Unit of Analysis – Designers Doing research: Post Graduate/Post Doctorate Academics and Practitioners engaged in Research, with a focus on their approach and understanding.

Grounded Theory: Navigating Difference

Coding Round: Four

Coding Category: Recognising Difference

Coding Sub Category: Value Difference (Personal to the Designer)

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Focused Code A Relating to Coding Category: Recognising Difference (Value Difference)	Seeing It Differently	Design researchers spoke of “see[ing] things differently” Val. In this way they were referring to both their ‘research values’ and their ‘way of seeing’. ‘Way of seeing’ as a methodology is considered in more detail in Coding Sub Category: Process Difference.			
Initial Code 1	“Designers do see things differently” Val	Val outlines how in terms of research “designers do see things differently, they see patterns differently and opportunities emerging”	4	21	Val – 3 Alex – 3 Ali - 4 Sydney - 4
Initial Code 2	“a word like research is fundamentally boring” Drew	Drew, a design practitioner speaks about a perception of research among designers as being “ fundamentally boring”. Here they are talking about ‘value difference’.	2	2	Drew – 3 Sydney - 4
Initial Code 3	“Every design researchers approach is different as well” Frankie	Frankie describes the importance of the individual researcher’s creative approach to the research.	1	14	Frankie - 1
Initial Code 4	“Every design research subject is different, to be explored in different ways” Frankie	Frankie describes how design research topics are ‘situated’ and require tailored research approaches.	1	14	Frankie - 1
Initial Code 5	“do we know we’re going to get value for data type rigour” Ali	Interesting definition of rigor looking at if the method had relevance to the question. This is interesting for design because many times the rigor of	1	1	Ali - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
		established research methods may be sacrificed for relevance.			
Focused Code B Relating to Coding Category: Recognising Difference (Value Difference)	Passion and Enthusiasm for Design	Design researchers were consistent in their reference to the necessity for passion and enthusiasm for design for a successful research outcome.			
Initial Code 1	“really pleased” with the outcome, Val	Val states “I’m really pleased another cool tool that’s needed” Here they are expressing their pleasure regarding the outcome of the PhD.	3	18	Val - 3 Alex – 3 Sydney - 4
Initial Code 2	“making it more fun” Drew	Drew, a practitioner speaks of the importance of enthusiasm and fun for the success of the project.	2	4	Drew – 3 Sydney - 4
Initial Code 3	“the fuel that is required is enthusiasm” Drew	Drew, a practitioner highlights the importance of enthusiasm in design and research for successful outcomes.	2	3	Drew – 3 Kelly - 4
Initial Code 4	Having “that enthusiasm to gather the data” Drew	Drew, a practitioner speaks of the necessity of having ‘enthusiasm’ for the project, the design and research.	3	11	Drew – 3 Sydney – 4 Kelly - 4
Initial Code 5	"enthusiasm"... "distill(ing) a sense of empowerment" Drew	Drew, a practitioner taking about enthusiasm and how it empowers people to good design and research.	1	3	Drew - 3

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 6	"without enthusiasm you cannot do a good job" Drew	Drew, a practitioner speaks about the importance of passion and enthusiasm for 'getting results'	2	9	Drew – 3 Sydney - 4
Initial Code 7	"being passionate for practice" Val	Val self-defines as having "a practitioner mind-set, passionate for practice, I wasn't a classic academic profile" This code could also be placed in 'practice' category.	4	22	Val – 3 Alex – 3 Drew – 3 Sydney - 4
Initial Code 8	"that's where the magic is" Drew	Drew, a practitioner speaks of, passion, enthusiasm and magic as important elements in design and research.	2	3	Drew – 3 Sydney - 4
Initial Code 9	"magic of design is when design starts telling you what to do rather than you telling it" Alex citing a work colleague	Alex an academic, quotes a work colleague, to illustrate how "magic of design", that is, design process, design problems and creativity bring the research to unanticipated places.	1	1	Alex - 3
Initial Code 10	Enthusiasm for the project	These researchers all express their enthusiasm for design approaches to research, whether it be in the public sector, ethnographic studies or new product development.	3	14	Jules – 2 Sam – 2 Ashley 2
Initial Code 11	Loving Design	These researchers speak of their love of design. To quote Ashley with reference to a research project worked on they stated, "It was, it was bliss."	2	16	Sam – 2 Ashley 2

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 12	Loving Design	To be a good design researcher, it is necessary to love design, to care about the outcome. (Different coding round)	3	19	Lee – 1 Frankie – 1 Sam - 1
Initial Code 13	“certainly a creative spirit” Kelly	Kelly discusses the importance of design researchers having a creative spirit	1	1	Kelly - 4
Focused Code C Relating to Coding Category: Recognising Difference (Value Difference)	Valuing Application and Impact	These researchers consistently refer to the value and importance of research application and impact.			
Initial Code 1	Research Purpose "to give you a result you can use" Drew	Drew, a practitioner outlines the fundamental importance of research, as a means of making decisions, 'otherwise it is fundamentally useless'	2	16	Drew – 3 Alex - 3
Initial Code 2	"take this process and product-ise it" Alex	Alex, an academic is talking about experimental Masters research projects in an art school where they might take some breakthrough in research and 'product-ise' it or look for a novel and useful product application. (Is this research?)	2	11	Alex – 3 Sydney - 4
Initial Code 3	"potential to come up with cool stuff" Val	Val, an academic researcher indicating that “because they [design researchers] really understand the details of the academic bit and they	3	17	Val – 3 Alex – 3 Sydney - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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		are creative, there's the potential to come up with cool stuff" Val			
Initial Code 4	"the impact of design is very, very powerful for the economy, important for society" Alex	Alex, an art school academic describes how important design and design research is, yet it struggles to get significant funding.	2	3	Alex – 3 Sydney - 4
Initial Code 5	"kind of project makes really exciting breakthroughs" Alex	Alex, an art school academic talks of experimental conceptual research projects which make "really exciting breakthroughs" but do not necessarily receive "the academic worlds respect".	2	7	Alex – 3 Sydney - 4
Initial Code 6	"much of the REF able material has been partly generated by practicing work" Alex	Alex, an art school academic speaks of practicing work being put in the REF.	1	2	Alex - 3
Initial Code 7	"the really exciting part was you know engaging the industry" "you got the sense of great it's not just about writing a paper and ticking I've got this many papers written, it's like I did create something that had an impact"	Alex, an art school academic talks of publication as almost an 'auditing exercise' but the "really exciting part was engaging with the industry" again valuing application and impact in research over publication.	2	4	Alex – 3 Sydney - 4
Initial Code 8	Noting how PhDs "just get stuck on a shelf" Val	Val, an academic notes how PhD research gets lost "they tend to come	1	2	Val - 3

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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		and go and then they just get stuck on a shelf and they're all down there"			
Initial Code 9	Noting "researchers identifying there was a need for this" Val	Val, an academic comments on design researchers' insight. He describes how this comes from practice experience.	2	12	Val – 3 Alex - 3
Initial Code 10	Continual focus on the outcome	These three researchers consistently refer to the value and importance of research application and outcome.	3	43	Jules – 2 Sam – 2 Ashley -2
Initial Code 11	Design research methodologies can produce successful outcomes in policy development	Jules, describes how design research approaches have great benefit for policy development outcome, as it is can adapt to, focus on and address complex questions. The point is that design research approach can improve research outcome.	1	3	Jules - 2
Initial Code 12	Design has application in non-traditional contexts	Jules goes on to outline how design research approach can improve research application and outcome in non-traditional contexts.	1	4	Jules - 2
Initial Code 13	"Realising that existing designs were based on notions rather than concrete research" Frankie	Frankie described how 'user focus' was missing in a medical research project undertaken and how design led research focused on concrete grounded research 'user needs'.	1	7	Frankie - 1

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 14	"cross overs in methodology...[between] research to inform developing a product and research to generate new knowledge" Ali	Ali speaks about cross overs in methodology between research for practice " to inform developing a product and research you do to generate new knowledge" Same methods but different aims and outcome.	3	12	Ali – 4 Sydney – 4 Kelly - 4
Initial Code 15	"looking for novel applications and designs"... "Seeing novel applications for technology" Sydney	Sydney describes how his PhD students are looking for "looking for novel applications and designs"	1	5	Sydney - 4
Initial Code 16	"it's still very tangible research that something comes out of it" Kelly	Kelly describes design research as having an outcome.	1	1	Kelly - 4
Focused Code D Relating to Coding Category: Recognising Difference (Value Difference)	Valuing Meaning	These researchers stress the importance of sense making and meaning in design research.			
Initial Code 1	"Making more sense" of the research. Val	Val, an academic researcher indicates that by being "ensconced" in the research, designers can then make more sense of it for practical application.	4	18	Val – 3 Alex – 3 Drew – 3 Sydney - 4
Initial Code 2	"designers can add value I think" Val	Val, an academic researcher outlines how "designers can add value" to research by making sense of it.	3	8	Val – 3 Alex – 3 Sydney - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 3	design research "fundamental game changer in new knowledge and development in research terms" Alex	Alex, an art school academic highlights the value of design research in terms of "new knowledge and development" and suggests design should build on that and "grow respect through rigour and discovery"	2	3	Alex – 3 Sydney - 4
Initial Code 4	"solving the world's problems through design thinking" Val	Val mentions feeling cynical when commenting on the evolution of design to 'design thinking' as a way of saving the world. 'Hard core', [traditional] design is getting devalued. Could move to 'feeling cynical'	3	5	Val – 3 Alex – 3 Sydney - 4
Initial Code 5	Acknowledging the value of design and design research methodologies in developing policy	Jules outlines how design research approach supports sense making and meaning, very useful in developing policy.	1	8	Jules - 2
Initial Code 6	Utilising design research methodologies to understand why policy development research methodologies don't work	Jules outlines how design research approach identifies why policy development research methodologies don't work, because they can sometimes be more quantitative and need to focus on meaning.	1	2	Jules - 2
opInitial Code 7	Utilizing design methods and design research in policy	Jules discusses the successful application of design methods and design research in policy development.	1	12	Jules - 2

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 8	Valuing design research	Both these researchers consistently refer to the value of design research to provide solutions to life's problems because of their focus on meaning and application.	2	12	Jules – 2 Ashley - 2
Initial Code 9	"They didn't know what they wanted" Frankie	Frankie felt that practice based research was the perfect vehicle to do this ergonomic/product study because the clients did not know what the issues were and a practice based approach provided a solid methodology. The practice based approach made sense of the problem.	1	14	Frankie - 1
Initial Code 10	"looking at meaning driven innovation" Sydney	Sydney describes design PhD projects where the focus is on finding innovative meaning and application for particular technologies.	1	2	Sydney - 4

Appendix I: Coding Round Four Matrix: Process Difference

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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Unit of Analysis – Designers Doing research: Post Graduate/Post Doctorate Academics and Practitioners engaged in Research, with a focus on their approach and understanding.

Grounded Theory: Navigating Difference

Coding Round: Four

Coding Category: Recognising Difference

Coding Sub Category: Process Difference (Interactive Role of Designer)

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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Focused Code A Relating to Coding Category: Recognising Difference (Process Difference)	Doing it Differently	Design researchers do research differently.			
Initial Code 1	"designers don't work like that" Val	Val outlining how PhD work practice/methodology is not the way designers work.	2	6	Val – 3 Alex - 3
Initial Code 2	"in that research methodology, we are very different" Alex	Alex, an art school academic talks about the very different approach of design researchers and that they don't "necessarily record endless notes in a lab unless it was particularly breakthrough".	1	1	Alex - 3
Initial Code 3	"researching or generating new knowledge in their own ways" Alex	Alex, an art school academic speaks of practitioners in the school "researching or generating new knowledge in their own ways" not like a university model.	2	3	Alex – 3 Sydney - 4
Initial Code 4	"fundamental difference....the point (role) of you in the research" Alex	Alex, an art school academic describes one of the fundamental differences with design research, the role of the designer in the research and his influence on the research outcome. Perhaps this is why it is so important that the design researcher	2	2	Alex – 3 Ali - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
		is passionate, etc., because their influence is relevant and the type of person they are has an impact on the research. They are not removed from it.			
Initial Code 5	"as a designer you can't really take yourself out of it" (the research) Alex	Alex, an art school academic talks about one of the fundamental differences of design research and scientific research. The position of the researchers as actively involved in the research or remaining outside of it.	3	3	Alex – 3 Ali – 4 Sydney - 4
Initial Code 6	Engineering "all their research was defined at the start" Alex	Alex, an art school academic describes an engineering approach to research where "all their research was defined at the start". Alex is referring to the problem being more clearly defined than a design problem.	1	2	Alex - 3
Initial Code 7	"feeling at sea in a world of theory" Frankie	Frankie described as "feeling at sea in a world of theory" when trying to resolve the "aesthetic contribution" in design research.	1	6	Frankie - 1
Initial Code 8	"Feeling unsure how to model the creative PhD process" Frankie	Frankie describes the difficulties of quantifying or referencing the creative process in design research.	1	9	Frankie - 1

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 9	"very used to quite a chaotic design process." Ali	Ali describes how design researchers are "very used to quite a chaotic design process." Ali	1	1	Ali - 4
Focused Code B Relating to Coding Category: Recognising Difference (Process Difference)	Incorporating Creativity/Requiring Freedom				
Initial Code 1	"What if you made" Alex	Alex, an art school academic speaks of the process of his masters students exploring the 'what ifs' in their research and design work.	2	4	Alex – 3 Sydney - 4
Initial Code 2	"there's a real lack of creativity with a product like that" Drew	Drew, a practitioner speaks of poor quality of design and highlights "lack of creativity" as being a contributing factor.	1	3	Drew - 3
Initial Code 3	"so the project became" Alex	Alex, an art school academic describes how "the project became" ..."suddenly flipping into a material science research" The code is about the unexpected route of design research.	3	5	Alex – 3 Ali – 4 Sydney - 4
Initial Code 4	"beautiful" through creativity Drew	Drew, a practitioner discusses the role and importance of creativity in addressing the constraints of design.	3	5	Drew – 3 Alex – 3 Sydney - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 5	Being a confident designer	To be a good design researcher, it is necessary to be a confident designer.	3	15	Lee – 1 Frankie – 1 Sam - 1
Initial Code 6	Being free to break the rules	Breaking new ground in research requires space and freedom to break the rules, to be creative.	3	23	Lee – 1 Frankie – 1 Sam - 1
Initial Code 7	“Being Creative”	For designers creativity is a fundamental part of the research process.	3	39	Lee – 1 Frankie – 1 Sam - 1
Initial Code 8	Making Judgements	Making judgements is an integral part of the design research process.	3	16	Lee – 1 Frankie – 1 Sam - 1
Initial Code 9	Relying on Intuition	Designers bring skills of intuition to the research process.	3	23	Lee – 1 Frankie – 1 Sam - 1
Initial Code 10	Loving Design	To be a good design researcher, it is necessary to love design, to care about the outcome.	3	19	Lee – 1 Frankie – 1 Sam - 1
Initial Code 11	Adding Creativity	These researchers speak of the importance of adding creativity to the research process.	3	27	Jules – 2 Sam – 2 Ashley -2
Initial Code 12	Design Researchers – “Dreamers that do” Ashley	Ashley describes design researchers as “dreamers who do” articulating the need for hard work and creativity.	1	9	Ashley - 2
Initial Code 13	Encouraging creativity and freedom	Jules makes a case for encouraging creative approaches in public sector	2	18	Jules – 2 Ashley - 2

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
		research. Ashley encourages research students to “create an abstract piece for me of their project” before commencing research.			
Initial Code 14	Importance of free exploration	Both these researchers discuss at length the importance of free and creative exploration in research.	2	39	Sam – 2 Ashley - 2
Initial Code 15	Methodologies for creativity and research	Both these researchers describe a range of creative approaches to research.	2	16	Jules – 2 Ashley - 2
Initial Code 16	Trusting the creative process	These three researchers speak of the importance of trusting creative design process in research.	3	26	Jules – 2 Sam – 2 Ashley -2
Initial Code 17	Utilising the iterative creative process	These three researchers speak of the iterative nature of creative design process in research.	3	12	Jules – 2 Sam – 2 Ashley -2
Initial Code 18	Working fanatically hard while exploring in a random fashion	Both these researchers speak of the requirement of working fanatically hard while exploring in a creative manner.	2	4	Ashley -2 Jules – 2
Initial Code 19	“looking for novel applications and designs” Sydney	Sydney describes how design PhD students are looking for "looking for a novel applications and designs" This requires a creative and inspiring approach.	1	3	Sydney - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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Focused Code C Relating to Coding Category: Recognising Difference (Process Difference)	Incorporating Practice	Design researchers model/frame their research on a design practice approach and/or incorporate design practice methods in their research methodologies.			
Initial Code 1	design research "doing the practice to try and find the theory" Alex cites a colleague	Alex, an art school academic quotes a colleague who says this about design research as opposed to engineering research where 'traditionally you study theory and carry out practice'	2	4	Alex – 3 Ali - 4
Initial Code 2	"practitioners coming to teach with some research" Alex	Alex, an art school academic talks of "practitioners coming to teach with some research" and how that model is changing to greater emphasis on research.	1	1	Alex - 3
Initial Code 3	"still born of a kind of practicing spirit" Alex	Alex, an academic in an art school is speaking of his research masters students, saying that their work is approaching formal/traditional research but because they do not support methodology teaching, it is not quite there.	2	16	Alex – 3 Ali - 4
Initial Code 4	"heritage around practicing" Alex	Alex, an art school academic speaks of their heritage around practicing.	1	1	Alex - 3

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 5	"as a baby you act in order to understand" Alex	Alex, an art school academic comparing design research to human development.	1	3	Alex - 3
Initial Code 6	"designs are wilful, they take you where they want to go and not where you want to go" Alex cites a colleague.	Alex, an art school academic talks about the 'wicked nature' of design problems and their lack of structure.	1	1	Alex - 3
Initial Code 7	"cybernetics like design 'feedback' loops and observers being able to feed into feedback loops" Alex	Alex, an art school academic describes how cybernetics is quite similar to design practice.	1	1	Alex - 3
Initial Code 8	"needing a real problem" Val	Val outlines how for good design research "you need a real problem, a real problem that is valued and identified by all' Could also be grouped with category 'outcome focused'	2	3	Val – 3 Alex - 3
Initial Code 9	Utilising iterative design process	All three researchers spoke of incorporating design process in their research.	3	11	Lee – 1 Frankie – 1 Sam - 1
Initial Code 10	Trusting the process	All three researchers continually referred to their confidence and trust in design led inquiry to solve the research problem/question.	3	66	Lee – 1 Frankie – 1 Sam - 1
Initial Code 11	Utilising staging posts	Frankie and Sam spoke of the necessity of staging posts to add structure/discipline and	2	23	Frankie – 1 Sam - 1

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
		reflect/question/assess the research at any given point.			
Initial Code 12	Not following a path	All three researchers spoke of the non-linear research process of design research, where research results continually inform and develop the process. Inductive/abductive logic.	3	27	Lee – 1 Frankie – 1 Sam - 1
Initial Code 13	Feeling comfortable addressing conflicting and confusing requirements	All three researchers felt comfortable addressing confusing and conflicting requirements. They felt the design process was suited to these 'wicked problems'.	3	14	Lee – 1 Frankie – 1 Sam - 1
Initial Code 14	Exploring new territory	Designers are accustomed to exploring new territory. They gain this experience because clients often do not know what they require in design practice.	3	25	Lee – 1 Frankie – 1 Sam - 1
Initial Code 15	Always returning to the problem	Design research is constantly guided by the problem. Design research focuses on the result, not the process.	2	18	Frankie – 1 Sam - 1
Initial Code 16	Going deep very quickly	Lee recommends jumping straight in, start designing early on in the research process. Because design researchers are solution focused, they need to 'fail fast' and move on and learn from this.	1	6	Lee - 1

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 17	Using design and design research words interchangeably	Sam talks about using the words design and design research interchangeably.	1	1	Sam - 1
Initial Code 18	Empathic design	All three design researchers speak about the importance of using an empathic design approach in research in order to understand the user of the product/service system the research is supporting.	3	33	Jules – 2 Sam – 2 Ashley -2
Initial Code 19	Exploring how design research and methods can inform policy development	Jules speaks illustrates the benefits of using a design led research approach in policy development.	1	12	Jules - 2
Initial Code 20	Framing the problem	All three design researchers speak about how a design led approach supports problem framing in the early stages of research.	3	33	Jules – 2 Sam – 2 Ashley -2
Initial Code 21	Importance of being reflexive and reflective in design research	Sam discusses the importance of being reflexive and reflective in design research.	1	2	Sam - 2
Initial Code 22	Noting a lack of success with other policy research approaches	Jules outlines how lack of success of some policy interventions is because the policy makers do not really understand the user and this is where design research user centred approach can help.	1	11	Jules - 2

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 23	Participatory design or co design methodology	All three design researchers see great benefit in utilising participatory design or co design methodology in design research as a way to understand human behaviour.	3	22	Jules – 2 Sam – 2 Ashley -2
Initial Code 24	triallying design research and design methods in policy	Jules speaks about trialling design research and design methods in policy development.	1	9	Jules - 2
Initial Code 25	User centred design approach	Jules outlines the benefits of user centred design approach in policy research	1	5	Jules - 2
Initial Code 26	Using narrative to communicate, share and explore in research	Ashley describes the use of narrative in design research to explore ideas and inspire productive research direction.	1	6	Ashley -2
Initial Code 27	Utilising abstract representation as a communication and development tool	Ashley describes the use of abstract representation as a communication and development tool in design research.	1	4	Ashley - 2
Initial Code 28	Utilising staging posts, milestones, reflection	Jules and Sam discuss the importance of staging posts, miles stones and continued reflection in design research.	2	9	Jules – 2 Sam - 2
Initial Code 29	Utilising a design user centred approach for policy research	Jules makes a case for utilising a design user centred design approach for policy research.	1	11	Jules - 2

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 30	"there has to be some kind of flexibility. But still there's deadlines" Kelly	Kelly describes design research practice noting the need for flexibility of approach but also the need for structure and deadlines	1	1	Kelly - 4
Focused Code D Relating to Coding Category: Recognising Difference (Process Difference)	Requiring Inspiration (many of the creativity codes could appear in this category also.)	Design researchers include inspiration as a formal process in their work/research (note: this does not work so well at PhD level because of specific research requirements.)			
Initial Code 1	"Enough kind of inspirational and sort of application focus to be relevant as a design project"	Alex, an art school academic speaks of the academic requirements of a masters design project, namely inspiration and application focus.	1	2	Alex - 2
Initial Code 2	"inspiring and intriguing " ... "start point"	Alex, an art school academic speaks of masters students research having 'inspiring and intriguing ' start points'	2	3	Alex – 2 Kelly - 4
Initial Code 3	"more conceptual lateral thinking" ... "the start of a research project"	Alex, an academic in an art school is speaking about 'experimental design project' strand at masters level allowing for more conceptual lateral thinking which may form the start of a research project.	1	7	Alex - 2
Initial Code 4	"works at a Masters level to kind of clash (different disciplines) people together"	Alex, an art school academic describes different disciplines can mix at masters level but it is more difficult	1	2	Alex - 2

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
		at PhD level because the requirements are more specific.			
Initial Code 5	"masters level stuff is intuitive and inspirational"	Alex, an art school academic outlines the difference between masters and PhD research in this art school. The PhD includes philosophical thinking, a stronger base, drilling down, understanding what the world is doing, what has been done. My question. Is this because of more formal evaluation criteria?	1	1	Alex - 2
Initial Code 6	"Relying on intuition in the creative process" Frankie	Frankie describes the importance of creativity, judgement and intuition in design research and the requirement for freedom.	1	9	Frankie - 1
Initial Code 7	"We would start a project almost like a discovery phase or a research phase where we're looking at competition and even inspiration around that kind of subject" Kelly	This practitioner researcher speaks about the inspirational starting point of a design research project.	1	1	Kelly - 4
Focused Code E Relating to Coding Category: Recognising Difference (Process Difference)	Undertaking a cross disciplinary approach				

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 1	Satisfying human needs requires a cross disciplinary approach	Design research is cross disciplinary borrowing methods from the natural and social sciences.	2	12	Lee – 1 Frankie – 1
Initial Code 2	Going back to the thought leaders in a methodological approach.	It is important to rigorously understand the other discipline methodology before attempting to adopt it.	3	15	Lee – 1 Sam – 1 Sydney - 4
Initial Code 3	Being careful how you blend methodologies	Other discipline methodologies need to be adapted to work for design application but be careful how you blend them.	2	18	Lee – 1 Sydney - 4
Initial Code 4	Being cognisant also of your own design ability.	All three researchers stress that is important to understand other discipline methodologies but also be cognisant of your own design ability to adapt them for design research purposes.	3	24	Lee – 1 Frankie – 1 Sam - 1
Initial Code 5	Engaging with design theory and methodologies	Jules makes the point that as design methodology moves into non-traditional design research contexts, for example, public sector and policy, designers need to become knowledgeable about the discipline area they are working within.	1	1	Jules - 2
Initial Code 6	Engaging with other discipline theory and methodologies	All three researchers engage with other discipline theory and methodologies.	4	22	Jules – 2 Sam – 2 Ashley -2

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
					Sydney - 4
Initial Code 7	Grounded qualitative methodology	All three researchers spoke of the need for grounded qualitative methodology in design research.	3	28	Jules – 2 Sam – 2 Ashley -2
Initial Code 8	Methodologies are useful tools for communicating and mapping when the project is chaotic	Ashley describes how research methodologies are useful tools for mapping purposes especially when the project become chaotic.	2	5	Frankie - 1 Ashley – 2
Initial Code 9	“that is a form of an ethnographic approach” Ali	Discussing the use of ethnography in design research	2	8	Ali – 4 Kelly - 4
Initial Code 10	“Design for me is multidisciplinary” Ali	Ali describes how design is multidisciplinary.	3	7	Ali – 4 Sydney – 4 Kelly - 4
Initial Code 11	“the wider sense of institutions have not grappled with multidisciplinary” Ali	Ali makes the suggestion that “the wider sense of institutions have not grappled with multidisciplinary” and that this is why design has difficulty with evaluation and funding	1	1	Ali - 4
Initial Code 12	“polymaths make the best designers” Sydney	Sydney discusses design and how “polymaths make the best designers”	1	3	Sydney - 4
Focused Code F Relating to Coding Category: Recognising Difference (Process Difference)	Requiring Empathy	This code also falls under Incorporating Practice, but as it is so important in design research practice, it has been highlighted as a Focused Code.			

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 1	"being able to be empathise enables you to ask the questions" Drew	Alex and Drew outline the importance of asking many questions and the right questions, They describe how being able to be empathetic is important to asking the right questions.	3	32	Alex – 3 Drew – 3 Kelly - 4
Initial Code 2	"abstract empathy is absolutely critical" Drew	Drew, a practitioner talks about the importance of empathy and extends this to empathising with the product, the environment etc.	2	4	Drew – 3 Kelly - 4
Initial Code 3	"asking the right questions" Drew	Drew, a practitioner highlights the importance of asking the right questions and never stopping asking questions to have design success.	2	28	Alex – 3 Drew - 3
Initial Code 4	Considering the user at all times	Sam stresses the importance of considering the user at all times	1	35	Sam - 1
Initial Code 5	"good designers have a natural empathy for the consumer" Kelly	Kelly describes the importance of empathy in design research	1	5	Kelly - 4
Initial Code 6	"the skill to identify the right questions to get the right information I think is huge because not everybody has that" ... "be really open so they can really absorb information".. "It's almost like a therapist, a design therapist" Kelly	Kelly also talks about the skills required to ask the right questions and having empathy.	1	3	Kelly - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 7	"to really listen and let the information come out" Kelly	Kelly describes the skills a design researcher needs. One is to really listen and let the information come out.	1	1	Kelly - 4
Initial Code 8	"it's all about the usability and experience" Kelly	Kelly talks about considering the user experience in design research. This is more than the functionality.	1	1	Kelly - 4
Focused Code G Relating to Coding Category: Recognising Difference (Process Difference)	Tenacity, Asking Questions and Testing				
Initial Code 1	"a billion whys" and "never stop asking questions" Drew	Drew, a practitioner stresses the importance of asking questions ' a billion questions' for a successful outcome.	2	27	Drew – 3 Kelly - 4
Initial Code 2	"test, test, test" and "you have to user test" Drew	Drew, a practitioner outlines the importance of user testing in design.	2	15	Drew – 3 Kelly - 4
Initial Code 3	"Tenacity is king" Drew	Drew, a practitioner speaks of the importance of tenacity in design and research.	1	7	Drew - 3
Initial Code 4	"Importance of being thorough in your research" Drew	Drew, a practitioner talks of the fundamental importance of research as a decision making tool in design.	1	17	Drew - 3
Initial Code 5	"there is no compromise" Drew	Drew, a practitioners " belief is that there is no compromise that when designing a beautiful object there is	2	5	Drew – 3 Kelly - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
		no half way house, it's all or nothing job and you do whatever it takes to get that job done properly, to get the job done to the best it can be."			
Initial Code 6	"always returning to the problem" Frankie	Frankie describes the importance of always returning to the problem, noting that design research is all about the result, not the process.	1	4	Frankie - 1
Initial Code 7	"asking yourself why at every stage" Kelly	Kelly discusses the importance of asking many questions and having answers	1	3	Kelly - 4

Appendix J: Coding Round Four Matrix: Problem Difference

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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Unit of Analysis – Designers Doing research: Post Graduate/Post Doctorate Academics and Practitioners engaged in Research, with a focus on their approach and understanding.

Grounded Theory: Navigating Difference

Coding Round: Four

Coding Category : Recognising Difference

Coding Sub Category: Problem Difference (Future Oriented and Situated)

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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Focused Code A Relating to Coding Category: Recognising Difference (Problem Difference)	Exploring a Real Wide Territory				
Initial Code 1	"Exploring a real wide territory" Alex	Alex, an art school academic describes his masters' students' projects as "broad lateral design research", "exploring a real wide territory" with "very vague start points". There is much "what if you made" and "framing and reframing what the research question was"	2	6	Alex – 3 Sydney - 4
Initial Code 2	"broadening of what design research is" Val	Val, a researcher outlining that "there's a broadening of what design research is and I'm just wondering is a service designer really a designer, a problem solver a designer?"	4	10	Val – 3 Alex – 3 Ali – 4 Sydney - 4
Initial Code 3	"I suppose now it's much broader" Alex	Alex, an academic is saying how the range and nature of industrial design Masters student projects are much broader.	1	3	Alex - 3
Initial Code 4	"Design is now... it reaches into all kinds of different spaces" Alex	Alex, an art school academic describes how design is changing and "reaching into all kinds of different spaces...it could go to the roots of	3	5	Alex – 3 Ali – 4 Sydney - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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		science you know, to the levels of business strategy”.			
Initial Code 5	"So many research methods" Val	Val, a researcher indicates that “there are so many research methods out there” but that you “need to engage with a bit of responsibility”.	4	7	Val – 3 Ali – 4 Sydney – 4 Kelly - 4
Initial Code 6	having "a very flexible approach" Alex	Alex, an art school academic describes their approach to PhD supervision as being very flexible to support all their PhDs. This is because each one is very different.	1	1	Alex - 3
Initial Code 7	"aren't necessarily form a design background" Alex	Alex, an art school academic describes how their PhD students come from diverse educational backgrounds and the challenges associated with that.	2	4	Alex – 3 Ali - 4
Initial Code 8	"it was a material science piece of research" Alex	Alex, an art school academic talks of how a masters student project became “a material science piece of research” highlighting both the unexpected outcome of some projects and the cross disciplinary nature of design research.	1	3	Alex - 3
Initial Code 9	"building your team is a milestone" Drew	Drew, a practitioner emphasises the importance of building a good team in	2	2	Alex – 3 Drew - 3

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
		design (referring to the broad range of expertise required).			
Initial Code 10	"passionate supporters of design but very different attitudes" Alex	Alex, an art school academic describes how two people one cybernetician, one engineer had very different attitudes but both supporters of design.	1	1	Alex - 3
Initial Code 11	Acknowledging the unpredictable nature of design research	Ashley describes the unpredictable nature of design research, acknowledging that it can move in many different directions.	1	5	Ashley - 2
Initial Code 12	"the word design is such a broad label" Ashley	Ashley discusses the many areas design encompasses and outlines how it is an interdisciplinary practice.	2	22	Jules – 2 Ashley - 2
Initial Code 13	Design Research for Policy	Jules describes the use and benefit of design research approach in policy development	1	13	Jules - 2
Initial Code 14	Design Research in a University	Ashley describes the many different approaches to design education from a university to an art school, highlighting the broad nature of the practice.	1	5	Ashley - 2
Initial Code 15	Design Research in an Art College	Ashley describes the broad interdisciplinary nature of post graduate design education in an art college	1	36	Ashley - 2

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 16	Ethical considerations	All three researchers describe the difficulties encountered with ethical applications due to the unpredictable nature of design research process combined with the need to interact with users.	3	19	Jules – 2 Sam – 2 Ashley -2
Initial Code 17	Interdisciplinary nature	Both Jules and Ashley discuss the importance of an interdisciplinary approach in design education and research.	2	18	Jules – 2 Ashley - 2
Initial Code 18	Noting unanticipated outcomes and directions of research	Ashley describes the unanticipated outcomes and directions of design research. "Because when I think of really successful projects, so many of them have looked like they're going to fail and then something wonderful comes out of it and then you have to try something else that you didn't know you were going to be trying"	1	4	Ashley - 2
Focused Code B Relating to Coding Category: Recognising Difference (Problem Difference)	Asking the Right Question	Because design research explores such a wide territory, framing the research question is a very important element of the research process.			
Initial Code 1	"framing and reframing what the question was" Alex	Alex, an art school academic speaks of his masters' students research and	2	6	Alex – 3 Ali - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
		design projects and how in the early stages they are “framing and reframing what the question was”. This reminds me of Schon.			
Initial Code 2	Comfortable addressing conflicting and confusing requirements.	Frankie discusses the issues with conducting design research, particularly those related to addressing confusing and conflicting requirements and the need to be able identify what the issues are.	1	7	Frankie -1
Focused Code C Relating to Coding Category: Recognising Difference (Problem Difference)	Requiring a Supportive Environment	Drew and Alex discuss the importance of having a supportive environment for “vaguely framed” design research.			
Initial Code 1	needing "an environment that supports that kind of vaguely 'framed' research" Alex	Alex, an art school academic speaks of how design researchers need an “environment that supports that kind of vaguely framed' research”.	1	3	Alex - 2
Initial Code 2	having "the freedom of design" Drew	Drew, a practitioner outlines how it was good and important for him to have “freedom of design” to be “allowed to run away with your own ideas”. He got this with small business clients as opposed to more inflexible large corporations.	1	1	Drew - 2

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 3	"Just be free and creative" Frankie	Frankie describes the importance of allowing PhD to be "free and creative" in their research approach	1	5	Frankie - 1

Appendix K: Coding Round Four Matrix: Experiencing Tension

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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Unit of Analysis – Designers Doing research: Post Graduate/Post Doctorate Academics and Practitioners engaged in Research, with a focus on their approach and understanding.

Grounded Theory: Navigating Difference

Coding Round: Four

Coding Category: Experiencing Tension

Code Level Identification	Category Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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Focused Code A	Experiencing Tension				
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Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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Relating to Coding Category: Experiencing Tension					
Initial Code 1	"trying to get over that fundamental difference" (between practice and academic research) Alex	Alex an art school academic speaks of "much more emphasis on research" and practitioners "trying to get over that fundamental difference", "getting people into that mind of academic research"	1	5	Alex - 3
Initial Code 2	noting "tension between industrial design and engineering design" Val	Val, a researcher describes an interest in researching the tension between 'industrial design and engineering designers as they negotiate new product development.	2	6	Val – 3 Alex - 3
Initial Code 3	"trying to be a designer in a research world" Alex	Alex, an art school academic outlines the difficulties of "trying to be a designer in a research world" highlighting their differing requirements and values.	1	7	Alex - 3
Initial Code 4	"the system tries to beat that out of them" creativity Val	Val, a researcher outlines how "the system [PhD constraints] tries to beat that [creativity] out of them". The tension between creative freedom and system (PhD) constraints.	1	3	Val - 3
Initial Code 5	"it's frustrating for us" Alex	Alex, an art school academic, in describing his masters student work speaks of them making "exciting	1	5	Alex - 3

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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		breakthroughs” that “the academia wouldn't respect that much” and the associated “frustration” with that.			
Initial Code 6	Feeling “like a straight jacket” Frankie	Frankie described how the fixed nature of academia felt “like a straight jacket” when conducting design research. Code also appears in Focused Code B Feeling Constrained.	1	4	Frankie - 1
Initial Code 7	Being aware of tensions around quantification of creative output.	Frankie described the challenge of assessing/quantifying the creative input/aesthetic encapsulation in design research.	1	17	Frankie - 1
Initial Code 8	Grappling with the theory/practice relationship	The output of theoretical research is theory. The output of design research is product/solution and theory.	2	20	Frankie – 1 Lee - 1
Initial Code 9	Feeling uneasy following a design led model	Both Frankie and Lee indicated that, with no design role models to follow, there were no guidelines, which made them feel uneasy pursuing a design led approach to research.	2	12	Frankie – 1 Lee - 1
Initial Code 10	Dealing with a lack of design led role models	Design research is emerging and there is a distinct lack of role models.	2	9	Frankie – 1 Lee - 1
Initial Code 11	Dealing with a lack of understanding of design research.	Both Frankie and Lee indicated that they felt restricted by academic models and that there is a lack of understanding of design research.	2	19	Frankie – 1 Lee - 1

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 12	Questioning academic models	Frankie questioned academic models to support design research practice noting that academic models often hindered the research process or weren't relevant.	1	6	Frankie - 1
Initial Code 13	Adapting the process to suit academia	Both Frankie and Lee stated that when undertaking their PhD, in the absence of design led role models, research was adapted to suit academia.	2	15	Frankie – 1 Lee - 1
Initial Code 14	Noting the limitations of some methodologies mapping tools	Both Jules and Ashley describe how some methodologies and mapping tools have limited application in design research.	2	10	Jules – 2 Ashley - 2
Initial Code 15	Reflecting on the fact that the policy makers didn't seek out design research methodology.	Jules is describing the lack of understanding of what design research can offer policy makers.	1	1	Jules
Initial Code 16	Tension between creative exploration and compliance relating to ethics application.	Sam is describing an ethics application noting that "I think the unpredictable nature of design research was something that they didn't really enjoy, maybe it was uncomfortable..."	2	2	Ashley – 2 Sam - 2
Initial Code 17	"industrial design and research is still very adolescent" Sydney	Sydney speaks about how Industrial Design and Design Research are only emerging disciplines in an academic context.	1	1	Sydney - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 18	"if you look at the big hitters or perceived big hitters, very few of them are designers are they" Sydney	Sydney describes how the 'big hitters' in design research are not from a design background. Why is this?	1	1	Sydney - 4
Focused Code B Relating to Coding Category: Experiencing Tension	Feeling Constrained				
Initial Code 1	"Research can be very constraining for a creative person" Val	Val, Alex and Sydney reflect on the constraining nature of research for creatives and practitioners.	3	9	Val – 3 Alex – 3 Sydney - 4
Initial Code 2	"being forced down that route" Val	Val discussing how some PhD design research students might feel they are being forced down a route.	2	2	Val – 3 Sydney - 4
Initial Code 3	"Cutting the leash" constraining work practice of PhDs. Val	Val speaking of the difficulties designers experience doing PhDs because it is a different way of working and indicating that "you need to cut the leash and let them get on with it".	2	4	Val – 3 Alex - 3
Initial Code 4	Feeling "like a straight jacket" Frankie	Frankie described how the fixed nature of academia felt "like a straight jacket" when conducting design research.	1	4	Frankie - 1
Initial Code 5	"the robustness of their methodology which probably does stifle a certain amount of creativity" Ali	Ali describes how research is evaluated by "the robustness of their	1	1	Ali - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
		methodology which probably does stifle a certain amount of creativity” Ali			
Initial Code 6	“didn’t have a PhD and in this world of research led universities that was going to be a hindrance” Sydney	Sydney speaks of the pressure to have PhD when working in academia.	1	1	Sydney - 4
Focused Code C Relating to Coding Category: Experiencing Tension	Struggling to do PhDs	Designers struggle to do PhDs			
Initial Code 1	"hard core practitioners struggle to do PhDs" Val	Val describes the constraining nature of research and “how hard core practitioners struggle to do PhDs” because it is “so rigorous, it’s about methodology, it’s all about citing”. Some of the researchers who had completed a design led PhD described their initial struggles. These were based mainly on not having a design led model to follow.	4	7	Val – 3 Alex – 3 Lee – 1 Frankie – 1
Initial Code 2	"it takes a different attitude" Alex	Alex, an art school academic speaks of how there is now a “greater emphasis on research” and that because of this “it takes a different attitude” to work.	2	2	Alex – 3 Sydney - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 3	"research as in PhD research has grown slower" Alex	Alex, art school academic speaks of the slow growth of PhD research in design.	1	1	Alex - 3
Initial Code 4	"High age profile of Industrial Designers undertaking PhDs" Val	Val reflects on the difficulty for industrial design practitioners to do PhDs and notes the advanced age of those undertaking PhDs.	1	2	Val - 3
Initial Code 5	Noting lack of practitioner expertise in PhD research.	Val notes the general lack of applied or practical design expertise in PhD research "it was a classic PhD tool, it was a little bit crude"	1	2	Val - 3
Initial Code 6	not seeing "where the research is in this" Alex	Alex, an art school academic describes an engineering students response to a design research method of unstructured people observation and how he struggled to see "where the research is in this"	2	2	Alex – 3 Sydney - 4
Initial Code 7	"how is this helping you answer it or explore it" Alex	Alex, an art school academic describes the difference of approach between design and engineering research. This engineering students supervisors were questioning the ability of his excellent engineering design solution to answer or explore questions.	2	3	Alex- 3 Ali - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 8	"when does it actually become research" Alex	Alex, an art school academic questions when a design project becomes research in the context of design PhDs.	3	10	Alex- 3 Ali – 4 Sydney - 4
Initial Code 9	taking "a long time to really know what the research is about" Alex	Alex, an art school academic contrasts design research approach to an engineering research approach noting how it takes a long time for the design "researcher to really know what the research is about". (This is a little like grounded theory, it emerges as a result of the research. Inductive research.)	2	2	Alex – 3 Sydney - 4
Initial Code 10	"having a humungous struggle" understanding the design process and the research process Ali	Ali describes the struggle for design students to understand the research process and the differences between them	2	6	Ali – 4 Sydney - 4
Initial Code 11	"struggling to fit into what she feels is a shoe horn" Ali	Ali describes the struggles of a PhD student trying to adapt her approach to academic PhD requirements	2	4	Ali – 4 Sydney - 4
Initial Code 12	"Risk with not using classic academic methods" Sydney	Sydney discussed the risk with not using classic academic methods and the risk with adapting them as they might not be accepted as rigorous.	1	1	Sydney - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Focused Code D Relating to Coding Category: Experiencing Tension	Lucky to get Funding	Much research funding is regulated by the use of research evaluation metrics.			
Initial Code 1	"REF 2014" Design case study can demonstrate impact Val	Val describes how a design research project worked on was used as a case study for the REF 2014 to demonstrate impact.	2	15	Val – 3 Alex - 3
Initial Code 2	"it's not part of STEM subjects, it's not funded, it's part of humanities" Alex	Alex, an art school academic describes how because design is not part of STEM, it receives less funding.	1	1	Alex - 3
Initial Code 3	"lucky to get funding" Val	Both Val and Alex describe how luck is involved in the funding process. Val goes on to describe how design research demonstrating greater impact may receive greater funding, which may influence the focus of design research moving it to be more socially focused that product focused.	3	4	Val – 3 Alex – 3 Sydney - 4
Initial Code 4	REF "someone who we might respect is completely irrelevant to ----- College" Alex	Alex, an art school academic talks about the REF and how collaborative projects/teaching can work between design and engineering universities because the individual outputs are non-competitive, for example journal	1	2	Alex- 3

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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		publications. (This could also fit with category 'navigating ways')			
Initial Code 5	funding difficulties "funding 'applications' as part of research" Alex	Alex, an art school academic speaks of the frustrations with existing UK funding models describing how they are prepared to fund pure research but it is much more difficult to get funding for the applied design aspect. This is changing now according to Alex.	1	4	Alex - 3
Initial Code 6	"the level of funding is that much different" Alex	Alex, an art school academic describes how "the level of funding is that much different" and that much greater sums of money are available for engineering research compared to design research.	1	2	Alex - 3
Initial Code 7	REF targets "they're very different sort of ultimate measurable targets" Alex	Alex, an art school academic speaks of how the targets for REF are so different for different disciplines, collaborative projects can work because each discipline will be looking for different impacts and outcomes.	1	1	Alex - 3
Initial Code 8	design research "it's not really funding it" Alex	Alex, an art school academic describes how the government is not really funding design research.	1	1	Alex - 3

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 9	"you know R and D, the D of design is not what they want to fund" Alex	Alex, an art school academic speaks about research funding and the difficulty of getting funding for the design part "or showing how it might be implemented". This is changing slightly with the REF impact criteria.	1	4	Alex - 3
Initial Code 10	"Funding model in UK beginning to change to more applied research" Alex	This could also be used in 'Evolution' category.	1	2	Alex - 3
Initial Code 11	"Impact strategy REF 2015" Val	Val and Alex outline how design research can demonstrate a different kind of practitioner impact than typical citation type journal publication impact. This is recognised in the new REF.	2	10	Val – 3 Alex - 3
Initial Code 12	"Slightly looser interpretation" of the REF Val	Val, a university researcher describes how "more visually creative institutions ... maybe have slightly looser interpretation" of REF criteria regarding methods and rigor. Alex, an art school academic mentions how "much of the REF able material has been partly demonstrated by practicing work".	2	2	Val – 3 Alex - 3
Initial Code 13	"much more emphasis on grant wins" Alex	Alex, an art school academic speaks of much more emphasis on "grant wins" in the school.	1	4	Alex - 3

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 14	REF "benefits design because the' impact 'measurement of it" Alex	Alex, an art school academic speaks of how the increased focus on impact in the REF benefits design.	1	4	Alex - 3
Initial Code 15	"getting a little bit cynical" re-funding process Val	Val describes "getting a little bit cynical" about funding metrics and researchers seeking funding, chasing the money as it were to the detriment of "hard core" design research.	1	2	Val - 3
Initial Code 16	"design does not fit the ref particularly" Ali	Ali describes how design does not fit the REF	1	1	Ali - 4
Initial Code 17	"shoe horn it in" design into the REF	Ali describes how design is shoe horned into the REF	1	1	Ali - 4

Appendix L: Coding Round Four Matrix: Seeking Recognition

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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Unit of Analysis – Designers Doing research: Post Graduate/Post Doctorate Academics and Practitioners engaged in Research, with a focus on their approach and understanding.

Grounded Theory: Navigating Difference

Coding Round: Four

Coding Category : Seeking Recognition

Code Level Identification	Category Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Focused Code A Relating to Coding Category: Seeking Recognition	Gaining Confidence				

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 1	Bringing tacit knowledge of the disciplinary area to the research frees the researcher to focus on methodologies	Jules describes the importance of the researcher having a strong working knowledge of the disciplinary area they are working in before introducing design research approach and methods. This point is echoed by Lee in Round 1 coding.	2	3	Jules – 2 Lee - 1
Initial Code 2	Drawing on previous experiences in design research.	Both these researchers describe how they draw on previous experiences in design research to frame and undertake the next project.	2	7	Jules – 2 Ashley - 2
Initial Code 3	Identifying and being motivated by the success of previous applications of design to policy.	Jules describes how he is motivated by the success of previous applications of design research approach to policy making.	1	1	Jules - 2
Initial Code 4	Increasing ambition with experience	Both these researchers describe how they became more confident using design research approach and became more ambitious with experience.	2	2	Jules- 2 Sam - 2
Initial Code 5	Increasing confidence with experience of exploring	All three researchers speak of gaining increasing confidence with the experience of exploring and using a design led approach.	3	14	Jules- 2 Sam – 2 Ashley - 2
Initial Code 6	Initial lack of confidence	Sam speaks of a lack of confidence initially of using a design led approach	1	3	Sam - 2

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
		to research but gained confidence with experience.			
Initial Code 7	Utilising previous research experience and knowledge gave policy makers confidence in my approach.	Jules outlined how by utilising previous research experience and knowledge gave policy makers confidence in my approach	1	1	Jules - 2
Initial Code 8	Realising the potential of design led inquiry to solve the problem	All three researchers spoke of realising the potential of design led inquiry to solve the problem.	2	11	Lee – 1 Frankie - 1
Initial Code 9	Gaining increased confidence in design led inquiry	All three researchers spoke of gaining increased confidence in design led inquiry	3	29	Lee – 1 Frankie – 1 Sam - 1
Initial Code 10	Feeling confident with design led inquiry	All three researchers spoke of feeling confident with design led inquiry	3	45	Lee – 1 Frankie – 1 Sam - 1
Focused Code B Relating to Coding Category: Seeking Recognition	Navigating Ways to incorporate Practice - Evolution				
Initial Code 1	“navigating ways” Val	Val outlined spoke of “navigating ways in which I could use my own practice to answer research questions” This was interesting as it was how all the participants conducted their research.	1	10	Val - 3

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 2	Noting move to practice based PhDs	Val indicates that “there are PhDs now with reduced word count 40,000 and you design some stuff, the stuff is part of the thesis”	1	4	Val - 3
Initial Code 3	"ideal PhD is design practice so design project but builds on a strong theoretical base" Alex	Alex, an art school academic describes their ideal PhD.	1	1	Alex - 3
Focused Code C Relating to Coding Category: Seeking Recognition	Recognising opportunities	This code also relates to Focused Code A ‘Gaining Confidence’.			
Initial Code 1	"perhaps there's a real opportunity for design research to grow respect" Alex	Alex, an art school academic discusses how “perhaps there's a real opportunity for design research to grow respect” ...”as being an important you know fundamental game changer in new knowledge and development and research terms”	1	1	Alex - 3
Initial Code 2	figuring "out what we were doing in design research that made sense" Alex	Alex, an art school academic talks of the journey figuring out what they were doing in design research that made sense to them.	1	4	Alex - 3
Initial Code 3	"ordinarily a design is just building on something rather than doing that fundamental research" Alex	Alex, an art school academic speaks of the struggles with getting funding for design research because design	1	1	Alex - 3

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
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		focuses more on the applications rather than the fundamental research .			
Initial Code 4	"launch point for some more serious research" Alex	Alex speaks of his masters' students work as being a launch point for more serious research. It's like they are the creative spark for research ideas with potential.	1	3	Alex - 3
Initial Code 5	design research "lots of great work in exploring new processes, methodology". Alex	Alex, an art school academic says it is easier to get funding for this type of design research than the applied type because it is more close to pure research.	1	3	Alex - 3
Initial Code 6	"work at the same level of rigour and quality at embodiment and application and understanding of science" Alex	Alex, an art school academic discusses how design researchers strengths lie in "embodiment and application" and he talks about how exciting it might be if they worked with scientists, but focused on "embodiment and application" at the same level of rigour.	1	1	Alex - 3
Initial Code 7	"huge opportunity for design to get into technology led innovation" Alex	Alex, an art school academic discusses the difference between "technology led innovation" and "design led innovation" indicating that collaborating would greatly improve the research.	2	2	Alex – 3 Sydney - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 8	"realising nobody had really addressed this research area" with a design led approach Frankie	Frankie described "realising nobody had really addressed this research area". He saw this as an opportunity for the application of a design led approach to this medical product area.	1	5	Frankie - 1
Focused Code D Relating to Coding Category: Seeking Recognition	Seeking Respect - Evolution	Design researchers seek respect from academia/other design researchers?			
Initial Code 1	"do it with enough rigour for it to be a respectful piece of research" Alex	Alex, an art school academic speaks of the requirements of academic research.	1	5	Alex - 3
Initial Code 2	"engage with a bit of responsibility" Val	Val indicates that "there are so many research methods out there" but that you "need to engage with a bit of responsibility". Be careful how you use them. Drew makes a similar point about research and the need for excellence.	2	4	Val – 3 Drew - 3
Initial Code 3	"the academia wouldn't respect that much" Alex	Alex, an art school academic speaks of "exciting breakthroughs" in masters student research projects, "that the academia wouldn't respect that much".	2	3	Alex – 3 Sydney - 4

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
Initial Code 4	"change to a more normal university style model" Alex	Alex, an art school academic speaks how their engagement with the REF is changing to a more normal university style model.	1	2	Alex - 3
Initial Code 5	"bring that up to a more, kind of normal university approach" Alex	Alex, an art school academic talks about the move to "much more emphasis on research" in the college and the REF and that their approach is to "bring that up to a much, kind of normal university approach" in terms of doing more formal type university research rather than practice based research.	1	1	Alex - 3
Initial Code 6	"we always team supervise our students" Alex	Alex, an art school academic speaks of the necessity of team supervision in PhDs in design, because the student back grounds are diverse with varying approaches and also it is important to have "research theory" support.	1	1	Alex - 3
Initial Code 7	opting "for the classic" PhD research route Val	Val describes a practice based approach and then outlines personally going for the "classic 70,000-word thesis" despite being interested in a practice based route, but doesn't say why. Suggestion, an obligation or greater recognition? This point was	1	6	Val – 3 Lee – 1 Frankie - 1

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
		echoed by Lee and Frankie in Round 1.			
Initial Code 8	"culture shift in training" Alex	Alex, an art school academic speaks of "greater emphasis on research" and how there is a "culture shift in training... of getting people into the mind of academic research"	1	1	Alex - 3
Initial Code 9	"much more emphasis on research" Alex	Alex, an art school academic speaks of "much more emphasis on research" now in the school than there used to be.	1	4	Alex - 3
Initial Code 10	always making sure "there is a PhD research theory" supervisor Alex	Alex, an art school academic notes the need for PhD research theory expertise to support the project.	3	4	Alex – 3 Ali – 4 Sydney - 4
Initial Code 11	"exploring classic design PhD" Alex	Alex, an art school academic speaks of a student exploring a "classic design PhD"	1	2	Alex - 3
Initial Code 12	"the methodologies section can be quite weak" Val	Val noting that some practice based PhDs methodologies section can be weak.	2	3	Alex – 3 Val - 3
Initial Code 13	"harder to imagine it (cross disciplinary collaboration) working at PhD (the Industrial Design/Engineering collaboration)" Alex	Alex, an art school academic describes how collaborative projects can work at masters level but it is more difficult at PhD level because the academic requirements are more	1	2	Alex - 3

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
		clearly defined and different between disciplines.			
Initial Code 14	"Accounting for 'classic' PhD route" Val	Val links completing the classic PhD with now being able to supervise PhDs.	1	7	Val - 3
Initial Code 15	"If you want to base it and like stretch your intellect then a PhD is the model" Alex	Alex, an art school academic outlines the difference between a masters and a PhD.	1	1	Alex - 3
Initial Code 16	"Using 'standard' academic PhD research methods" Val	Val describes using "research methods which were standard academic PhD research methods". Why is he doing this? There is a suggestion that their might be other ways, that it is up for debate (my interpretation). Ali also describes design researchers using standard academic methods.	3	9	Val – 3 Ali – 4 Sydney - 4
Initial Code 17	"Getting people into that mind of academic research" Alex	Alex, an art school academic speaks of the need to "getting people into that mind of academic research" as there is "much more emphasis on research"	2	3	Alex – 3 Sydney - 4
Initial Code 18	"Using 'rigorous and metric based' methods" Val	Val a university researcher describes their research methods as "particularly rigorous and metric based"	2	6	Val – 3 Sydney - 4
Initial Code 19	"Just to make sure everything is recorded in an academic process" Alex	here Alex, an art school academic talks of "churning those out" academic	1	2	Alex - 3

Code Level Identification	Focused Code or Initial Code	Description	Number of Interviews	Number of Citations	Participant Pseudonym & Initial Coding Round Ref.
		papers but that “the really exciting part was you know engaging the industry”			
Initial Code 20	"needing 'classic research training" Val	Val a university researcher outlines the importance of receiving “classic research training” to conduct research. This is echoed by Alex, an art school researcher.	3	9	Val – 3 Alex – 3 Ali - 4
Initial Code 21	"it's not focused on how to capture that new knowledge" Alex	Alex, an art school academic speaks of practitioners “researching or generating new knowledge in their own ways..[.but] it’s not focused on how to capture that new knowledge” Alex is talking about how more thought needs to go into capturing that new knowledge and making it visible.	1	2	Alex - 3
Initial Code 22	“Evolution of Design” Sydney	Sydney, Alex, Val and Jules describe how design is evolving to meet the needs of society	4	5	Jules – 2 Val – 3 Alex – 3 Sydney - 4
Initial Code 23	“little awareness of design research in the community” Kelly	Kelly discusses the importance of raising awareness of what design researchers do.	1	1	Kelly - 4
Initial Code 24	"there is very little appreciation” or understanding of design research from the general public or SMEs”	Kelly describes the lack of understanding of design research	1	1	Kelly - 4