TENSIONS BETWEEN THEORY AND PRACTICE IN SUSTAINABLE ARCHITECTURAL DESIGN

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ABSTRACT

Architectural practice is often criticised for being contingent on a plethora of standards, regulations and commercial pressures. Such contingency is concerning given that the objectives for architectural and urban sustainable design are based on a reductive epistemology that places ‘zero-carbon’ design at the centre of what is really a hydra-headed paradigm. In the context the rising commercial interest in the accreditation of sustainable architecture through assessment methods such as BREEAM, the thesis indicates that the skills of architects and the morals embedded in the profession diffuse the focus of objectives in order to establish the best all round design outcome.

The thesis explores the different ways in which designers diffuse the focus of objectives through a series of qualitative ex post facto studies of the design work of novice designers and new professionals, and a series of semi-structured interviews with established practitioners. The findings reassert recurring discourses in the architectural profession about the commensurability of pedagogy and practice and the value of architecture. The conclusions indicate that at the root of these issues, is a fracture between the production of assessment method criteria and the implementation of it. Consequently, the thesis suggests that practice-based research has the potential to reconcile this fracture, by feeding knowledge directly to the source of contingency.

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Regulations and codes comprise “a combination of written and graphical rules” (Street, 2006: 7) and, with regard to the design of architectural and urban form, are formalised during the design processes conducted by architects and designers. This study refers to both regulation and objectives. UK Policy on the production of regulation is characterised by the construct of “better and fewer” regulations (BIS, 2011; 2012), where regulation is increasing devolved to arms length bodies (Levi-Faur, 2005; Braithwaite, 2009). This results in a reduction of legislative regulation, the objectives of which are subsequently managed by commercial ventures. It follows from this that where regulations are referred to throughout the thesis, they incorporate local regulatory devices, such as urban codes, and non-legislative forms of regulation such as sustainability assessment methods for built form. The term ‘objectives’ is used to refer to the specific criteria set out in such mechanisms.

1.0 INTRODUCTION

This thesis is concerned with dualities that exist within sustainable design as a product of its regulation through design objectives. Predicated on the understanding that sustainable design is an evolving concept, the thesis draws on interdisciplinary research to provide a better understanding of the implications of mainstream constructs of sustainability and sustainability objectives for design on creative processes in commercial practice.

1.1 CONTEXT

Sustainability pervades all aspects of architectural and urban design. Methods of regulating sustainable design are manifest in policy agendas (see; DECC, 2011), and mechanisms to measure the performance of buildings take the form of assessment methods, such as BREEAM (2012). The requirement to deliver sustainable design is increasingly built in to construction contracts for architectural and urban form (Parker, 2012; Patterson & Rossetta, 2010; Menteth, 2012) and it would be difficult to place an architectural practice that did not “profess passionate commitment to ‘green’ buildings” (Sudjic, 1996: 7).

The objectives set out in these mechanisms are predicated on a pro-market interpretation of sustainable design which is absorbed into mainstream constructs of sustainability. Criticism of this approach suggests that it misguides design outcomes on the basis that it seeks an untenable equilibrium in evolving urban contexts (see for example, Batty & Marshall, 2012). Batty and Marshall (ibid) argue that sustainability should be understood as an evolving concept that requires responsive and adaptive design.

In order to improve the ability of designers to respond to complex and dynamic conditions, and to inform the steps that professional bodies might pursue to facilitate such improvements, this research examines the influence that objectives have on creative and commercial design practice.

On the one hand, architects are understood to be creative designers, on the other, they are principle agents involved in the delivery of built form. This duality has caused multiple conflicts within the profession which have rendered education (considered to focus on creative and academic processes at the expense of practical skills) irrelevant to practice, and created a divide between the relevance of academic research for practice (Till, 2009).

Dualities also create contradictions between prevailing assumptions about the implications of regulations on design practice and the findings of researchers. Regulatory mechanisms can be said to be both constraining and auxiliary to practice. Both views have been shown to have some validity when the creative process is considered in isolation of commercial practice, where the former refers to the processes of conceptualising and detailing design proposals, and the latter places greater emphasis on the decision making, business and management activities of delivering design projects.

There are a limited number of studies on the implications of regulations. One study has shown that increased numbers of objectives have a negative impact on creativity (Ostad-Ahmad-Ghorabi & Collado-Ruiz, 2010). While this makes generalisations about the overall impact of objectives on the innovative properties of designs, it does not explain in detail how objectives have this effect. Other studies that examine the technical requirements of design (Ross, 2012) suggest that different sets of objectives are plagued with contradictions, however this does not describe the way in which they are implemented in practice, or how practitioners resolve these conflicts. Finally, studies which suggest that objectives are part and parcel of architects practices, in particular assisting with risk management (Imrie & Street, 2011) and providing a level platform for distributed decision making (Carmona, 2009), paint a picture of design as a process of decision making, distinct from creative induction.

To respond to the complexities of sustainability, the future of architectural practice relies on the reconciliation of this dichotomy (Buchanan, 2012). Echoing this, several studies have called for a more integrated approach to sustainable design, one that goes beyond compliance with quantitative criteria (Building Futures, 2003, Building Futures, 2011; RIBA, 2005). This study aims to further this discourse by providing a better understanding of the implications of sustainability objectives for the dualities of design practice.

1.2 RESEARCH OBJECTIVES

What are the implications of sustainability for design as both a creative process and commercial practice and what drives these implications?

The central aim of this thesis is to provide a clearer understanding of the prevailing dichotomy between studies that suggest sustainability objectives are either detrimental or auxiliary to design. Such findings are exposed to manifold variables. One pertinent factor influencing such findings is the context in which the implications of objectives are observed. This thesis will specifically focus on the duality of architectural services as both a creative process and commercial practice; developing an understanding of how sustainability is tackled outside of commercial pressures and requirements to comply with sustainability objectives (in education), and exploring the implications of the combination of commercial pressures and sustainability objectives (in commercial practice). Comparisons of the two contexts will focus on:

- **Problem Framing**; how design projects are initiated and briefs developed, taking specific note of the themes explored by designers and how they characterise sustainability.
- **Design Approach**; the methods used by designers to navigate design problems and deliver solutions.
- **Dependency**; whether designers are contingent upon objectives in the way that they frame problems or the design approaches they take and the types of objectives that designers are reliant upon.

The objectives of the thesis are as follows:

1. Develop an understanding of how sustainability is tackled in non-commercial design practice, where creative processes are liberated from the requirement to meet specific objectives in relation to sustainable design.

2. Explore how sustainability objectives are managed in commercial practice and how practitioners perceive the implications of sustainability objectives for design outcomes in this context.
3. Examine the differences and similarities between creative processes and commercial practice to provide descriptions of how designers manage the requirement to produce sustainable designs in creative and commercial contexts.

1.3 METHODOLOGY

This research engages with designers in education and practice. In contrast to established practitioners, designers in education will be aware of sustainability objectives according to design experience. However, they are not obliged to meet such specific criteria and are liberated from the commercial pressures of practice. With respect to these differences in design experience, this thesis comprises two forms of inquiry, as follows:

- **Ex post facto studies**, organised as a series of design labs, involving *novice designers* (second year, mixed-disciplinary art and design undergraduates) and *new professionals* (architectural postgraduates).
- **Semi-structured interviews** with *established practitioners* from leading practices in the construction industry.

The design labs involve setting designers in education the task of producing sustainable design schemes. Designers of different levels of ability are studied in order to compare the effect of the emphasis on sustainability objectives and the consequences it has for design outcomes; whether or not meeting sustainability objectives is a requirement of the design brief. The findings of these studies are examined through thematic mappings which illustrate how designers represent the influences on their designs through design reports and therefore provide an understanding of how they justify their schematic designs.

Interviews investigate the experiences of established practitioners designing to achieve benchmarks set by sustainability assessment methods, specifically examining how and why practitioners implement sustainability assessment methods in a practice environment. A synopsis of each interview is also given in the form of a thematic mapping, in addition to a written summary of the prominent points made by each interviewee. Full details of the inquiry methods are provided in chapter 7.0.

1.4 OUTLINE OF CHAPTERS

The current chapter serves to highlight the focus of the thesis and clarify the scope of the inquiry. Chapters 2.0 - 5.0 set the context of the thesis, covering the following themes; the context and epistemology of sustainability, sustainability policy, sustainability in design practice, and regulation and creative processes. Chapter 6.0 revisits the research objectives and hypothesis in advance of the detailed description of the methodology that is presented in chapter 7.0. Chapters 8.0 and 9.0 analyse the findings of the research methods. Subsequently, chapter 10.0 compares the findings of the research prior to summarising the research and drawing conclusions in chapter 11.0. These chapters are described in greater detail below (also see Fig. 1a):

2.0 Sustainability Theory and Policy: Epistemological Dichotomies

Chapter 2.0 sets out the broad context for the thesis and introduces the concept of sustainability, discussing how in contemporaneous science it is analogous to evolution, as is the social and environmental context it operates in. The chapter reveals that policy agendas for sustainability encourage a deterministic view of sustainable design that is not commensurate with this evolutionary construct.

3.0 Measuring Value in Sustainable Design

This chapter argues that guidance and regulations for sustainability define design in different ways, consequently placing greater or lesser emphasis on the creative activity of design as a tool to mitigate the consequences of climate change. In this way, objectives for sustainability reflect the duality of design.

4.0 Authoring Sustainable Architecture

To contextualise the implications of policy for design, this chapter provides an introduction to architectural design in education and practice, specifically noting the dichotomy between design as a creative process and commercial practice reflected by these two contexts. Subsequently,

regulations are shown to simultaneously be auxiliary in design practice, yet detrimental to creative processes.

5.0 Problem Structures in Creative Processes

Expanding on prevailing assumptions that regulations are detrimental to creative processes, this chapter looks in greater depth at the implications of rational problem structures, such as those advocated by sustainability assessment methods, on creative processes.

6.0 A Disparate Context: The Current State of Knowledge

Summarising the current state of knowledge in the literature, this chapter sets out the hypothesis on which the subsequent inquiry design is predicated.

7.0 Methodology

This chapter presents the design of the inquiry which includes two methods to enable the study of designers with a range of levels of design and practice experience. It provides full details of how the inquiry was conducted and analysed.

8.0 Novice Designers and New Professionals: Exploring Creative Processes

This chapter introduces the data resulting from ex post facto studies of novice designers and new professionals and evaluates the findings from studying the design reports produced by these designers.

9.0 Established Practitioners: Practicing Sustainable Design

This chapter presents data from semi-structured interviews with established practitioners from prominent practices in the construction industry. The findings of the study draw commonalities and distinctions between various specialists and practice sizes who work with and implement assessment methods such as the Code for Sustainable Homes (CSH), the Building Research Establishment's Environmental Assessment Method (BREEAM) and the Leadership in Energy and Environmental Design (LEED).

10.0 Creating Opportunity within Compliance

This chapter evaluates the similarities and distinctions between designers in education and practitioners and by doing so compares the implications of sustainability constructs on commercial practice and creative processes in architecture. It describes how objectives are valued in the prevailing litigious society.

11.0 Conclusions

Finally, the findings of the research are reviewed, setting out the contributions to knowledge in addition to the limitations of the study.

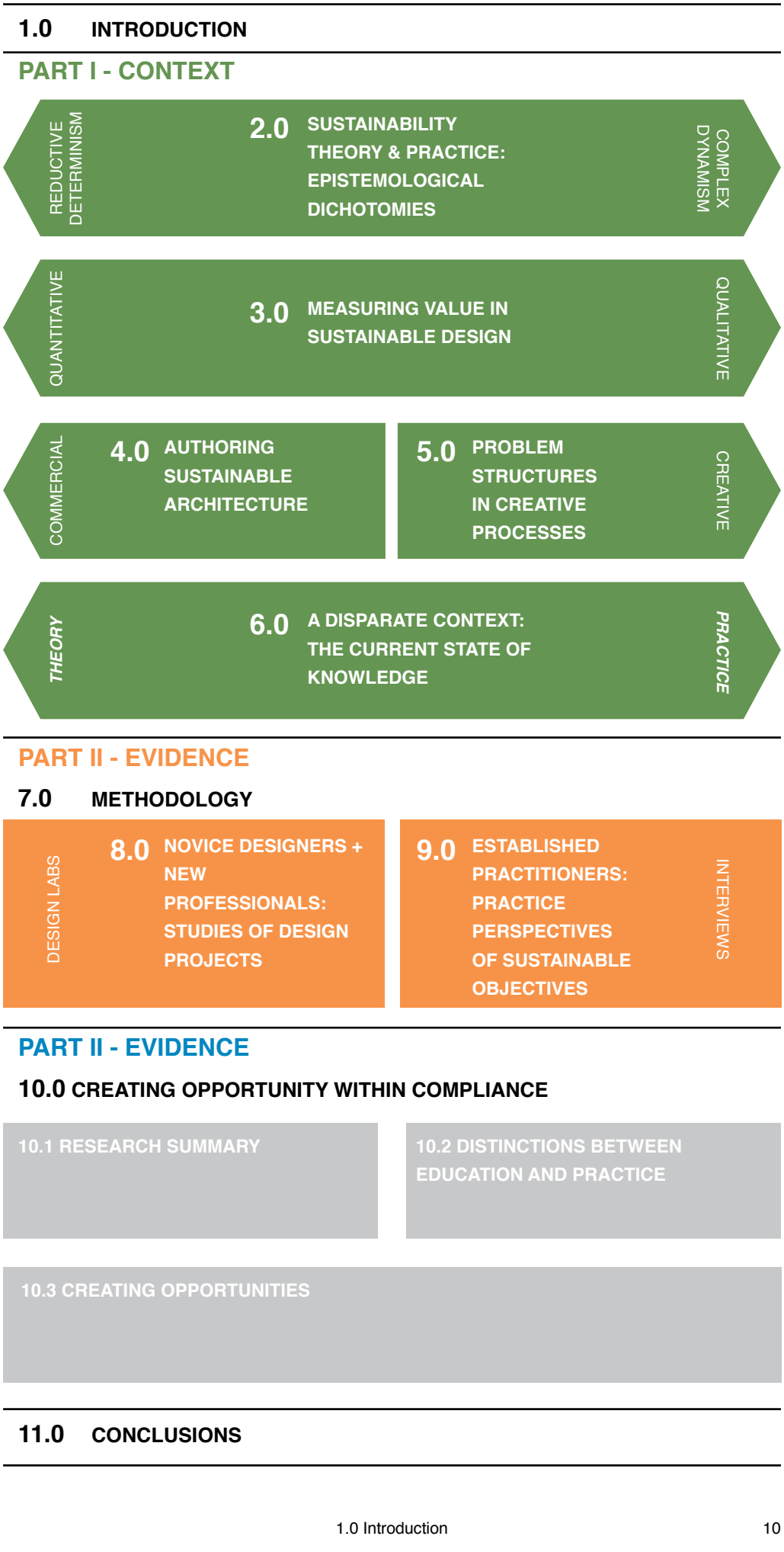


FIG. 1a
Diagrammatic structure of the thesis.

2.0 SUSTAINABILITY THEORY AND POLICY: EPISTEMOLOGICAL DICHOTOMIES

> "Ignorance of the uncertainties and ambiguities that these products of a practical logic owe to their functions and to the conditions in which they are used leads to the production of artefacts as impeccable as they are unreal."
>
> (Bourdieu, 1990: 85)

As Bourdieu (1990) points out, the application of theory through practice adopts a distinct logic. This chapter presents an epistemological dichotomy which creates tensions between theory and practice in sustainable architectural design.

This chapter comprises three main sections, covering the following topics:

2.1 Theory: Dynamic Complexity

This section provides a synopsis of sustainable development, the nature of urban form as concentrations of economic activity and the context for architectural intervention. It presents the complex and multidimensional properties of urban in relation to architectural sustainability.

2.2 Practice: Reductive Determinism

This section identifies that mainstream pro-market policy agendas are based on a reductive and deterministic epistemology which assumes a causal relationship between action and effect and provides a synopsis of the way in which architects operate within these limited variables.

2.3 Operating Within the Unknown

The final section introduces some ways in which this field of research is moving forward. The changing nature of the construction industry is explored, illustrating how this motivates the architectural profession to reconsider the implications of their services, taking account of uncongenial dependencies.

2.1 THEORY: DYNAMIC COMPLEXITY

This section outlines the challenges faced by a profession aiming to contribute to sustainable development, and highlights the need to make trade-offs between the three dimensions that constitute sustainable development; society, economy and the environment. The nature of urban form is also presented, specifically highlighting that urban areas are not only concentrations of social and economic activities, but they constitute the dynamic and unpredictable context in which designers operate.

2.1.1 SUSTAINABLE DEVELOPMENT

The definition of sustainable development is a heated discourse because achieving it is dependent on numerous unknowns (Redclift, 1989; 1991; Dryzek, 2005). The most cited definition of sustainable development can be found in *Our Common Future*; the report of the Bruntland Commission (WCED, 1987). Commissioned by the General Assembly of the United Nations (UN) in 1983, the report sought to address the relationship between economic development and environmental concerns. It defined sustainable development as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (ibid: 8). It proposed that realising a balance between three dimensions; social equity, economic growth and environmental conservation, would palliate the negative impact of human activity on the environment (Dryzek, 1997; Huber, 1998; Batty, 2001). Rydin (2010) provides a comprehensive definition of these three dimensions. It is useful to present these here before putting the relationships between them into perspective:

- "The economic dimension is about using market-based dynamics to meet people's needs, wants and desires and thereby provide the material basis for quality of life.
- The social dimension is about the non-material dimensions of quality of

life,and equity, including a sense of community, local well-being and security, and the elimination of poverty, perhaps even the achievement of a more equal society.

- The environmental dimension encompasses all those environmental goods, assets an service on which we depend and are threatened by pollution, carbon emissions, resource exploitation and destruction of habitats."

(Rydin, 2010: 2. Emphasis Author's own)

There are three models that articulate different ways in which the relationship between these elements can be considered. These are; the *Venn Diagram*, the *Nested Model* and the *Pillars Model* (see fig. 2a). The Venn Diagram is perhaps the most common model. It suggests that sustainable development is achieved where all three dimensions overlap. The Nested Model echoes this relationship, but indicates that sustainable development is achieved when the economic activity integral to society operates within environmental limits. The Pillars Model represents the analogy that sustainable development is 'upheld' by the three key dimensions, and consequently if one of the pillars is displaced, or not fulfilled, sustainable development is not achieved. Often, this model includes a fourth pillar, representing cultures, politics or institutions. The possibility of a fourth pillar signifies that sustainable development is only achievable if the mechanisms to deliver it are reinforced by social praxis.

Achieving sustainable development is dependent on the variables that constitute each of the three principal dimensions. The role of economics is particularly pertinent from this perspective as it is one of the mechanisms through which society interacts with the environment and has a number of often imperceptible effects. As much as these models illustrate an equilibrium, the inherent conflicts between the dimensions capture the need to make trade-offs (Neumayer, 2003). There are two models for economic sustainability that describe how trade-offs can be handled. These are the *Weak* and *Strong* Models of sustainability

and are characterised by the Venn Diagram and Nested Model, respectively (Neumayer, 2003; also see Rydin, 2010).

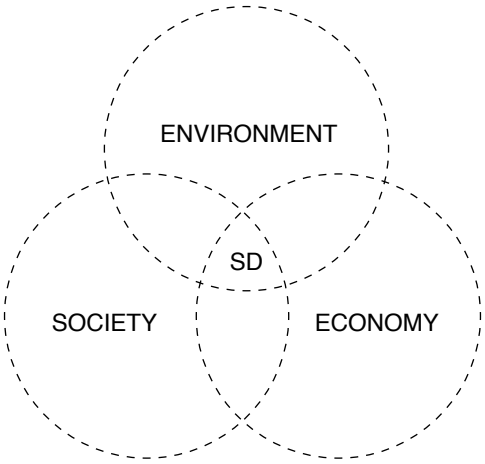
Weak sustainability allows for the (incomparable) substitution of capital: “It is based on a belief that what matters for future generations is only the total aggregate of ‘man-made’ stock and ‘natural’ capital” (Neumayer, 2003: 1). Therefore, the Weak paradigm affords compensation for the depletion of non-renewable resources, provided that sufficient technology and infrastructure replaces it. Following this model is desirable “because it offers the prospect of continuing with patterns of economic activity that are only marginally altered, primarily to compensate for environmental damage” (Rydin, 2010: 5).

Ecological modernisation provides a socioeconomic construct for Weak Sustainability (Mol, Spaargaren, & Sonnenfeld, 2009; Dickens, 2004; Gleeson & Low, 1999; Hajer, 1996). One dimension of ecological modernisation advocates ‘green-growth’. In the UK, this is epitomised by the *Green Deal* (DECC, 2010); a financial mechanism that encourages energy efficiency improvements in homes at no up front cost, with repayments made through the household’s energy bill. Ostensibly, the mechanism encourages economic growth by investing in technologies that have environmental benefits.

The Weak Model is criticised for valuing economic development and environmental capital equally when, in fact, they have fundamentally different characteristics and benefits. Reflecting these criticisms, the Strong Model is predicated on the understanding of the character of environmental capital as a system in which lost capital is irreplaceable, actions are irreversible, and there is a level of uncertainty about the implications of actions (Clayton & Radcliffe, 1996; Rees & Wackernagle, 1996). Represented as three concentric circles; where society and economy are nested within the environment, the Strong Model comprises definitive boundaries in which the loss of capital in one area can not

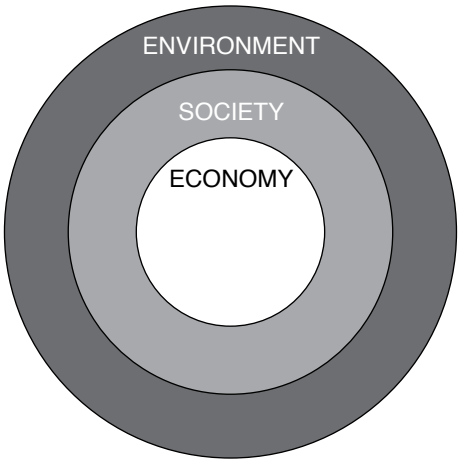
THE VENN DIAGRAM

In this model, sustainable development is achieved where all dimensions overlap (the point of equilibrium). It is synonymous with the weak economic model of sustainability in which capital is interchangeable between dimensions. In economic terms this suggests that improvement in technology indirectly compensates for the loss of environmental capital.



THE NESTED MODEL

Nesting society and economy within the environmental dimension of sustainability resonates with the strong model of economic sustainability in which natural resources are not substitutable and consequently, society and economy must operate within the confines of environmental limits.



THE PILLARS MODEL

In this model the three dimensions of sustainable development are known as 'the three pillars of sustainability'. Sustainable development is supported by each of the columns. If a column is missing, then sustainable development is unstable.

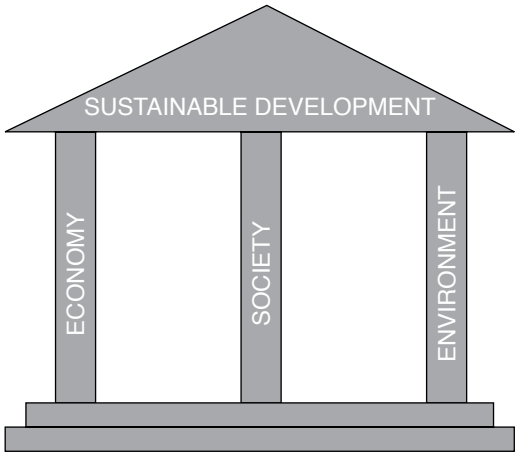


FIG. 2a
Models used to represent the interdependencies between society, economy and environment in sustainable development.

be substituted with capital from another area (Neumayer, 2003: 23); aspiring to a steady state. In economic terms, a sizeable economy may develop, but should not continually grow, as this would create an imbalance in the throughput of the system.

This captures the difficulties in dealing with trade-offs. As polar opposites, neither the Weak or Strong Model propose viable solutions: the Weak Model is too focussed on economical capital, to the detriment of the environment, while the Strong Model appears to restrict the potential for economic growth.

2.1.2 THE NATURE OF CITIES

From the perspective of *Cities as Complex Systems* (Batty & Marshall, 2012), urban form and the concept of sustainability exist in a largely unpredictable context informed by the co-evolution of social, economic and environmental forces (Marshall, 2010). As Marshall (ibid: 163) suggests, akin to "biological evolution, urban change is not linear or progressive and there is no knowable optimum future state" (also see; Marshall, 2009; Batty & Marshall, 2012). To this end, traces of the interdependencies between the production of architecture and social systems are evident in the morphology of urban configurations.

Urban configuration refers to the arrangement of a city's parts, such as buildings streets, infrastructure and spaces (Marshall, 2009. For further discussion, also see, Steadman, 1983; Kostof, 1999a & 1999b; Hillier, 1996). Configuration differs depending on the extent of design (see; Lynch, 1981). For example, the planned city may be said to have a much clearer order to their configuration than an unplanned city. This is because the former is the product of extensive urban design, and the latter of accumulated building designs.

Unplanned cities still have order. In *The City in History*, Mumford (1961) observed patterns throughout the urban configuration of unplanned cities, which

Kostof (1999a: 35-36) described as an aggregate order that is the product of designed parts “grafted” and “meshed” together. As the title of Rudofsky’s book, *Architecture Without Architects* (1972) implies, this was the product of requirement (for a historic overview of urban form and processes see; Kostof, 1999a & 1999b; Habraken, 1998; also see; Hillier & Hanson, 1984; Hillier, 1996 for inquiries into the relationship between society and urban formation).

The production of cities is a process that is inherently connected with the societies that inhabit them. Jacobs (1961) and Alexander (1966) were some of the first to emphasise the importance of this relationship. Using the term “natural cities” Alexander (1966) proposed that problems in cities were connected to structured, linear relationships between the components of a city. Natural, and consequently less problematic city forms, displayed more complex, interlaced connections. Referring to Weaver (1948), Jacobs (1993 [1961]) articulated a new analogy of the city as an organised complex system, in that what might appear chaotic in image, was actually the construct of social and cultural orderliness that frames how society operates:

> “Cities, happen to be problems in organized complexity, like the life sciences”
>
> (Jacobs, 1993)

From this perspective, cities have been described as ecologies. Ecology refers to the relationship between organisms and the environment in which they exist. Cities are ecologies in that, as Alexander and Jacobs express, they are relational parts as well as contexts. Geddes (1913) touched upon this when he suggested that in addition to the city as a living being, the city was an environment that shared reciprocal influence with the societies it supports (Batty & Marshall, 2009: 556). Or, as Churchill’s aphorism later surmised: “we shape our buildings, and afterwards they shape us” (cited in Ratti, 2004: 487).

The morphology of cities has been described as evolutionary (Batty & Marshall, 2009). Under this construct, urban forms are “seen as a collection of interdependent co-evolving parts” (ibid: 552). This “allows us to appreciate the organic qualities of cities, without implying there is a fixed relationship between the parts and the wholes, or an optimal mature form. Evolution is open ended and unpredictable in the long term, and thus has implications for how we conceive of, understand, and plan cities” (ibid).

Evolutionary ecology is the scientific field that deals with the study of ecology in a way that accounts for the evolution of collective species over time and the interactions between them (see; Pianka, 1999). To borrow this term and apply it to cities is to indicate the two characteristics of urban form outlined above:

1. The **ecology** of cities; the interdependent relationship between its parts.
2. The **evolution** of cities; the implications of those interdependencies between parts over time.

This highlights that the production of sustainable architecture is a process that has implications for and is implicated by multiple dimensions.

2.2 PRACTICE: REDUCTIVE DETERMINISM

Hajer (1995: 20) considers that each variation of the sustainable discourse "tends to be dominated by specific emblems: issues that dominate the perception of the ecological dilemma." According to Rees (1992) this arises from the deterministic epistemology of prominent economy theory. The policy agendas and mechanisms derived from this deterministic epistemology advocate measurable aspects of sustainability. As Hajer (1995) points out, this can lead to repetitive emblems and issues that are seen to ameliorate the effects of climate change, and as Gunder (2006) points out, can obscure many other dimensions of sustainability.

Such mechanisms are perpetuated by the architectural and planning professions. This manifests the view that sustainable development can be predetermined and deliverable at the architectural scale. As a result, there is a need to understand how policy mechanisms for sustainable design relate to the constructs and theories that drive them and how they become adopted and perpetuated by the architectural profession, resulting in their projection as ultimate goals for the public good.

2.2.1 DETERMINATES OF SUSTAINABLE FORMS

The impetus for sustainable architecture in the UK is rooted in the Government's commitment to reduce harmful emissions by 80% from 1990 levels by 2050, as set out in the Climate Change Act (DEFRA, 2008). Through *Carbon Budgets* (DEFRA, 2008) and the *Carbon Plan* (DECC, 2011) regulation 'trickles down' to provide specific performance targets for development at local and regional levels. The overall outlook in this domain is to make all new housing zero carbon by 2016 (DCLG, 2007c). Non-domestic buildings are to be subject to the same requirements in 2019 (ibid). The *Building Regulations* provide the legislative impetus for these targets by setting out minimum energy performance standards (Part L, 2006). The UK Government also supports assessment methods for

sustainable design, such as the *Code for Sustainable Homes* (CSH. DCLG, 2010) and the *Building Research Establishment Environmental Assessment Method* (BREEAM. BRE, 2013), which is described by its producers as "The world's leading design and assessment method for sustainable buildings." (BRE Global, 2010). The two assessment methods are "de facto measure[s] used to describe a building's environmental performance" (BRE, 2012a). However, the Government's use of CSH as a (non-mandatory) backdrop to its policy to make zero carbon buildings indicates that the measure of environmental performance, referred to by BRE (DCLG, 2007c), is more specifically a reduction in carbon emissions.

There is some debate about whether such performance targets constitute sustainable design or green design. From Williams' (2007) ecological perspective, sustainable design and green design are fundamentally different. Sustainable architectural design "includes continuing, surviving, thriving and adapting." (ibid: 16). Green design, in contrast, "incorporates ecologically sensitive materials and creates healthy buildings and processes that do not negatively affect the environment." (ibid). Rydin (2010: 15) proposes that "sustainability at the building scale has economic and social dimensions but the discussion starts by considering environmental aspects." Others argue that both are synonymous and that green design is incorporated in the rubric of sustainability (Jarzombek, 2003). In this context "the debate [...] is about which version [of sustainability] we want..." to pursue (ibid: 7). From another perspective, Gunder refers to sustainability as a fuzzy concept, one "that everyone purports to understand intuitively but somehow finds very difficult to operationalise in concrete terms." (Gunder, 2006: 211). In practice, the aspects of sustainability operationalised through policy are those that can be more easily quantified and measured, such as energy efficiency and reduction of carbon emissions.

Wackernagel (1994) argues that policy agendas which pursue green design

are predicated on the reductive and deterministic epistemology of mainstream macroeconomics, which ultimately inform political decision making (also see; Rees, 1992; Rees & Wackernagel, 1996). This epistemology is that of "traditional science", which Wackernagel (1994: 30-31) states is "scientific enquiry that is able to predict reproducible events" as can be found in "classical science, such as Newtonian physics". Where this epistemology breaks down is in the context of "non-replicable events involving complex systems such as social behaviour". In such cases "scientific inquiry can only explore probable outcomes, but never its predictive claims." (ibid. Also see; Rees, 1992; Rees & Wackernagel, 1996).

Paradoxically, notwithstanding the apparent focus on green design, or rather, the measurable dimensions of sustainability, Gunder notes that the word 'sustainability' is also used as a catchall term "for many of humanity's diverse environmental concerns and responses" (ibid: 209). Gunder argues that this narrow perspective of sustainability emerges from sustainability's deployment as an imperative of economic growth. He identifies that it is this myopic interpretation of sustainability that is embodied in planning policy and is presented as a set of incontestable, meaningful goals.

Such a state is chimera: Gunder (2005) suggests, values and ideals create varied interpretations of overarching goals. In this context, what constitutes gains for some, results in losses for others. Satterthwaite (1997) illustrates this through the carrying capacities of urban areas. He describes how wealthy cities are able to improve their inner environmental quality because they "can import all the goods whose production requires high levels of resource use and usually includes high levels of waste (including serious problems with hazardous wastes), pollution and environmental risk for their workforce." (ibid: 1668). With this he suggests that a city's isolated activities might be considered sustainable, but it is not necessarily conducive to the concept of sustainable development. It is this relationship between actions and the unpredictable nature ecological

systems [1] that market-orientated policy agendas for sustainable design neglect to consider (also see; Wahl & Baxter, 2008).

> "Planning driven and/or justified by dominant institutional interpretations of sustainability often no longer is concerned about its traditional ideal of social justice in which it balances market and social interests in the public good; now, it is concerned primarily with pursuing "sustainable cities that balance environmental concerns, the needs of future populations, and economic growth" (Beauregard 2005, 204)."
>
> (Gunder, 2006: 214)

Other issues do not disappear, Gunder points out; they are engulfed in the catchall term sustainability, the ultimate goal of which in hegemonic policy is carbon reduction. Injustices are both subsumed and subsequently obscured by the pro-market interpretations of the sustainable agenda (ibid).

2.2.2 PERPETUATING REDUCTIVE DETERMINISM

The universal acceptance of goals is illustrated through utopian visions of desired spaces (Gunder, 2005). Utopia, as Colman (2005: 16) explains, is the perpetual search for unity engendered by the complex and disordered nature of reality. Coleman (ibid) sees the work of the architect as a solution-finding exercise to such problems and shows how historically architecture has delivered manifestos for the formalisation of the built environment. One well established example of this is Vitruvius' (1960) Ten Books on Architecture, which outlines his desires to "bring the whole body of the discipline to great order" (Till, 2009: 27). Referring to McEwan (2004), Till (2009: 28) points out that the idea of 'the whole' comes from the perception of the body as a set of coherent, organised parts. Analysing architects' conceptions of the human body, Imrie (2003: 49) notes that Vitruvis saw the body as "the embodiment of God", and therefore an example of perfection; something worth replicating in the fabric of the public environment.

[1] Rees (1992: 122) defines ecology as "the scientific study of the flows of energy and material resources through ecosystems and of the competitive and cooperative mechanisms that have evolved for the allocation of resources among species."

In Vitruvius' order, the body, or corpus (as it appears in the Vitruvian text), is the figural basis for proportional measure (McEwan, 2004). Till (2009: 28), however, identifies that the Vitruvian orders are not simply a visual agenda, but rather "a wider pretension of Vitruvius to tie his architectural approach into the imperial programme of expansion and authority."

These ideas of order, supported by the goal of unity, resonate through the Modernist movement by the way in which modernists sought to organise the unplanned [2]. This is true for both architecture and planning. In *The City of Tomorrow and its Planning*, Le Corbusier (2000: 6) concerted that the plan and growth of "continental cities" was the product of "meander[ing]", "scatter-brained and distracted" donkeys, whose pathways, in response to prevailing topography, would "take the path of least resistance."

To achieve order and displace uncertainty architects have always sanctioned a series of rules or codes, such as those devised by Vitruvius, Palladio and Alberti, and in modern practice, by Howard (The Garden City, 1898), Wright (Broadacre City, 1932), Le Corbusier (Ville Radieuse, 1935), the MARS (Modern Architectural Research) Group (Plan for London, 1938) and CIAM's (Congrès International d'Architecture Moderne) Athens Charter (1943). The need to control, implicit in these descriptions, is a product of the acceptance of uncertainty. Asserting control automatically rejects that which does not conform to specific values.

[2] The idea of unplanned cities stems from the view of cities as organisms, such as Lynch's (1981) organic model in which no overarching masterplan has played a part in its creation.

The representation of professionals as experts is a further example of this misconception: "Experts" Till (2009: 159) suggests, are "endowed with the authority of professional knowledge, [to] legislate what is the right or wrong way to deal with issues. If this operation assumes the status of a battle with the forces of uncertainty and disorder then this just serves to reinforce the heroic status of the professional." Referring to Bauman (1991), Till (2009: 159) proceeds to say;

"'expertise becomes its own cause (rather than its own purpose).' [...] Bauman sees the expert as one of the key agents in modernity's war on ambivalence and the consequent overriding of contingency with the presumed virtues of certainty." In this way, "Architects are no different from any other profession in exerting their independence as a means of defining their territory, their area of control, apart from others." (ibid: 17). Naturally, the "protection of interests, to improve [the profession's] social status" has been a perennial pursuit since the advent of the architect (Wilton-Ely, 2000: 191), but the more critical concern here, is "a system in place that helps make demand responsive to supply" (Gutman, 1988: 97).

Sarfatti-Larson refers to the syllogism that "only architects produce architecture. Architecture is an art. Architects are necessary to produce art." (Sarfatti-Larson, 1993: 5). Carried with this belief are the ideological constructs that illustrate professional services as solutions to public concerns. After Lefebvre (2003), Gunder suggests that "planning policy [for sustainability] often is constructed by drawing on a strategy that mixes ideological values and beliefs with rationality as though it is all technological science" (Gunder, 2006: 217). With this rationality, sustainability is accepted as a public good which inevitably reinforces the value of design and planning disciplines, "particularly if sustainability is now the profession's core purpose and goal." (ibid: 213). From this perspective, sustainability empowers planning and design disciplines, and "places planning's very justification largely beyond public challenge" (ibid: 214). Similarly, Bennetts (2008) discusses the virtues of increasing the value of the architectural profession by demonstrating that the core skills of the profession are crucial to the production of a more sustainable landscape.

Professionals are urged to "justify the value [they offer], and to do so in terms that reassure clients and patients that they are getting their money's worth" (Gutman, 2001: 107). Approaches to design that reinforce sustainable benchmarks also

reinforce the value of architects. Gunder and Hillier (2009) have also noted this, and as a result suggest that sustainability (as set out in regulatory benchmarks) has become an empty signifier (also see, Davidson, 2010). Davidson (2010) points out that “we no longer have a marker that designates certain qualities; for instance that sutainability is concerned with low emissions, more community trust and more resilient economies. Rather the master-signifier becomes the cause itself, losing its necessary qualities [... and] something which ‘turns disorder into order’ (Zizek, 2006: 37).” (Davidson, 2010: 392). With this he proposes that sustainability becomes a process for treating the symptoms rather than examining the causes. The critical issue here is that these dominant constructs are accepted, seemingly without question, by professions, and by the public through architectural manifestations (Gunder, 2006: 218-219).

2.3 OPERATING WITHIN THE UNKNOWN

The perspective that both sustainable development and the nature of urban form (concentrations of economic activity and the context in which architects operate) exist in a state of dynamic complexity. This is to say that they should be considered fluctuating and uncertain contexts, thus presenting a myriad of often immeasurable conditions for architects to accommodate in their work. It has been argued that the epistemological foundations of mainstream economic theory drives a reductive and deterministic approach towards sustainable design focussing on the measurable aspects of architecture. Put into practice through policy agenda, these qualities of sustainability often obscure the diverse and multidimensional aspects of sustainable development in favour of those aspects which best promote economic growth. This problem is augmented by planners and architects (Gunder, 2006), who embody these interpretations of sustainability in their services. Consequently, at the building scalesustainability is reduced to focus on elements of architecture that can be pursued with greater determinacy if they are isolated from the complex environment in which they exist. To summarise the situation Rees (1992: 122) quotes cyberneticist Stafford Beer (1981), who stated: “we can not regulate our interaction with any aspect of reality that our model of reality does not include because we cannot by definition be conscious of it.”

This dichotomy is exacerbated by an apparent disconnection between the production and implementation of objectives against which sustainable design is measured. In part, this stems from a lack of literature regarding the production of CSH and BREEAM from a research perspective, in addition to more general information that might be provided by the British Research Establishment (BRE). Goodbun (2012) recognises this when, in view of a cybernetic approach to the relationship between entities over time, he suggests that “whether we think of the large-scale technological fixes at the core of many contemporary ecological urbanist approaches at one end of the scale, or the back-to-nature philosophies

of more traditional green building advocates [...] an over-emphasis on efficiency [in sustainable design] might in fact impede the success of either approach" (Goodbun, 2012: 54).

Knox (1987) identifies similar issues to those posed here and states that the field of research exists "with an overwhelming emphasis on micro scale interactions between architecture and human behaviour and equally overwhelming emphasis on the deterministic interpretation of people-environment relationships" (ibid: 114-115; also see Saint, 1983; Cuff & Wriedt, 2010).

Goodbun (2012) supports Gregory Bateson's, view that "urban theorists, designers and indeed city dwellers need to develop what [Bateson] described as an 'ecological aesthetic': a new way of seeing how complex systems like cities behave" (ibid: 54). This 'way of seeing' embraces the idea that systems (such as society and the environment - including cities) interact and are constantly changing and concludes the following from this:

> "Developing a critical socio-ecological understanding of global urbanism remains a key challenge. Perhaps we might develop out of Bateson's thinking some new tools and suggestions towards a new kind of learning process, an experimental socio-ecological practice in which we recognise that 'the ecological ideas implicit in our plans are more important than the plans themselves, and it would be foolish to sacrifice these ideas on the altar of pragmatism.' (Bateson, 2000: 513)."
>
> (Goodbun, 2012: 55)

Parallel to this, Wahl & Baxter (2008) argue that the parameters set by sustainability policies pursue environmental performance objectives potentially at the expense unquantifiable requirements. They consider that sustainability can not be explicitly defined as a sequence of objectives that represent social,

economical and environmental requirements, because the nexus of values it constitutes are constantly evolving (ibid: 72-73).

Beginning in January 2012, the *Architectural Review* initiated a series entitled *The Big Rethink* to reconsider the position of the architectural profession in light of changing conditions in the construction industry (Buchanan, 2012). This reveals a growing impetus to reassess architects' practices, particularly with concern for sustainable design, with a view to broaden perspectives of, and approach to, sustainability.

Notwithstanding the gradually developing body of research that recognises the multifarious disconnections between sustainability and design, this thesis focusses on generating a better understanding of the prevailing circumstances for sustainable design, in order to better inform further research into how such disconnections might be addressed. Consequently, the following chapters explore how sustainable design is regulated and the implications of this for architectural design.

3.0 MEASURING VALUE IN SUSTAINABLE DESIGN

Williams & Lindsay (2007) note that the diversity of policy and guidance is one of the challenges facing the implementation of sustainable design. Within this plethora of regulation, two guises of design emerge that reflect the epistemological dichotomy presented in chapter 2.0:

3.1 Sources of Impetus for Sustainable Design

To set the scene, this section briefly introduces the broad array of sources of impetus for sustainable design, drawing a distinction between regulatory devices and the role of design conveyed by them.

3.2 Quantitative Value

This section concentrates on how performance efficiency, [3] particularly energy efficiency and carbon reduction, is central to mandatory design objectives and capitalistic regulatory devices, which emphasise the measurability of design.

3.3 Qualitative Value

Design is the *raison d'être* of sustainability from a qualitative perspective. In this context, energy performance is viewed as one of many broader social and cultural issues that are intimately connected to the formal characteristics of architecture. It is a distributed approach that reinforces the significance of social imperatives.

3.4 The Duality of Sustainable Design

The chapter concludes that treating design in these polarised ways not only leads to confusion about what constitutes sustainable design, but reinforces the duality of design.

[3] Performance efficiency is used here to refer to how well a building performs, or is anticipated to perform, in terms of energy efficiency and carbon reduction.

3.1 SOURCES OF IMPETUS FOR SUSTAINABLE DESIGN

> "The central tenets of a sustainable building are still resource and energy efficiency and the prevention of pollution and waste. However, as the concept of sustainability has matured, and sustainable design has grown as a discipline, a number of considerations have also been included that relate to the broader social and economic impacts of the built environment."
>
> (Williams & Lindsay, 2007: 33)

The impetus for sustainable design comes from a wide range of sources. The most prominent guidance in this arena comes from the Commission for Architecture and the Built Environment (CABE) who have published widely on the benefits of good design and the ways in which design can be approached to ensure sustainability. Documents such as *Hallmarks for a Sustainable City* (CABE, 2009) address the broader scope of how design can manifest more sustainable solutions, while *Sustainable Design, Climate Change and the Built Environment* (CABE, 2007) emphasises the role of design in improving certain aspects of design quality.

One new platform for evaluating energy efficiency in buildings during use is *CarbonBuzz* (RIBA, et al., nd). Other guidelines that apply to pre- or during design activity include, *Building for Life* (Design for Homes, et al., 2012), which promotes factors that contribute to raising design standards and quality, *Design Quality Indicators* (Construction Industry Council, 2005), and *Lifetime Homes* (Habinteg Housing Association, 2011), which offers foresight in adaptability and accessibility. These all bear some relationship to sustainable design, although they do not constitute comprehensive assessments.

Practitioners also develop their own guides, which potentially inform the practices of others too. For example, ARUP's (2000) sustainable assessment tool, *SPeAR* (Sustainable Project Appraisal Routine), is designed to provide a

method through which to balance the many factors that contribute to sustainable design. Similarly, housing specialists, PRP, developed the *Domestic Low Carbon Retrofit Guide* (2011).

There are a considerable number of other membership organisations, charities and QUANGO's (Quasi Autonomous Non-Governmental Organisations), such as the Green Building Council, the Zero Carbon Hub and the Institute for Sustainability. Implicit in this proliferation of driving organisations, is a variety of conceptions of sustainable architecture. It is no surprise that the report of the Sustainable Buildings Task Group, recommended "that the Government review the advisory bodies concerned with sustainable buildings to simplify and consolidate them and to provide clear direction to the industry" (2004: 7).

A distinction can be drawn between those regulations that are mandatory or are manifest in forms of regulatory capitalism, which conventionally drive efficiency, and those with the imperative to drive quality. The following sections will explore each of these paradigms, with the purpose of describing how sustainability is presented to architects; examining how they are guided by a myriad of (sometimes conflicting) ways in which sustainable architecture can be generated and analysed post-production.

3.2 QUANTITATIVE VALUE

Whilst regulation sets mandatory standards, a commercial backdrop to these is becoming increasingly influential, not simply because of a commercial impetus for corporations to illustrate their social and moral responsibility, but also because of the government's obligation to do the same. The section will review how mechanisms for sustainable design assessment, which emphasise quantitative measures, are embedded in the political impetus for sustainable design and how such assessments function.

3.2.1 THE SUSTAINABLE AGENDA AND ASSESSMENT

Legislative regulation in the UK is characterised by the construct of "better regulation" (BIS, 2012), which intends to facilitate a shift from "prescriptive to performance based systems of control" (Imrie & Street, 2011: 71). The key mechanism for this is a strategy which specifies that the introduction of new regulations should reduce the overall number of regulations (BIS, 2012). This aims to simplify regulation, making it easier to enforce and, ultimately, more effective (ibid). In this context, the *Building Regulations,* which impose minimum standards for efficiency, accessibility and risk, are intended to be met without interfering with the formal qualities of architecture. Although inevitably part of the design process, this regulatory structure is intended to satisfy criticism that regulations contradict good design practice (Ben-Joseph, 2005a; Talen, 2012. Also see; Marshall, 2009; Imrie, 2007; Imrie & Street, 2006; 2009; 2011. Also see chapter 4.0).

Providing a backdrop to the building regulations and national planning policy (DCLG, 2012) are the *Code for Sustainable Homes* (CSH. DCLG, 2010) and the *Building Research Establishment Environmental Assessment Method* (BREEAM) assessment methods (BRE, 2013). These are non-mandatory standards at both the national and international scale. However, they are endorsed by local authorities in the UK, who may stipulate specific CSH ratings

for housing and BREEAM ratings for non-domestic buildings (DCLG, 2012; BRE Global, 2010). Additionally, select buildings procured by the government and QUANGOs require assessment, these include; hospitals, schools and social housing.

Originally established as the government's Department for Scientific and Industrial Research, BRE has been a private, "research-based consultancy", since 1997 (BRE, 2012), responsible for developing and maintaining both CSH (BRE Global, 2010; BRE 2012a; DCLG, 2010) and BREEAM (BRE, 2010). With this in mind, the role and influence of such assessment methods comes close to regulatory capitalism. Levi-Faur (2005: 15) describes regulatory capitalism as the condition for regulation where "the state retains responsibility for steering [regulation], while business increasingly takes over the functions of service provision and technological innovation." (also see, Braithwaite, 2009).

BREEAM is tailored to specific building typologies, such as retail, industrial, health care, offices, education, courts, prisons and multi-residential (BREEAM New Construction, 2011). To assess buildings not addressed by any of these pre-defined schemes, BREEAM Bespoke (2008) exists. There are also schemes designed to assess masterplans (BREEAM Communities, 2012), 'Refurbishment' (BRE, 2012a) and buildings 'In-Use' (BRE, 2012b). These accommodate the performance specificities of building typologies.

Fig. 3a sets out the assessment issues that are considered in grading sustainable buildings. Many of these issues can be addressed through technological means, such as thermally efficient materials and energy efficient goods, which are geared towards minimising harmful emissions from buildings.

Rating benchmarks for CSH range from 1-6, with 6 representing zero carbon. The rating benchmarks for BREEAM comprise Pass; Good; Very Good or Excellent.

In 2008 the rating system was revised and an Outstanding category added (BRE, 2011). Overall ratings are determined by the following factors (adapted from BREEAM New Construction, 2011, however these are also applicable to the assessment procedures of CSH):

- **Assessment issues and credits**

  Ratings are achieved on a credit based system, where credits (or points, as they are also often described) are accumulated in a number of categories. Within categories, assessment issues relate to the number of achievable credits (see fig. 3a for a table of categories and number of assessment issues for each category). Additional credits are available for innovation.

- **Minimum BREEAM standards**

  Credits are designed to be traded between categories in order to accommodate flexibility. For example, where a design may not be compliant in one category, it might attain more credits in an alternative category to compensate (see BREEAM New Construction, 2011: 19-27) Within this model, minimum standards provide a minimum performance level for each category, below which a design scheme would fail overall assessment.

- **Category weighting**

  Assessment calculations are based on a system of category weighting, which highlights the significance of specific categories in attaining low carbon architecture.

Assessment involves the independent role of the assessor who determines which assessment scheme is the most appropriate. Assessments are made during the design stages and re-examined post-completion, leading to a final certified rating. The performance- and assessment-based criteria of BREEAM and CSH can be said to follow the government's strategy for less prescriptive regulation and therefore should not interfere with the formal qualities of design.

FIG. 3a Categories and assessment issues as set out by CSH (DCLG, 2010) and BREEAM New Construction (2011). **W** (weighting) represents the percentage weighting for each category. It is noteworthy that assessment issues are geographically generic, but tailored to specific building typologies.

CSH			**BREEAM**		
	Assessment Issues	W		Assessment Issues	W
Energy + C02 emissions	Dwelling Emission Rate; Fabric Energy Efficiency; Energy Display Devices; Drying Space; Energy Labelled White Goods; External Lighting; Low and Zero Carbon Technologies; Cycle Storage; Home Office	36.4	Energy	Reduction of Emissions; Energy Monitoring; External Lighting; Low + Zero Carbon technologies; Energy Efficient Cold Storage; Energy Efficient Transportation Systems; Energy Efficient Laboratory Systems; Energy Efficient Equipment; Drying Space.	19
Water	Indoor Water Use; External Water Use	9.0	Water	Consumption; Monitoring; Leak Detection and Prevention; Efficient Equipment	6
Materials	Environmental Impact of Materials; Responsible Sourcing of Materials – Basic Building Elements; Responsible Sourcing of Materials – Finishing Elements	7.2	Materials	Life-cycle Impacts; Hard Landscaping + Boundary Protection; Responsible Sourcing; Insulation; Designing for Robustness	12.5
Surface Water Run-off	Management of Surface Water Run-off from Developments; Flood Risk	2.2	Transport	Public Transport Accessibility; Proximity to Amenities; Cyclist Facilities; Maximum Car Parking Capacity; Travel Plan	8
Waste	Storage of Non-recyclable Waste and Recyclable Household Waste; Construction Site Waste Management; Composting	6.4	Waste	Construction Waste Management; Recycled Aggregates; Operational Waste; Speculative Floor and Ceiling Finishes	7.5
Pollution	Global Warming Potential (GWP) of Insulants; NOx Emissions	2.8	Pollution	Impact of Refrigerants; NOx Emissions; Surface Water Run-Off; Reduction of Night Time Light Pollution; Noise Attenuation	10
Health + Wellbeing	Daylighting; Sound Insulation; Private Space; Lifetime Homes	14.0	Health + Wellbeing	Visual Comfort; Indoor Air Quality; Thermal Comfort; Water Quality; Acoustic Performance; Safety and Security	15
Management	Home User Guide; Considerate Constructors Scheme; Construction Site Impacts; Security	10.0	Management	Sustainable Procurement; Responsible Construction Practices; Construction Site Impacts; Stakeholder Participation; Life-cycle Cost + Service Life Plan	12
Ecology	Ecological Value of Site; Ecological Enhancement; Protection of Ecological Features; Change in Ecological Value of Site; Building Footprint	12.0	Land Use + Ecology	Site Selection; Ecological Value of Site + Protection Ecological Features; Mitigating Ecological Impact; Enhancing Site Ecology; Long-term Impact on Biodiversity	10
			Innovation		

3.2.2 THE COMMERCIAL VALUE OF ASSESSMENT

Recent studies of the use of BREEAM have indicated that it is also underpinned by a commercial impetus: its role appears to be particularly pertinent for corporations wishing to demonstrate a level of moral responsibility to their customer base (BRE, 2012b). A recent study of *The Value of BREEAM* (Parker, 2012) emphasises this point through evaluations of client and user satisfaction with BREEAM rated buildings and views of the network of consultants who implement standards. This follows from studies of the Leadership in Energy and Environmental Design (LEED) assessment method, the US equivalent of BREEAM [4], that reveal economic incentives for clients pursuing the higher high rating levels (Sentman, 2009). In this regard, optimum performance is incentivised, rather than specifying rules for minimum performance, as legislative regulation does. The study reports that increased costs associated with obtaining higher rating levels are subsidised by demand and return on rent (Ibid: 3). Sentman also suggests that meeting the requirements of lower levels of the criteria, which have lower associated costs during the design stages, the return is much less significant. This leads to BREEAM increasingly being built into design briefs and procurement contracts by clients (Patterson & Rossetta, 2010, also see Menteth, 2012). For commercial clients, such as developers, these are clearly significant benefits.

[4] One distinction between BREEAM and LEED is that BREEAM is based on accounting for carbon, whereas LEED is cost based (see, Parker, 2009)

Parker (2012: 31) concludes that the integration of BREEAM in the design process from the outset is paramount to maximising market benefits. The performance-focus of the assessment method, together with the appropriate exclusion of any assessment of formal design qualities in the resultant rating, indicates that the performance rating itself is more important than formal qualities and details of design. This can be seen in distinctions between the way in which commercial clients and 'the supply chain' [5] value BREEAM (and consequently design). For the supply chain, specifically referring to designers and consultants, Parker (ibid) suggests that (commercial) value is distributed throughout the delivery of

[5] 'The supply chain' is the phrased used by Parker (2012) in reference to those involved in the processes of building production, such as contractors, consultants and architects..

design information for construction.

Architects operate under an obligation to conform to the *Architects Code* (ARB, 2009), which includes the obligation to deliver socially and environmentally integrated designs [6]. However, for the commissioners of buildings, value, broadly speaking, is predominantly commercial. From this perspective, the formal qualities of architecture are arguably marginalised against the final assessment rating.

The process of developing designs in line with the assessment method is, as Parker (2012) proposes, ultimately concerned with the *composition* of performance-related specifications. Although assessment is disconnected from the formal qualities of design, the overall design process contradicts the study of design as a form of social and cultural practice, and instead positions it as a process of aesthetic composition (Lang, 2009: 9). This brings into question the role of design in the capitalist market.

The (deregulatory) mechanism of regulatory capitalism is intended to resolve the popular belief that (prescriptive) regulation is anathema to design and also business more generally (BIS, 2012, also see chapter 4.0). Notwithstanding this, the value of sustainable design is placed in direct competition with commercial value. Design then shares a contested relationship with assessment, begging the question; does BREEAM accreditation displace the value of the formal qualities of design?

[6] Section 5 of The Architects Code: Standards of Conduct and Practice (ARB, 2005), states "*Whilst your primary responsibility is to your clients, you should take into account the environmental impact of your professional activities.*"

3.3 QUALITATIVE VALUE

In *Hallmarks of a Sustainable City*, CABE (2009) present the issues of climate change as an opportunity for design, suggesting sustainability "means re-designing how we think and how we organise our lives", which "requires courage, vision and leadership" (ibid: 3). In this context design is fundamental to the production of sustainable architecture, thereby emphasising the qualitative value of sustainable design, as opposed to the quantitative performance characteristics of buildings.

Valuing quality is visible in design guidance as opposed to specific assessment, or regulatory legislative measures (DCLG, 2011; 2012; CABE, 2009; Llewelyn Davis, 2007; Urban Task Force, 1999). There is no standard route to reconcile the diverse issues exposed by the discourse on sustainable design, thus raising the significance of the designer as an intermediary between regulation and production. Jenks & Dempsey (2005: 415) resonate this when they note; "the complexities of the scale and variety of urban forms, and the intimate interweaving of environmental, social and economic issues, could easily suggest that, as everywhere is different, consistently meaningful [design] action is almost impossible [...] There is no 'one size fits all' solution, [but] there are strategies and actions that have some commonality within particular urban contexts" (ibid).

The subsections that follow provide a synopsis of the different ways in which sustainability can be understood in terms of architecture and review alternative ways to generate sustainable design, beyond considerations for energy efficiency.

3.3.1 PLURAL PERSPECTIVES OF SUSTAINABLE DESIGN

Guy (2001; also see Redclift, 1989 & 1991; Dryzek, 2005) asserts that sustainable design equates to a "bewildering array of contrasting building types, employing a great variety of different technologies and design approaches,

each justified by a highly diverse set of interpretations of what a sustainable place might represent" (Guy, 2001: 140). To make sense of these disparate agendas he (ibid; also see; Guy & Farmer 2000) performed an extensive review of the literature from which he elicited six primary 'logics' of sustainable design. These are as follows:

- **Eco-technic**

  An approach based on environmental management in order to control the impact of development on the environment. Designs are 'high-tech' and "attempt to maximise the efficiency of building in spatial, construction and energy terms" and lead to "innovations in building fabric and servicing systems." (Guy, 2001: 142).

- **Eco-centric**

  Rooted in the understanding of ecology as a system too complex to be described in terms of economics and commodity, environmental palliation rests with actors (social communities) within the system. As a result, architectural design seeks not to control environmental conditions, but to work in tandem with them through passive cycles.

- **Eco-aesthetic**

  Stemming from the "postmodern paradigm", this approach emphasises the role of the senses in the design of architecture, suggesting that 'a sense of place' offers the necessary utility to avoid further environmental degradation (ibid: 143).

- **Eco-Cultural**

  Drawing on the concept of a sense of place, Guy proposes that design approaches in this context are predicated on the indigenous and the ability to respond locally and culturally to environmental conditions which follow the processes Alexander (1964) coins 'unselfconscious'.

- **Eco-medical**

  Linking issues of sustainability to concerns for wellbeing and health, this

approach embodies a “humanist and social” perspective. Guy explains it often has a focus on the building interior and the effect of this on its occupants; linking natural and passive, ‘eco-centric’ approaches to generate healthy environments.

- **Eco-social**

  Sustainability is considered from the perspective of social hierarchies and networks; that is collective society, rather than individual sociological needs as in the ‘eco-medical’ logic. It address industrialised networks, with a view to understand technological approaches (Pepper, 1996). As such, design is concerned with the processes of creation, depending largely on public and stakeholder participation.

(Adapted from Guy, 2001: 141-146)

Guy & Moore (2007) render the persistent desire to establish an ultimate and singular answer to sustainable living unproductive on the basis that the environment is both physical and social, and consequently are rarely interpreted in the same way. To this end, it is the collective diversity of interventions operating at different scales that constitutes one of the many factors of sustainable form, rather than the search for an optimum performance.

3.3.2 PLURALIST ACTION

“Ultimately, the users of urban environments create or erode sustainability, with the physical, social and economic infrastructures forming the ‘places’ that locate lifestyles. Therefore, for sustinability interventions to succeed, a human centred approach must be adopted.”

(Cooper, et al., 2009: viii)

Here, the emphasis shifts from creating sustainable places by manifesting the technological mechanisms that satisfy goals, to a form of agency (see; Till & Schneider, 2012). Many approaches that attempt to facilitate this concentrate

on collaboration and stakeholder participation in order find the best approach to ineffable situations. Such propositions support methods such as actor-consulting as practical tools (de Roo, 2007; Porter, 2007). Other methods comprise decentralised, distributed decision-making methodologies, which rely on more than one approach, (design, coding, development control) to generate a non-biased method involving "a multiplicity of actors and types of instruments, and feedback between users, designers and public policy makers" (Marshall, 2012: 203).

Jamison (2003) proposes that knowledge of sustainable design "is not so much about the environmental conditions in which we live, so much as about how we can take those conditions into account in pursuing more sustainable paths of socio-economic development" (ibid: 703). From this perspective, Guy (2001) argues for critical reflection and an understanding of the actors and mechanisms through which design approaches and conventions become manifest, in order to generate sustainable conditions (also see; Moore, 2006).

A rejection of 'relativism' is needed to begin a shift to a 'pluralist' dialect where discourse contributes the making and remaking of sustainable futures (Marvin & Guy, 1999). Such approaches are predicated on a deeper understanding of what public engagement and collaboration can offer. To explain this further, Guy and Moore (2007), use a case study of Commerzbank, Frankfurt by Foster + Partners (1997) [7] to describe the outcomes of the pluralist approach. The case suggests that the Commerzbank project positively influenced a prevailing negative attitude towards skyscrapers by association with its environmental approach (ibid: 20). They propose that a "pluralist practice" should mean "seeking out the synthetic opportunities that are latent in the conflicting imaginations of citizens" through a medium of "speculating about what might become true in the future." (ibid: 21-22). However, this falls short of explaining how a 'pluralist' approach can be operationalised in the field.

[7] Moore (2007), also provides a further series of case studies which arrive at the same conclusion; that participatory action facilitates sustainable design.

The socio-technological perspective projected by Guy & Moore (ibid) is an appealing in that it rejects the desire to establish an omnicompetent approach. However, it is operationally inconclusive, neglecting to provide practical approaches that deliver unambigous results. They do, however, highlight the importance of developing a better understanding of the role of research (and hence theory) in practice. To this end, design is not simply the conception of architectural conditions, but it is the mechanism with which to shape the processes that inform cultural production.

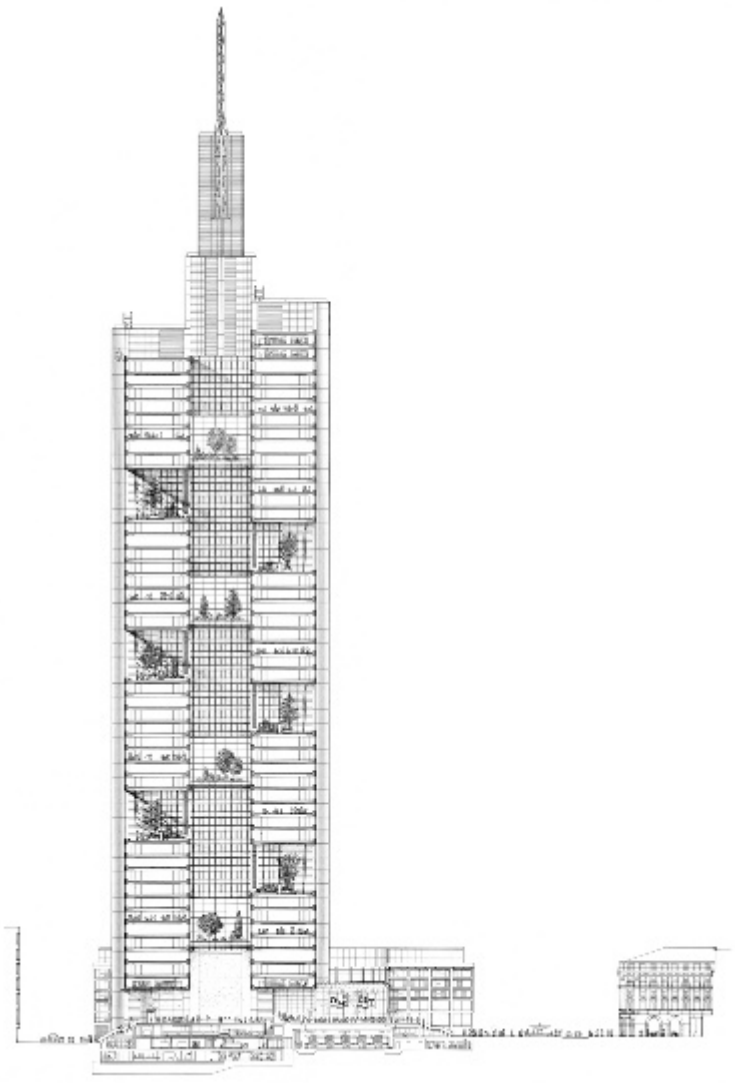


FIG. 3b
Section through the Commerzbank Tower in Frankfurt (Foster + Partners, 1997). The sky gardens can be seen dispersed throughout the structure. These allow more natural light to penetrate the interior, reducing the need for artificial sources and cultivating a general sense of well being. Image taken from (Buchanan, 2012a).

3.4 THE DUALITY OF SUSTAINABLE DESIGN

Valuing the quantitative characteristics of sustainability pays little attention to the role of design. In contrast, valuing sustainability qualitatively views design and sustainability as synonymous. In the former scenario, it would appear that design is considered in terms of the delivery of a building, more specifically, the procurement and management of producing a building, rather than the creative procedure of conceiving and resolving a design intervention. In the latter approach there is a stronger emphasis on the creative procedures of design, including a collaborative and investigative approach to evaluating prevailing cultural tendencies: it is akin to what McLennan (2004; also see, Williams, et al., 2003) describes as “a holistic approach” to design. From this perspective, design is a platform from which to initiate change.

As Williams & Lindsay (2007) have suggested, the concept of sustainability is deliverable as a series of material efficiency measures. Antrop states that “Sustainable landscapes will remain utopist if too precise time horizons for landscape management are set” (Antrop, 2006: 195). With this he explains how shifting conditions, and consequently requirements for sustainable built form, mean that material efficiency, manifest in regulations such as those associated with quantitative values, may pursue out of date or irrelevant criteria for sustainable architecture. Quantitative and qualitative values are therefore complimentary and it is imperative that they are employed in tandem in order that a varied perspective prevails to inform design and drive discourse.

Reconsidering professional capabilities and values in light of the prevailing emphasis towards sustainable design is a useful task given the varied approaches and impetus at policy level. Guy & Moore suggest:

> “We need to investigate how the social systems of reward and penalty that now isolate practice from research, and research from practice, can be

> modified to stimulate new modes of architectural production [...] In this way, debates about sustainable architecture may be constantly reshaped by the experience of practice, while practice might be reframed by public talk."
>
> (Guy & Moore, 2007: 22)

Most significantly, the two paradigms presented in this chapter reveal how design is positioned within different regulations and guidelines. What remains to be discussed is how designers work within these scenarios, and what effect these paradigms have on the design process. This will be addressed in the following chapter.

4.0 AUTHORING SUSTAINABLE ARCHITECTURE

This chapter elaborates on the regulatory duality of sustainable design by exploring dualities in the architectural profession. The core duality of concern is the distinction between commercial practice and creative processes, which will be evaluated in parallel with prevailing assumptions of the implications of regulation for design. The chapter comprises four sections:

4.1 Dualities in the Profession

The first section explores the character of architectural practice and outlines two principal features of architectural practice (commercial and creative activities) that are the product of hyperbole.

4.2 Sustainability in Commercial and Creative Contexts

Using architectural practice and education to represent the distributed decision-making environment of contemporary commercial practice and the creative process of conceiving and developing design ideas respectively, this section will review the mechanisms put in place to guide sustainable design in both contexts.

4.3 Regulatory Influences: Prevailing Assumptions

Drawing on multiple aspects of the built environment, including planning, urban design, engineering and architecture, this section unveils the ways in which regulations can affect design practice.

4.4 Duplex Dualities: Alignments Between Design Definitions and Policy Implications

This section explores the alignment between the dualities of design and prevailing assumptions of the implications of regulation for design. It reveals that the effects of regulation for design are polarised; being either detrimental or auxiliary according to the context in which design is observed.

4.1 DUALITIES IN THE PROFESSION

Constructive Change, the report of an investigation into the future of the architectural profession (RIBA, 2005, also see; Gelder, 2012), identified that the key strengths of the architectural profession include creative problem solving and its ability to deliver bespoke design. These strengths sit within a demand-led industry dominated by standardisation, towards which, the architectural profession is seen to express "outdated norms and behaviour" (RIBA, 2005: 6). This might be understood as a reaction to protect the value of design, which the same report found to be poorly conveyed by practitioners (ibid).

Whilst design is identified as one of the principal values that the architectural profession contributes to the construction industry, most architects are not the "heroic form givers" (Bentley, 1999: 28) portrayed by romantic visions of renaissance master-builders, modernist visionaries epitomised by the iconic image of Le Corbusier's hand hovering over *La Ville Radieuse* (1964, Fig. 4a), or contemporary 'starchitects' (Jencks, 2005; Knox, 2009; 2011). Contrarily, the practice of architecture is inextricably linked to the design project, its context, the client and other stakeholders, in addition to the various consultants party to a design project (see; Blau, 1984; Cuff & Wriedt, 2010; RIBA, 2005; Saint, 1983; Sarfatti-Larson, 1993; Stevens, 1998). Conceptualisation is one small activity in a complex process of distributed-decision-making and project management, which is notably distributed throughout the project in response to various client and programme requirements, and environmental and technological parameters. It is the contrast between this reality and the vision of the architect as heroic form giver that promulgates questions concerning the marginalisation of architectural activities and from which the dualities of the profession stem.

To set the context for the relationship between sustainability and commercial architectural practice, this section will introduce the nature of contemporary architectural practice and explore the dual nature of its activities.

FIG. 4a
Le Corbusier, La Ville Radieuse, Paris.
Source: Editions Vincent, Fréal & Cie, 2nd ed., 1964: 135

4.1.1 THE STRUCTURE OF ARCHITECTURAL SERVICES

The procedures of practice are earmarked by phased outputs during the course of a design project. These are guided by the *Outline Plan of Work* (PoW. RIBA, 2007, see Fig. 4b), which "sets out the [architectural] industry standard for the way that projects are managed and administered" (see, 3DReid, 2010: 191). Defining project outputs as "descriptions of key tasks" (RIBA, 2007: 1) the PoW highlights the distinction between design activity and products of those activities. In the capacity of formalising and standardising design projects, the PoW has three primary functions:

1. To clarify the diverse scope of architects' services.
2. To provide a comprehensive structure of the architectural design process for clients and other parties concerned with the profession about the role of the architect and their services.
3. To determine a standard set of procedures for practitioners, designed to minimise risk, reduce time wastage and costs, and ensure quality.

There are five phases of a complete design project within the PoW; *Preparation; Design; Pre-Construction; Construction* and *Use*. Within these phases the letters A-L represent outputs and tasks. The following paragraphs will examine each phase and the outputs and actions they comprise:

Preparation involves the identification and assessment of design objectives. Crucially, this indicates that designers are not necessarily provided with explicit problems. Instead, they are often approached by a client with a series of requirements and must evaluate issues of importance within the provided context. The PoW presents preparation as a two-stage sequence involving *Appraisal* and the production of a *Design Brief*. The appraisal stage seeks to establish key objectives and requirements in addition to the feasibility of meeting these. It culminates in the Design Brief to clarify the client's requirements and

objectives and a proposed programme of work. That the architect should produce information “to enable the client to decide whether to proceed” (RIBA, 2007: 1) acknowledges the process is not a solitary one and that it should be conducted with engagement from the client to ascertain their motivations and requirements.

Design, in this context, refers to the progression from design concept to technical resolution and refinement. Studies of the creative process recognise that these steps involve different aspects of design problems and consequently require different kinds of design thinking. It is also noteworthy that design is confined to a single phase in this context. In architectural practice, depending on how the project is procured, ‘design’ continues throughout all phases of the design project. For example, under certain forms of procurement there may be insufficient time, or no urgent need to resolve technical details until later in the construction process.

The **Pre-Construction** phase involves the production and packaging of information for the tendering process and thereby includes the continuation of technical resolution. Its separation from the design phase suggests a distinction between design as the generation of a scheme, and the technical detailing for the purposes of construction (or manufacture). The PoW is currently under revision [8], following the criticism that it fails to acknowledge and support contemporary methods of practice, such as the influence of computer-aided design (CAD), more specifically, building information modelling (BIM). BIM is a method of collating information to inform design decisions. It operates as a central reservoir of information that is attached to, or embedded in, a CAD model which is shared between consultants. Consequently, it intends to provide a vehicle for a more coherent technical design process, potentially raising issues in that may only have become apparent during construction, in advance.

[8] In 2013 a new version of the PoW was published by the RIBA. This literature review was conducted while the 2007 PoW was still in circulation. Both versions follow the same principle. The new version is intended to relate to new systems and procedures such as BIM and emphasise the need for research, such as building performance evaluation (BPE) or post occupancy studies as is required by BREEAM for ‘outstanding’ ratings.

		RIBA Plan of Work Stage	Description of Key Tasks
PREPARATION	A	**Appraisal**	• Identification of the client's needs and objectives, business case and possible constraints on development. • Preparation of feasibility studies and assessment of options to enable the client to decide whether to proceed.
	B	**Design Brief**	• Develop an initial statement of requirements into the design brief by or on behalf of the client confirming key requirements and constraints. • Identification of the procurement method, procedures, organisational structure and range of consultants and others to be engaged for the project.
DESIGN	C	**Concept**	• Implementation of the design brief and preparation of additional data. • Preparation of concept design including outline proposals for structural and building services systems, outline specifications and preliminary cost plan. • Review of procurement route.
	D	**Design Development**	• Development of concept design to include structural and building services systems, updated outline specifications and cost plan. • Completion of project brief. • Application for detailed planning permission.
	E	**Technical Design**	• Preparation of technical design(s) and specifications, sufficient to coordinate components and elements of the project and information for statutory standards and construction safety.
PRE-CONSTRUCTION	F	**Production Information**	• Preparation of production information in sufficient detail to enable a tender or tenders to be obtained. • Application for statutory approvals. • Preparation of further information for construction required under the building contract.
	G	**Tender Documentation**	• Preparation and/or collation of tender documentation in sufficient detail to enable a tender or tenders to be obtained for the project.
	H	**Tender Action**	• Identification and evaluation of potential contractors and/or specialists for the project. Obtaining and appraising tenders; submission of recommendations to the client.
CONSTRUCTION	J	**Mobilisation**	• Letting the building contract, appointing the contractor. Issuing of information to the contractor. • Arranging site hand over to the contractor.
	K	**Construction to Practical Completion**	• Administration of the building contract to practical completion. • Provision to the contractor of further Information as and when reasonably required. Review of information provided by contractors and specialists.
USE	L	**Post Practical Completion**	• Administration of the building contract after practical completion and making final inspections. • Assisting building user during initial occupation period. Review of project performance in use.

FIG. 4b
RIBA Outline Plan of Work (2007).

Within the **Construction** phase it is important to note the scope of architectural services: depending on the terms of their appointment, architects are not only be responsible for design and the production of information concerning their designs, but also for the delivery of them. That is, the process of overseeing the manufacture or construction. Consequently, design continues throughout construction, whether it concerns the finalisation of technical information and specification, or the need to modify spatial programme in response to findings on site that were otherwise unknown and/ or unknowable. Design resolution and production in architectural practice are often concurrent.

Use incorporates post-occupancy evaluations as a mechanism for feedback, for designers and building users. Anderson (2011) reflects briefly on making and reflecting in the design process, considering the nature of design decision being part of a continuous “feed back loop” (also see; Ambrose & Harris, 2009).

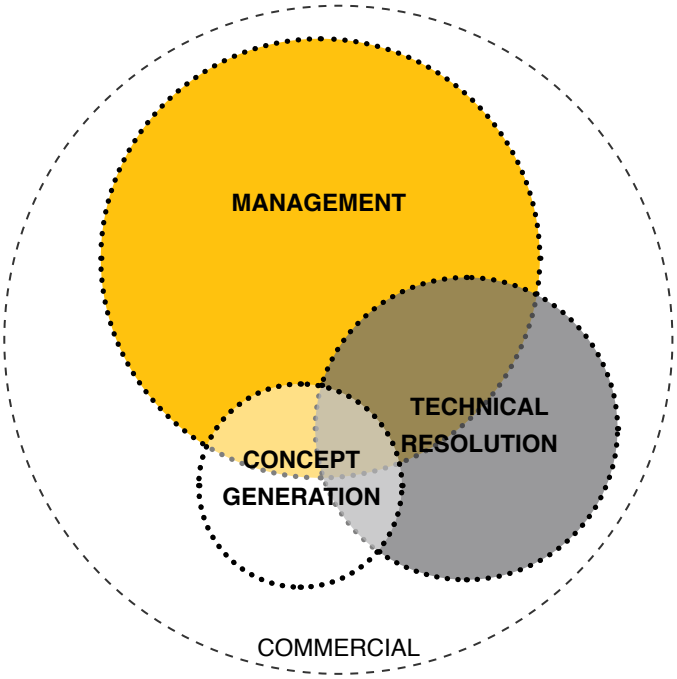
Chapter 10 of the *Architect’s Handbook of Practice Management* (3DReid, 2010) focuses on how the PoW can be administered to minimise risk and ensure quality and practice profitability. To demonstrate good practice for projects with appointment to conduct full architectural-services, the handbook places the PoW outputs (A-L) in a sequence to illustrate the type of information required and points of review between the architect and stakeholders throughout the project (ibid).

4.1.2 TENSIONS BETWEEN CREATIVE AND COMMERCIAL ACTIVITIES

Reductionistic exaggerations that place architectural design activity in one of two categories; creative or commercial (Cuff, 1992) add to this confusion. Here, creative activities are art and design orientated and commercial activities refer to the decision making and liaison that are akin to business and management activities. Fig. 4c illustrates the configuration of activities that characterise the distinction between the creative and commercial architect.

Parallel to this, Cuff unveils four chief dualities in which “the profession favours one pole while neglecting the other and this bias creates its own new dilemmas” (Cuff, 1992; 250, also see Fig. 4d). Firstly, Cuff refers to an emphasis on the *individual* rather than the *collective*. This is less apparent in contemporary practice, yet there remains an active motivation to reassert the value of the profession in relation to sustainable design within a growing number of specialist consultants in the construction industry that can make the architect’s role appear marginalised and insignificant (Bennetts, 2008; Cuff & Wriedt, 2010; Gutman, 1988; Saint, 1983). Secondly, Cuff describes the tensions between *decision making* and *sense making*, suggesting that “design is believed to sprout from a series of independently made decisions rather than from the emergent sense made of a dynamic situation.” (Cuff, 1992: 250). Thirdly, she suggests that “*design and art* have been separated from *business management* concerns, in spite of the fact that the two dimensions are inextricably bound in everyday practice” (ibid). Finally, “the image of the architect as a generalist - a Renaissance man - is countered by the challenges facing practicing architects who specialise in their market for services.” (ibid). Although the initial situations that Cuff describes have shifted in the contemporary context, dualities remain fuelled by observations that a focus on the creative processes, rather than distributed decision making, amplifies the polarisation of practice and education, which is said to occur as a product of education being predominantly focussed on theory and concept generation, rather than the technicalities of running an architectural practice (see, Cuff, 1992; Cuff & Wriedt, 2010; Dorrian, 2012; Trogal & Care, 2007).

Addressing the need to reconceptualise the relationship between education and practice in light the demand for sustainable design Buchanan (2012c) argues the most appropriate place to learn design is in an apprenticeship situation, “by letting the student watch someone who has mastered the skills, who knows how to think with his/her fingers...” (ibid).Practice conventions and the knowledge to



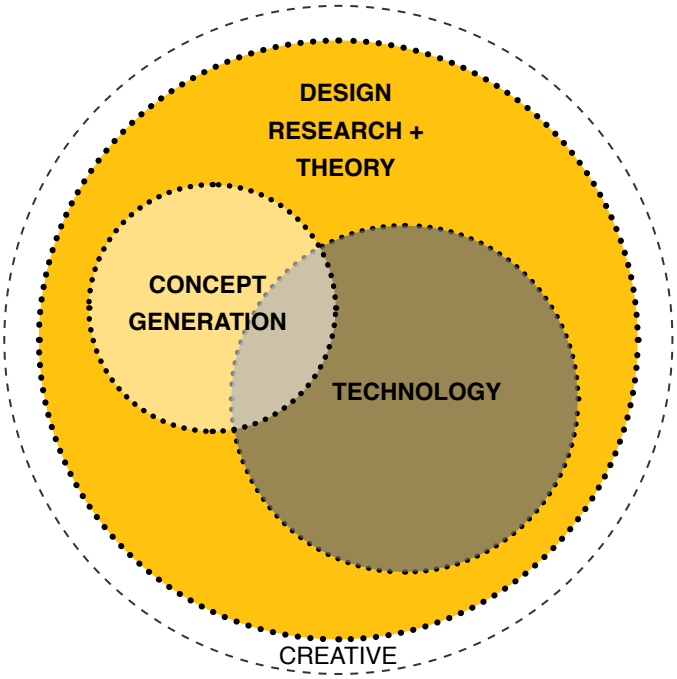


FIG. 4c
Diagrammatic representation of the configuration of the activities that constitute the disparate perceptions of the creative and commercial architect. These might also be said to represent prevailing perceptions of commercial architectural practice and architectural education.

manage and realise building construction may be best developed in the office environment, however, this may engender continuity at the expense of adaptation to contemporaneous knowledge and conditions. In the same way that Buchanan argues that the disparity of interests amongst units and tutors in architectural schools further fragments the discipline and the issues of sustainability situated within it, his solution disregards the need for critical thinking and novel research which have the potential to develop sustainable design beyond the aspects that are malleable through practice. Instead he argues for cohesion over progress, favouring the generalist position.

This is one way in which the dualities of the profession are active in current discourse, and how they are intimately connected to concerns for the progress of sustainable design through education. It also accentuates the futility of making architectural education more like practice, or vice versa, but suggests that sustainability should be at the centre of any reconfiguration.

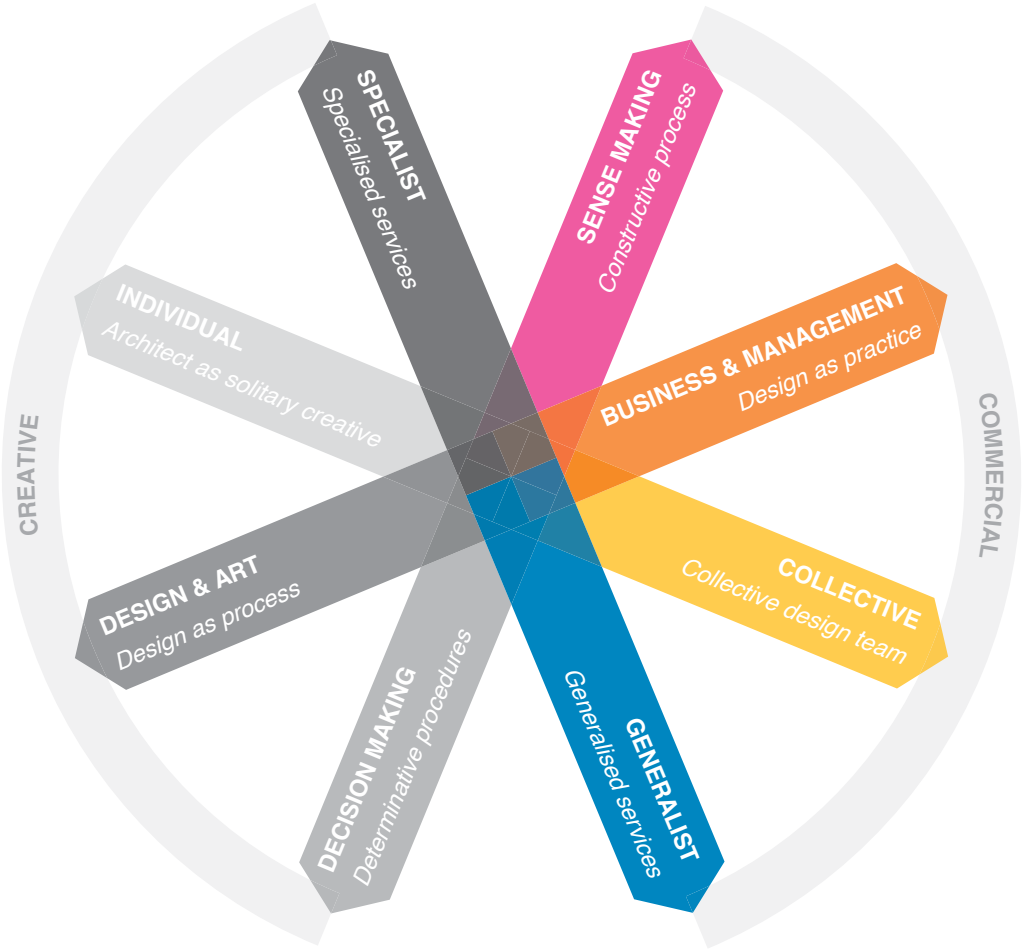


FIG. 4d
The dualities of the profession outlined by Cuff (1992) visualisation developed from Butcher (2011).

4.2 SUSTAINABILITY IN COMMERCIAL AND CREATIVE CONTEXTS

Examining the practice of sustainable design, Guy & Marvin (1999) propose one of the first difficulties is eliciting research from a domain drowning in solutions rather than the skills and activities it comprises (see; Williams, Burton, & Jenks, 2000; Williams, Jenks, & Burton, 2001; Jenks & Dempsey, 2005). This section concentrates on sustainability in relation to the skills and activities reviewed in section 4.1, in particular the hyperbolic disparity between the creative and commercial activities of architectural practice. In this section those activities will be represented by examining commercial practice and education respectively.

4.2.1 THE SUSTAINABLE OVERLAY TO PROFESSIONAL PRACTICE

Sustainable design does not explicitly feature in the PoW (2007), it is provided as a *Green Overlay to the Outline Plan of Work*, which offers a series of checkpoints at each stage in the PoW (RIBA, 2011). Fig. 4e sets out the key points of the PoW in line with the checkpoints of sustainability, taken from the Green Overlay. This illustrates that sustainable design is conceived of as a series of sequential and deliverable outputs that are presented in a comprehensible format for the purposes of stakeholders in design projects to align their work patterns and outputs accordingly.

Checkpoints, like sustainability assessment method criteria, are generic in order to accommodate the design differences of individual projects. The checkpoints set out by the Green Overlay highlight key considerations for built form, including the reuse of existing building fabric, internal environments and construction and management strategies. The document also contains further explanations of deliverable criteria that architects can conduct in line with client requirements. It is a resource that reinforces the value of built form and justifies ways of formally assessing sustainability. Implicitly, those with the skills to assess and realise high scoring assessment ratings, i.e. architects, are equally valuable. In summary, practice is defined by sequenced outputs and actions

Stage		Sustainability Checkpoints
PREPARATION	A	• Strategic sustainability review of client needs and potential sites, including re-use of existing facilities, building components or materials. • Internal environmental conditions and formal sustainability targets stated. Building lifespan and future climate parameters stated.
	B	• Early stage consultation, surveys or monitoring undertaken as necessary to meet sustainability criteria or assessment procedures. • Involvement of design team after practical completion defined. Site Waste Management Plan (SWMP) started.
DESIGN	C	• Key design team members appointed. • Formal sustainability pre-assessment and identification of key areas of design focus. Deviation from aspirations reported. • Environmental impact of key materials and construction strategy checked. Resilience to future changes in climate considered.
	D	• Full formal sustainability assessment. • Interim Part L assessment and design stage carbon/energy declaration (e.g. Carbon Buzz). • Design reviewed to identify opportunities to reduce resource use and waste and recorded in SWMP.
	E	• Principles of handover process and post completion service agreed. • Details audited for airtightness, continuity of insulation and subcontractor package coordination.
PRE-CONSTRUCTION	F	• Part L submission, design stage carbon/energy declaration update and future climate impact assessment. • Non-technical user guide drafted; format and content of Part L log book agreed. Building handover process and monitoring technologies specified. • Compliance of contributions by specialist consultants and contractors with agreed sustainability criteria demonstrated.
	G	• Contractor sustainability standards specified.
	H	• Contractor sustainability credentials assessed against specified standards. • Implications of cost reductions and contractor substitutions reviewed against sustainability targets.
CONSTRUCTION	J	• SWMP passed to contractor. • Design stage sustainability assessment certified. • Construction sustainability procedures developed with contractor. Review of commissioning and handover programme.
	K	• Contractor's interim testing and monitoring of construction reviewed and observed, particularly airtightness and continuity of insulation. • Implications of changes to specification or design reviewed against agreed sustainability criteria. • Non-technical user guide completed and aftercare service set up. • Assistance with collating as-built information for post-construction sustainability certification.
USE	L	• Assistance with collation of post-completion information for final sustainability certification. • Observation of building operation in use and assistance with fine tuning and guidance for occupants. • Declaration of energy/carbon performance in use (e.g. Carbon Buzz).

FIG. 4e
Sustainability Checkpoints to the Outline Plan of Work (RIBA, 2011).

that contribute to sustainable design and the activity of design is never isolated from this context.

4.2.2 EDUCATING FOR SUSTAINABLE DESIGN

In the UK, the Architects Registration Board (ARB) is the competent authority which certifies that graduates have completed and passed the necessary stages to be registered as a qualified architect. This process comprises three parts. Part I involves three years full-time undergraduate study to develop "a broad range of skills and architectural understanding", followed by a minimum of 12 months professional experience "working under the supervision of an architect or qualified industry professional" (RIBA, 2011). Part II comprises a further two years of full-time study which "provide[s] students with enhanced architectural knowledge and project complexity" (ibid). This is appended by a further 12 months (minimum) professional experience, during which candidates study construction practice, management and law in preparation for the Part III examination. In Part III, the final stage, candidates undertake a final examination, following which, successful candidates are invited to subscribe to the Architects Registration Board (ARB), without which, the title 'Architect' can not be used. In the final exam, candidates are assessed on:

- A record of the candidates' 24 months professional experience;
- Professional CV and career evaluation
- Case Study
- Written Examination on practice, management and law
- Final Oral Examination

(Adapted from RIBA, 2011)

As a constituent of the EU and therefore party to EU Directive 2005/36/EC (European Commission, 2005), which outlines the conditions of the free movement of professionals within the EU, validated institutions delivering

architectural education in the UK conform with the requirements for the recognition of professional qualifications by EU member states. Article 46 of the same directive sets out the requirements for training architects and stipulates that education must provide candidates with a balance of creative and technical skills together with knowledge of professional practice and construction processes. There is no explicit reference to sustainable design criteria, however, it is implicit in a number of requirements: ensuring that candidates have an "understanding of the relationship between people and buildings, and between buildings and their environment, and of the need to relate buildings and the spaces between them to human needs and scale", and an "adequate knowledge of physical problems and technologies and of the function of buildings so as to provide them with internal conditions of comfort and protection against the climate" (European Commission, 2005: Article 46).

The directive also refers to the *Validation Criteria* set out by the RIBA (Gloster, 2010), which is subject to the Quality Assurance Agency for Higher Education (QAA), *Subject Benchmark Statement for Architecture* (2010). Institutions offering exemption from any part of the tripartite training through degree qualifications, are assessed against these criteria. Validation criteria are designed to be flexible, encompass a wide range of topics and allow for new and emerging topics in line with changes within the profession and wider industry. Altomonte (2009) notes that although the criteria is punctuated with implicit references to sustainable design, the "emphasis often lies on the central generalist role of design, whilst technical and environmental knowledge is frequently assigned only a seemingly marginal role." (Altomonte, 2009: 14. Also see, Altomonte 2012a, 2012b, 2012c; Guy & Moore, 2007; Roaf & Bairstow, 2008). Bennetts (2008) emphasises the significance of this for practicing architecture:

> "Architectural students need to emerge from higher education with idealism intact, but they also need to have sufficient knowledge of technique if

> sustainability is going to have any resonance with the future form of architecture. This is not something that can be picked up during practical training; in particular, the notion that this is a team based activity is something that needs to be instilled from the earliest encounters with design education."
>
> (Bennetts, 2008: 15)

Within educational discourse this can be related to the distinction between acquiring knowledge and developing skills and acute judgement. Notwithstanding the need for technical and environmental knowledge, Till (2003) points out that knowledge is easier to assess and therefore demonstrate improvements within education, unlike developing a good sense of judgement and a core set of *general* creative problem solving skills that can be applied to any given circumstance:

> "What we need to do in education is to develop judgement rather than to package up knowledge in neatly assessable chunks. More specifically for architectural education, what is crucial is to encourage multiple modes of thinking rather than specific methods of doing. However, it is difficult to assess, let alone legislate, judgement, whereas one can 'benchmark' knowledge."
>
> (Till, 2003: 97)

Architectural education is "where so many of the values that define the profession are first established." (Till, 2009: 17). Whilst pedagogic discourses challenge how architectural education should prepare graduates for practicing sustainable design (see, Roaf & Bairstow, 2008), education tends to focus on the design process, including the ability to operate in a team environment, thereby developing the necessary skills required for practice. It is from this perspective that Altomonte (2009) argues that education marginalises technical knowledge and processes for sustainable design. If this is true, then a greater focus on such issues is only viable if architectural education also ensures that students

develop the skilled ability to apply knowledge (Brittain-Caitlin, 2008). Doing so, as Till points out above, is the challenge of benchmarking subjective attributes.

A recent survey by the EDUCATE consortium reported that over 80% of practitioners strongly agreed that considerations towards environmental sustainability issues were prioritised during design (Altomonte, 2012b). In the survey, the design process was divided into four principal stages: outline proposal and sketch design; scheme design and planning; detail design; products and material specification. These align with the initial key tasks described in the PoW. The survey also indicated that when looking to employ graduates, practitioners provided a more neutral response, suggesting that sustainability is important, but not necessarily imperative for employment within the profession (ibid: 12). Read in conjunction with results from the same report that suggests practitioners consider architectural education should have a much stronger focus on sustainability and competence in the subject should be required for professional registration (that it should be included in Part III graduate criteria). This highlights conflicts within the profession about how and when sustainability is required in training.

Other criticisms of the current educational agenda include the suggestion that sustainability is often only "proposed uniquely as elective subjects not available at the beginning of the curriculum, or as modules for specialisation offered in graduate or postgraduate degree" and that there is a specific lack of sustainability in undergraduate courses (Altomonte, 2012c: 21). More generally, it is recognised that "architectural education must adapt, and quickly, to the needs of a vastly changing and increasingly disparate profession" (Murray, 2012).

Further research from the EDUCATE consortium suggests that the conceptual clarity of sustainability, together with transmissive pedagogic approaches,

“where theoretical knowledge is delivered (and acquired) independently from its practical application and creative design exploration”, underpinned by a limited understanding of how knowledge is acquired and applied in the design fields, contributes to conflicts and confusion (Altomonte, 2012c: 6-7. Also see, Roaf & Bairstow, 2008). To this end, the EDUCATE consortium identify ten recommendations for sustainable architectural education. These include ensuring that sustainability is a priority in education, and not simply as a product of regulatory requirement. Of primary concern, however, is the encouragement of “critical awareness, responsibility and reflection of the interdependencies within the design process”, and the support of “investigative discourse between different disciplines, parties and professions” (Altomonte, 2012c: 9).

4.2.3 DIGITAL DESIGN FOR SUSTAINABLE ARCHITECTURE

Sustainability has for some time served as a defining issue for the development of digital design methods and tools, and consequently, schools of architecture adopt very different approaches to sustainability. Approaches that concentrate on the use of digital design methods, including computational drafting, simulation and analysis, and the use of emergent technologies in design, are commonplace. Such approaches are amenable to considering sustainable architectural designs in terms of several specified parameters which allows the definition of relationships between design elements and can be used to find a ‘good fit’ (for a comprehensive review of optimisation techniques for sustainable building design see; Elvins, 2013).

Optimisation through the use of digital design tools is often described as performance-based design, or performative architecture (Kolarevic, 2003; Oxman, 2008). Parameters can relate to various aspects of building performance, such as formal, structural and environmental, and commonly result in geometric alterations to an initial design concept developed by the designer prior to refining parameters. Kolarevic notes:

> “There is currently an interesting gap in the esthetics (and ethics) between form- or cultural performance-oriented designers (Frank Gehry, Greg Lynn, etc.) and those whose work aims at environmental performance (Thomas Herzog, Glenn Murcutt, etc.). On the other hand, there is another group of designers—the ones whose work is neither too formalist or environmentalist (Foster, Grimshaw, Piano, Sauerbruch and Hutton, Jourda and Perraudin, etc.). The design strategies in the projects of that group vary considerably as they respond to different cultural and environmental contexts.”
>
> (Kolarevic, 2003: 458-9)

Schumacher, of Zaha Hadid Architects, suggests that parameter based design is itself a new stylistic approach to architecture (Schumacher, 2008). Such an approach is preoccupied with the manipulation of associative geometry, potentially to the detriment of other performance variables. Kolarevic (2003) criticises the post facto development of initial design concepts with digital tools and argues for a more instrumental approach which he describes as “performative formalism”, where “digital design tools [can] provide dynamic [generative] processes of formation based on specific performative aspects of design.” (ibid: 463). With this he proposes a paradigmatic transformation from ‘form making’ to ‘form finding’.

Technology provides a set of tools that can accelerate the process of finding a good fit for complex design problems, with many multiple and maybe contradictory design criteria, such as those related to sustainability. However, in design education it is important to consider technology as an instrument; technology can not replace the designer. Architects are still the decision makers about what parameters are included, which criteria, limits and goals are set. The role of the architect is to creatively integrate these with a programmatic need to produce the architectonic: technology simply facilitates a smoother transformation from conception to realisation.

4.3 REGULATORY INFLUENCES: PREVAILING ASSUMPTIONS

The previous section set out the nature of architectural practice and education, and the dualities within the profession emphasised by sustainable design. This section reviews the implications of regulation for the distributed decision making context of commercial architectural practice from a limited but growing body of research (for example see; Ben-Joseph 2005a; Bentley 1999; Carmona, et al, 2006; Carmona, 2009; Imrie, 2007; Imrie & Street, 2011; Knox, 2007; Marshall, 2010; Ross, 2012; Talen, 2012).

This section introduces two core assumptions about the effects of regulation on design practice. It refers to a body of work that considers the plurality of architecture in light of the many forces that inform commercial practice and aligns the implications of regulation with the dialectical dualities of the architectural profession (Cuff, 1992).

Imrie & Street (ibid) frame two schools of thought about the implications of regulation for creative practices. The first school of thought is that design practice is influenced by “code officials and the bureaucratic procedures of the building regulatory process” (ibid: 77). This is most often attributed to prescriptive regulation. On the contrary, performance standards are said to “allow firms the freedom to innovate” (Gann, et al., 1998: 292). However, as Gann, et al. convey, the distinction between the two types of regulation is fuzzy as “both are concerned with performance and prescription”, and in reality, “the most appropriate form of standards depends on the sector and the goal to be achieved” (ibid).

4.3.1 REGULATION AS CREATIVE TYRANNY

That regulation is a bureaucratic process, anathema to creative practice is more commonly associated with prescriptive regulations than performance-based regulations, which endeavour to establish standards rather than methods to

meet those standards (Gann, et al., 1998). A lack of clarity about the use of regulation appears to fuel to the assumption that regulations are largely of prescriptive quality, rather than performance-based. This is evident in Julier's (2009) perception of the paradoxical nature of urban coding: that whilst it is auxiliary in the respect that it provides a shared language for stakeholders, it is detrimental as prescription restricts creative opportunity.

Notwithstanding the performance-based character of prevailing regulation, skepticism of the implications of regulations, codes and standards remains amongst practitioners. Critiques suggest that current modes of regulation are inadequate because, as Guy & Farmer (2000) indicate, they do not necessarily respond well to user requirements or future needs. Referring to the US LEED system, Garde (2009) points out that assessment methods for sustainable development often evaluate factors of the built environment equally, "because it is difficult to determine the relative importance of criteria" out of context (Garde, 2009: 438). He conveys that the variation in location and design requirements make it difficult to tell how much specific objectives in the code will contribute to sustainability in a specific circumstance.

Regulations are assumed to possess a disproportionate power over the design process. However, some studies reveal that the situation is more complex. Carmona (2009) identifies that regulation is one of a number of restraints acting on architects and urban designers. He states that regulation is one of three notable factors influencing design practice. The other two are; the internal battle for creative recognition, and the influence of market forces. The former, which Carmona coins the 'creative tyranny', "results from the fetishing of design where the image rather than the inherent value (economic, social or environmental) is of paramount concern and where the freedom to pursue the creative process is valued above all" (Carmona, 2009: 2645). The latter, 'market tyranny', captures the "argument that the market knows best and what sells counts." (ibid).

4.3.2 REGULATION AS PROJECT RESTRICTION

Regulation is associated with increased project costs in ways varying from construction costs, to costs associated with prolonged approval periods to confirm that designs comply with regulation. Increased costs are said to prohibit, or at the very least create barriers to, the production of affordable housing in America (Imrie & Street, 2011: 78). Delays in decision making are said to discourage investment and as a result contribute to the social and economic decline of certain areas (ibid).

Parker (2012) suggests that the design team and stakeholders alike consider that achieving BREEAM benchmarks incurs greater project costs, particularly in terms of equipment for the building. *Putting a Price on Sustainability* (BRE, 2005) provides further evidence that achieving highly energy efficient buildings, in accordance with CSH and BREEAM criteria, comes with associated costs. More recently, Yates and Halewood (2010), who assess the viability of BREEAM and CSH as a mandatory planning requirement in light of the "likely impact upon development cost and value." (ibid: 1), propose that whilst lower benchmarks "can be achieved at no or very little extra cost, an increase in capital expenditure due to unexpected planning requirements can erode project viability" (ibid).

Sweett (2005) points out, however, that increased costs do not simply correlate with higher benchmark levels. In reality, the cost of sustainable design depends on the type of project, the location and site conditions and the brief requirements identified by the client. For example, on an open brownfield site, basic decisions about building orientation can be made to meet sustainability criteria through passive, natural and relatively inexpensive methods. In contrast, on a constrained urban site, building orientation is predetermined and is likely to require greater expenditure to ensure it meets standards (see; Sweett, 2005).

Where inflated capital expenditure is incurred, there is a growing body of

research that suggests this is compensated for in the long term though “sale or rental premiums associated with sustainability ratings.” (Yates & Halewood, 2010: 2; also see Sentman, 2009). However, Yates & Halewood (2010) note that this phenomenon is, at current, more prevalent in the US and associated with the LEED assessment method (also see, Sentman, 2009). The British Property Federation (BPF), et al. (2010) report that despite a lack of empirical data, anecdotal evidence supports the mimicry of such market premiums in the UK. Additionally, there is speculation of a ‘brown tariff’ where organisations faced with the choice of “two buildings where price levels are relatively similar, organisations will naturally select the greener building.” (ibid: 43). Other, less quantifiable values in terms of cost, associated sustainable building ratings are also noted. BPF, et al. suggest that occupying a rated building has “the ability to demonstrate an organisation’s corporate social responsibility and sustainability strategy” (ibid). They also suggest that occupying “a green building is also seen by some as adding value by enabling organisations to future proof their business and operations against the effects of new regulations and further development of the sustainability agenda.” (ibid).

4.3.3 DISCONNECTIONS: REGULATORY PRODUCTION AND IMPLEMENTATION

Arguments against regulation, however, are not simply concerned with the content and weighting of regulations. The need for sustainable design is strongly supported by architects (Imrie & Street, 2011; Sudjic, 1996). Many arguments against regulation are rooted in concerns for how they are developed, imposed and enforced. Imrie and Street (2011: 84-93) suggest that the government is seen as a weak source of regulation. With this they propose that systems of enforcement are not watertight and the origins of standards set out in regulations are not always clear, or considered to appreciate the dimensions of design practice, construction techniques and the use of buildings in the long term.

When Carmona (2009) refers to regulation, he refers specifically to mandatory regulations, such as the Building Regulations. He argues that a different type of regulation, urban coding, can help to distribute the powers of these tyrannies (also see Carmona & Dann: 2007). Here, urban coding refers to "a distinct form of detailed design guidance that establishes the three dimensional components of a particular development and how these relate to one another but does not prescribe the overall outcome." (Carmona & Dann, 2007: 16). On the contrary, Julier (2009) proposes that urban coding can be seen as equally restrictive as Carmona considers regulation. Julier suggests that this is the result of a paradox, which highlights that whilst urban coding offers a clear and shared knowledge between clients, stakeholders and the design team, it also constrains design practice as a result. The most important factor in this paradox is the understanding that the designer's skill is not simply design creativity, but the coordination and management of the design process and the agents and actors involved in it:

> "The urban designer's creativity resides not just in the formal shaping of public realm environments, but in the management of the design process between various stakeholders. The multiple roles that design is expected to undertake - incorporating environmental, social and promotional functions - within designing the city means that its management and creative value are finely balanced."
>
> (Julier, 2009: 54)

Studies of decision making in this context of conflicting requirements and objectives have provided an understanding of cooperation and prioritisation in the design process (see for example; Boyko, et al., 2006; Cooper, et al., 2009; Lombardi, et al., 2011). In this field, Cooper, et al. (2009) suggest that sustainable design depends on a number of issues. In line with Carmona's (2009) findings they indicate that certain types of coding and regulation may assist distributed

decision making to procure more sustainable developments in all three - social, economic and environmental - dimensions. Their case studies of a broad range of factors affecting the sustainable design process for earmarked regeneration areas, suggest that decision making structures provided by tool kits, guidelines, checklists and process maps, are often superseded by the tacit knowledge and experience of professionals and experienced agents in the design process (Cooper, et al., 2009).

In light of this, Cooper, et al. (2009) note that policy agendas need to be flexible to accommodate development in knowledge and the ability to tailor sustainable responses to unique situations. This highlights one important factor which explains why leading assumptions render regulation a creative tyranny: rather than considering regulation as a framework within which to explore approaches and pose new solutions, regulation is envisaged by some as a fixed form-work that specifies solutions.

4.4 DUPLEX DUALITIES: ALIGNMENTS BETWEEN DESIGN DEFINITIONS AND POLICY IMPLICATIONS

Imrie and Street (2011) suggest that regulation provides an important role minimising risk through a framework that allows interpretation by multiple agents. Guy and Fisher (2009) report that the Building Regulations should actually be seen as a mechanism that forces clients to "'fund' better buildings; better in this case means anything from more energy efficient to more accessible buildings." (Guy & Fischer, 2009: 2590). Similarly, in the context of urban coding Carmona (2009; also see Carmona, et al., 2006, Carmona & Dann, 2007) argues that such codes provide a framework and shared language that supports design decision making.

Moore & Wilson (2009) propose that codes, regulations and guidelines are implicit representations of social trends. As a result, they can be seen as a sequence of contradictions (Ross, 2012). However, in a period in which regulation for the built environment is dominated by economic imperatives, the interpretive context shifts and "symbolic capital" increases (Dovey, 1999: 39). Dovey (1999) explains "architecture has become both a form of currency and a decisive component of political life" (ibid). This superficial acceptance of architecture raises interest in the commodity, rather than establishing a deeper understanding and interpretation of built form as a medium for social and cultural interaction.

Exploring the architect's role in enforcing regulation, Guy and Fischer (2009) examine the value of the architect's role in the construction industry. In this context regulatory powers may be seen to have a greater influence on the design project than the value of design practice which acts as an 'intermediary', to broker decisions on how performance targets are meaningfully met. One argument in this domain is that if building requirements are set out by regulation that can be implemented by other professionals such as engineers, then the

architect's role is a luxury addition to a construction project. However, viewed as an intermediary, as Guy & Farmer (2009) argue, the architect's role is crucial for mediating and engendering cooperation within stakeholder requirements and regulation. They describe four categories of intermediary behaviour:

1. Bridge-builders, mediators, go-betweens or brokers, facilitating dialogues, resolving conflicts of building partnerships.
2. 'Info-mediaries'; disseminating information, offering training and providing technical support.
3. Advocates, lobbyists, campaigners, gatekeepers or image makers, fighting for particular causes, and;
4. Commercial pioneers, innovators and entrepreneurs.

(Taken from Guy & Fisher, 2009: 2588)

Much of the work an architect does is synonymous with the role described in the first category. They describe the role of the architect as "driving the design agenda by bringing together the requirements of different other professionals, reinterpreting the brief and related regulations accordingly, and reconciling various interests that may act on the design process" (Guy & Fischer, 2009: 2590). This is not to suggest that architects should be enforcers of regulation, but that their skills are highly tuned to devise ways of meeting regulations within the dynamics of commercial practice. One important aspect of this that has previously been alluded to is the pace of change of regulations (see chapter 3.0). Whilst regulations set out performance requirements, the architect's role is not simply a task of prescribing predefined solutions, but of establishing and resolving the relative importance of regulations, within a complex and collaborative process (ibid. Also see; Berglund, 2008; Hrivnak, 2007).

Guy and Fischer (2009) assert that there is still much research to be done in investigating how design practice is affected by regulation and understanding

the implications of this for the built environment. Emerging research, however, suggests that regulation is an integral part of the practices of architects and designers in the construction industry (Imrie & Street, 2011; Imrie, 2009; Guy & Fischer, 2009; Carmona, 2009; Carmona, et al., 2006).

These findings stand in contrast to the leading assumptions that regulation is detrimental to design projects. The idea that regulation is a creative tyranny links to the misconception that architects operate as creative individuals rather than as part of a design team. It follows from this that the dualities of the profession observed by Cuff (1992) resonate with perceptions of regulation: either regulation augments the dialectical dualities of the profession, or it adds a further dimension to the existing dualities (see Fig. 4f). These include;

- **Creative tyranny vs. shared goals**

  From the perspective of the creative individual, regulation constrains creativity, whereas from the perspective of the design team it provides a series of shared goals that provide the design team with a common language to share with project stakeholders.
- **Prescriptive vs. performance-based**

  Regulations affect design outcomes and design processes. Read as prescriptions, regulations can inform design outcomes by prescribing requirements. Read as performance-based requirements, regulations provide a platform for devising the most appropriate way of meeting regulatory requirements through the creative design process.
- **Conclusive vs. inductive**

  Design is known as a constructive process (Cross, 2007). Determinative regulations provide instructions for practice procedures, such as identifying which specialists and consultants to engage and how to initiate public consultations. Constructive regulation is a mechanism that enables development, ensuring that it brings together the necessary professionals

at the project outset.

- **Auxiliary or Detrimental**

  The above points amount to the idea that regulation either supports design practice, or is detrimental to a design project through costs incurred or by limiting creative possibilities with its objectives and requirements.

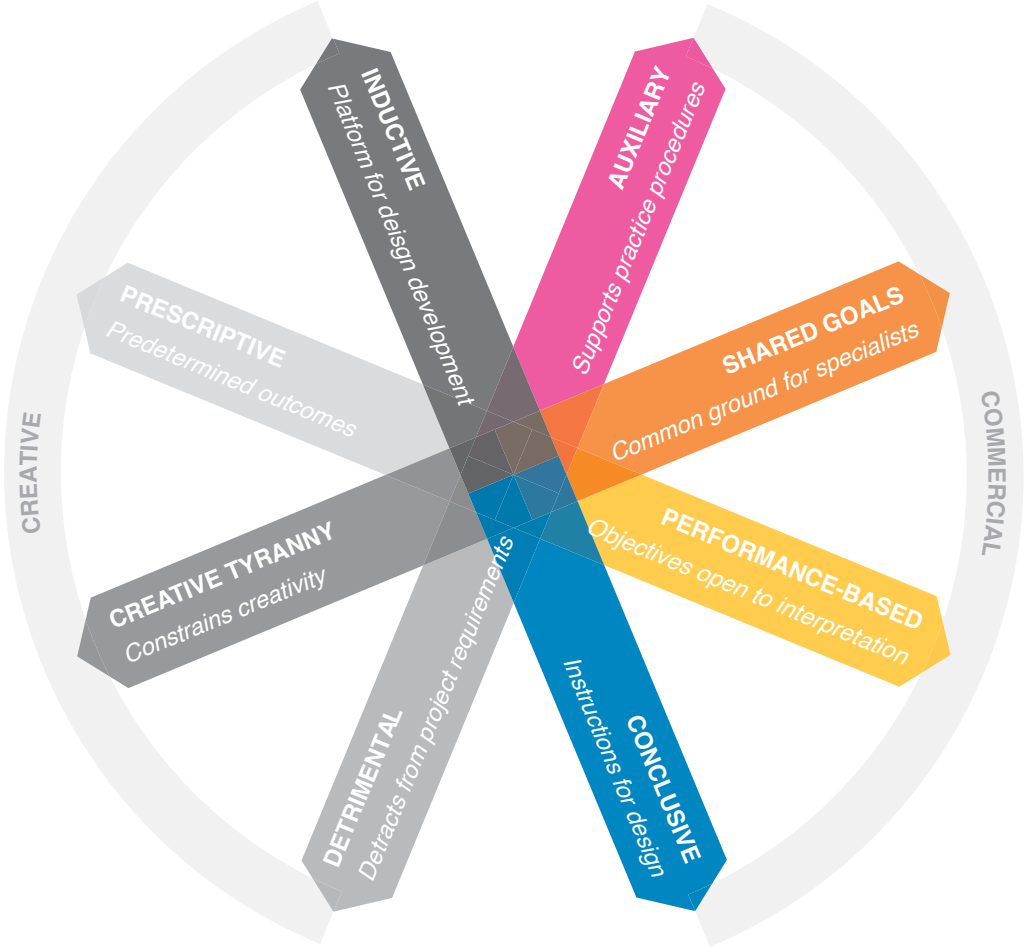


FIG. 4f
The dialectic dualities of regulation in practice.

5.0 PROBLEM STRUCTURES IN CREATIVE PROCESSES

This section refers to the specific objectives set out in regulation, rather than overall regulatory devices as in the previous chapters. There are few studies on the implications of objectives on the creative process (with some exceptions; Chan, 2001; Ostad-Ahmad-Ghorabi & Collado-Ruiz, 2010). However, parallels can be drawn between the implications of objectives and problem structures, in addition to corresponding design methodologies. By exploring the nature of design problems and the current understanding of design processes through which designers resolve problems, this section identifies how rigid problem structures are understood to affect the design process.

5.1 Design Problem Definition

Examining creative processes, this section introduces how structures of design problems have been portrayed and how such theories have informed design methods. Parallel to this, it compares design problem structure to the structure of objectives set out in regulation as a means of better understanding the implications of regulatory objectives for the design process.

5.2 Deciphering the Design Process

This section discusses the current understanding of the nature of creative design processes. This identifies that creative processes of design are not a 'black box' scenario (Jones, 1992). Rather, they involve inductive processes that often involve making assumptions and forming conjectures about the problem at hand.

5.3 The Influences of Objectives

The influences of objectives on creative processes will be explored. The section reveals that the structure of regulatory objectives, akin to structured design problems, affects the ability to think holistically.

5.1 DESIGN PROBLEM DEFINITION

How do objectives relate to the structure of design problems? Objectives such as those set out by BREEAM, set out a framework for design in the form of a set of goals. These are taken into consideration by the designer when defining the design brief.

In order to initiate a solution to a problem, the problem must first be interpreted and represented. Rowe (1991: 74) identifies that defining a design problem inherently involves the designer's perception of the topics at stake. Problem definition, he reasons, is a means of representing design problems in order to clarify the relationships between such topics; assisting designers in generating an appropriate solution (also see, Goel & Pirolli, 1992; Dorst, 2003; Dorst, 1996).

The duality of the profession that divides practitioners between those who see design as a *problem solving* process, and those who consider it a process of *sense making* is manifest in how architects envisage or impose the structure of design problems. This section discusses two generic branches of perceived design problem structures that relate to Cuff's *problem solving - sense making* duality, namely; *rational* problems and *wicked* problems, respectively.

5.1.1 RATIONAL DESIGN PROBLEMS AND METHODS

Predicated on scientific rationality and the rigid procedures of the decisions sciences, including graph theory, information theory, and operations research (see, Bayazit, 2004; Broadbent, 1969), rational design methods structure problems as systems comprising determinable components (for an overview see; Broadbent, 1969).

Alexander's (1964) *Notes on the Synthesis of Form* provides a principal example of how rational problems are structured. He proposed that design problems could be aggregated into constituent components that make up the

whole; mapping variables and identifying the relationships between them. Each variable is seen as a problem in its own right and can exist in one of two states; ‘fit’ or ‘mis-fit’. Mapped systems must be resolved to an equilibrium in which all components ‘fit’. In theory, the technique allowed the designer to decode the design solution. Similar scientific methods were endorsed by Briggs and Havlick (1976, see Dubberly, 2004: 37), who proposed that scientific methods delimited ambiguity and were therefore able to generate optimised design solutions.

Rational design methods, Colquhoun identified, are derived from biological determinism: this is the idea that the genotype of an organism is the sole informant of its behaviour and its development. It contrasts with the findings of D’Arcy Wentworth Thompson’s (1917) allometric study, which indicated that environmental forces were determinants of an organism’s structure. Nature, seen to ‘design’ itself (freely self-regulate and adapt), has frequently served as an ideological model of design as both noun and verb. Therefore, applied to design methods, biological determinism defined the need to map the genetic makeup of design problems in order to derive the optimum solution (see, Maldonado, 1972).

“Without sharper tools for analysis and classification, the designer tends to fall back on previous examples for the solution of new problems” (Colquhoun, 1969: 71). Colquhoun put forward that the “exclusion” of conventions, would challenge the “reduction” of traditional typologies in resulting solutions/ outcomes:

> “The process of change must involve a dialectical relationship between those parts of the system that are resistant to change (because they are conventional) but changeable (because they are arbitrary); and those parts of the system which depend on natural laws which progressively come to light under the pressure of new technology.”
>
> (Colquhoun, 1969: 74)

Similarly, Jones (1992: 46) describes such methods as “rigidly fixed in advance just like a computer system” and proposes that tolerance of ambiguity and conflict must be high in anyone who wishes to produce anything but stereotype designs (also see Cross, et al., 1981). Similarly, Broadbent (1969) concludes that a balance between methods is most like to provide better results:

> “We know that the ‘traditional’ designer, who tends to only work in visual images, is prone to significant error, but the ‘map-maker’ too, who tries to deal only in mathematical abstraction, is equally prone to make mistakes, where the evidence of common sense is submerged in a welter of intellectual processes.”
>
> (Broadbent, 1969: 19)

5.1.2 WICKED PROBLEMS AND INDUCTIVE METHODS

> “Rittel & Webber note that wickedness typically leads to new problems which are consequences thrown up by the first solution”
>
> (Biddulph, 2012: 12)

MacCormac observed from his own procedures that design problems could not be resolved simply by “absorbing information and then hoping to synthesise it into a solution”. Instead he proposed, “what you need to know about the problem only becomes apparent as you’re trying to solve it” (MacCormac, from Cross, 2007: 52). Levin (1960) asserts that this is the product of designers exerting a system of ordering on to their perception of the design problem. Similarly, Rowe (1991: 35) observes a tendency for the designer’s perception of the problem “to fluctuate from being rather nebulous to being more specific and well defined.” He suggests that this fluctuation is a result of “moments of “blinding” followed by periods of backtracking [...], where blinding refers to conditions in which obvious connections between various considerations of importance go unrecognised by the designer” (ibid).

Design problems are not rational problems for two reasons. Firstly, in contradiction to his *Notes on the Synthesis of Form*, Alexander (1966) later acknowledged that the context for design problems is too complex to be comprehensively mapped, and the variables of design problems too dynamic to only exist in one of two states (Alexander, 1966). Secondly, it is impossible to conceive and reconcile such situations (Newell & Simon, 1972; Simon, 1950). This means that rather than rational, design problems are ill-defined and incomplete.

With his theory of wicked problems, Rittel (1972) proposes that delivering a solution to design problems is a non-linear process. He highlights the inconsistency and incomplete nature of information in design problems and in doing so identifies that in order to appreciate the complexity of the problem, a general solution first has to be formulated (Bousbaci, 2008; Conklin, 2005; Protzen & Harris, 2010; Newell & Simon, 1972; Simon, 1950). In this context, Cross (2007) notes that designers are "not limited to given problems but find and formulate problems within the given brief" (also see Jones, 1992). Concerned with the point at which the designer begins to interpret his problem, Best (1969) proposes "to act we must interpret; to interpret is often to distort" (ibid: 155).

Drawing parallels between rational methods and scientific methods, Gregory (1967) provides the following conclusions about the nature of design problem definition:

> "The scientific method is a pattern of problem-solving behaviour employed in finding out the nature of what exists, whereas the design method is a pattern of behaviour employed in inventing things of value which do not yet exist. Science is analytic; design is constructive."
>
> (Sidney Gregory, from Cross, 2007: 24)

In practice, design projects comprise both types of design problems. Some

design problems appear to have established variables which can be addressed through rational, and perhaps conventional design methods and approaches. Examples include technical details which are in part predetermined by available construction details and materials. Notwithstanding this, chapter 2.0 introduced the idea that sustainability is a condition of dynamic complexity, making it ill-defined and incomplete. In 1973, Rittel & Webber attributed these characteristics to design problems, defining them ‘wicked’ (Rittel & Webber, 1973). Wahl & Baxter (2008) identify that the ambiguity of design problems is still prevalent in design issues that arise from the need for sustainable architectural and urban form.

The ways in which designers tackle design problems, whether structured or otherwise, are inherent representations of problem definition. Designers responses to wicked problems are characterised by the inductive processes that enable designers to generate design ideas.

5.2 DECIPHERING THE DESIGN PROCESS

Rowe (1991) discusses how studies of design processes, observed from a number of perspectives, have led to descriptions of design as a staged and sometimes episodic sequence, “characterised by dominant forms of activity, such as analysis, synthesis and evaluation” (ibid: 46; also see, Cross, 2007; Dubberly, 2004; Jones, 1992; Lawson, 2006; Schön, 1983). Asimow (1962) describes this protocol as a continuous circuit consisting of the following activities; analysis, synthesis, evaluation, decision, optimisation, revision and implementation. Deviating from circular patterns of decision-making, Lawson (2006) refers to Markus (1969) & Maver’s (1970 see, Dubberly, 2004) process maps, to describe the decision-making activities involved throughout a design project. In this model, the project is represented as three stages; *outline design*, *scheme design* and *detailed design*. Like Mesarovic‘s (1964, see Rowe, 1991; Dubberly, 2004) process element, the map comprises four episodic elements, *analysis*, *synthesis*, *appraisal* and *decision*. ‘Analysis’ is “the exploration of relationships, looking for patterns in the information available, and the classification of objectives” (Lawson, 2006: 37). ‘Synthesis’ concerns what Cross & Dorst (2001) refer to as the ‘creative leap’. ‘Appraisal’ is the “critical evaluation” of those ideas and ‘decision’ is reached when evaluation identifies a satisfactory outcome (Lawson, 2006: 37). Mesarovic‘s map suggests that synthesis and appraisal form an iterative feedback loop, where the designer moves between generating and testing potential solutions prior to formalising a decision and progressing to the next stage.

Synthesis, or the creative leap, has been of particular interest to design researchers (Cross & Dorst, 2001). The concept represents the movement from information to initial design proposal. Studying this cognitive movement, Darke (1979) presents a paradigm that adds to and reinforces Hillier, Musgrove and O’Sullivan’s (1979) model of conjectures. The model comprises cognitive pre-structuring that employs ‘variety reduction’ in order to frame an initial solution to

an ill-defined problem. In addition to this, Darke proposed that characteristic to the architectural design process, was the employment of simplified objectives that aided the initial design concept. In a number of cases studied by Darke, results displayed a 'rationality gap' between the production of initial concepts and the justification of the concepts:

> "...either the visual concept springs to mind before the rational justifications [...] or the analysis does not dictate one particular concept rather than others."
>
> (Darke, 1984: 181)

Darke proposes that such a phenomenon can be summarised by the concept of the primary generator. For Bousbaci (2008), this concept is "usually more of an article of faith of the architect" which can then be justified on rational grounds through the representation of the problem space.

Lawson (2006: 39) argues that, like circular decision making patterns, the loop between synthesis and appraisal is not truly representative of the design process either. He proposes that while designers adhere to standardised outputs, their decision-making sequences are idiosyncratic. Similarly Schön (1983) suggests that throughout the whole process practitioners follow a form of conversation with their designs, fluctuating back and forth between problem, information and solution in order to refine them. This renders the consistent looped variations of 'analysis', 'synthesis' and 'evaluation' obsolete as fluctuations depend on the designer, the problems and the outputs required. In this context, it has been suggested that designers operate with both rationale and judgement, rather than following specific design trajectories as maps of the design process would suggest (see, Nelson & Stolterman, 2003, also see Schön, 1998).

5.3 THE INFLUENCES OF OBJECTIVES

> "Too many designers miss the fact that the new issues which legitimately demand new forms are there, if the pattern of the problems could only be seen as it is and not as the bromide image (of a previous solution) [...] every problem has a structure of its own. Good design depends upon the ability to act according to this structure and not to run arbitrarily counter to it."
>
> (Alexander & Chermayeff, 1963)

Problem definition, together with creative processes, are influenced by a number of factors. So far in this thesis, these factors have been shown to include the generators of constraints, such as clients, stakeholders, professional bodies and legislators, and internal and external constraints, relating to the clients programmatic requirements and the external context respectively (see, Lawson, 2006). Lawson proposes a third category of influential factors, including; *radical*, *practical*, *formal* and *symbolic* (Lawson, 2006: 103-106). Radical factors are concerned with the rudimentary reasons for design. Practical factors "are those aspects of the total design problem which deal with the reality of producing, making or building design" (ibid: 103). Formal factors "include rules about proportion, form, colour and texture" (ibid: 104) and symbolic factors are associated with the "expressive qualities of design" (ibid: 105). Aligned with this, Lawson identifies that designers do not initiate design de novo, "rather, [they] have their own motivations […] sets of beliefs, values and attitudes" (ibid: 159).

Rowe (1991) identifies that design discipline specificities are also driven by a number of prevailing theories, represented by a corpus of accepted principles pertaining to individual disciplines. Rowe categorises these as "normative positions that guide design" (ibid: 115). Strongly linked to the constructive nature of designing, theory is "ineluctably concerned with 'what ought to be'"(ibid), rather than what currently exists (also see, Van Bakel, 1995; Chan, 2001; Goldschmidt & Porter, 2004).

Whilst rational design methods have been discredited, their formulaic approach to design is analogous to the performance-based parameters defined by sustainability polices and codes. Wahl & Baxter (2008) argue that the parameters set by sustainability policies pursue environmental performance objectives potentially at the expense non-quantifiable requirements (qualitative value, see chapter 3.0). They recognise that the environment undergoes continuous adaptation, identifying that sustainable development is commonly appreciated as equilibrium between society (and its systems) and nature: a process of communication and adaptation analogous to that of evolution. In this regard, sustainability can not be explicitly determined as a sequence of objectives that represent social, economical and environmental requirements, because the nexus of values it constitutes are constantly evolving (ibid: 72-73)

Clevenger & Haymaker (2011: 449; also see Ostad-Ahmad-Ghorabi & Collado-Ruiz, 2010), provide evidence of a link between sustainability objectives and a reduction in creativity. For the purpose of the study Ostad-Ahmad-Ghorabi & Collado-Ruiz define creativity as “generating something unique and relevant for a society” (ibid: 484). They consider that the nature of design policies, as “incremental approaches”, is isolated from the creative and predominantly social process of design (ibid, 2010: 480) and argue that regulation is predefined by existing technological conventions that influence typology, materials and function. They argue that ‘eco-design strategies’ are driven by the requirements of the market, which can encourage the specification of particular materials; the reduction of material consumption and performance targets, such as the strength or capacity to retain heat. Predictable design outcomes are useful for measuring sustainability. However, as Guy & Farmer (2000) indicate, they do not necessarily respond well to user requirements or future needs, nor, as Ostad-Ahmad-Ghorabi & Collado-Ruiz (2010) have shown, do they produce the most innovative results.

6.0 A DISPARATE CONTEXT: THE CURRENT STATE OF KNOWLEDGE

6.1 The Implications of Policy for Design: A Synopsis of Three Tensions in Sustainable Architectural Design

Summarising the three tensions set out in chapters 2.0 - 5.0, this section draws together the prevailing understanding of the implications of sustainability objectives for architectural design.

6.2 The Need for Research

Reviewing the gaps left by the contested landscape of sustainable architectural design, this section specifies the need for research.

6.2 Research Objectives and Hypothesis

Referring to the need for research, this section sets out the overarching research question and associated objectives and hypothesis.

6.1 THE IMPLICATIONS OF POLICY FOR DESIGN: A SYNOPSIS OF THREE TENSIONS IN SUSTAINABLE ARCHITECTURAL DESIGN

Part one of this thesis has provided the context for further study by highlighting three tensions that exist between theory and practice in architectural design. These tensions correspond to the following core generators for sustainable design, which have been discussed in chapters 2.0 - 5.0 (also see Fig. 6a):

- **Epistemology (Chapter 2.0)**

  Studies of urban areas show that they are characteristically complex dynamic entities. Legislation intended to engender sustainability, on the other hand, is formulated by the reductive determinism of mainstream economics. In short, policy is not commensurate with the nature of cities.

- **Value (Chapter 3.0)**

  Guidance and assessment methods for sustainable design are divided by quantitative and qualitative measures of how design attributes are valued in sustainable architectural design.

- **Application (Chapters 4.0 + 5.0)**

  The profession of architecture has internal tensions which augment existing tensions in sustainability objectives (which are manifest by legislation and applied through guidance and assessment methods) and polarise the implications of sustainability objectives for creative and commercial design processes.

The resulting disparity between the implications of objectives for design, which depends on how design is contextualised, demands further investigation. Inquiries into the consequences of regulatory devices have relied on the retrospective evaluation of architectural edifices and urban patterns they have informed. Carmona & Dann (2007) note a rise in support of supplementary codes in planning policy. Often these are place-specific codes with the intention of creating desirable place (real-estate). Ostad-Ahmad-Ghorabi & Collado-Ruiz

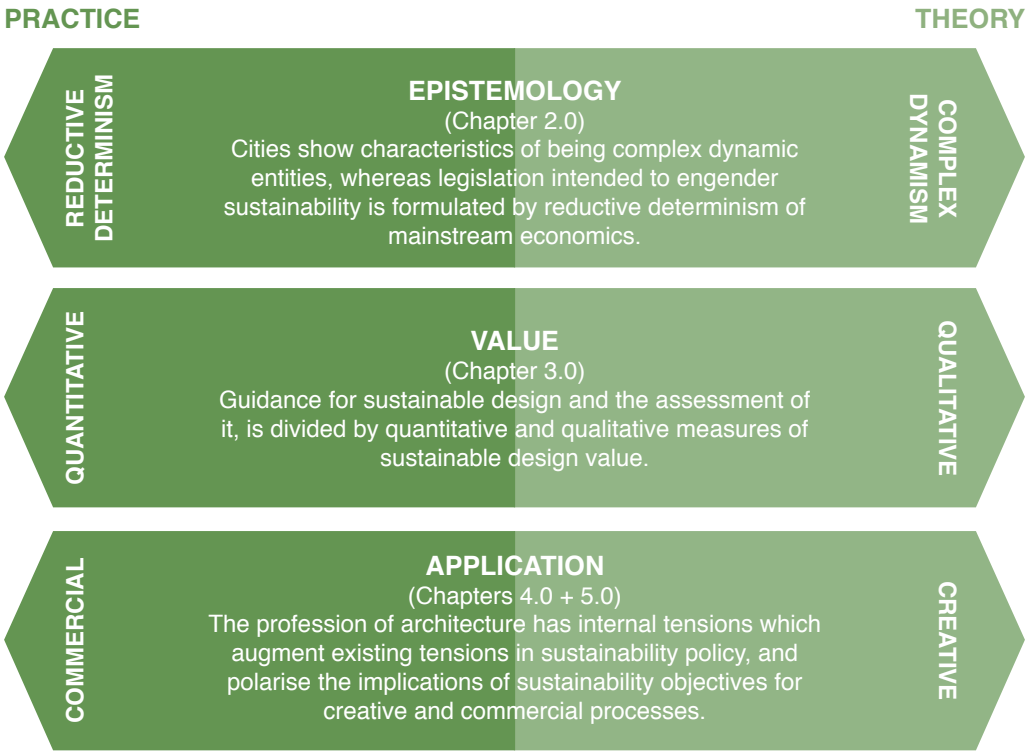


FIG. 6a
The tensions between theory and practice in sustainable design that are represented by the four chapters that comprise Part I of this thesis.

(2010) articulate that the pivotal need to address sustainability issues has led to the unquestioned application of performance-based objectives, without any indication of the efficacy of these, or, how they reconcile with the processes of the designers that formalise them.

Studies of creative processes suggest that objectives are detrimental to design (Clevenger & Haymaker, 2011; Ostad-Ahmad-Ghorabi & Collado-Ruiz, 2010; Ross, 2013). From the perspective of design practice, however, they can assist distributed decision making by serving as a shared language and a set of common goals in situations where groups of professionals and non-professionals work together on wicked problems (Cooper, et al., 2009; Moore & Guy, 2010; Imrie & Street, 2011; Lombardi, et al., 2011).These disparate findings of existing studies are a product of the way in which design has been characterised, which can be defined as follows:

- **The implications of objectives for *technical design*.**

  This study comprises the most specific variables; objectives and outcomes. These are analysed in relation to external conditions, such as the comparison of intended and actual use (see, Ross, 2012).
- **The implications of objectives for *conceptual design*.**

  In this context design activity comprises three principal variables: the individual, the project and the objective requirements for design. In most cases, the designer tends to be isolated from external forces, with the exception of a few studies which begin to consider tacit knowledge (see, Dorst, 1996; Ostad-Ahmad-Ghorabi & Collado-Ruiz's, 2010).
- **The implications of objectives for *commercial decision making*.**

  This refers to commercial practice, specifically referring to professionals operating within multidisciplinary teams. This is the most complex situation as the architect is not intentionally isolated from external factors, however, studies typically result in the creative activity of design being portrayed as a

process of trade-off between individuals and groups with incommensurate views (see, Cooper, et al., 2009; Guy & Moore, 2010; Lombardi, et al., 2011).

The problem with objectives is their utopian endeavours (Jabareen, 2006), which become accepted as normative design responses (Biddulph, 2012). Some studies indicate that the affects of this are more acute at a smaller scale (see for example, Ross, 2013; Ostad-Ahmad-Ghorabi & Collado-Ruiz, 2010), at which conventional technologies can dictate design outcomes (Kolarevic, 2011: 457). To address this, research into wicked problems seeks to develop non-linear ways of design thinking (Wahl & Baxter, 2008; Teal, 2010; Johnson, 2010; Goodburn, 2012b; Buchanan, 2012, Alexiou, et al., 2010) and forms of digital design generation (for example see; Kolarevic, 2011; Ulieru & Doursat, 2011).

6.2 THE NEED FOR RESEARCH

Research into the implications of objectives for sustainable design is greatly needed in order to inform new design methods and approaches. Without this research, methods currently under development may be inadequate as result of a poor understanding of current conditions and the polarisation of commercial and creative design activities..

Sustainability is an emergent agenda, which is becoming more prominent in an increasingly litigious society. There are strong indications that sustainability will shape the architectural profession and the construction industry in the long term (RIBA, 2005). There is a requirement to establish a better understanding of how sustainability should be integrated within pedagogic approaches, which will have implications for the future of the profession as a whole.

6.3 RESEARCH OBJECTIVES AND HYPOTHESIS

What are the implications of sustainability for design as both a creative process and commercial practice and what drives these implications?

The context outlined so far suggests that objectives are a burden on creative processes, and yet are facilitators in commercial practice. In a comparative experiment observing the processes of designers in education and practitioners, the *reductio ad absurdum* outcome of this hypothesis would be that designers in the early stages of their education, who are liberated from complying with objectives, will be free to explore and develop novel approaches to sustainable design and consequently deliver more innovative, polemical design schemes. By comparison, practitioners, who are familiar with sustainability objectives will exhibit linear and constrained design processes that generate conventional outcomes commensurate with the quantitative constructs of sustainability manifest in objectives.

The studios of architectural education and practice provide ideal environments in which to explore the similarities and distinctions of the implications of sustainability for creative processes and commercial practice. By association, these contexts correspond to designers of different levels of expertise. According to the hypothesis above, designers in education (novice designers) without professional experience would be expected to be uninhibited by professional conventions and demonstrate a design process free from specific obligations to meet sustainable design objectives. In contrast, established professionals, who have a lengthy experience of working in the construction industry towards specified client requirements, using practice conventions and familiar with the varied disciplines that constitute design teams will be constrained by commercial and professional obligations.

There is, however, a third level of experience to be explored. The Part II

Architectural Assistant and Postgraduate designer has some experience in practice, but is not yet qualified. This thesis recognises that commercial practice and creative processes do not operate as separate entities, rather, they are integrated activities that require interdisciplinary input to deliver sustainable architectural design. On this basis, the designer with intermediate level design experience (new professionals), positioned between professional practice and academic education, may expose some professional conventions, but with the freedom provided by academic education to explore theoretical positions of sustainability through design. These three levels of design experience provide the context to explore the following objectives:

1. Develop an understanding of how sustainability is tackled in non-commercial design practice, where creative processes are liberated from the requirement to meet specific objectives in relation to sustainable design.
2. Explore how sustainability objectives are managed in commercial practice and, in particular, how practitioners perceive the implications of sustainability objectives for design outcomes in this context.
3. Examine the differences and similarities between creative processes and commercial practice to provide descriptions of how designers manage the requirement to produce sustainable designs in creative and commercial contexts.

7.0 METHODOLOGY

Cash, et al. (2012: 211) identify that where “method implementation” has not been adequately defined, inconsistencies in the method may be ignored and consequently inferences can be inaccurately drawn. This chapter documents the methodological and analytical frameworks devised to qualitatively explore sustainable architectural design in creative processes and commercial practice. The chapter is structured as follows:

7. 1 Overview of the Inquiry Design

This section provides an overview of the inquiry design introducing three levels of design experience that informed the use of two methods of inquiry specific to the educational and professional design settings.

7.2 Justification of Methods

This section explains the strengths and weaknesses of the methodology and explains how the two methods of inquiry are synthesised.

7.3 Design Labs: Ex Post Facto Studies

The details for the ex post facto method are provided and the nature of the resulting data is described.

7.4 Interviews with Established Practitioners

This section presents the structure and format of the interviews and describes the data acquired through this method.

7.5 Analytical Framework

The content analysis procedures used to analyse the qualitative data are introduced and the benefits of the approach are presented.

7.6 Summary

7.1 OVERVIEW OF THE INQUIRY DESIGN

Silverman (2009) states that research methods should be informed by the research problem at stake. This section reviews two linked factors; design experience and discipline, in relation to the inquiry.

7.1.1 DESIGN EXPERIENCE AND DISCIPLINE

Three levels of design experience were studied as part of this inquiry. These were; undergraduates (novice designers), postgraduates (new professionals) and established practitioners. These were identified on the basis of their ability to represent the traditional three-part RIBA accredited route to becoming a qualified architect (RIBA, 2011), with Part I of the process aligning with undergraduate studies, Part II aligning with postgraduates and Part III aligning with established professionals.

As part of this educational route in architecture, there are two aspects of design experience that exist in parallel; the experience of design activity learned through education, and the experience of the profession, gained through professional work experience. The first refers to the length of time designers have been designing, whilst the second relates to the influence of design conventions imposed by the profession (Cuff, 1992; Till, 2009. The former has been suggested to directly influence the structure of problem solving (Ho, 2001).

Discipline was an important factor in the inquiry in order to distinguish between the implications of professional conventions and sustainability objectives. Interdisciplinary design was factored into the study through the involvement of undergraduates from a range of design disciplines, in addition to experienced practitioners active in a range of design disciplines in the construction industry. Justification and reasoning for the sampling is set out in 7.3 and 7.4. Fig. 7a sets out the three parts of RIBA education, aligning these with the three levels of design experience and the hypothesis.

FIG. 7a
Alignment between the levels of design experience involved in the study, with descriptions experience levels and hypothesis.

RIBA Architectural Education		Level of Experience		Hypothesis
Part I	Part I of this process involves three years full-time undergraduate study to develop "a broad range of skills and architectural understanding", followed by a minimum of 12 months professional experience "working under the supervision of an architect or qualified industry professional" (RIBA, 2011).	**Undergraduates from a Range of Disciplines**	The ability to design (Cross, 1990), with little or no experience of commercial design practice, in any design field, but a developing knowledge of design history and theory.	Interdisciplinary designers without professional experience are expected to portray design processes uninhibited by professional conventions and reveal an understanding of how designers generate sustainable design unhinged from specific obligations to meet sustainable design objectives.
Part II	Part II comprises a further two years of full-time study which "provide[s] students with enhanced architectural knowledge and project complexity" (bid). This is appended by a further 12 months professional experience, during which candidates begin studying aspects of construction practice, management and law in preparation for the Part III examination.	**Architectural Postgraduates**	Developed experience of design activity, with a good knowledge of architectural design and the process of project realisation in architectural practice and the construction industry.	It is anticipated that the intermediate position between professional practice and academic education may expose some conventions and preferences of practice, but with the freedom provided by academic education to explore theoretical positions through design.
Part III	In Part III, the final stage, candidates undertake a final examination, following which, successful candidates are invited to subscribe to the Architects Registration Board (ARB), without which, the title "Architect" is can not be used. The final exam is based on: • A record of the candidates' 24 months professional experience; • Professional CV and career evaluation • Case Study • Written Examination on practice, management and law • Final Oral Examination	**Practitioners from a Range of Construction Disciplines**	Qualified architects and practitioners with professional experience in their design field and a specialist knowledge of the practices and procedures of design in the construction industry.	Objectives are expected to be a central focus of practitioner activity and with a lengthy experience of architecture, working towards specific client requirements whilst following practice conventions and working as part of an interdisciplinary design team, established practitioners are expected to be confined by them.

7.1.2 INQUIRY CONTEXT

Noting the tendency to ignore design experience in studies of the design process, Lawson (2004) explains that such studies often focus on students and less experienced designers because it tends to be easier for researchers to gain access to students to make observations about how they work. By contrast, the commercial demands of practice, such as time constraints on practitioners and the sensitivity of client information, can restrict researchers from observing naturalistic processes (although there are some examples of this, see; Yaneva, 2009).

The levels of design experience outlined above align with different studio settings in which design activity takes place, in addition to different constraints acting on the design process: for example, less experienced designers in education are located in the university studio setting and subject to the particular requirements of the curriculum, whereas established practitioners operating in professional practice offices and studios are subject to client and user requirements as well as the demands of the business.

7.1.3 METHODOLOGICAL FRAMEWORK

This inquiry used two methods of inquiry:

- An ex post facto study of design projects, produced by inexperienced designers and new professionals in design education, and;
- Semi-structured interviews to explore the sustainable architectural design approaches of established practitioners.

To illustrate the set up of an ex post facto study more clearly, Ross & Morrison (2004) describe an inquiry in which a class of students is given the option to make notes with either a word processor or pen and paper during lectures. Over three days, the researcher collects notes made by the students and conducts

daily quizzes to evaluate their progress. This allows the inquiry to take place in the educational setting, in line with the curriculum.

Semi-structured interviews draw on methods successfully used in previous studies of the architectural profession (see, Imrie, 2007; Imrie & Street, 2011; Cuff, 1992). These studies rely on techniques that are able to elicit a clear understanding of architectural practices without intrusive and prolonged periods of research that might deter participation. Additionally, interviews can be conducted in the practice setting, meaning that interviewees have access to work which might provide useful examples to support descriptions of their experiences in practice.

The methodological framework for this inquiry was designed to consider design experience and discipline. Fig. 7b outlines methodological framework, specifically highlighting which methods were used to explore the three different levels of design experience.

Method of Inquiry		Experience and Discipline
DESIGN LABS	Ex post facto studies of a twelve week design project conducted in a studio environment within the Birmingham Institute of Art and Design (BIAD). The goal of the design project was to investigate and produce sustainable design, with no disciplinary limitations on the design outcomes.	**NOVICE DESIGNERS** (Undergraduates from a range of disciplines) **NEW PROFESSIONALS** (Architectural Postgraduates)
INTERVIEWS	A series of semi-structured interviews conducted with professional design practitioners in a range of disciplines, dealing with sustainable design for architectural and urban form, with a particular interest in projects subject to sustainability assessment rating methods, in order to explore the implications of commercial practice on sustainable design.	**ESTABLISHED PRACTITIONERS** (Professional designers from a range of practice disciplines and practice sizes)

FIG. 7b
Alignment between the levels of design experience and methods of inquiry used to respond to the different contexts of design education and professional design practice.

7.2 JUSTIFICATION OF METHODS

This section reviews the strengths and weaknesses of the methods adopted in this inquiry. It also explains how the two methods are synthesised.

7.2.1 DESIGN LABS

Existing studies of design processes have predominantly employed observational methods to acquire data (Cross, 2007). Designers are either observed in their field (ethnography), or as part of a specially constructed design experiment (see, Cash et al., 2012; Cross et al., 1996; Cross et al., 1992). In either circumstance, the designer might play an active or passive role in the observational context (Cross, 1992: 3) where data can be recorded concurrently, or retrospectively (Blessing & Chakrabarti, 2009). Concurrent data is intended to reveal unsullied impressions of design thinking and activity, whilst retrospective recordings offer insights into the rational logic behind design decisions (ibid, also see, Lloyd et al., 1996).

Cash et al. (2012) point out that artificial and structured settings, such as the limited-time approaches employed by Cross, Dorst, & Christiaans (1996) and Ostad-Ahmad-Ghorabi & Collado-Ruiz (2010) where participants are asked to generate design ideas over a 1 - 2 hour period, can have implications for the design creativity witnessed as part of the study. Prolonged methods, such as the ethnographic field work conducted by Yaneva (2009), which followed designers at work over the course of a year are less viable for a study involving a range of design experiences.

A true experiment strictly controls the introduction of stimuli in order that resulting correlations can be identified as causal (Campbell & Stanley, 1963). However, controlled conditions are often unable to offer a naturalistic design setting which reflects the way design projects are realised. For example, a study conducted by Ostad-Ahmad-Ghorabi & Collado-Ruiz (2010) measured how environmental

information affected the creativity of design solutions. Participants were asked to produce designs that reduced the environmental impact of an office chair using a method called *Life-Cycle Assessment*. Different groups were allocated varying intensities of information (the 'treatment') and the design task was limited to a 45 minute period in which participants had time to sketch, but not refine, design ideas. Such an experiment is not a true reflection of the design process as it might happen in practice.

The ex post facto (design lab) method adopted took place over twelve weeks; with the design work compiled over that time being the source of the data. This aligns with Christiaans' (1992) observation that allowing more time for developing an understanding of the design problem has positive implications for the creativity of design outcomes. The participant self-selection process the ex post facto study involved, allowed the researcher to identify variables of importance. However, the reduction in control meant that it was imperative that the researcher was aware of the increased number of factors potentially affecting the variables under evaluation (ibid, also see, Shadish, Cook, & Campbell, 2002). A summary of the strengths and weaknesses of the ex post facto method adopted for the purposes of this thesis, are provided in the table below (Fig. 7c).

7.2.2 INTERVIEWS

Interviews can be structured, unstructured, or semi-structured. A structured interview is designed to acquire simple and measurable responses, and consequently often involves closed questions which can constrain answers. Unstructured interviews use open questions, with responses generating subsequent questions. This form of interview tends to be difficult to analyse because of the diversity in data collected. The intermediate approach is a semi-structured interview, which is said to be best used in circumstances where a single opportunity to interview a person exists (Bernard, 2000: 191).

Strengths	Weaknesses
Events are allowed to unfold naturalistically giving a more truthful reflection of how design occurs in the design studio setting. This is in distinction to controlled experiments where participants must design using only a priori knowledge and information provided by the researcher.	The lack of control in ex post facto studies makes it difficult to elicit causal inferences, therefore the findings are unable to prove or disprove hypotheses. Instead, the findings of the study are only able to provide descriptions which indicate variables for further study (Shadish, Cook, & Campbell, 2002).
The twelve week period of the study allows sufficient time for participants to develop detailed design schemes, as opposed to sketch ideas.	The time period also allows participants to post rationalise design solutions meaning that design reports are weak evidence of when design ideas arise in the design process.
The curriculum for the elective and the brief for the design labs emulate the brief and requirements set by clients or design competitions in practice.	In any situation of this kind the researcher needs to be aware of the influences of demand characteristics (Gomm, 2004); where participants affect the study by producing what they think is required.
The design lab brief enables participants to explore the diverse characteristics of sustainability and the scalar implications of interventions meaning that the study benefits from being able to explore how participants define sustainability and which aspects they consider important in designing sustainable architecture.	The lack of control within the study means that the design outcomes are diverse and are therefore not directly comparable. Appropriate analytical techniques need to be used, such as content analysis, which allows the comparison of unstructured data.

FIG. 7c
The strengths and weaknesses of ex post facto studies of design.

They follow a basic list of questions and topics to ensure that key criteria are discussed and are considered to be the most efficient use of a respondents time; demonstrating that the interviewer is “prepared and competent” and that the respondent is not being excessively controlled (ibid). Fig. 7d sets out the strengths and weaknesses of semi structured interviews.

7.2.3 METHODOLOGICAL SYNTHESIS

The time-based data captured by the design labs describes the design process by documenting the generation of a design scheme. Interview transcriptions provided observational statements about the design process and the influences acting upon it through the participant’s experiences.

The approach of this study raised issues concerning the comparability of findings because of the variety of outcomes in the design labs and responses from interviews in addition to the difference between the types of data. Content analysis was employed as an analytical technique to compare such unstructured data. As part of the process, themes were mapped to draw out commonalities relating to:

- **Problem Framing**; how designers frame problems in relation to issues of sustainability.
- **Design Approach**; including the methods used by designers to navigate design problems and deliver solutions.
- **Dependency;** the ways in which designers demonstrate and describe the implications of the requirement to deliver sustainable design.

A full description of the mapping techniques developed is provided in section 7.3 (design labs) & 7.4 (interviews).

Strengths	Weaknesses
Semi structured interview provide a rich report from actors in the field. This means that a smaller sample size can be used, providing key actors in the field are targeted.	The researcher is relying on the respondents telling the truth and providing details of actual examples and experiences.
Semi structured interviews are the most effective use of respondents time. They are flexible enough to allow respondents to refer to examples and experiences, and allow the interviewer to encourage the respondent to unpack and explain their answers.	Researchers need to ensure that all the key topics are addressed in semi structured interviews as the loose structure can allow the respondent to digress. The researcher needs to establish good rapport with the respondent in order to minimise the risk of the respondent answering by stating what they think is required.
A small sample allows the researcher to focus on where the process being studied is most likely to occur.	A large sample size is required to make generalisations about a population. Such sample sizes preclude the use of qualitative analysis techniques. This means that the implications of specific variables can not be isolated and the findings of the data can only be used to identify variables for further investigation.

FIG. 7d
The strengths and weaknesses of semi structured interviews.

7.3 DESIGN LABS: EX POST FACTO STUDIES

The ex post facto method introduced in the previous section was formatted as a series of design labs held within the Birmingham School of Architecture (BSA), which involved self-selecting participants enrolled on undergraduate and postgraduate design courses at the Birmingham Institute of Art and Design (BIAD). In a design lab designers are involved in exploring topics through design, in a naturalistic setting.

7.3.1 INQUIRY CONTEXT

The design labs were conducted as part of an elective programme at BIAD. Electives form a mandatory part of both undergraduate and postgraduate courses and run throughout the first semester of each academic year. Undergraduate elective programmes take place in the second year of undergraduate study and are offered by each design discipline within BIAD. The intention of the undergraduate programme is to encourage interdisciplinary working and knowledge exchange. Postgraduate elective programmes are architecture-specific and offer a range of prevailing theoretical discourses concerning the built environment.

Students select electives based on the unit brief. The design lab brief was titled ‘BIGsmall’ and it was described as a unit exploring the scalar relationship between sustainable design interventions and social, cultural, economic and environmental implications. With this brief, participants had the disciplinary freedom to explore sustainability. Birmingham, the location of the institution, provided a context for the design projects but participants were not limited to this location and had the freedom to determine the relevance of this in line with their own interests.

In total, three design labs were held. In 2009 two design labs were conducted concurrently: one involved interdisciplinary art and design undergraduates and

one comprised postgraduate architecture students. The third design lab was held in 2010, and involved a further group of mixed-disciplinary undergraduates.

Fig. 7e gives an outline of the number of participants in each design lab and clarifies the disciplinary nature of each. It also identifies the code that is used to refer to each design lab throughout this thesis.

FIG. 7e
Codes used to refer to design labs throughout the thesis and an outline of the number of participants and the disciplinary nature of each design lab.

Code	Expertise	Year	No. Participants	Discipline
UG09	Undergraduate	2009	20	Interdisciplinary
UG10	Undergraduate	2010	13	Interdisciplinary
PG09	Postgraduate	2009	12	Architecture

7.3.2 LIMITATIONS OF THE INQUIRY SETTING

Silverman (2006: 293) asserts that the study setting (place) should be commensurate with the generalised setting to which the findings apply. This is predominantly applicable to exploratory studies and it is expected that where participants are required to conduct design activities they should be allowed to do so in a design studio setting.

Issues of sustainability were addressed through research for design (Frayling, 1993), which, within BSA, considered the ecological implications of interventions, from urban morphology to building materiality. There was no predetermined process through which sustainability had to be addressed. Students were encouraged to develop computational skills and knowledge of software and applications used in practice, however, there was no obligation to demonstrate this through their design work; hand drawings and manual analysis were equally valid methods.

Studio environments differ between each institution, according to the values and facilities of the faculty and school. The findings of this inquiry are therefore specific to BSA. Against schools that focus on digital design methods for

sustainability (see section 4.2.3), some generalisations can still be made on the basis that the use of digital design methods relies on a priori knowledge and understanding of design, or at least the parameters to be manipulated. In this sense, the findings of this inquiry offer an insight into rudimentary design processes that precede the use of digital design tools; reflecting Cedric Price's commonly cited aphorism "Technology is the answer, but what is the question?"

7.3.3 DESIGN LAB BRIEF

Fig. 7f sets out the requirements of the design lab brief each week. To ensure that suitable information was obtained without constraining design concepts to a specific cause, the brief did not set out requirements for final designs. Rather, it required participants to record design decisions and their influences during the design process. In line with the RIBA Plan of Work (PoW, 2007) the design lab brief required weekly outputs to document design decisions and progress. These staged outputs are distinct from the reality of the production of information in practice where the development of both the problem and design solution is considered to be simultaneous (Schön, 1983; Maher, et al., 1996; Dorst & Cross, 2001). Within the design lab brief, stages were categorised into two principal design phases;

- **Preparation**, the phase in which participants explored the context of sustainable design, and;
- **Development**, the generation and refinement of design proposals.

The preparation phase involved two outputs in line with the PoW; *appraisal* and *design brief*, which were devised to allow participants to establish and respond to their own design problem by exploring the territory of sustainable design and devising their own design briefs accordingly [9]. The appraisal stage initiated by asking the participants to provide their own understanding and definition of sustainability. In light of these definitions, participants were subsequently asked

[9]
It is important to distinguish between the ***design lab brief*** and the ***design brief*** produced by participants. The ***design lab brief*** refers to the information outputs required by design lab participants throughout the course of the design labs, whereas the ***design brief***, refers specifically to the brief produced by participants, which stipulates the conditions they decided to respond to through sustainable design as well as any overall requirements for the design scheme they produced.

	RIBA PoW	Week/ Stage		Brief Requirements
PREPARATION	A - Appraisal	1	DEFINE CONTEXT	A personal understanding of the broad context of sustainable design.
		2	IDENTIFY ISSUES	Explorations of the social and cultural implications of sustainable design.
		3	EXPLORE INITIATIVES	Explore initiatives designed to support the production of sustainable architectural and urban form.
		4	ANALYSIS	Analyse and synthesise issues to develop a theoretical position on the implications of sustainable design.
DEVELOPMENT	B - Brief	5	DEFINE BRIEF	Develop a design brief that identifies the goals of the design in relation to the theoretical position.
	C - Concept	6	DESIGN POSSIBILITIES	Initial stages of concept generation; testing design ideas.
		7	CONCEPT DEFINITION	Generation of design concept for development.
		8	CONCEPT JUSTIFICATION	Justification of the concept in relation to the brief and the objectives identified.
	D - Design Development	9 + 10	DESIGN RESOLUTION	Resolving design to meet brief objectives.
		11	PROCESS SUMMARY	Collate design report to explain processes and reasoning.
		12	DESIGN PRESENTATION	Presentation of design scheme with supporting statement.

FIG. 7f
Weekly stages and information production as set out by the design lab brief.

to consider society and culture, and how these reconcile with the definition of sustainability they had provided. To encourage such exploration, a series of readings were set (see Appendix A) and participants were also encouraged to complement these with other literature they had identified. To record this, participants were asked to provide a full list of references for any literature and data used. The second phase *development* focussed on translating the explorations conducted in the preparation phase into design ideas, including the refinement of those ideas and the presentation of them.

7.3.4 ORGANISATION AND THE ROLE OF THE RESEARCHER

The design labs were delivered between October and December in 2009 and 2010. The elective course criteria (supplied by the institution, BIAD), required participants to spend 6 hours each week on work for their selected elective modules. Three hours of this time was contact time, with the elective module leader (the researcher) and a further three hours of self-directed study was expected in line with the elective module requirements. Meetings took place within the design studio at BSA. Studio space, materials workshops, computer labs and the University libraries were all freely available for students to use during working hours (9am - 6pm) for their self-directed study. There was no requirement to work in isolation. Participants had been introduced to all the facilities available as part of their university induction, and were encouraged to use the facilities in all their modules.

During the three-hour weekly group meetings, participants presented their progress in line with the design lab brief requirements. The researcher's role was to encourage group discussion. This involved questioning participants about their decisions to get a better understanding of their design and decision making processes. During these sessions, observations were recorded in note form. Fig. 7g provides a brief example:

FIG. 7g
Excerpt of notes taken during from PG09 during week 5. Participants were analysing their explorations of sustainable design and drawing conclusions about what the design brief might be. Participant names have been removed to make the data anonymous.

	Notes
Participant 1	Reveals a type of concrete that can sequester carbon emissions and suggests that if all new housing was constructed using this then carbon emissions could be reduced.
Researcher	What implications does that have for the design?
Participant 1	Could change the shape of buildings to maximise surface area.
Participant 2	Concrete could change construction approaches and typologies as material works on the basis that greater surface exposure means less carbon.
Participant 1	Going to look at volumetric shapes that maximise surface area, see if they could be used to develop new housing typologies.

Outside the contact hours, the researcher was obliged to carry out to administrative duties, including responding to e-mails from participants. On five occasions, undergraduate participants e-mailed the researcher with enquires about their work. Responses to these involved reassuring participants about their work so far and reiterating the brief requirements.

Every other week, undergraduate design labs were assisted by staff from within the school of architecture to provide teaching input and assessment. Postgraduate design labs were assisted by staff on a weekly basis. In both cases, this was to ensure that students' needs were met beyond this research inquiry and to provide assessments of the students work in line with University standards.

7.3.5 PARTICIPANTS

Postgraduate and undergraduates were self-selecting; they were provided with an outline of the module agenda to aid their selection. After the introduction of the brief on the first week, participants had two weeks in which they could transfer to an alternative module In total 35 undergraduates and 20 postgraduates willingly participated for the duration of the design labs.

Undergraduates had varied backgrounds from 2D and 3D fields of design, including photography, fashion, graphics, fashion management, as well as

architecture and landscape architecture. Architecture and landscape students formed a majority against other disciplines. Fig. 7h provides a breakdown of the proportions of participants from each discipline in undergraduate design labs.

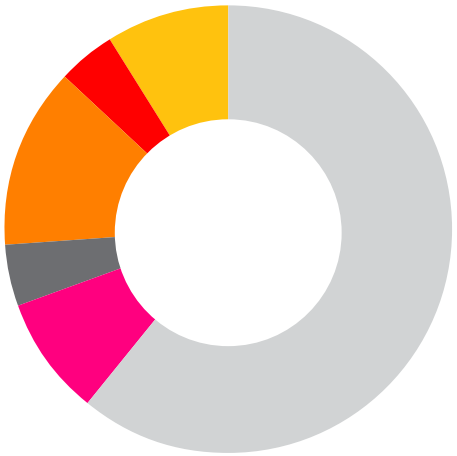
Postgraduate participants all studied architecture, and also had at least a year of experience in professional practice. Half of the postgraduate group studied part-time, working in professional design practices for the majority of the week. In the practice environment, these students would be Architectural Assistants.

Within each design lab, participants decided whether they would work individually or in groups. All postgraduate participants worked within a group, with four members in each group. In UG09, all undergraduate participants worked individually. However, in UG10, four pairs and three groups containing three members were formed, these were not necessarily discipline specific; of the seven collaborations formed, three comprised students from different design disciplines (see Fig. 7h).

7.3.6 DATA FORMAT

Two principal types of data were produced: *design reports* (including the presentation of design schemes) and *project synopses*. In architectural education it is typical for students to be asked to produce design reports to encourage the process of critical reflection and to require students to express the theoretical and technological position of their designs, in particular, justifying those positions within geographical and cultural contexts. The design reports produced in these design labs required participants to compile an overall narrative of the design process as well as convey the theoretical position of their design schemes. This includes documenting significant developments and decisions made during the design process, in addition to the justifications for those developments and decisions. The design reports comprised text and images, which were collated in electronic format, such as power point and PDF documents. To support these

UG 09

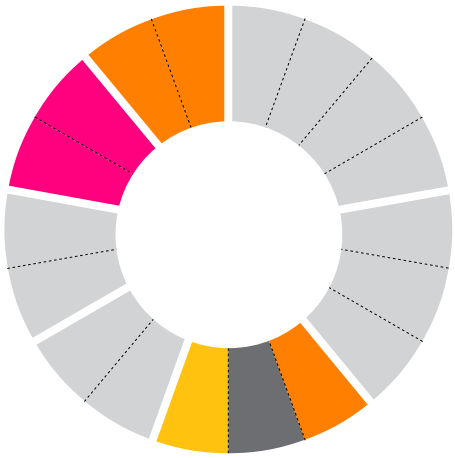


UG 10

FIG. 7h
Charts to show the proportion of participants form each discipline for undergraduate design labs conducted in 2009 + 2010. In 2010 a number of participants worked in groups. The bottom chart documents the number of groups, the number of participants in each group and their respective disciplines.

KEY

- Architecture
- Design Studies
- Fashion
- Fashion Retail Management
- Interior Design
- Landscape Architecture
- Visual Arts
- Visual Communication



Disciplinary Composition UG 10

reports with a clear and concise description of the project, participants were asked to write a 500 word statement about the work - the project synopsis. This ensured they set out a theoretical position for the project and used this position to justify resultant design schemes.

Schön (1992) identifies that, despite the design process being iterative and incremental in many respects, it is not always smooth or consistent. Consequently, the design reports are post-rationalised illustrations of the design process as participants had the opportunity to select the information included.

Course handbooks provided students with all the relevant information relating to expected learning outcomes and marking criteria. The integration of design labs within an assessed module of the participants' courses provided an incentive for participants to deliver clear and reliable reports: participants were expected to produce designs that reflect their level of experience in the field while developing their knowledge and design skills. Silverman (2006) highlights that such approaches can ensure reliable and honest participation, leading to credible research. The marking criteria provided by BIAD for the electives (design labs) can be found in Appendix B, and is organised around the following three, key criteria:

- **Research**; to illustrate an understanding of the topic
- **Thinking**; independent and clear thinking
- **Presentation**; a good level of clear and logical graphical, written and oral presentation

Effective design reports demonstrated the skilled compilation of images and text which communicated to the examiner (someone who did observe the students' progress first hand) that they fulfilled the marking criteria to a high level. Key attributes of this included the ability to summarise secondary data efficiently and

effectively, and communicate visually how this data informed their decisions in order to justify the chosen approaches to the scheme produced. Three types of content were contained in design reports:

- **Preparatory Data**; representing secondary data, its influence on the participants own design brief and its implementation in the design process.
- **Design Process**; demonstrating informed decision making and reflection on design decisions and their implications for design.
- **Design Scheme**; explaining the resulting design scheme, detailing how it responds to the design brief developed by the participants.

Participants were asked to present work in a format that reflected the issues of interest in the project and the resulting design scheme. There was no minimum or predetermined length for design reports, and as such the reports vary in length. The project synopsis was limited to 500 words and was submitted electronically with the design report.

7.3.7 ETHICAL CONSIDERATIONS

There are a number of issues associated with research involving students as participants in faculty research, owing to the conflict of interest between the faculty's fiduciary relationship with students and the need to collect data (Ferguson, et al., 2004). In respect of this there are two core ethical considerations that informed the design of this inquiry:

Consent; students can be considered captive participants where the agency of the teacher doubles as researcher - teacher. Intrinsic to the student - teacher relationship is the power relation between them and the students' trust that the teacher is committed to their learning. The research is the teacher's self-interest which can compromise voluntary participation (Ferguson, et al., 2004). To address this issue, participants in the design labs were self-selecting. The role

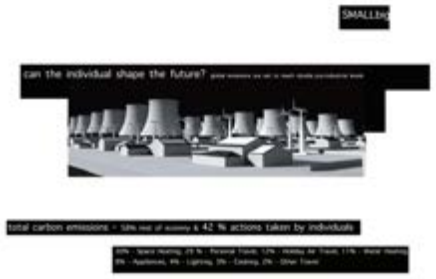
of the study as part of the elective was verbally communicated to students at the introduction of the elective. Following this students had a two week window in which to transfer to an alternative elective if they did not wish to participate, or if they simply decided the would be better suited to an alternative elective. To appease power relations, teaching was supported by senior staff within BSA, allowing the researcher to concentrate on the research.

The *confidentiality* "of research data is based on the principle of respect for the dignity and autonomy of research participants" (Ferguson, et al., 2004: 7). Not all data must be made anonymous, however participants must have the right to confidentiality. Design lab participants were made anonymous throughout this thesis and descriptions of work are provided through thematic mappings of the original data to protect anonymity. Exclusions to this include examples of work set out within this chapter. These participants were consulted and verbally consented that their work could be used as an example under the University agreement for student work to be published in University documents. To acknowledge the support of these students and the quality work they produced, they have been acknowledged accordingly and where appropriate within the thesis.

Novice Designer Design Report Excerpts

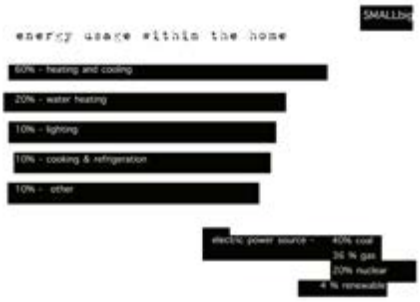
1. Define Context

This design report initiates by outlining a problem; a global concern for energy supply and demand, and the associated emissions related to energy use. It provides snapshots of information, specifically statistics, about energy use and related emissions. The image, produced by the participant, emphasises the culturally invisible relationship between energy production and consumption.



2. Identify Issues

This page provides a breakdown of domestic energy use. There is no visual explanation or indication of the implications of these figures, but some smaller, offset text that associates usage with sources of energy production. It effectively highlights an issue, but does not explicitly explain its relevance or relationships.



3. Explore Initiatives

The participant identifies heating and cooling as primary contributor to domestic carbon emissions and sets out to explore methods of reducing the amount of energy required for domestic heating and cooling. Using select historic images of clothing designed for arctic explorations, the participant proposes to “rely on individuals clothing” rather than heating spatial volumes.

4. Analysis

This sample page provides a collection of images and data briefly exploring fabrics and textiles. This data is presented in individual blocks of images an text, which are clear but not analysed. More specifically, data refers to weights of textiles and their insulative properties, but does not give a clear indication of the implications of these for the design development.

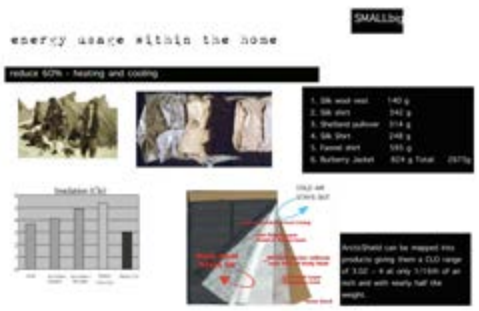


FIG. 7i
Sample excerpts from design reports produced in 2009 design labs by ***novice designers***. This illustrates typical outputs produced by participants at each stage in the design lab. (Examples continued on following page)

ACKNOWLEDGEMENTS: Tom Gardener, (Architecture student, 2009)

5. Define Brief

In this sample it is clear that the participant simultaneously developed research, design ideas and the brief. However, at this stage, the participant refers to weather data and the environmental condition for which the project is proposed to reinforce the purpose and specification of the project. Data is presented in a raw format and the brief is short and concise.

6+7. Design Possibilities & Concept Definition

In addition to textile properties, the participant, who in this case begins to explore technology devised to improve the feasibility of the proposal by reducing fabric thickness and weight. Images and text are presented separately, without explicitly drawing together what this means for design development.

8. Concept Justification

The benefits of reducing emissions by reducing the need for domestic heating are presented in the format of branding labels for clothing design to eradicate the need to heat spatial volumes, which the participant implicitly suggests is inefficient. At this stage the project develop a title. The labels are produced in the same graphic style used at the outset and the design is indicated using hand drawings.

12. Design Presentation

The participant made a prototype of the final design, which was documented in the report with a photograph. The design is presented without any annotative text and is compared and contrasted with space exploration equipment. This implicitly highlights a challenged between designing something high performance and fashionably desirable.

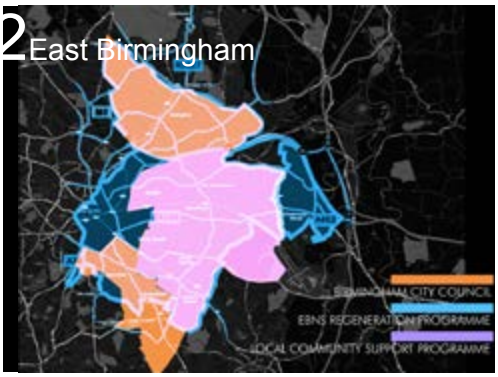
FIG. 7i cont.
Sample excerpts from design reports produced in 2009 design labs by ***novice designers***.

ACKNOWL-EDGEMENTS:
Tom Gardener, (Architecture student, 2009)

New Professional Design Report Excerpts

1. Define Context

This report initiated by defining an urban context and exploring its conditions. The image, compiled by the participants, highlights the area of East Birmingham under investigation and defines a number of boundaries relating to local regeneration and community programmes in place at the time. With this the participants undertake some translation of raw data into their own images.



2. Identify Issues

Having explored environmentally harmful emissions related to peripheral surface car-parking provision, this except highlights the geographical, environmental, social and cultural relationship between three disconnected areas. Here the size of the highlighted areas relates to the scale of impact in addition to site and again, the participants can be seen to (re)present data and ideas graphically.

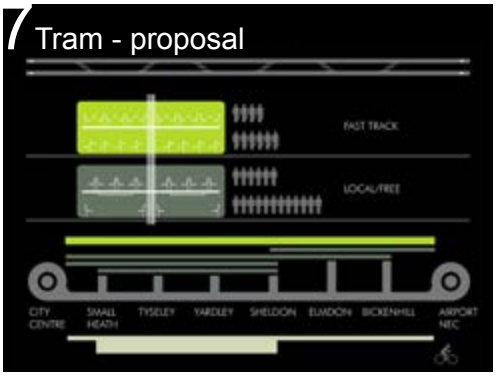
FIG. 7j
Sample excerpts from design reports produced in 2009 design labs by ***new professionals***. This illustrates typical outputs produced by participants at each stage in the design lab. (Examples continued on following page.)

3. Explore Initiatives

This excerpt draws together explorations of existing techniques for capturing environmentally harmful emissions and examines how these could be implemented on the site under investigation as well as beginning to consider the spatial implications. In doing so it synthesises a number of data sets in order to give an initial proposal context.

4. Analysis

Secondary data is analysed through design: Drawing together the information explored, this design report page explores a schematic intervention as a means of experimenting with the secondary data collected so far. The diagram illustrates a strategy for a transport link between the three sites investigated earlier.



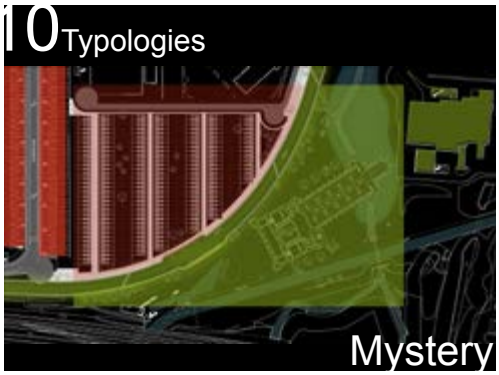
ACKNOWLEDGEMENTS:
Maciej Debsku;
Abubakar Kumshe;
Zahid Khan;
Ming-Kao Tsai;
Chen Lui.
(PGDip candidates)

5. Define Brief

This page presents one aspect of the design brief. The excerpt shows how an infrastructural intervention can address significant environmental issues, while simultaneously stimulating regeneration on the periphery of a post-industrial city. Other aspects of the brief included the regeneration of a residential area between the city and the car park.

6+7. Design Possibilities & Concept Definition

This sample explores design across scales. This page illustrates how the site, divided by a transport route, adopts two contrasting approaches that reflect the existing forms and changing demography of the area: The red area indicates traditional housing typologies (banal), whist the green explores surrounding industrial buildings (mystery).



8. Concept Justification

Here the 'local' scale site, which makes up the 'building' aspect of the design scheme is justified in terms of current planning policies by illustrating the which aspects of the intervention are encouraged as part of Planning Policy Guidance (DCLG, 2009).

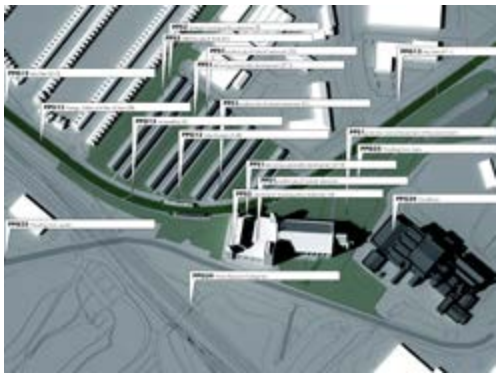
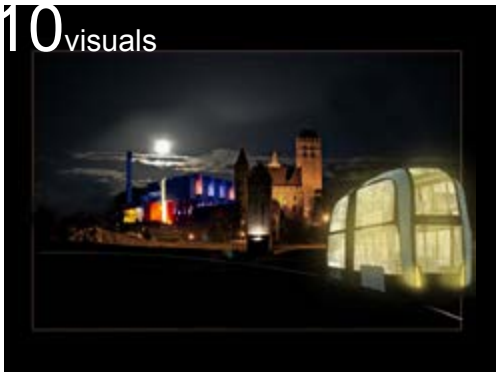


FIG. 7j cont. Sample excerpts from design reports produced in 2009 design labs by ***new professionals***.

ACKNOWLEDGEMENTS:
Maciej Debsku;
Abubakar Kumshe;
Zahid Khan;
Ming-Kao Tsai;
Chen Lui.
(PGDip candidates)

12. Design Presentation

The design scheme was presented as a series of photomontage images. This example shows a night time view of one angle of the design scheme, which focusses on the 'mystery' section of the project.



7.4 INTERVIEWS WITH ESTABLISHED PRACTITIONERS

This section describes in detail the semi structured interview method used to explore the design processes of established practitioners.

7.4.1 QUESTION DESIGN

Interview questions were designed to elicit an understanding of the design processes of experienced designers, active in professional practice, working towards sustainable design. Questions were qualitative and open-ended to allow participants the opportunity to refer to appropriate experiences and to explain these in relation to the idiosyncrasies of their design projects. Where closed questions featured, they were followed by prompts, pursuing the reasons for the participant's answer.

The questions were designed to guide discussion about the design process in two main areas; *sustainable design practice* and *the role of objectives for sustainable design*. The questions explored the driving forces for sustainable design in practice, in addition to what established practitioners think sustainable design is, what it should be and how it is generated and delivered in professional practice (see Fig. 7k).

7.4.2 INTERVIEW PARTICIPANTS

"The purpose of sampling is usually to study a representative subsection of a precisely defined population in order to make inferences about the whole population" (Arber, 1993: 70). Conversely, Silverman (2006) articulates that identifying and tailoring qualitative research studies, to make representative generalisations about a specific population is difficult because "to construct a representative sample of cases, the sample size would likely be so large as to preclude the kind of intensive analysis usually preferred in qualitative research" (ibid: 304).

	Interview Questions
SUSTAINABLE DESIGN PRACTICE	In your view, what techniques best facilitate sustainable design? What are the reasons for this?
	From experience, what are the difficulties in generating sustainable design?
	What are the initial three things you consider when aiming to achieve excellent or outstanding BREEAM criteria, or similar levels of alternative codes?
	Do you think the way in which policies and codes for sustainable design are set out has consequences for the design process? What do you think the consequences of a target-driven design process are?
	How are code requirements weighted against other requirements in design schemes?
THE ROLE OF OBJECTIVES FOR SUSTAINABLE DESIGN	Do you think current performance assessment methods, such as BREEAM, provide a sufficient strategy for producing sustainable design?
	Does the accreditation of BREEAM or LEEDS offer benefits other than environmental?
	In your experience, to what extent do architects engage with writing codes, guidelines and policies for sustainable building?

FIG. 7k
The interview questions and corresponding main areas of concern for the interview design.

Flyvbjerg (2011) articulates that a select sample of “real-life situations … is important for the development of a nuanced view of reality, including the view that human behaviour can not be meaningfully understood as simply the rule governed acts … found in most theory” (ibid: 303). In qualitative research, emphasis is placed on the fact that useful findings can be gained by identifying “groups, settings and individuals where … the process being studied is most likely to occur” (Denzin & Lincoln, 1994: 202). Mason (1996) articulates that sampling in such a manner should be conducted in line with the research questions, theoretical positions and “the explanation or account [being] develop[ed]” (ibid: 93).

Architects are not solely responsible for architecture; consultants of many other disciplines assist in the product of sustainable buildings. Nor is it necessary to be a qualified architect to act in the same capacity. To this end, design rarely takes place in isolation (see, Hillier, 1996; Scruton, 1979; Rudofsky, 1972). Parallel to this, the interview sample focussed on architects, but also included interviews with practitioners from multidisciplinary practices.

In total, 10 practitioners were interviewed. Projects that have received particular public and media attention were targeted in order capture cutting edge sustainable design, meaning that although the sample size is small and limited, it provides a view from leading practices. Also important was the work conducted by the practice and the size of the practice since these factors command different requirements from different types of clients, in addition to different regulatory and legislative frameworks for residential and commercial projects and even building typologies. The interview sample includes professionals who have worked on sustainable refurbishment projects in addition to new build projects. The same question framework was used to guide all interviews. Established contacts from within the School of Architecture were prioritised for accessibility. Fig. 7j presents the details of all participants.

Practice	Expertise	Practice Profile	Participants	
Architecture m	CSH & BREEAM Assessment	Small practice, currently dealing mostly with domestic projects.	Mark Percival Director, Architect, BREEAM Assessor	p
Raynes Architecture	LHS PV Assessment	Small practice, in the housing, social housing, master planning, commercial and listed building sectors.	Lisa Raynes Director, Architect	p
Wilson Mason	AV Hill Building Manchester BREEAM Excellent	Medium sized practice with offices in Preston and London. Work in a large range of sectors including education, industrial and retail. Holds a number of awards for BREEAM accredited buildings	Derek Southworth Partner, Architect	p
			Alan Williams Partner, Architect	p
Austin-Smith: Lord		Large practice with three offices in the UK conducting work across a range of sectors.	Kal Gill-Faci Knowledge Manager	t
			Catherine Cosgrove Head of Sustainability	e
Feilden Clegg Bradley Studios	School of Art Manchester BREEAM Excellent	Large practice with offices in Bath and London. Work in a large range of sectors.	Adam Chambers Project Architect	p
3D Reid	Coop HQ Manchester BREEAM Outstanding	Large practice, 3 UK offices with national and international expertise in a range of sectors	Mike Hitchmough Director, Architect	p
Arup	Masdar Sustainable City LEED Assessment	Large, international, multidisciplinary practice including planning, design, engineering and specialist technical services. Expertise in LEED assessment methods.	Peter Budd Director, Aviation	t
			Alistair Guthrie Director, Sustainability	t

FIG. 7I
Interview participants, their disciplines, practice environment and expertise. The 'Method' column indicates how the interview was undertaken, whether in person (p), by telephone (t), or, by e-mail (e).

7.4.3 DATA FORMAT

Interviews were limited to an hour. Working within time and geographical constraints, in addition to encouraging participation from the identified sample group, interviews were conducted in person, over the telephone and in one case, answers were provided by e-mail.

The different forms of response raised some issues concerning comparability. For example, interviews carried out in person or over the telephone would be less structured than those conducted by e-mail because the opportunity for discussion is limited in the latter. Notwithstanding this, the e-mail response acquired as part of this research was followed with a telephone interview with another practitioner from the same practice who added to and explained the responses given by their colleague in the e-mail. This provided the opportunity to question and obtain a better understanding of the comments provided.

Respondents were asked if interviews could be recorded and all agreed. In addition, participants identified that they would prefer to be acknowledged as part of the research and therefore none of the interviews have been anonymised. Audio recordings were transcribed by the researcher in preparation for analysis. During the course of the interview, the researcher also made detailed notes (see Fig. 7m).

FIG. 7m
Extract of typed up notes taken by researcher during the course of an interview.

Notes

Q Do you think the way in which policies and codes for sustainable design are set out has consequences for the design process?

A Yes, it can be prescriptive and not all encompassing. It also provides a maximum – efforts beyond which aren't acknowledged.

Q In your experience to what extent do architects engage with writing codes, guidelines and policies for sustainable building?

A As a large multi-disciplinary practice, ARUP are able to provide advice and feedback. They have contributed to government reviews and commented on new policy guidance and legislation.

Q From experience, what are the difficulties in meeting code for sustainable design?

A There's a difference in the measurements used by LEED and BREEAM. I don't know if you're aware, but LEED isn't based on carbon, but on cost. So the two aren't necessarily comparable and it depends on how you measure sustainability.
There are also difficulties in understanding them; they're not always intuitive.

Q How are code requirements weighted against other requirements in design schemes?

A ARUP start off thinking about what the best possible design might be. Take a holistic view of the building project and consider all the things that make for the best design possible on that site. So, to begin with we ignore all the assessment method criteria and base the design of considerations of orientation, natural ventilation, and carbon neutrality. We aim to design carbon neutral buildings form the outset. Then we go back and use the assessment methods. So we really use it as an assessment rather than a starting point for design and so the original design, what we consider most appropriate, still stands, the assessment methods is simply an addition.

One recording of a telephone interview was a corrupt file and a full transcription could not be made. In this instance, the notes taken during the interview were used as a primary source of data.

7.4.4 ETHICAL CONSIDERATIONS

Semi-structured interviews rely on the ability of the interviewer to establish good rapport with respondents in order to formulate a trustworthy relationship in which sensitive information can be exchanged. Such qualities are ethically sensitive and thorough consideration of confidentiality and anonymity was required, especially where interview topics may concerned third parties, such as clients or users.

Respondents were happy to be named within this inquiry and verbal consent was gained prior to recording the interviews. References to third parties were removed from the data. To ensure "a high level of congruence between concepts and observations" (Bryman, 2008: 376) and thereby put in to place preventative mechanisms to ensure the credibility of the research.

7.5 ANALYTICAL FRAMEWORK

Babbie (2007: 333) describes content analysis as “the study of recorded human communications” which encompasses spoken, written and drawn forms of communication, extending to creative expressions such as painting and musical composition. It is suitable for use with unstructured data and involves iterative searches for themes in the context in which they occur (Silverman, 2006: 159). In the data, context was understood as the information that informed design decisions. The framework for analysis for all data was derived from Bryman’s (2008) four stages of qualitative analysis:

1. A review of the data was undertaken to generate a good knowledge of the data content and an overview of the themes it contained.
2. The data was marked with detailed notes, which constructed a deeper understanding of it and the relationships contained within it.
3. Systematic analysis was undertaken to ensure consistency and to identify all nodes of potential interest.
4. The constructs derived from the data were placed within a theoretical framework and interpretations were made in relation to the literature.

For the purposes of this inquiry, stages two and three were combined in a process of thematic mapping. This facilitated the examination of implicit and explicit connections and relationships in a rich and diverse data set. Thematic mapping also offered the ability to present design lab data anonymously. The following subsections describe the organisation of the data and the procedure of thematic mapping.

7.5.1 ORGANISING THE DATA

After design lab data was made anonymous, pages of the design report were collated in a matrix with each stage in the design lab brief (refer to Fig. 7d) on the vertical axis and projects across the horizontal axis. A further horizontal row

was applied to each project to accommodate notes taken during design lab contact time. Interview data was organised by sorting responses into a similar matrix of questions and transcribed responses.

7.5.2 THEMATIC MAPPING

Thematic mapping refers to the process of systematically identifying themes in the data, exploring the relationships between them and unpacking the implicit and explicit meanings of these themes in the context they occurred in, and in view of the research question posed.

Given the marked distinctions in the way in which the design process is documented by design lab data and interview data, two distinct approaches were adopted to map the specific nature of each data set. The approach to the thematic mapping of each data set is introduced individually in the subsections below. The fundamental distinction between the two approaches is informed by the time-based nature of design lab data and the reflective nature of the interview data. Thematic mappings of design lab projects focus on how the sequence of the design process unfolds (as documented by design reports). In contrast, the thematic mapping of interview data focussed on identifying themes and exploring the relationship between them.

7.5.2.1 THEMATIC MAPPING FOR DESIGN LABS

The design lab data illustrates the co-evolution of problem-solution originally observed by Schön (1983). Commensurate with this, thematic mapping began by illustrating the sequence of problems and solutions that were represented throughout design reports.

Referring to Slater (1989), Silverman (2006: 241) articulates that the analysis of images in isolation from the processes that generated them can “neglect the way in which such images are shaped by economic logic and social organisation

of the relationship between [designers] and their clients". Thematic mapping of design lab projects used the raw data from the outset, specifically noting the prevalence of problems and solutions in the design report. This was captured in the mappings using a vertical dashed line which divides the map into two parts; problems and solutions. The horizontal positioning of the problem - solution line allowed space for descriptions of the more prevalent of the two.

To summarise and categorise each piece of key information presented in design reports was summarised with a theme. A theme is a short description of the contents of design reports. The theme category is an indication of the way in which that theme was presented in the design report. For example, using the two samples of design reports above, '1. Define Context' as shown in Fig. 7i, was described as *data* relating to "economies of energy production and consumption, and related emissions" and was presented as a *problem* in the mapping. The design report sample shown under the same heading in Fig. 7j, was described as *context* relating to the "boundaries of local authority (LA) regeneration programmes", and was positioned as a *problem* on the basis that the information indicated that the area was acknowledged as one in need of investment. Indents were used where consecutive themes directly related to each other, for example, where an idea was unpacked and explored in the design report.

This built up a map of the content that the design reports presented and the sequence in which participants presented information. Fig. 7n provides an example and explains in greater detail how the mappings should be read.

7.5.2.2 THEMATIC MAPPING FOR INTERVIEWS

As reflective data, it was not necessary to map the content of interviews as a function of time. Thematic mappings of interviews were generated with consideration for the relationships between explicit or implicit themes indicated

by participants. Just as design lab mappings represent individual projects, thematic mappings represent individual interviews. The sequence of identifying themes within each interview involved four steps:

1. A simple word frequency programme was developed using the Processing Integrated Development Platform (IDE) [10]. This programme 'read' through the organised text and image descriptions in order to identify the frequency of words (excluding adjoining words) and re-write the passages to a file, scaling the size of the text relative to the frequency. Frequently used words would be larger, highlighting linguistic concordances within the data (see Fig. 7o).
2. The data was manually searched for words associated to high frequency words; comparing the context in which they occur and building up a network of themes, associated phrases and passages from the data. Emergent themes were categorised as one of the following; practice, objective or outcome, in order to assist the differentiation between design as a verb and a noun. 'Outcomes' also include products of actions, for example, the commercial forces underpinning BREEAM might lead to outcomes such as the increased awareness of BREEAM, or a drive to exceed benchmarks.
3. Searches for important aspects of the data not highlighted by frequency searches, but considered significant by the researcher in line with the literature (reviewed in chapters 2.0 - 6.0), were undertaken.
4. A detailed definition for the theme was developed which enabled the researcher to systematically check the data for further references. A manual approach allowed the researcher to acknowledge and document related terms that might not be recognised by computer software.

A collective list of themes and their definitions can be found in Appendix C. Compiled from individual interviews, duplicate themes were eliminated. The consistency of this process relied on the concise definition of each theme,

making clear distinctions between similar or related themes through the use of the three categories; practice, objectives and outcome. During analysis it was important to ensure all the themes were highlighted within the context of the raw data, in order to map the relationships between themes and give a synopsis of each project and interview which could then be explored and cross-examined. The following steps enabled the mapping of elicited themes (an illustration and key for the mappings can be found in Fig. 7p which is spread across two pages):

1. To explore the emphasis of each interview, the proportion of each category was calculated and represented as a pie chart. This illustrated whether the themes were primarily concerned with design practice, the scheme (outcome) or the information and criteria that informed decision making (objectives).
2. Within the pie chart segments, the positioning of themes was informed by the proximity of themes as they appeared in the raw data. Themes related across categories were placed along respective boundaries. Explicit relationships between themes, as indicated by the participants, were acknowledged by drawing lines between themes, in the same way that a bubble diagram illustrates relationships. Implicit links portrayed by participants (as understood by the researcher) were acknowledged with dashed lines between themes. One further distinction was made between references relating to current practice and references that concerned participants insights into how practice might be improved. This stemmed from interview data where respondents who highlighted challenges and barriers to sustainable design alluded to ways in which practice might overcome these.
3. The relative frequency of themes were calculated for each interview using the number of references relating to each theme. These were represented in thematic mappings by adjusting the size of each theme ‘bubble’ relative to the proportion of references accumulated to define the theme.

[10] Processing is a software application with the relevant facilities for developing a computer script or programme that can perform specific tasks. The script was developed with Matt Ault (Architect at Foster + Partners) and can be found in Appendix X

7.5.3 INTERPRETATION

Interpretations made reference to the following issues of sustainable design practice, as set out in chapters 2.0 - 6.0 of this thesis:

- The role of benchmarking objective and performance-focussed criteria in design.
- Critical reflections on measures of sustainable design informed by social and physical characteristics of urban form.
- The characteristics of architectural practice and the concerted effort to drive sustainable design through cultural shifts in the architectural profession.
- The influence of sustainable design norms for the design process.

FIG. 7n
This mock thematic mapping of a design lab project introduces the layout and key of the mapping. The sequence of themes indicates how the design report is set out.

SITE/ CONTEXT

DATA

PRECEDENT

DESIGN PREP.

DESIGN SCHEME

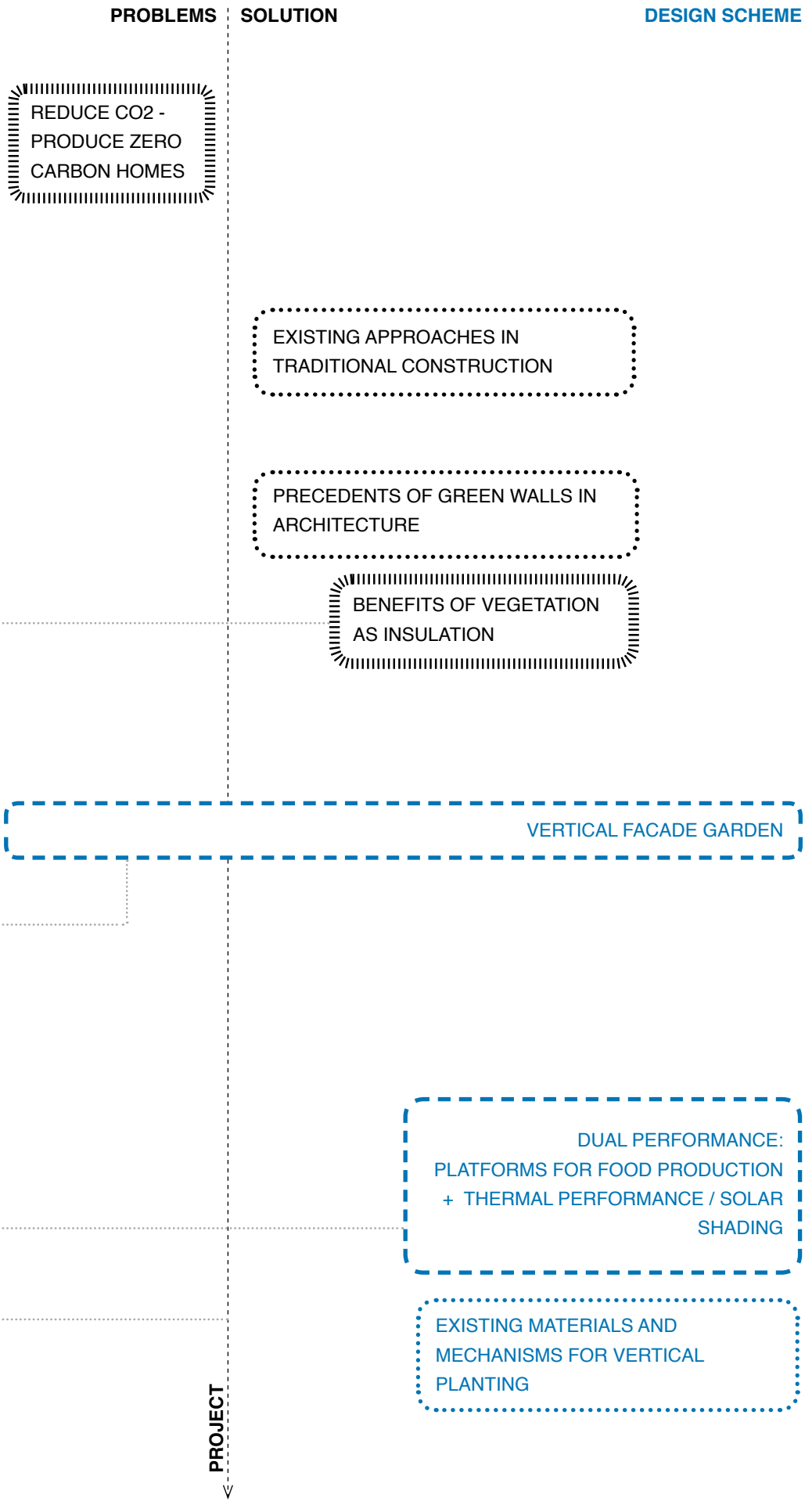


FIG. 7o
Sample output of the word frequency searches, illustrating how the transcript retains its existing structure, but with emphasis on frequently used words, allowing the context to inform the definition of themes from the outset.

FIG. 7p
This mock-up identifies the key and main elements of interview thematic mappings.

Theme concerning a proposition

Theme concerning a statement about prevailing praxis

Themes discussed in relation to each other

Explicit links between themes

Implicit links between themes

Indicates the proportion of themes focussed on process, objectives and outcomes.

These lines indicate the composition of the three categories throughout the interview.

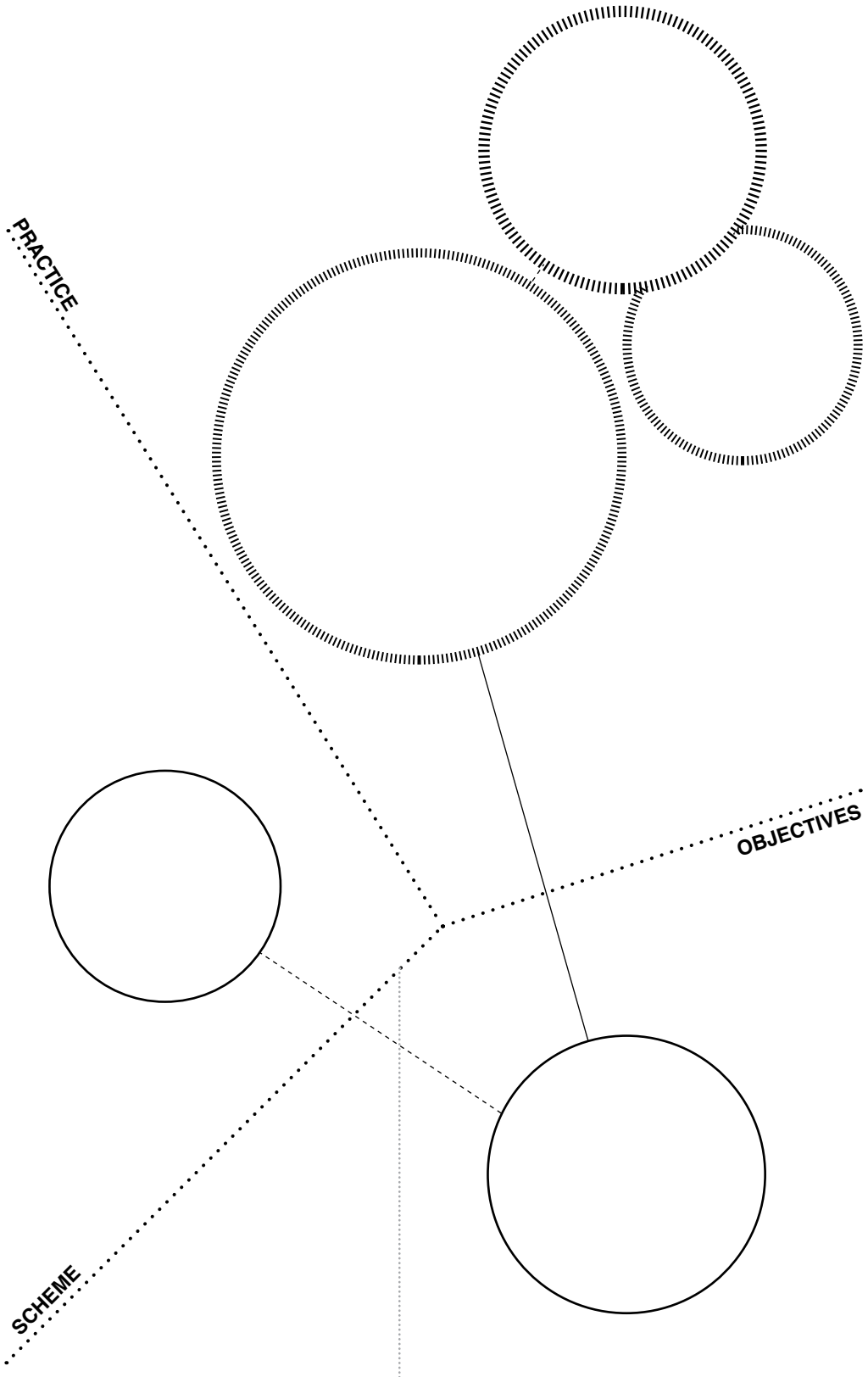
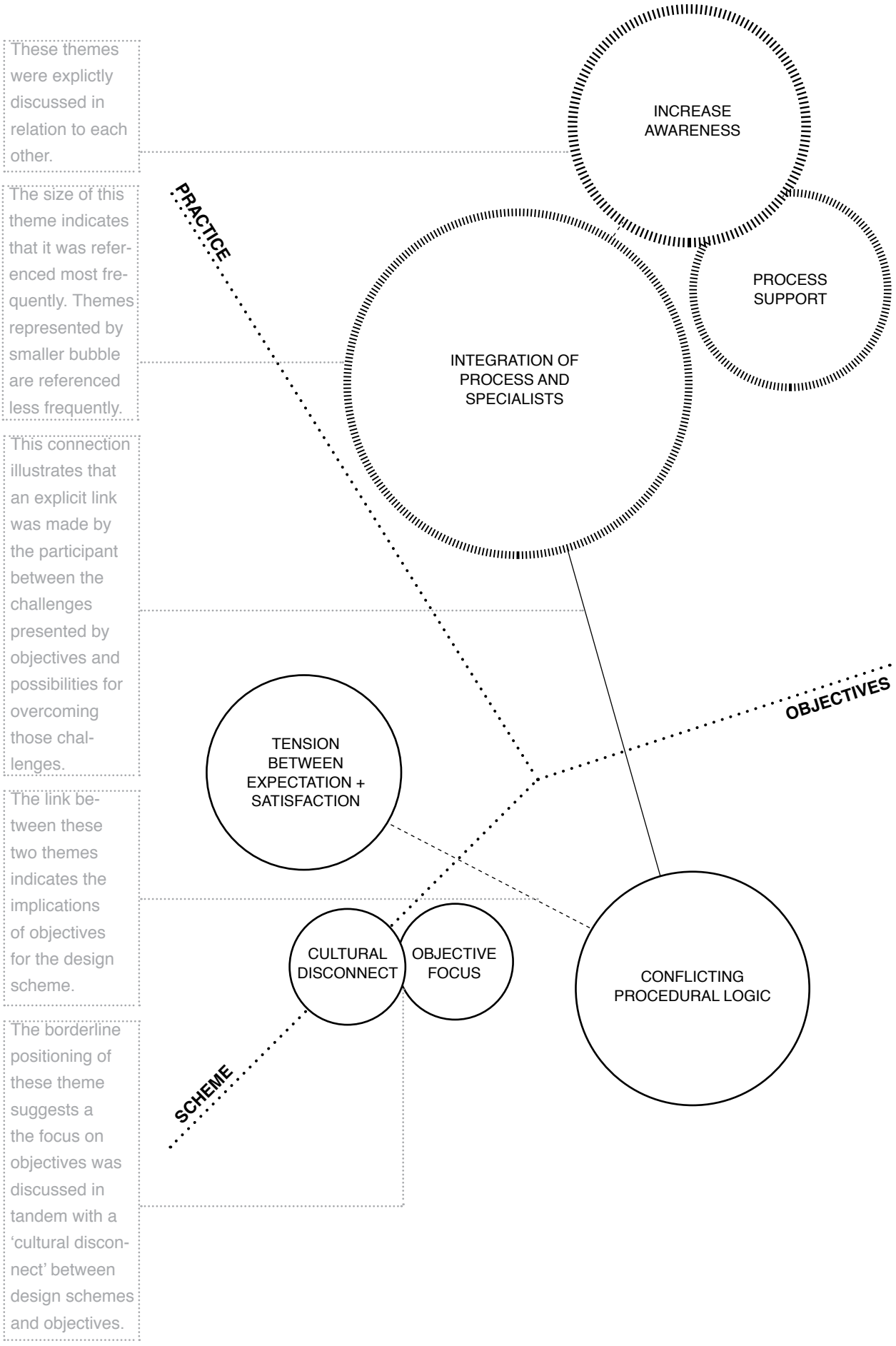


FIG. 7p (cont)


These themes were explictly discussed in relation to each other.
The size of this theme indicates that it was referenced most frequently. Themes represented by smaller bubble are referenced less frequently.
This connection illustrates that an explicit link was made by the participant between the challenges presented by objectives and possibilities for overcoming those challenges.
The link between these two themes indicates the implications of objectives for the design scheme.
The borderline positioning of these theme suggests a the focus on objectives was discussed in tandem with a 'cultural disconnect' between design schemes and objectives.
INCREASE AWARENESS
PROCESS SUPPORT
INTEGRATION OF PROCESS AND SPECIALISTS
PRACTICE
OBJECTIVES
TENSION BETWEEN EXPECTATION + SATISFACTION
CULTURAL DISCONNECT
OBJECTIVE FOCUS
CONFLICTING PROCEDURAL LOGIC
SCHEME

7.6 SUMMARY

The overall approach to the present inquiry is divided into two methods which were applied to three different levels of design experience. The different levels of design experience include; novice designers, new professionals and established practitioners.

Novice designers and new professionals were involved in a series of design labs. These followed an ex post facto format and required participants to produce design schemes in response to their own understanding of sustainable design. Participants developed designs over a period of twelve weeks, involving three hours studio contact time and three hours of self directed study each week. Participants could work in groups or individually. Design projects were documented through the production of design reports.

The views of established practitioners were explored through interviews. Ten established practitioners were interviewed, ranging from small architectural practices, predominantly delivering domestic projects, to large, international, multi-disciplinary practices delivering complex building and masterplans.

Content analysis procedures were used to examine the data for themes and a series of thematic maps were developed to provide a synopsis of design projects and interview transcriptions. One fundamental distinction between design lab data and interview data is that the former is time-based whilst the latter is reflective. This meant slightly different approaches to thematic mapping were used to explore the sequences, connections and relationships in the data, but that the content analysis supported the comparison of themes despite this distinction. As an overview to these approaches and the three different levels of design experience, Fig. 7q provides an overview of the methodology.

FIG. 7q
Alignment between the levels of design experience and methods of inquiry used to respond to the different contexts of design education and professional practice, the data these produced and the analytical procedures used to explore it.

Experience and Discipline	Method of Inquiry	Data	Analysis
NOVICE DESIGNERS (Undergraduates from a range of disciplines) NEW PROFESSIONALS (Architectural Postgraduates)	**DESIGN LABS** Ex post facto studies of the design process over a twelve week period conducted in a studio environment within the Birmingham School of Architecture (BSA). The goal of the design project was to investigate and produce sustainable designs, with no disciplinary limitations on the design outcomes.	Design lab participants produced design reports which document a synopsis of the design process and present the resulting design scheme. Supplementary to this, participants were also asked to provide a short written statement describing the project.	Thematic mappings of design reports were used to explore the sequence of themes and the way in which design schemes arise. These provided a flow diagram of the order in which themes were presented in design reports.
ESTABLISHED PRACTITIONERS (Professional designers from a range of practice disciplines and practice sizes)	**INTERVIEWS** Semi-structured interviews were conducted with established practitioners of sustainable architecture with a particular interest in projects subject to sustainability assessment rating methods. These explored the implications of commercial practice on sustainable design.	Interviews were recorded and transcribed. Transcriptions were supplemented with notes taken during the interviews. Interview data was reflective and was based upon participants' experiences of delivering sustainable design.	Interview data was represented and analysed through thematic mappings. These differ from design labs because they focus on connections and relationships between themes rather than the order in which they occur.

8.0 NOVICE DESIGNERS + NEW PROFESSIONALS: STUDIES OF DESIGN PROJECTS

This chapter discusses the findings of the design labs. Referring to example cases, the chapter discusses the characteristics of design reports and the influence of experience on sustainable design. The chapter is divided into the following sections:

8.1 The Nature of the Data

Key characteristics of the data which aid the understanding of thematic mappings are presented.

8.2 Studies of Novice Designers

Example cases of design projects by novice designers are presented and examined through thematic mappings.

8.3 Studies of New Professionals

Example cases of design projects by new professionals are presented and examined through thematic mappings.

8.4 Characteristics of Sustainable Design Projects

Referring to the example cases, the characteristics of design projects are described.

8.5 The Influence of Experience on Sustainable Design

This section explains the distinctions between novice designers and new professionals. The findings suggest that dependency plays a significant role, even in the processes of designers disconnected from the context of commercial design practice.

8.6 Conclusions

A summary of the key findings and conclusions is given.

8.1 THE NATURE OF THE DATA

As the examples of design reports in section 7.3.6 illustrate, participants typically document problems and solutions. For example, in Fig. 7f, under the heading '4. Analysis', the design report sheet states the overall problem identified (the need to reduce energy used for domestic heating) and subsequently moves between an overall solution (the use of thermal clothing) and an exploration of the properties of fabrics and the feasibility of their use; thereby acknowledging problems embodied in the overall solution. Seen this way, the design brief is a constantly evolving set of requirements responding to both problems and solutions as they arise during the design process.

Problems and solutions are provided by participants in a number of formats. For example, the same figure (Fig. 7f, under the heading '4. Analysis'), includes both precedents (an image of arctic exploration clothing, top left) and data (an image supported with text describing fabric weights, in addition to a graph providing the insulative properties of different fabrics, top right and bottom left). The former can be read as a *precedent* of a *solution*, whilst the latter presents *data* regarding a *problem*. A further image of fabric layers and composition, concludes the sheet with a further *precedent* of a *solution*. Precedents were not exclusively presented as solutions and images were also found to provide examples of existing conditions, or current design approaches, which present problems for further exploration in the project. Problems and solutions can be found throughout design reports in the following five formats:

- **Context**; place-specific descriptions presented through photographs, drawings of text. An example of this can be found in Fig. 7h under the heading '1. Define Context', where the design report illustrates the boundaries of specific local regeneration programmes.
- **Data**; typically refers to aspects of design reports where supporting information is provided, such as the graph in Fig. 7g (under the heading '4.

Analysis') and also the chart of average weather conditions provided under the heading '5. Define Brief' in the same figure.

- **Design**; references to generic design processes and where design is discussed or presented, but it is not a precedent or the participant's own design scheme.
- **Precedent**; an example of an existing approach or intervention.
- **Design scheme**; the participants own design ideas and work.

Each example case in the subsequent sections is an evaluation of a design project and is spread over two pages. The first page provides a thematic mapping of the design reports produced by participants, which illustrates the flow of information presented in each design report. The second provides a written description which elaborates on the thematic mapping and is formatted to include the following interconnected aspects of design projects:

- **Introduction**; a brief description of the project focus and the resultant design scheme.
- **Scheme Conceptualisation**; looks at how the project arrived at a design concept and how this was presented within the design report. Was it indicated at the outset, in the conclusion, or, did it build up throughout the design report?
- **Contextualisation**; the relationship between design scheme ideas and the background information presented in the design report that underpins those ideas.
- **Project Sequence**; the way in which participants manoeuvre between information and design concepts, looking in particular at links between design scheme ideas and the information presented within the design report.

8.2 STUDIES OF NOVICE DESIGNERS

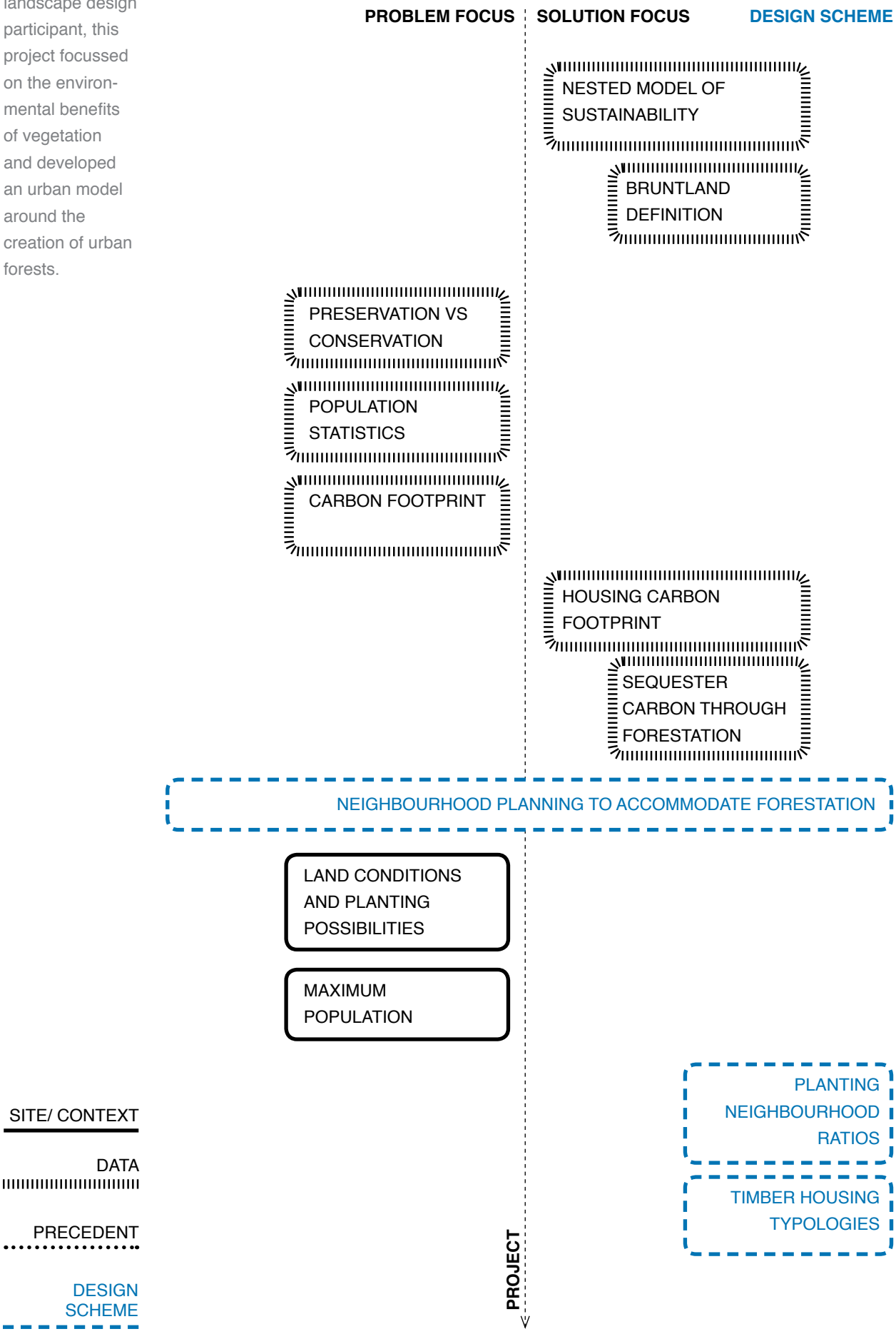
This section presents eight example cases from a sample of twelve projects in design lab UG09 and thirteen in UG10. The examples represent a mix of design disciplines and a range of design schemes, including examples of where participants produce a scheme with strong influences of a design discipline other than their own (see Fig. 8a). Fig. 8a shows the working organisation (whether participants worked individually or collectively), participant discipline and scheme discipline of each example. All UG09 participants chose to work individually. Participant discipline refers to the discipline of the course on which participants were enrolled. Scheme discipline refers to the discipline into which the design scheme produced best fits.

FIG. 8a
Table to show the working organisation, participant disciplines and scheme disciplines of the following eight case studies. It is noteworthy that all design lab participants in design lab UG09 worked individually. Numbers in brackets in the working organisation column refer to the number of group members.

Example	Design Lab	Working Organisation	Participant Discipline	Scheme Discipline
1	UG09	Individual	Landscape	Urban Design
2	UG09	Individual	Landscape	Product
3	UG09	Individual	Architecture	Architecture
4	UG09	Individual	Architecture	Urban Design
5	UG09	Individual	Architecture	Fashion
6	UG10	Group (2)	Landscape	Product
7	UG10	Group (4)	Architecture	Product
8	UG10	Group (4)	Architecture	Architecture

8.2.1 EXAMPLE 1

Produced by a landscape design participant, this project focussed on the environmental benefits of vegetation and developed an urban model around the creation of urban forests.



8.2.1 EXAMPLE **1** (cont.)

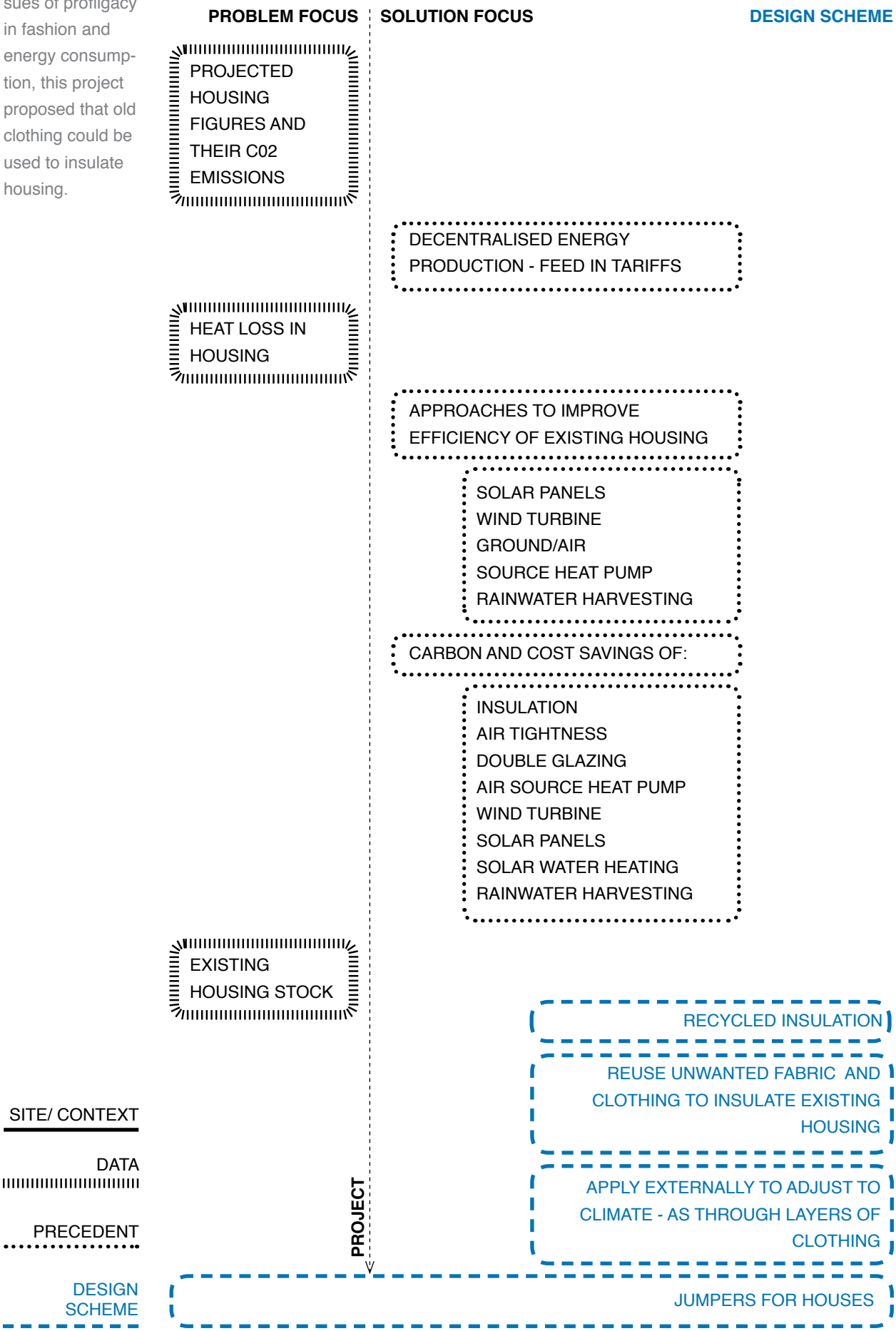
Produced by a landscape design participant, this project explored the environmental benefits of planting trees for use as building materials. The design report presents the development of an urban model predicated on the number of trees each household would need to plant to off-set a low carbon lifestyle.

The design report synopsis indicates that the scheme was generated as a product of existing information presented by the participant in the design report, beginning with a diagram of the nested model of sustainability and the definition of sustainable development given by the Bruntland Commission (WCED, 1987). Exploring the problems inherent in these definitions substantiates this model as an ideal solution, demonstrating how it might be manifest through design intervention. Focussing on the information presented in the design report, two key themes are exposed; environment and space. Of particular importance is the relationship between these themes.

The scheme concept was identified at a mid-point in the design report. Preceding this, the predominant use of existing data at the project outset, and more specifically the shift between problems and solutions appear characteristic of Schön's (1983) 'problem-solution coevolution' construct. Examples of this include the way in which existing information is presented as problems and solutions prior to the concept introduction without being critically analysed or interrogated through the design process, and the way in which the scheme combines pre-established ideas which are reformulated through experimentation of neighbourhood and residential planning. Implicitly, the project challenges planning ideals such as new urbanism, however, this is not explicitly acknowledged in the design report.

Tying together issues of profligacy in fashion and energy consumption, this project proposed that old clothing could be used to insulate housing.

8.2.2 EXAMPLE **2**



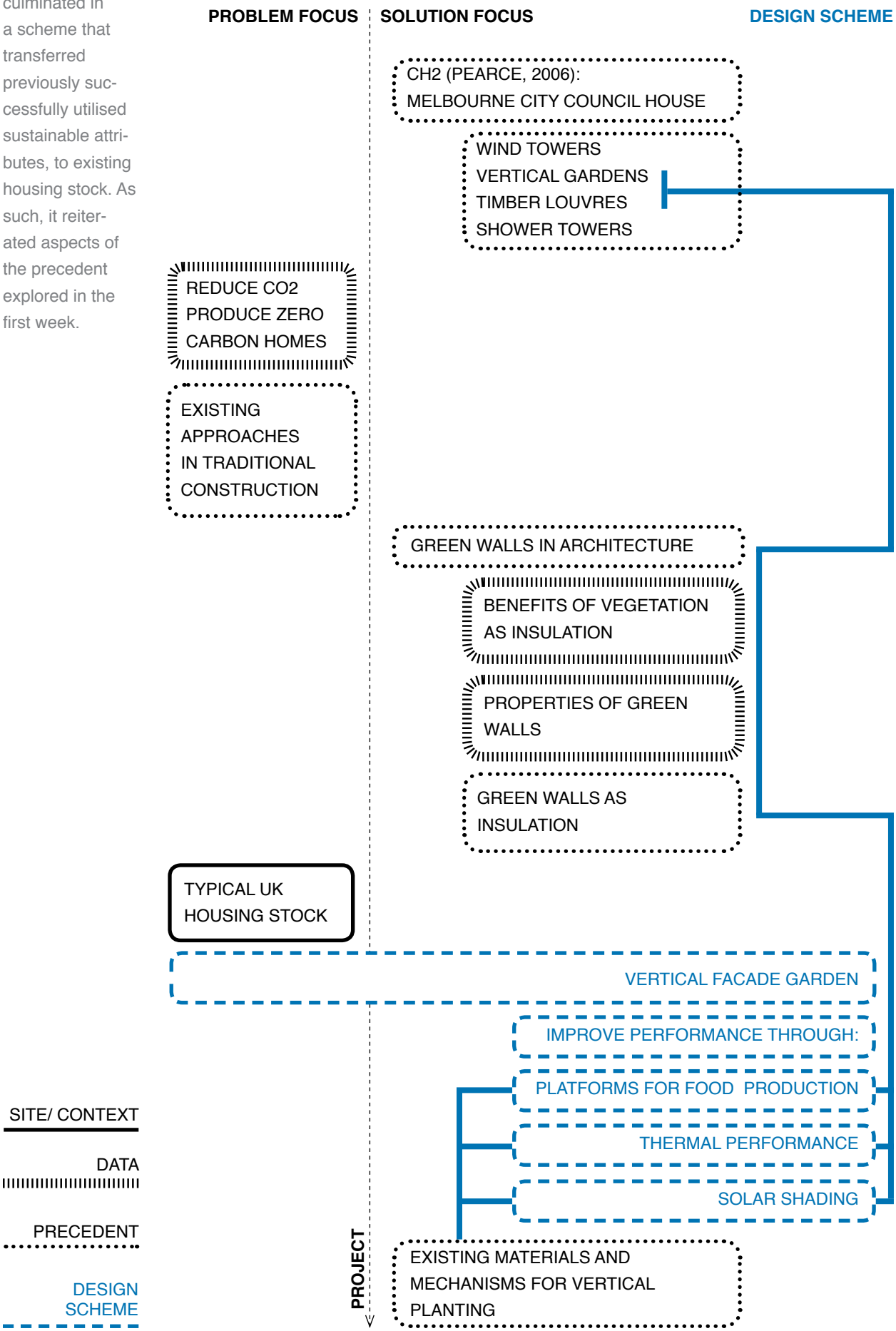
8.2.2 EXAMPLE **2** (cont.)

This project explored conventional techniques affiliated with creating low energy housing. It took a circuitous route to identify existing housing as a problem, rather than the production of new housing as a solution. To address this problem, profligacy in fashion was identified as a protagonist. The scheme proposed redundant clothing and fabric could be used as exposed insulation for existing housing; highlighting the role of fashion in consumer society, and questioning the conventional appearance volume built suburban housing.

After identifying a need for new housing and the emissions associated with domestic buildings, over half of this design report was dedicated to examining the benefits of existing low carbon strategies for housing. It is not until the final pages of the report that this issue is explicitly addressed and the resulting design scheme is uncovered. The initial examination of measures to improve the energy efficiency of housing is appended with the question "*what of existing housing?*", prior to introducing the design scheme. The key problem of emissions and energy efficiency identified in the report is carried through to the final scheme, However, there appears to be a disconnection in the way in which the information presented at the beginning of the project is synthesised and put to use in the design scheme development. This disconnection is not characterised by the shift from new to existing housing, but from new technology to reusing (or up-cycling) materials. One interesting aspect of this shift is the distinction between the descriptions of new materials and approaches and used materials. New materials are discussed in terms of efficiency and carbon reduction. In contrast, used materials are described, and indeed manifest in the design scheme, in line with their conventional use. This is captured by the way in which what is now insulation (textiles and fashion), is described in the project title in terms of its former use (clothing).

This project culminated in a scheme that transferred previously successfully utilised sustainable attributes, to existing housing stock. As such, it reiterated aspects of the precedent explored in the first week.

8.2.3 EXAMPLE 3



8.2.3 EXAMPLE **3** (cont.)

This design project is predicated on the transfer of sustainable architectural attributes previously successfully utilised in commercial architecture, to existing domestic housing stock. It results in a proposal for vertical gardens, that are retrofitted to the facade of existing housing. The scheme is proposed to perform a number of functions, including solar shading and thermal insulation.

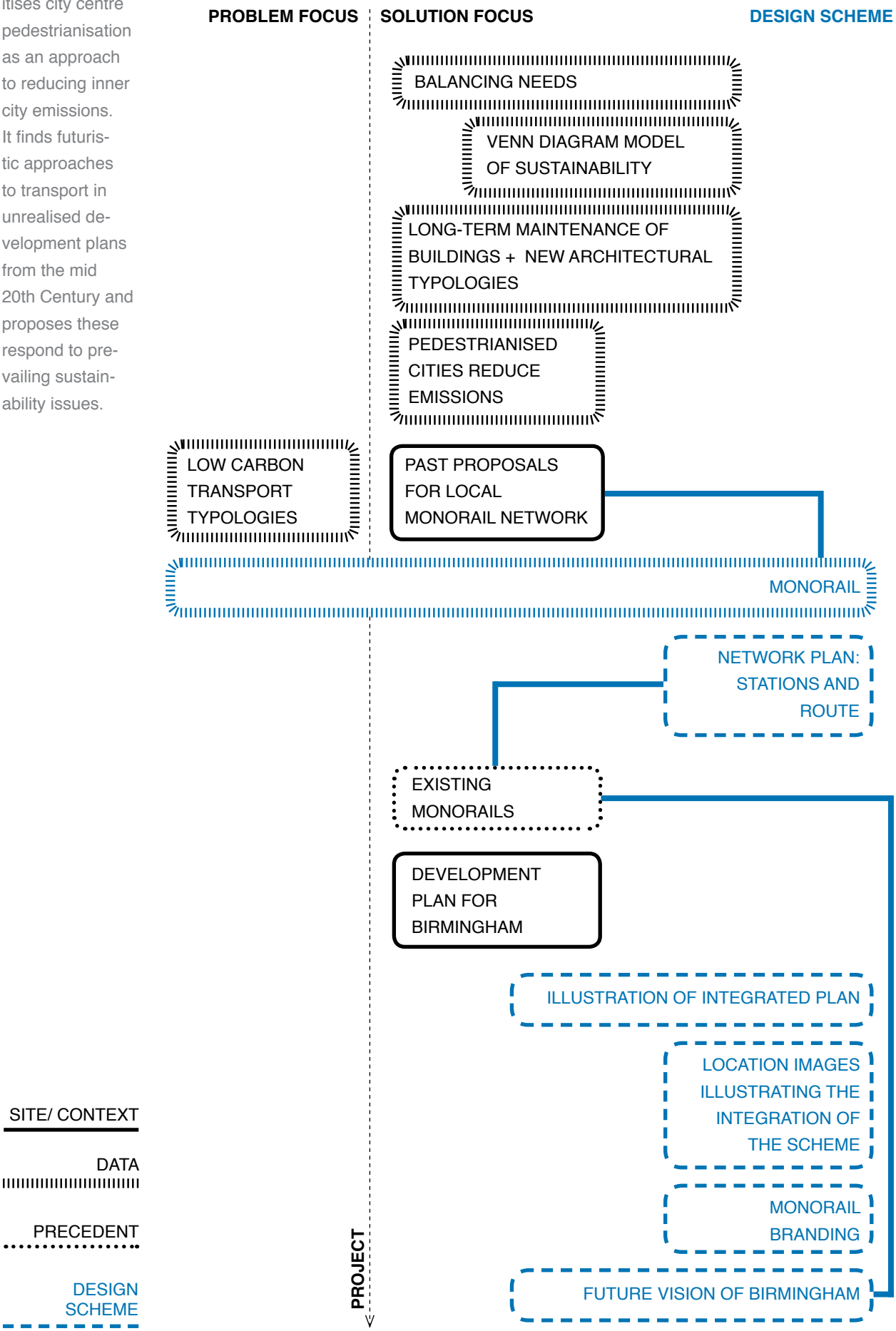
One particular architectural precedent (Council House 2, Melbourne, 2006) introduced at the outset, resonates throughout the project. The precedent is notable for its sustainable credentials, four of which are documented at the outset of the report. Whilst treating these as exemplar characteristics, traditional construction methods are reviewed in the design report as problematic and even inefficient.

An iterative sequence is visible (highlighted in the mapping with a thick blue line) between the initial, exemplar precedent, further precedents of similar sustainable architectural devices, and the resultant scheme proposal. In this sequence, a move to state the need to develop zero carbon homes, and the idea that traditional construction methods are inefficient in this regard, serve to reinforce the exemplary devices of the original precedent. Subsequently, with the added function to improve self-sufficiency (food production) vertical gardens and louvres (solar shading devices) appear transposed into the context of existing UK housing stock, specifically the terrace typology.

Rather than iterations of proposed design schemes, as might be expected of a design project, here justifications for particular, existing and previously successfully utilised devices are iterated. The eagerness to justify the scheme is evidenced through the project concluding with further precedents of the feasibility of the proposal.

This project prioritises city centre pedestrianisation as an approach to reducing inner city emissions. It finds futuristic approaches to transport in unrealised development plans from the mid 20th Century and proposes these respond to prevailing sustainability issues.

8.2.4 EXAMPLE **4**



8.2.4 EXAMPLE **4** (cont.)

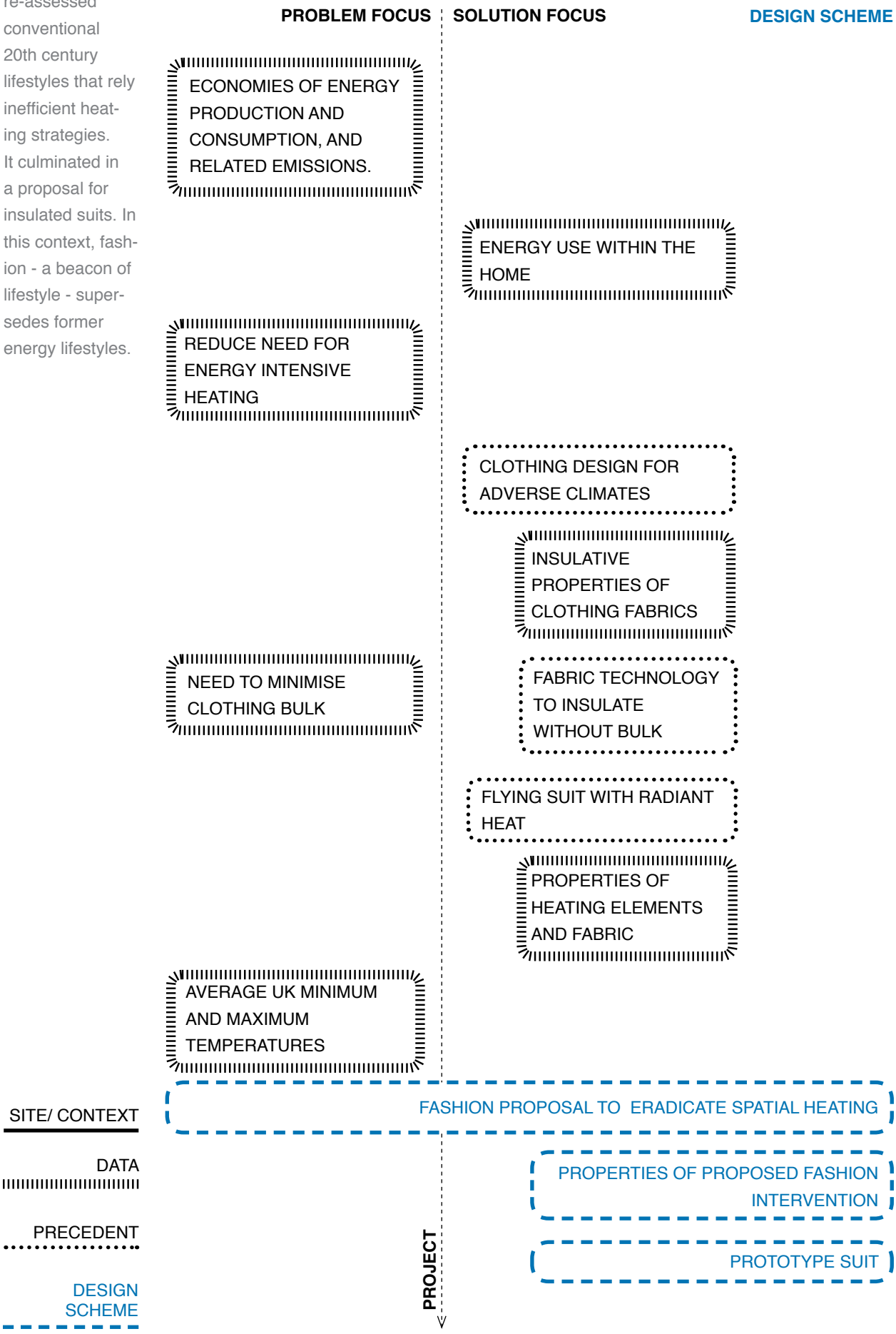
Using mid 20th Century plans for a monorail in Birmingham City Centre, this project proposed the reinstatement of this vision to pedestrianise the city centre in order to reduce inner city vehicular emissions.

This design report initiates with a concise and smooth transition from sustainable development as the need to establish equilibrium (indicated by a Venn Diagram model of sustainability), to the identification of transport as an issue integral to improving the environmental and social conditions of the city. The simultaneous discovery of Birmingham's past visions of the future, which include a public transport monorail, directly translate into a scheme at an early point in the design report. The remaining report fluctuates between this proposal and how it meets the objectives of current development plans for Birmingham. Rather than the transplantation of an idea into a new context, the project develops the idea in parallel with contemporary issues. Although iterations of a single idea are present here, there is consistent development of the scheme proposal.

Inherent in this is the site specific nature of the project which is reinforced by the way in which the scheme is developed and presented towards the end of the report. Whilst the technology embedded in the scheme is not new, the scheme is manifest in the site by the way in which it is presented through montages and through branding designed as an integral part of the scheme. This is significant as it highlights that the scheme is not concerned with emissions reductions, rather it is concerned with the tensions and conflicts present between sustainability and the culture of 'place making'. This is demonstrated by the integration of past and present development, which indicates the participant's recognition of continuous transition.

This project re-assessed conventional 20th century lifestyles that rely inefficient heating strategies. It culminated in a proposal for insulated suits. In this context, fashion - a beacon of lifestyle - supersedes former energy lifestyles.

8.2.5 EXAMPLE 5



8.2.5 EXAMPLE **5** (cont.)

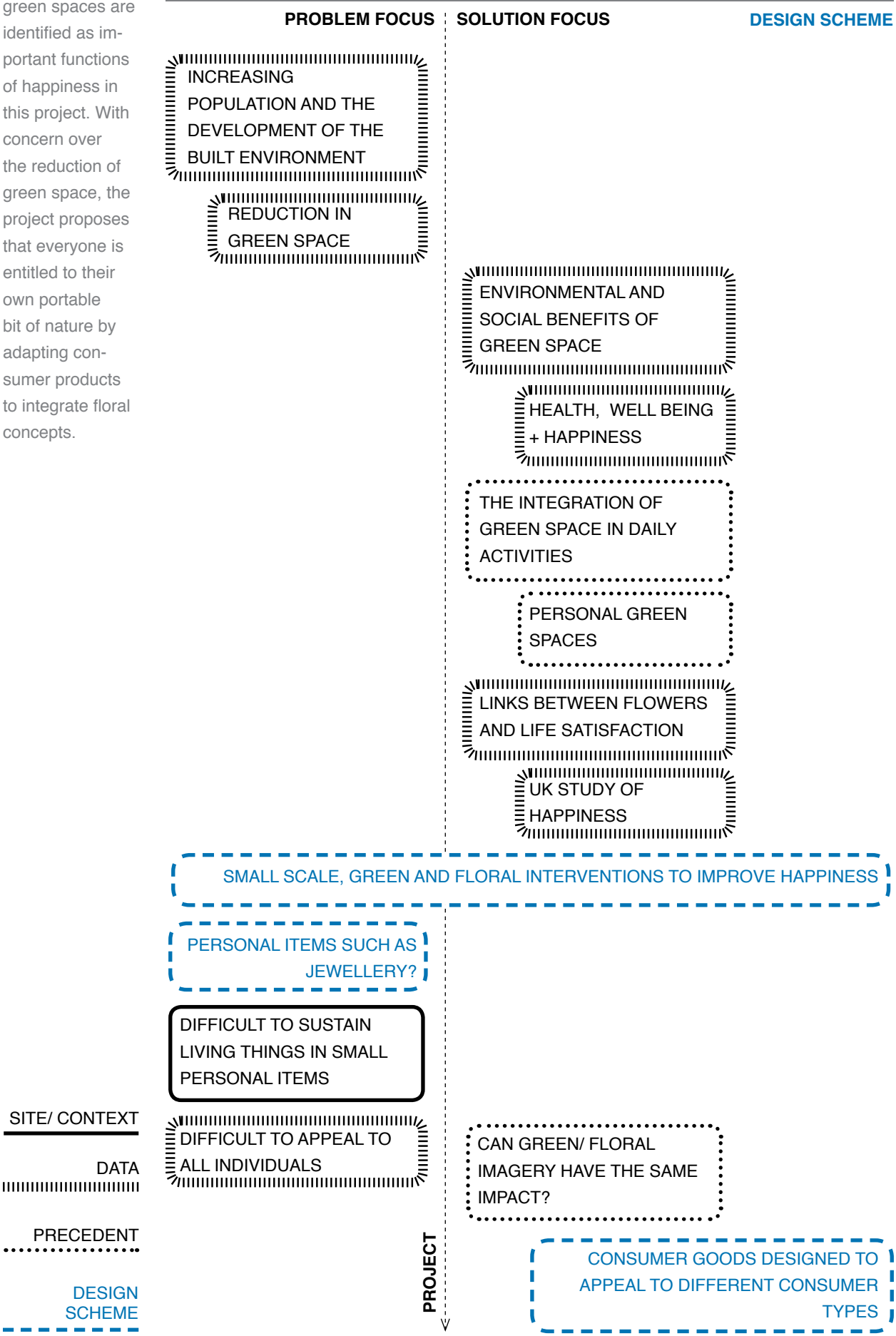
This project investigates conventional 20th century lifestyles that rely on what the design report describes as "*inefficient heating strategies*". The design report argues for more efficient and less energy intensive heating strategies by reconsidering the role of fashion and proposing insulative suits to eliminate the need to heat volumes of space.

The sequence of this report demonstrates the accumulation of information which subsequently cumulates in a scheme proposal. One particularly interesting factor of this approach is that the project initiates with a rhetorical question which is promptly refined without the exploration of multiple possibilities. This is illustrated by the shift from themes concerning the inefficiency of domestic heating to clothing for adverse climate conditions. Notably, this is also a shift from problem to solution. The characteristics of the final design scheme indicate that this is significant as such clothing directly informed the resultant design scheme, suggesting that the design proposition precludes its formal introduction in the design report. This appears to be synonymous with Cross' (2007) construct of "*designerly ways of knowing*".

The nature of the precedents used throughout the project are significant. Rather than architectural precedents (architecture being the participant's discipline), the subject of architecture is seen as the root of the problem, thereby leading the participant to look to other disciplines for ideas. Alternative disciplines also infiltrate this project by the way in which the scheme is presented as a hand made prototype. The design scheme is risk adverse in the sense that it does not offer new typologies, but it is innovative and interdisciplinary in that it adapts and transposes everyday objects into an alternative context.

Flowers and green spaces are identified as important functions of happiness in this project. With concern over the reduction of green space, the project proposes that everyone is entitled to their own portable bit of nature by adapting consumer products to integrate floral concepts.

8.2.6 EXAMPLE 6



8.2.6 EXAMPLE **6** (cont.)

This project was concerned with the provision of green space and the benefits it has for wellbeing and happiness. It proposed that with an inevitable reduction in green space to accommodate a growing population, green space should become personalised to provide mementos of it.

The design report follows a clear narrative that begins with widely debated issues of sustainable development and immediately focusses on one aspect of it; the availability of green space. The issues and questions addressed by the scheme are revealed following the presentation of precedents and data in the design report, which indicates a rational design process.

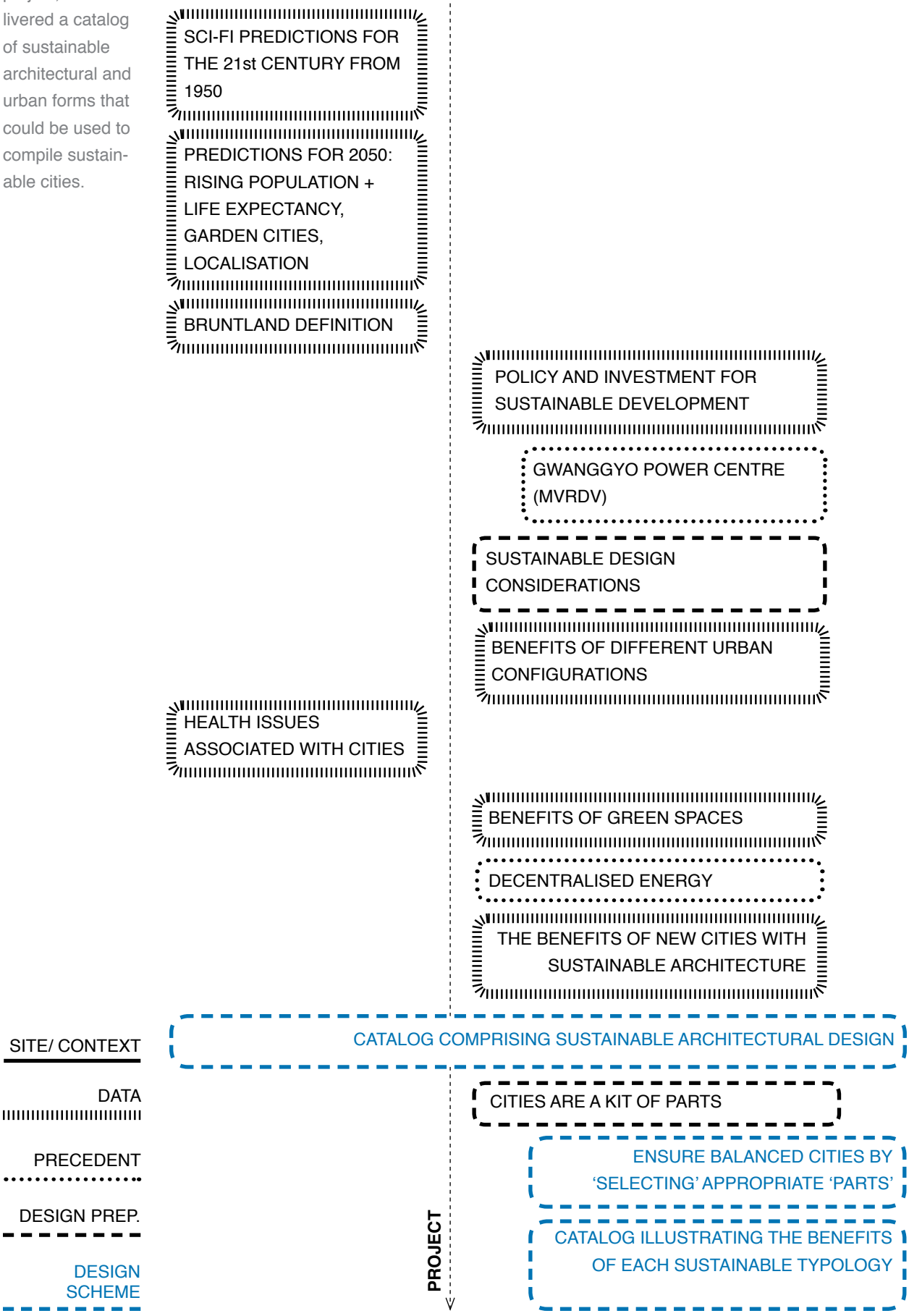
The thematic mapping demonstrates repetition, where a theme is introduced and subsequently explained in greater detail. Such sequencing occurs on three consecutive accounts. Each time it occurs, it incrementally builds up an image of the final scheme. Scheme development in the design report opens with a question which results in the scheme being tailored in line with market segregation.

The shift between data, precedent and the subsequent questions posed by this project indicates that the participants are interested in responding to context, rather than sourcing predefined solutions. Notwithstanding this, links between the scheme proposal and the preceding precedents are evident, but these are subject to interrogation in the design report and are adapted and refined in the resulting scheme, rather than directly transposed.

This project initiates as a spatial concern for environmental and social issues, but concludes as a line of products with no direct spatial connection, emphasising the potential inverse proportionality of design scale and implications.

A 'kit city' is proposed by this project, which delivered a catalog of sustainable architectural and urban forms that could be used to compile sustainable cities.

8.2.7 EXAMPLE 7



8.2.7 EXAMPLE **7** (cont.)

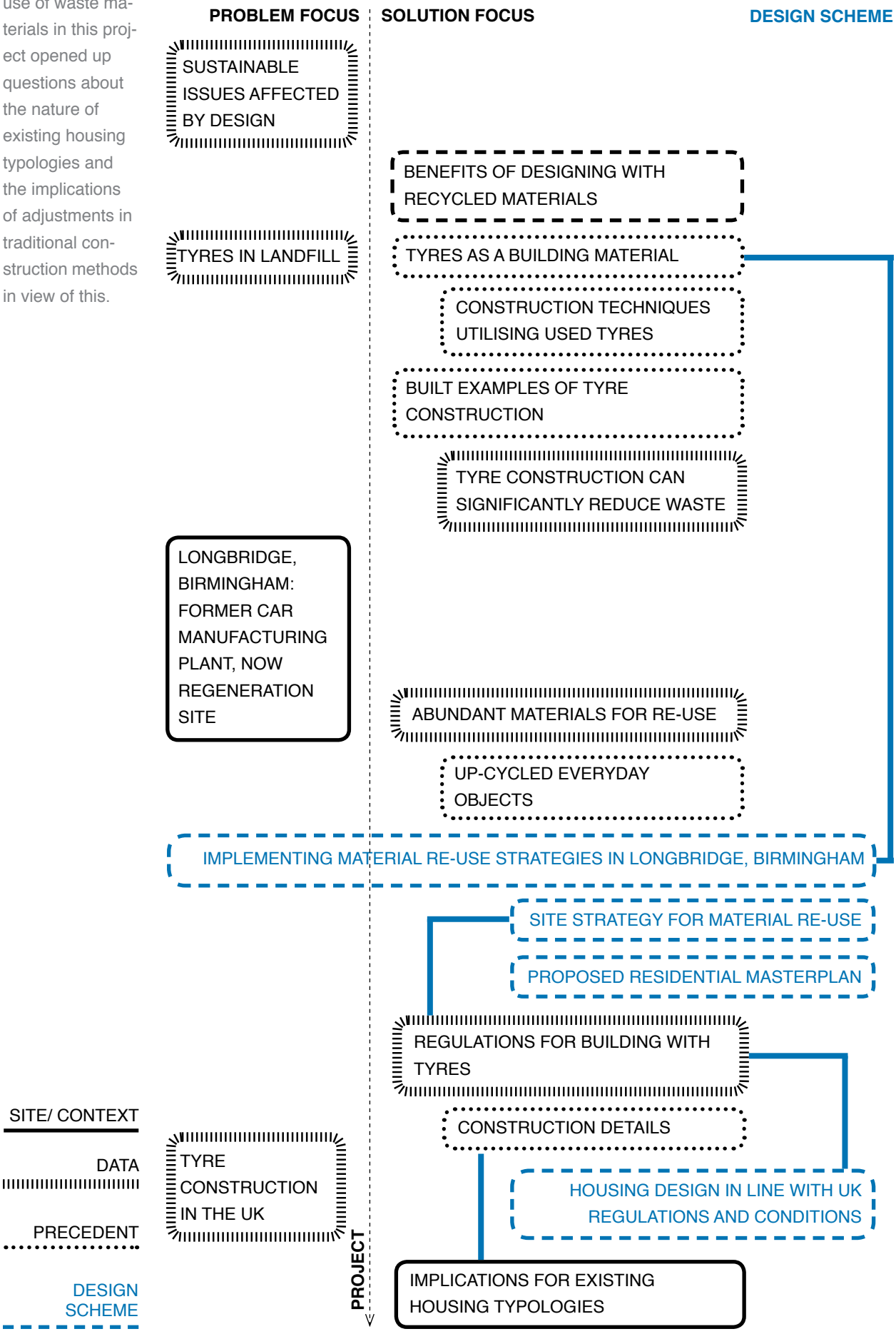
A city of sustainable parts is proposed by this project, to bring together all developments in sustainable architecture into one compendium; a catalog of existing buildings that are symbolic of sustainable design from which cities can be compiled. The idea is predicated on past predictions of the future, and contemplates how feasible it is to achieve sustainable urban form when so many models of sustainable design exist, often seemingly in ignorance of each other.

In this project the participants recognise urban form as an ecology and draw connections between elements of it considered to contribute to sustainable cities. References to generic design processes (or rather, the activity of composition as a form of design), demonstrates an awareness of the implications of design for urban ecologies. The precedents presented, also indicate that the project is preoccupied with connections between elements integral to the production and function of urban form, in this case energy infrastructure, and urban form in its own right.

The structure of the design report resonates with the resultant scheme, in that both are concerned with the assembly existing parts. The scheme implies that recognised emblems of sustainable design provide predefined answers, rather than developmental steps in architectural design. The scheme is therefore not strictly a design project, rather it refers to the organisation and management of sustainable architectural knowledge and how that knowledge is manifest in design. The rhetoric of the project implies that design practice emulates this process of replicating adapted examples of leading sustainable architecture in a more subtle manner.

The resourceful use of waste materials in this project opened up questions about the nature of existing housing typologies and the implications of adjustments in traditional construction methods in view of this.

8.2.8 EXAMPLE **8**



8.2.8 EXAMPLE **8** (cont.)

Resourceful construction materials are explored in this project. The project focusses on the abundance of worn tyres, the environmental issues associated with this and the potential to tackle landfill issues by converting them to building materials. The approach, which has numerous precedents globally, is adapted to suit the UK climate and Building Regulations.

Themes are often presented in parallel in this design report. This is potentially a product of the working organisation of the group, as much as it is the development of the project, where the potential of a design concept generated from an existing indigenous building precedent, is explored on a site in Birmingham. The site and the precedent are implicitly linked: the site is a former car manufacturing facility in Birmingham which is now nominated for regeneration, while the precedent is a technique for house building using redundant tyres rather than traditional construction methods. Whilst the precedent is presented first, the dual presentation of problem focussed and solution focussed themes suggests that the two reciprocally informed each other, generating the design scheme in parallel.

Following the introduction of the scheme idea, the sequence of themes fluctuates between precedents and data; recognising the issues of transferring indigenous construction techniques to alternative contexts. Concluding the design report with “The implications of the approach for existing housing typologies”, denotes that the design scheme provoked a series of further questions, rather than definitively answering a problem. This addendum also indicates that the participants identified other social and cultural implications that arise when a change in construction materials is applied. This, however, is not explicitly stated in the design report.

8.3 STUDIES OF NEW PROFESSIONALS

In 2009, a design lab was held with twenty participants who were enrolled on the PGDip Architecture course at the BSA. Working in groups of four, five design projects were conducted. This section provides three example cases of those design projects.

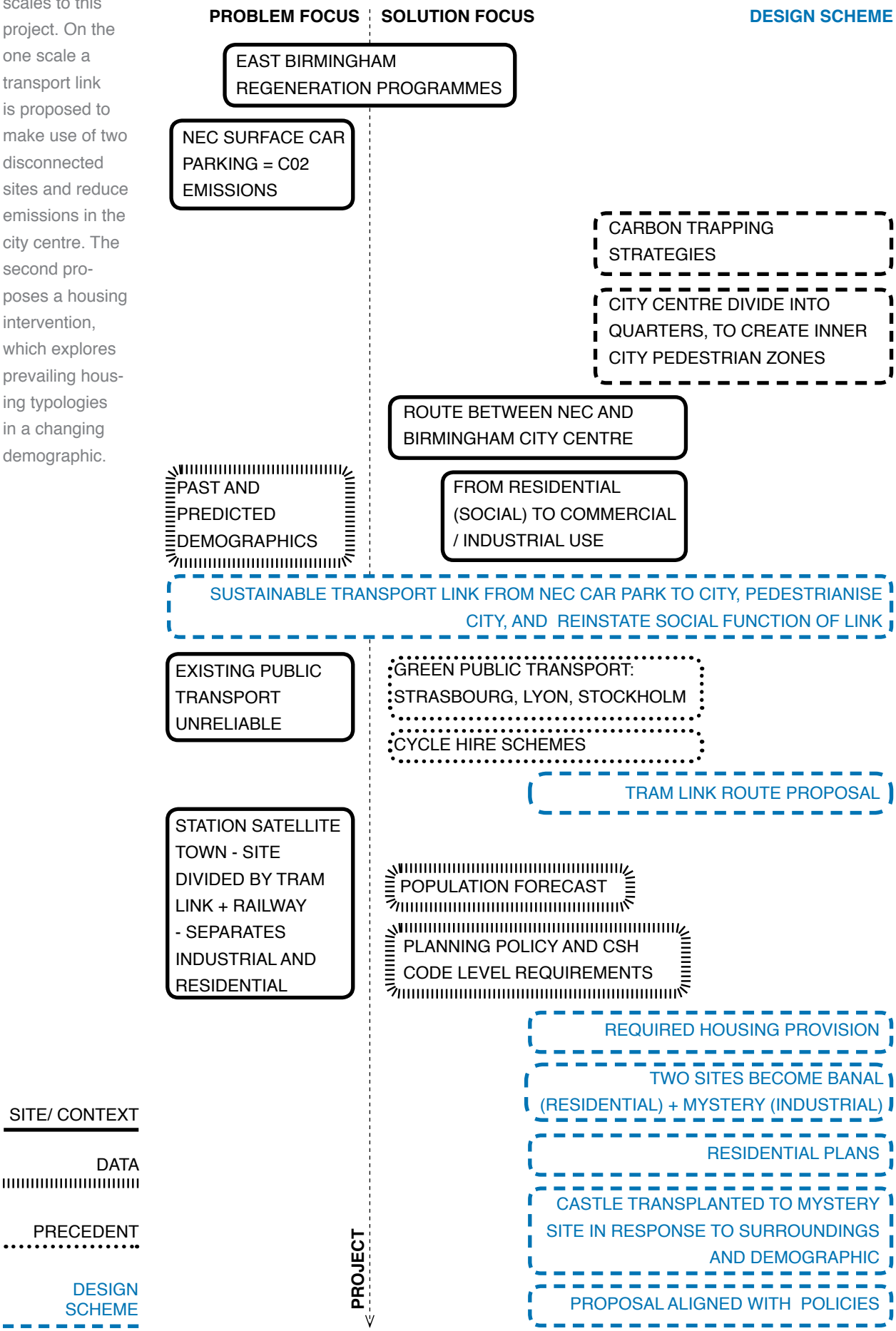
One of the main distinctions between the design projects of novice designers and new professionals is that new professionals begin by defining a broad site area for investigation. Consequently, all the schemes described in this section can be categorised as architecture and urban design outcomes.

FIG. 8b
Table to summarise the working organisation, participant disciplines and scheme disciplines of the following three example cases.

	Design Lab	Working Organisation	Participant Discipline	Scheme Discipline
Case Study 1	PG09	Group (4)	Architecture	Urban Design/ Architecture
Case Study 2	PG09	Group (4)	Architecture	Urban Design/ Architecture
Case Study 3	PG09	Group (4)	Architecture	Architecture

There are two scales to this project. On the one scale a transport link is proposed to make use of two disconnected sites and reduce emissions in the city centre. The second proposes a housing intervention, which explores prevailing housing typologies in a changing demographic.

8.3.1 EXAMPLE 9



8.3.1 EXAMPLE **9** (cont.)

The scheme proposed a transport link between Birmingham city centre and a vast resource of surface car parking east of Birmingham, as a means of eliminating vehicular emissions from the city centre. This link follows a former key artery to the city and the project documents how the area adjacent to this has developed from a residential site, to a commercial and industrial district which is now in decline. Siting new tram link stops along this route reinstates the residential landscape and calls for regeneration.

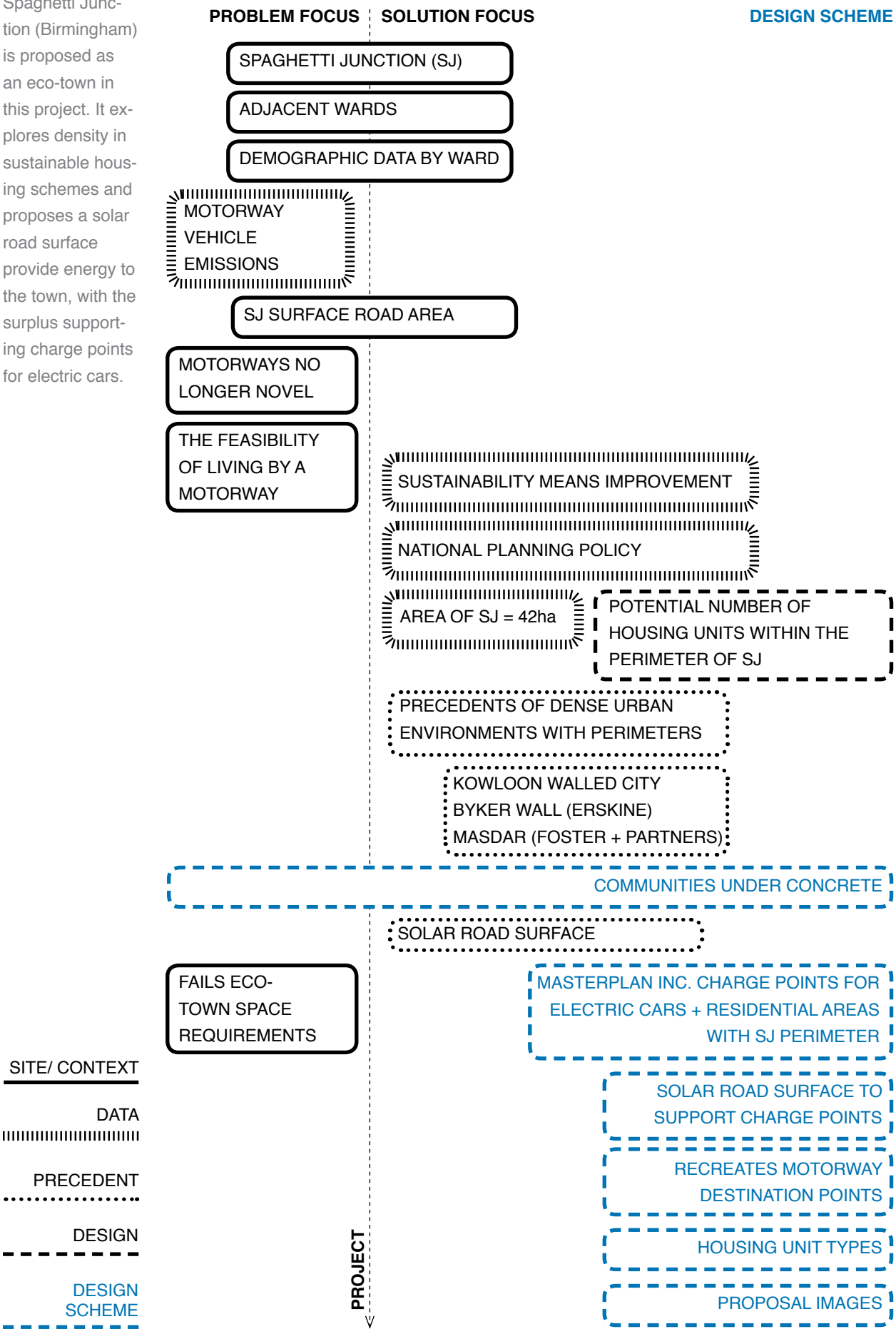
A site along this route is divided by the existing railway. On one side the site is dominated by terrace streets, on the other it is occupied by a waste incinerator. In the design report these are coined “banal” and “mystery”, respectively. The project proposes a series of CSH level 6 houses on the banal site, and a castle, transferred from Poland, to the ‘mystery’ site. The project concludes with an isometric plan, highlighting the ways in which the scheme meets all relevant planning policies, supplemented with a series of montage images of the proposed scheme.

The initiation of the project with a site indicates that some decisions have already been made about the context of the project and the particulars it will address. This suggests that the design report documents the design scheme more than it does the design process.

Although there are precedents underpinning both the transport strategy (green transport systems in other cities) and the residential strategy (CSH and national planning policy) the project is more broadly informed by the site and its existing and predicted conditions. This is illustrated by the way in which themes are addressed in parallel with each other, particularly where problems and solutions are coordinated and subsequently intersected by elements of the design scheme.

The perimeter of Spaghetti Junction (Birmingham) is proposed as an eco-town in this project. It explores density in sustainable housing schemes and proposes a solar road surface provide energy to the town, with the surplus supporting charge points for electric cars.

8.3.2 EXAMPLE **10**



8.3.2 EXAMPLE **10** (cont.)

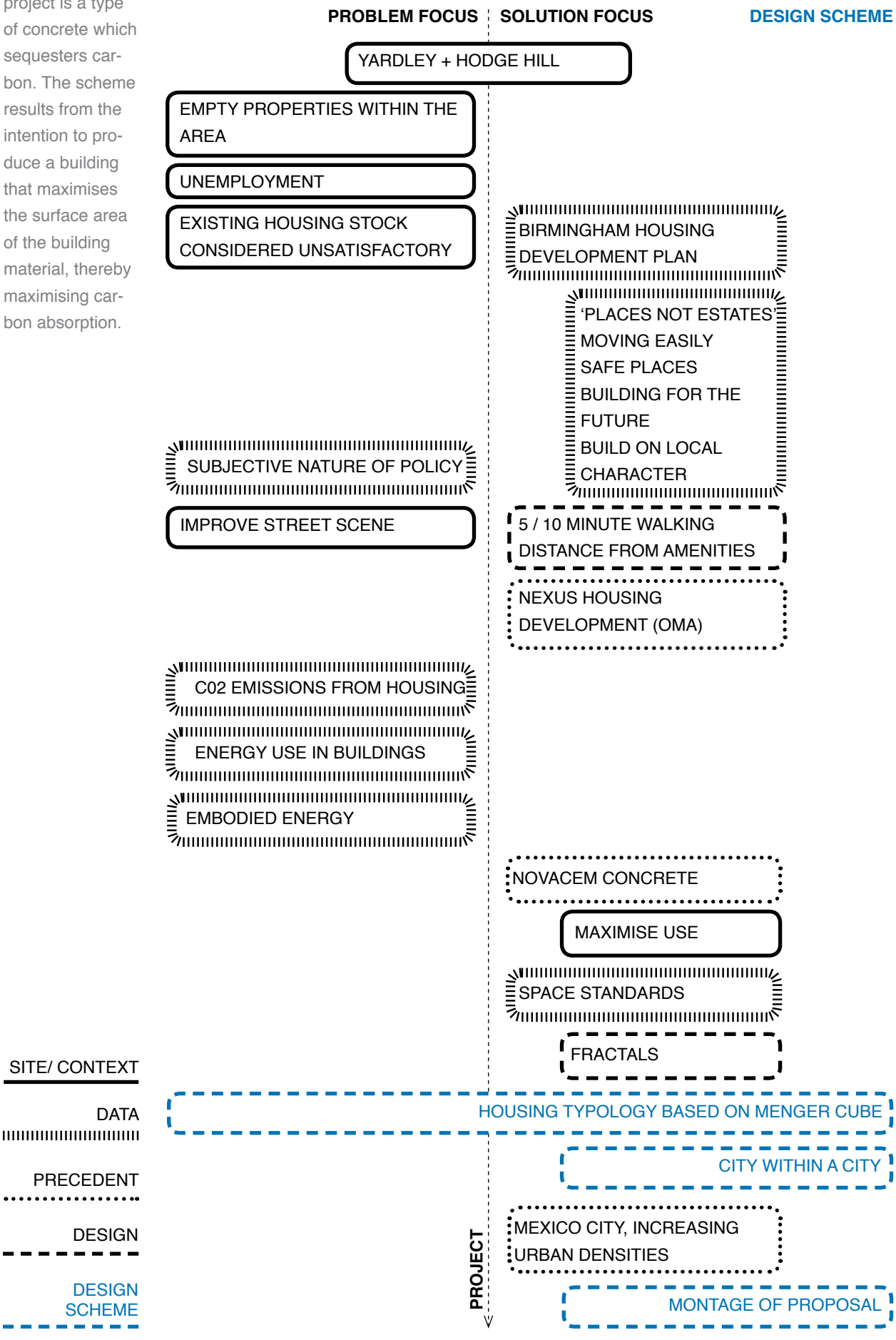
Focussed on the area of Spaghetti Junction and the adjacent three wards that meet at its mid point, the project proposed an eco-town to meet the needs of an increasing population. It proposed that this need also tallies with the fact that motorway services are no longer the novelty destinations they initially were. In addition, the road surface of the site is identified as suitable for the use of solar surfaces which have the capacity to withstand traffic flow and generate energy. The project explores eco-towns and calculates that surplus energy from solar road surfaces could be used to supply a charging point for electric cars.

The project opens with information about the site of Spaghetti Junction and identifies a site for investigation. It is difficult to place this as wholly problem or solution focussed. Consequently, it is positioned at a neutral point in the thematic mapping. Shifting between neutral and problem focussed themes, the project is presented in a way that does not clarify the objectives of the project from the outset, or even the type of scheme that may ensue. The evidence base for the scheme is presented through statistical references and calculations.

The precedents of urban forms presented, support the concept of high-density as a sustainable urban form. In contradistinction, eco-town legislation requires a much lower density than that achievable on the identified site. The proposal then fails to meet eco-town criteria and as such highlights that only certain strategies for sustainable architectural and urban form are endorsed by policy. The rhetoric of the project challenges how sustainability is measured by policy and local agendas, as well as assessing the difficulties in meeting assessment method criteria on urban sites.

The focus of the project is a type of concrete which sequesters carbon. The scheme results from the intention to produce a building that maximises the surface area of the building material, thereby maximising carbon absorption.

8.3.3 EXAMPLE **11**



8.3.3 EXAMPLE **11** (cont.)

The implications of materiality for sustainable architecture is the centerpiece of this project. The material in question is a type of concrete which is able to sequester carbon emissions. This property is the driving force of the design as it informed the decision to explore typologies to maximise facade surface area in order to capitalise on the performance of the material.

Set out as a written report with illustrations, rather than an annotated visual report, this report significantly alters the way in which the design project is represented. This is demonstrated by the way in which the report fluctuates between problem focussed themes and solutions. With each problem focussed theme, a new topic is presented. The sequence of these is as follows; site context, housing, sustainability and design. Three sustainability concerns are highlighted, namely; carbon emissions, energy use in buildings and green construction materials, demonstrating a shift from problem to solution. The sustainability section is the centrepiece of the design report; the preceding sections provide a context.

Further evidence of this separation between report elements is embedded in the design scheme itself, demonstrated through an evaluation in the report where the scheme is proposed as transportable typology. It follows from this that the site of intervention is arbitrary to the scheme design.

8.4 CHARACTERISTICS OF SUSTAINABLE DESIGN PROJECTS

This section presents three primary characteristics of sustainable design projects, as documented by the design reports presented above:

- **Characterising Sustainbility**; refers to the sustainable issues identified at the outset of projects, looking at the way in which at least two elements are often fused and how they are presented.
- **Context - Solution Focus**; how themes were presented during the course of the project and, for example, how the focus on precedents often has a significant influence on the characteristics of design schemes.
- **Project Sequences**; refers to the patterns exposed by the way in which design reports were composed.

8.4.1 CHARACTERISING SUSTAINABILITY

Devising their own design brief meant that design lab participants were faced with a wicked problem, that is, a problem with multiple, interconnected issues, not easily resolved (Rittel & Webber, 1973). Faced with these problems, designers are said to 'frame' problems in order to open up potential for design intervention (Darke, 1979). Characterising sustainability, as seen at the outset of these design projects, is part of the problem framing process.

Characterising sustainability is a product of the thematic representation of design issues by participants which enables them to focus on a specific issue or question, to which they respond through the design scheme. Similar to, and in some cases overlapping with, Guy's (2001) six approaches to sustainable design, themes in the data are commonly coupled. Five combinations were visible:

- **Socio-spatial;** the combination of social and spatial issues. Example 6, where issues of an increasing population and shortage of green space are

presented, demonstrates this.

- **Socio-economic;** combining social considerations with economic values. This combination is evidenced on a single account, where the preconditions for the design project are financial incentives to reduce emissions.
- **Socio-cultural;** example 5 illustrates social and cultural issues as it addresses the relationship between energy use in the home and the semiotics of fashion.
- **Eco-spatial;** the combination of environmental and spatial issues, such as carbon emissions linked to a specific territory.
- **Eco-technical;** technological solutions to environmental problems. Example 3, in which an exemplary building precedent and the specificities of its sustainable attributes are explored, is an example of this.

Coupled themes appear to raise social concerns over ecological concerns, as the categories coined by Guy (2001) do. It is possible that this is a product of analysing design projects, rather than approaches. This is not to say that the prevalence of social issues in the design lab data is insignificant but that it is specific to the context of the study.

8.4.2 CONTEXT - SOLUTION FOCUS

Solution focussed projects examine current technologies and predefined solutions. Context focussed projects explore the ways in which problems can be resolved. This is not simply a distinction between the problem and solution focussed themes demonstrated in the thematic mappings. Nor is ‘context’ restricted to themes that represent the specifics of site intervention. Rather, it refers to the framing of the design scheme, the sequence and composition of precedents, data and design and how these factors culminate in the design scheme.

Solution focussed projects accented precedents and predefined paradigms of

sustainable design. This is not to say they were preoccupied with the process of design development, but that they appear to focus on potential solutions prior to introducing the scheme in the design report. Solution focussed projects typically begin by identifying the nature of sustainable design through well known documents, including legislation, as well as the critical examination of built and technological precedents. Participants not only predefine the problem, but also provided themselves with a set of potential solutions, much like collating a catalogue of ideas with which to configure a design scheme. The upshot of this is that participants appear to spend less time exploring what the design problem might be. Instead, they do what Lawson (2006) refers to as “treating the symptoms” by placing objectives for sustainable design at the forefront of the research stage.

Solution focussed projects include examples 3 and 10. Example 3, which begins with a building precedent is solution focussed by the way in which design elements appear to be prerequisite, not only in the design scheme, but also in the preceding research. Example 10 is solution focussed in the way that it accumulates precedents and data, which are subsequently used to justify the design scheme.

Context focussed projects appear to “search for the cause” (Lawson, 2006). The search is not scientific or rigourous, but participants who followed this approach accept prevailing explanations of causes. In the data, these all relate to climate change and include, for example, consumption and profligacy of energy and goods. The information stems from common documents such as the *Bruntland Report* (WCED, 1987) and the *Low Carbon Transition Plan* (DECC, 2009).

Rather than accepting technological norms as a design response, context focussed projects appear to test how norms are received and how they relate to other conditions and events. Example cases 2 and 6 are evidence of this.

Although example 2 begins with an in depth exploration of existing norms in sustainable housing design, the report concludes that rather than solutions, these present a context in which existing housing is overlooked and as such the design scheme responds by connecting two previously unexplored (in the context of the design report) themes; existing housing and profligacy. Example 6 is context focussed as a consequence of the clear and gradual definition of the design problem, by beginning with and maintaining particular themes from which the design scheme evolves. In this case, the precedents identified are critically tested and explored, and subsequently dismissed as potential solutions.

Notwithstanding this, the boundaries between solution and context focusses are fuzzy. Some reports provide characteristics of both, such as example cases 5 and 9. In both these examples, context is explored and precedent solutions are transferred from other disciplines or contexts, which is indicative of solution focussed projects.

8.4.3 PROJECT SEQUENCES

Models of design styles and processes are often described as shapes (Dubberly, 2004). The most common models are cyclical and visualise design as a sequential and continuous process (Asimow, 1962; Marcus, 1969; Maver, 1970). This section describes three types of sequence evident in the data. These are not design styles, or metaphors of the design process per se, as they are derived from post-rationalised presentations rather than concurrent observations. However, the data exposes similar sequences that are used in the justification of design projects:

- **Iterative Sequences** echo cyclical design processes. They represent a process whereby reoccurring themes are presented, developed and evaluated.
- **Compositional Sequences** display properties of collating and assembling

themes in such a way that the design scheme is a compilation of these themes.

- **Observational Sequences** are more complex and resonate the chaos metaphor of design processes that van Bakel (1995) describes. Such sequencing is associated with design reports in which it is difficult to identify the connections between the themes that inform the design scheme.

8.4.3.1 ITERATIVE SEQUENCES

Iterative sequences tend to be apparent in solution focussed design projects. Design development in such projects tended to reflect on transposing elements of existing exemplary sustainable design. The design schemes of iterative sequences revealed marked similarities to precedents presented at the outset of design reports.

Blue lines between connected themes in the thematic mappings illustrate iterative sequences and shows how precedents used at the outset of the design report reoccur throughout the report, finally re-emerging in the design scheme. As such, the iterative trajectory is dependent on existing design to demonstrate feasibility and value.

8.4.3.2 COMPOSITIONAL SEQUENCES

Compositional sequences also seem to be most evident in solution focussed projects. They are characterised by clustered themes which are coordinated to formulate a design scheme throughout the design report. In this context, the report illustrates a process in which relevant materials and technologies are assembled in the best possible way in relation to the site and the design brief set by the participant. Developed designs are often indistinguishable from initial concepts; adopting desirable vernacular typologies and relying on materials to improve energy efficiency and performance. In some cases, designs appear to adhere to contemporary typological conventions, incorporating often visible,

technological additions that satisfy policy criteria, for example, wind turbines or photo-voltaics are used to symbolise compliance with renewable energy criteria.

Dependency also appears to be at the root of this sequence. This can be explained using example 10. In this design report it is difficult to see where the report is leading because many disconnected themes are introduced at the outset of the report. Following a review of national policy agendas and precedents of a high density housing, it becomes apparent that a housing scheme is considered. The report documents how eco-towns are incommensurate with high density schemes, but proceeds to address other elements, such as renewable energy provision, to comply with other eco-town objectives. In this regard, the project is a composition of preconceived architectural and infrastructure elements that meet most eco-town objectives. The design of the composition is novel, but individual components are not. The sequence is beneficial for evidencing feasibility and compliance.

8.4.3.3 OBSERVATIONAL SEQUENCES

Observational sequences are evident in design reports that present existing theories and definitions of sustainability, expressing tensions between these and current social and cultural attitudes towards sustainability. Justification of the design scheme in such projects is not dependent on predefined solutions or objective compliance.

Observational sequences typically stem from context focussed projects: reports are structured as though projects have examined tensions and identified and explored a variety of fields searching for precedents of similar problems, rather than looking for solution precedents (as can be seen in iterative sequences). Schemes tend not to focus on specific objectives, such as eco-town or CSH criteria. Rather, they claim to address overarching targets, such as the emissions reductions set out by the Climate Change Act (2008). Example 5

provides evidence of this sequence. Initiating with a target to reduce domestic emissions, the report subsequently questions the role of individuals and makes observations about capitalist society. This rhetoric leaves the scheme with fewer objectives to justify. In the other sequences observed in the data, such an introduction would have been followed by the presentation of exemplar solutions, rather than probing questions.

8.4.4 SUMMARY

Approaches to characterising sustainability, solution - context focus and project sequences are interconnected (see Fig. 8c). The data suggests that in order to make sense of issues of sustainability, designers fuse issues to reveal relationships between them; thus providing a platform from which to initiate a design proposal. The ways in which coupled themes are represented in design reports appears to inform whether projects are solution or context focussed. For example, themes presented as precedents tend to generate solution focussed projects. It is not simply the quantity of precedents presented, but the manner in which they are presented, and in particular, how this influences the design scheme.

These qualities lead into three different design sequences that can be observed in the design reports, namely; iterative, compositional and observational, which relate to different modes of dependency. Iterative sequences appear to be concerned with feasibility and practicality, and are incumbent on precedents to justify this. The design schemes of compositional sequences appear to employ many different precedents to express how they satisfy objectives. The data suggests that observational sequences, which are focussed on exploring the context of problems, are less concerned with validating their design schemes through precedent or regulation and consequently tend to explore novel design territories which could otherwise be dismissed as unfeasible or impractical.

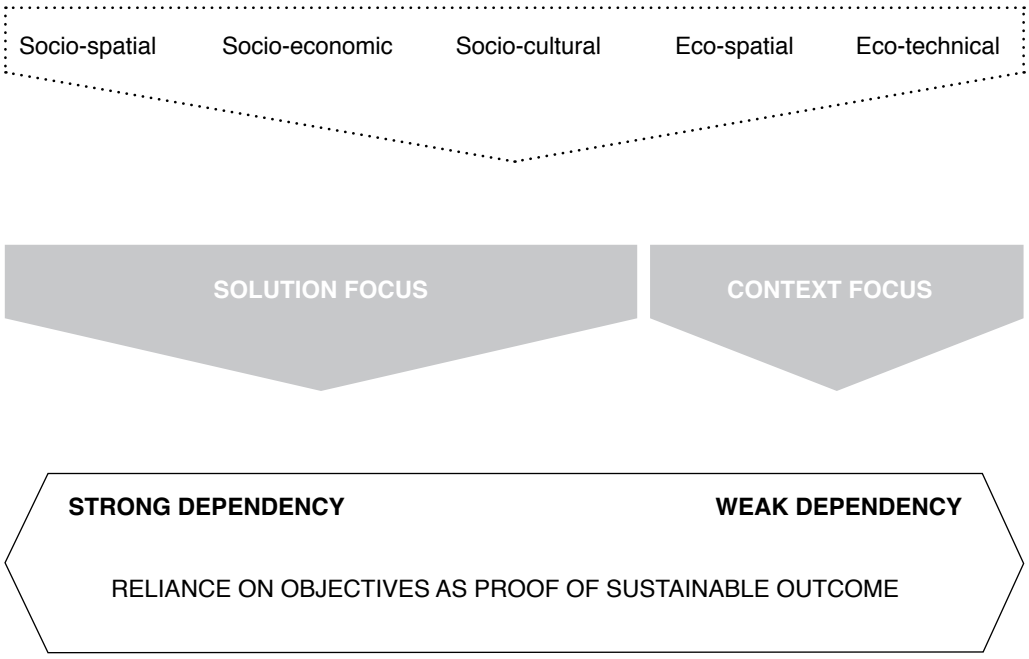


FIG. 8c
Diagram to show the interrelationship between the characteristics of design project as documented in the design lab design reports.

8.5 THE INFLUENCE OF EXPERIENCE ON SUSTAINABLE DESIGN

So far, the characteristics of sustainable design projects have been described without noting the distinct mannerisms of novice designers and new professionals. This is because the design projects of novice designers and new professionals exhibit similar characteristics in the ways in which they justify design schemes. The differences between the two resides in the details of how design reports are compiled, as this section explains. In total four distinctions are addressed:

- **Report Consistency;** the flow of themes in design reports.
- **Critical Analysis;** the ability to critically question information in ways relevant to the design project appears to be a product of experience.
- **Documenting Implications;** whether design reports document or evaluate the implications that design schemes could engender.
- **Risk and Contingency;** the way in which novice designers and new professionals appear to coordinate their projects to account for different types of risk.

8.5.1 REPORT CONSISTENCY

In the basic graphical presentation of design reports, new professionals provided short concise prose that typically introduced points of concern before unpacking and explaining them in relation to design issues. In contrast, novice designers presented data ‘as found’, largely without editing. This was often presented in isolation, or disconnected from images. It follows from this that the design reports of new professionals have greater visual coherence evidenced by the use diagrams to explain the relevance of data to the development of the design scheme. Novice designers tend produce compilations of work that do consider layout and presentation but largely in order to define a template in which to display data, allowing them to fluctuate between their own design work and secondary data or precedents, without reconciling the two.

Overall, new professionals present a smoother, coherent sequence of themes. By comparison, novice designers present fragmented themes evidenced by a sharper contrast their own work and supporting information. In the reports of novice designers, connections may be latent, however, their influence or meaning in the context of the design project is not always explicit. This suggests that the experience of new professionals has equipped them with the capacity to rationally present the formulation of ideas. Novice designers address many similar themes, but appear to be less skilled at rationalising them within the report.

Beginning with the novice designer, in the extract from example 4 (reproduced in Fig. 8d), the first thematic shift is from theoretical (the Venn Diagram model of sustainability) to physical (build maintenance an new buildings). Whilst buildings have latent connections to the social, environmental and economic issues highlighted by the Venn Diagram model of sustainability, how this model informed the shift from theory to practice is not explicit in the report, nor is the theme of balance, which the diagram represents. The subsequent shift from the building to city is concerned with scale, yet this is not explicitly expressed in the report either.

In distinction, the parallel occurrence of themes evident in the excerpt from example 11 (see Fig. 8d), not only illustrates that the design reports of new professionals tend to contain more themes, but also that these themes are more detailed. Greater detail is achieved through the identification of a site early in the project which tends to lead new professionals to concentrate on a specific context, relating other themes directly to that context in order to define a design brief. Greater coherence in the flow of themes is illustrated by the simultaneous presentation of themes in design reports, and also by explaining those themes through other means, such as precedents.

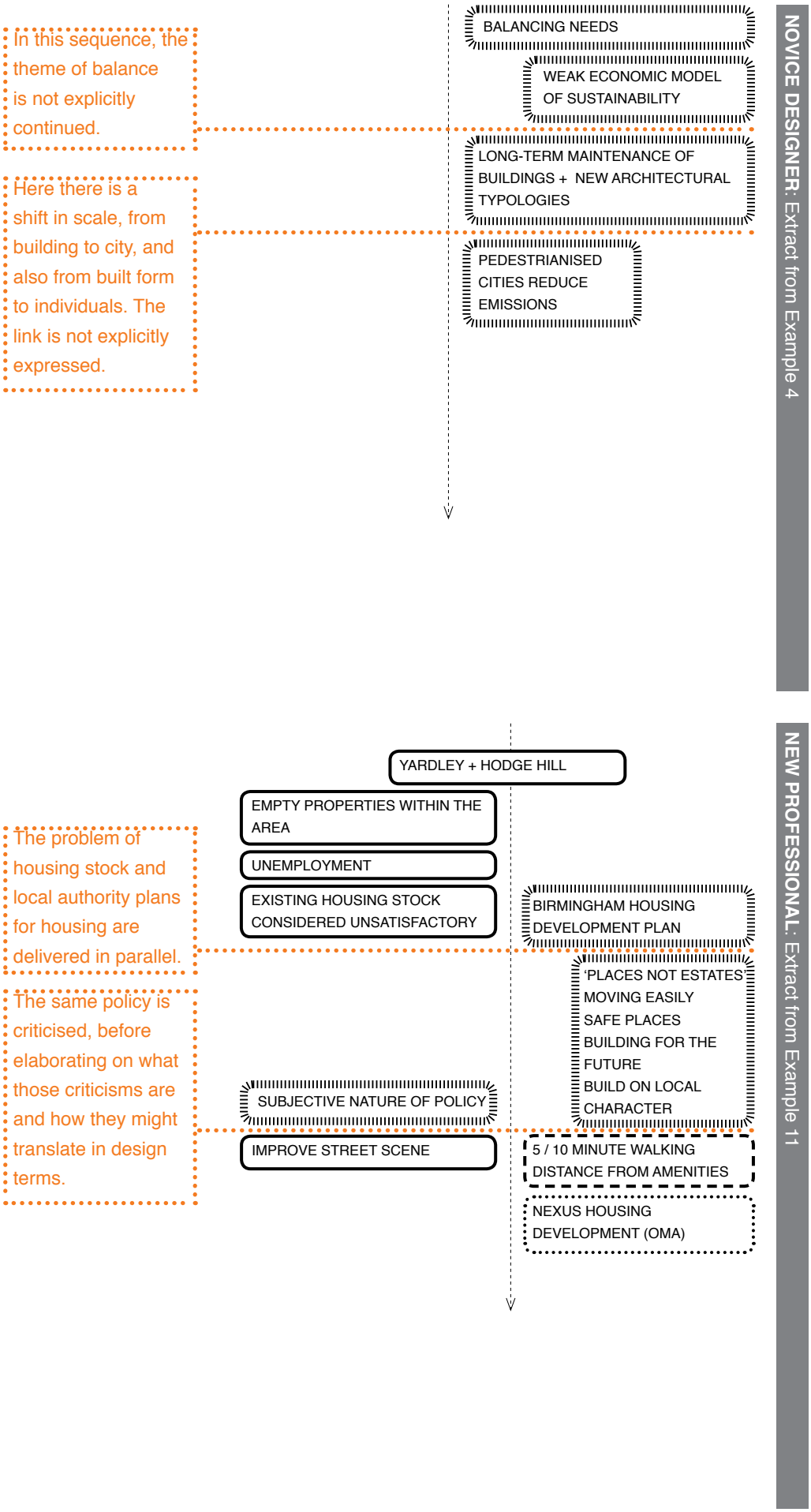


FIG. 8d
Extracts taken from examples 4 and 11. Example 4 represents the design report of a novice designer. Example 11 represents that of a new professional. They illustrate the disconnections evident in design reports by novice designers, and the consistency with which new professionals present arguments.

8.5.2 CRITICAL ANALYSIS

Critical analysis is a characteristic of both novice designers and new professionals, although it is more acute in the work of new professionals.

It is useful to refer to an iterative design report here, such as example 3. There are three key iterations in this example (see Fig. 8e). Iterations begin with a precedent of exemplary sustainable design. In the second stage, further information about these devices is provided. In the final iteration, the devices are transposed into the design scheme. Throughout this process there is clear evidence of understanding, but the scheme is problematic because it lacks contextual critical analysis and consequently the report fails to recognise fundamental issues created by the transposition of design elements from one climatic context to another.

Notably, there were no examples of iterative design sequences in the design reports of new professionals. In distinction to iterative sequences, compositional and observational sequences illustrate elements of contextualistion. Example 9 (reproduced in fig. 8e), illustrates the development of three key areas, which subsequently are revealed in the design scheme. This indicates that new professionals have developed a refined ability to critically analyse, and as Ho (2001) observed, to show strategic patterns of problem deconstruction, through experience.

Evidence of different levels of critical analysis can also be seen in the project synopses produced by participants. Novice designers tended to demonstrate one of two approaches to this: they either made brief statements relating to the issues they addressed, highlighting the gap that their design scheme addressed, as the following extracts illustrate:

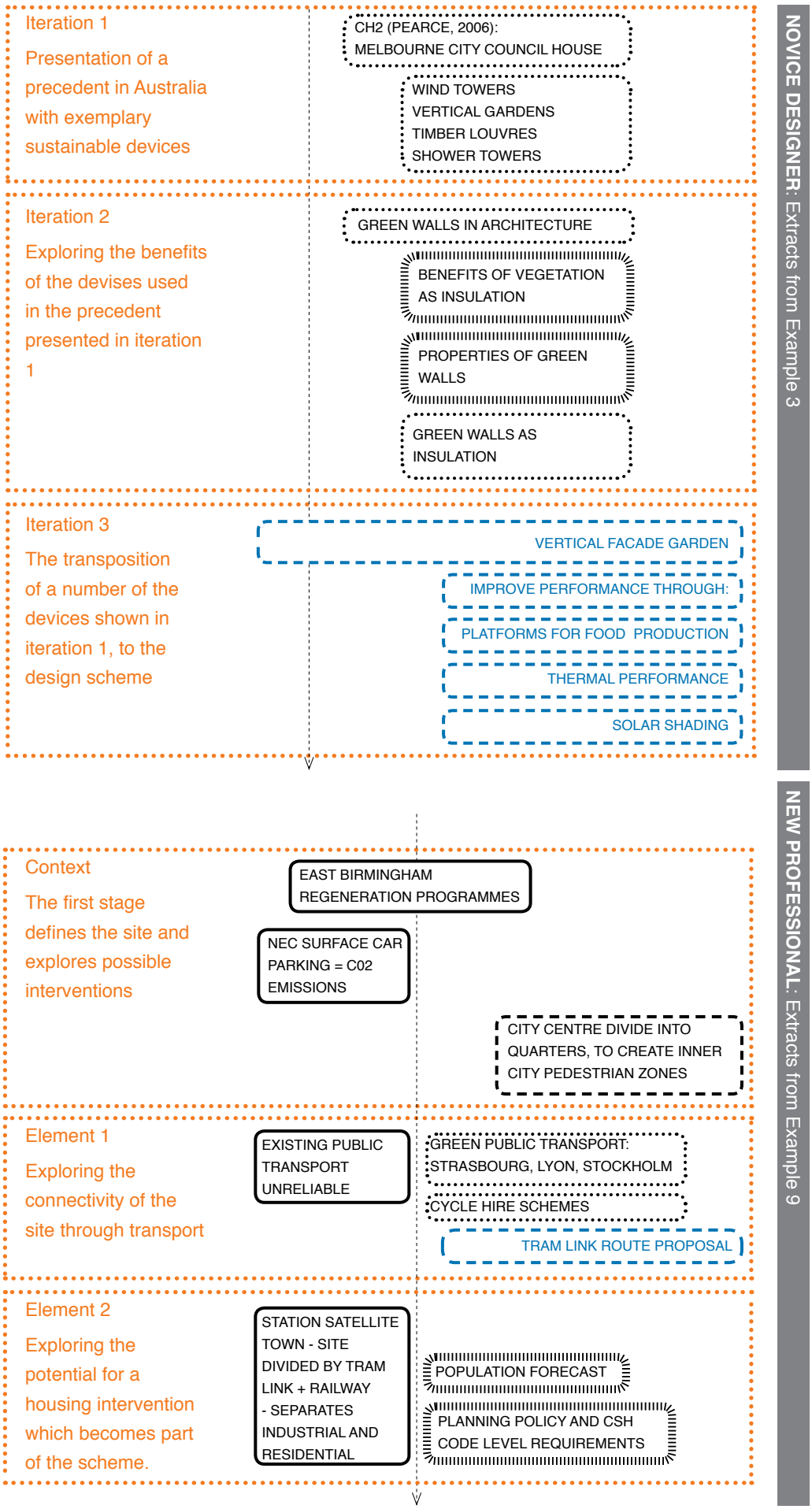


FIG. 8e
Extracts taken from examples 3 and 9. These extracts highlight fragmented parts of thematic mappings to illustrate how these parts culminated in the final design scheme. Example 3 is used to illustrate an iterative project to show how this sequence arises from a lack of critical analysis. Example 9 shows a compositional project to illustrate how critical analysis is a formal part of compiling design elements rather than iterating them.

Example A:
Domestic energy consumption has been increasing steadily since the 1970s, which is largely a result of the spread of installed central heating. This has surprisingly made space heating the highest carbon emitter within the household [above personal travel]. A key objective would be to drastically reduce the amount of energy required to heat the occupant within the home. The simplest way to do this would be to completely remove space heating from the home and rely on the individuals clothing to provide thermal comfort.

Example B:
1 m² of grass roof can remove 0.2 Kg of airborne particulates from the air every year. 1.5 m² of uncut grass produces enough oxygen per year to supply 1 human with their yearly oxygen intake requirement. [...] The effects of grass can reduce the impact of pollution within certain areas of Birmingham. As a design proposal covering specific areas in Birmingham could spark an environmental movement as people notice green roof areas more often.

Or, they provided descriptions of overall proposals, explaining, often in first person, what they did and why:

Example C:
Next I considered ways of producing green energy. Using air source heat pumps, mast mounted wind turbines, solar electricity panels and solar water heating systems, I found that I could make the house 100% sustainable, and also make sufficient energy to sell back to the electricity grid, making the house owner money, and offsetting the Co2 emissions produced by existing households. I added to this a water harvesting system to help reduce the risk of flooding and droughts in the future.

Example D:
My initial proposal is to introduce a new subterranean network of tunnels to create effective and comfortable links for pedestrians and cyclists across Birmingham City Centre. At present the city is poorly equipped to accommodate cyclists over ground, and the climate in our region also creates an obstacle for encouraging the idea of cycling to the and around the city. I therefore think by introducing cycle and pedestrian routes below street level would address both these problems. Part of the Big City Plan includes an objective to make Birmingham more cycle friendly however the details of this will be achieved are not yet clear, so perhaps my tunnel proposal could address this objective.

The former approach (examples A and B) communicate the design scheme with the conviction that it has a role to play in addressing the issues highlighted by the participants research. Examples C and D appear to be reflective, looking in greater detail at the process of design delivery. The major distinction between the two is the participants' ability to emphasise the value of design.

New professionals also made statements relating to the issues they addressed through their design schemes. In distinction to novices' project synopses, new professionals demonstrate a much deeper level of knowledge and understanding about translating their research into design. More specifically, it suggests, as other authors have noted (Cross, 2007; Lawson, 2006), that experienced designers have a body of tacit knowledge which informs their design. Extracts of the work of new professionals are as follows:

Example E:

Materials for building construction will be reduced by utilising the existing structures and refurbishing existing housing stock. Footpaths, bridleways and cycle-ways within the site will be designed to link the canals and the city centre as well as serve the residential, business and Parkway areas, by actively contributing to the general health and well-being of the population and to reduce carbon emissions.

Residents of the eco-town will be provided with community owned land offering the opportunity to grow their own food either in shared gardens or in communal allotments, incorporating modern and organic horticultural techniques. Surplus food grown would be sold in the eco-town market or local retail shops. It is anticipated that some of the assets associated with the eco-town will be community owned. For instance, bio-mass boilers, energy from waste plants, combined heat and power plants, vacuum waste disposal, land for organic food production etc. This will make living in the eco-town cheaper for its community.

Example F:

Foremost in our ambition was the creation of an environmentally sustainable housing design, concerned with reducing CO2 both in construction and in use. As noted in our research, embodied energy is an important factor here. Secondly, in order to be a truly utopian proposal, the design must also be livable and as successful as possible according to objective policy. Internal space standards would form the building blocks, constrained by the key factors identified of density, street definition and open space provision and use. In terms of scale, policy tends to relate more to wider urban issues as opposed to the detailed design of individual dwellings, which is largely prescribed by building regulations, so it was our intention to propose an urban housing typology, as opposed to a detailed single dwelling.

8.5.3 DOCUMENTING IMPLICATIONS

The combination of presenting coherent reports and the ability to acutely analyse also indicates that new professionals are more aware of the implications of their design interventions. In contrast, novice designers are more likely to demonstrate characteristics of a 'creative leap' (see Example 2 in Fig. 8f). In the example, the creative leap is illustrated by the jump from exploring how to

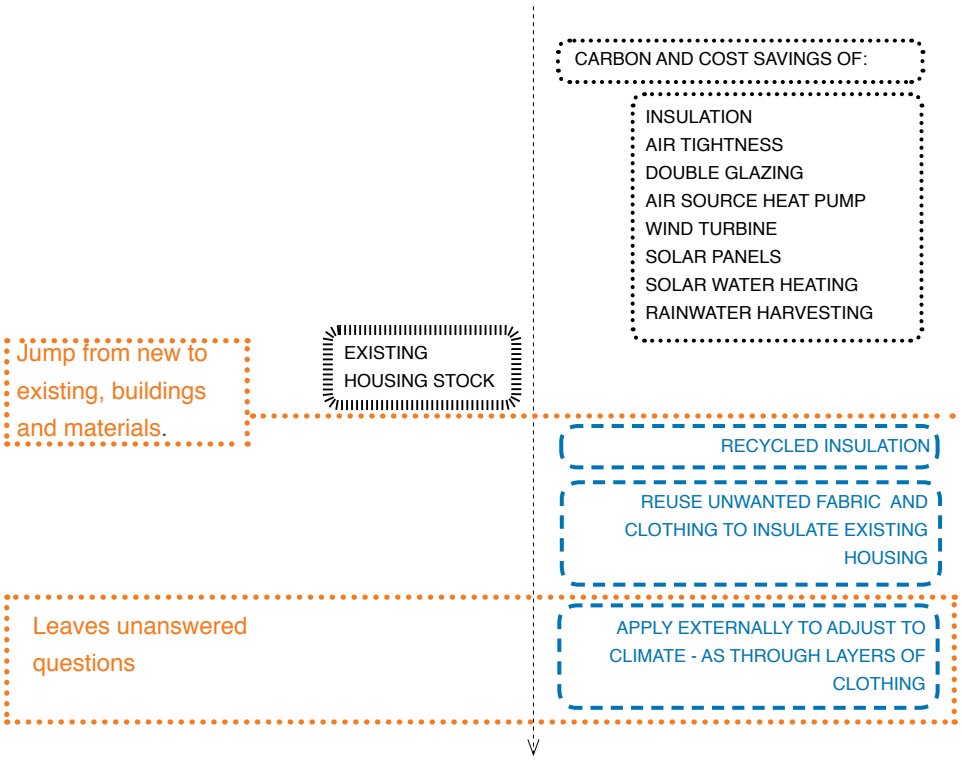
improve energy efficiency in housing to the use of recycled fabrics as insulation. The leap is notable, not least because the project focus changes from new build to existing housing, but because it changes from conventional to unconventional. Here, 'unconventional' is characterised by exposing insulation on account of its potential aesthetic qualities.

Notwithstanding the number of practicalities yet to be resolved in this scheme, the explanations for the creative leap are ambiguous. The design report documents a concern for existing housing as part of this jump, however, the shift also includes the move from new material to existing materials. Moreover, implicit in this design scheme is rhetoric concerning the aesthetics of housing. The scheme emulates the regulation of body temperature with layers of clothing, but the design report does not explicitly explain the significance of this analogy for housing.

Ambiguity is less common in the design reports of new professionals who tend to explain the implications of the scheme in detail. Evidence of this can be seen in example 11 (see Fig. 8f) where the report concludes with a discussion of the implications of the scheme for other cities. With this, the participants propose that the scheme has the ability to address issues beyond the context it was designed for.

8.5.4 RISK AND CONTINGENCY

The concept of designers in education catering for risk seems implausible. Central to the rift between education and practice in architecture is the practitioners' view that students arrive in practice unprepared, because they have not been subject to 'real-world' pressures (Cuff, 1992). It is perceived that the primacy of theory in design education displaces the practical skills that commercial practices desire, and as such, the university environment is conceived as a studio of abstract ideas and unfeasible designs (ibid). On the contrary, the



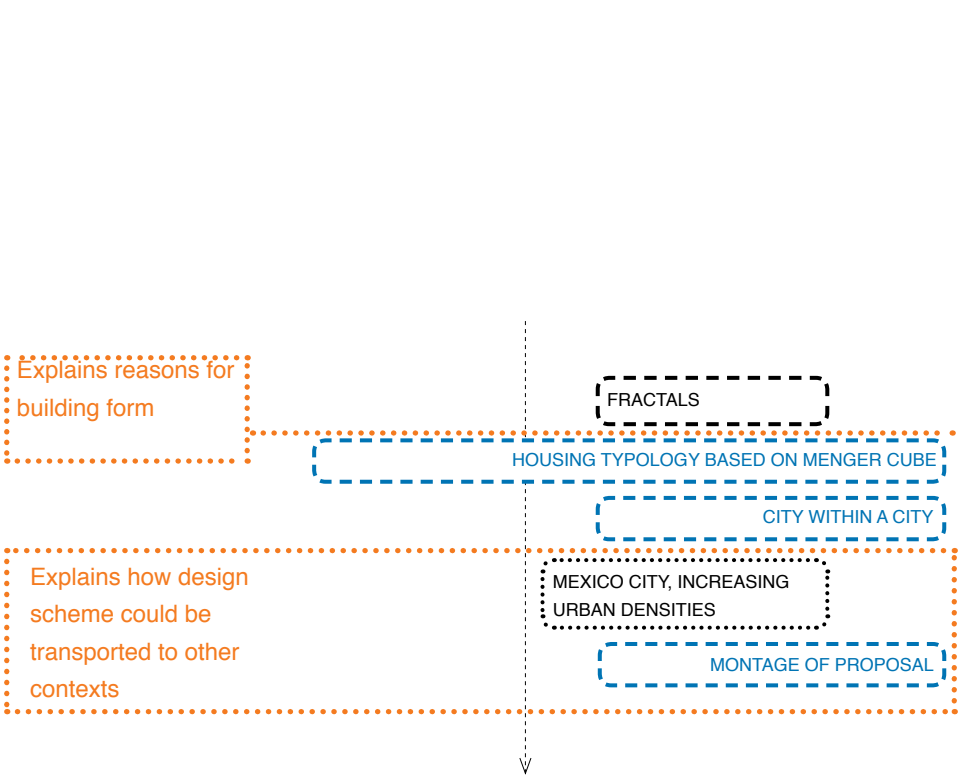


FIG. 8f
Extracts taken from examples 2 and 11. Example 2 highlights the jump from preparatory design stages to a design scheme where the design proposes an intervention in which very little of the preparatory information is relevant. The lack of explanation suggests that novice designers are less adept at documenting the implications of their proposals.

design lab data suggests that risk management is embedded in the very nature of producing a design project in academia. What cements these distinctions appears to be the types of risk novice designers and new professionals could be said to cater for.

The emphasis on employability in architectural education is a clear example of a move towards performance-based education. Under these conditions students are experiencing increasing pressures, not only to graduate with the kudos of a degree, but one of high classification in order to gain employment afterwards. The increasing gravity with which employability ratings are ascribed to higher education courses is testimony to this. Hence it is these two factors, graduation and employment, that contribute to the way in which students appear to seek out certainties within their projects.

Putting into context the projects conducted here, which formed part of an elective module in BIAD, made only a minimal contribution to the students' overall mark at the end of the year [11]. This is significant as the potential weighting of the grade in the context of the overall mark may influence the quality of the design report. To this end, novice designers, whose concern in this instance is to pass the module, rather than excel in it, as is assumed to be the case in design studio modules that make up a significant proportion of the over all mark, can be said to compile design reports in such a way that reinforces the feasibility of the design scheme. For example, where the reliance on precedents in the work of novice designers is evident, it may be as such in order to achieve two things: to quickly delimit a well-defined design problem, and to demonstrate the feasibility of the work, which they think will ensure that they satisfy assessment criteria.

In addition to the pressure to do well, is the potential influence of interdisciplinary working. From this perspective, dependency may also be a product of employing design skills in an unfamiliar discipline. Evidence of observational sequences in

[11] At this point it is worth reiterating that the elective course was a vehicle used to collect data and consequently the evaluations are ex post facto. More specifically, marks were awarded in isolation of this research, and the evaluations provided in this thesis had no role in the formal assessment and grading of the work.

novice designer design reports indicates that this is not consensus: it suggests that operating within an interdisciplinary programme can be bewildering (and therefore increase dependency), but that doing so also offers potential to experiment across disciplinary boundaries. This appears to be the same for individual designers and groups alike.

There is also an act of faith displayed by novice designers. Specifically, faith in the technologies that novice designers iterate in their design schemes which is rarely contested in design projects. This is also true of new professionals. It is not necessarily within the qualifications of architectural designers to interrogate the technical properties of materials and components. However, it should be in their nature to question the use of such elements in design. For example; are they commensurate with the design proposal? What implications do they have for the design scheme? The more pertinent question for design practice latent in these questions is; to what extent is technology shaping design practice, its products and outcomes?

These factors appear to have two effects in terms of how novice designers deal with dependency. Novice designers tend to work *for* dependencies, in the way that they iteratively follow pre-tested sustainable design solutions. In contrast, in the examples of observational paradigms, they can work *against* dependency, by defaulting to broader objectives where the implications of their design schemes are less measurable.

Although they are marked on the same criteria the assessment benchmarks for new professionals are set much higher than those for novice designers. New professionals are expected to demonstrate a working scheme that encompasses novel ideas. Through their comprehension and awareness of the commercial practice of architecture, in addition to their analysis and presentation skills, they are dependent in ways other than relying on precedent. Instead, as the

examples above show, the design reports of new professionals all refer to aspects of national and local policy agenda which becomes a core mechanism to illustrate the practicality of the scheme proposal. Additionally, the skill set of the new professional contributes to the ability to synthesise a number of design approaches. This resonates with their ability to propose synchronised design interventions at different scales and to adapt precedents to form a novel proposal. This is not only a product of critical analysis, but also of the understanding of how to use it in order to defend a design scheme. Rather than working *for* or *against* objectives, the experience and developed skills of new professionals enable them to work *within* objectives. The data suggests that new professionals are more aware of objectives at the urban and architectural scale and consequently use their skills to manipulate them.

8.6 CONCLUSIONS

The thematic mappings revealed that many of the same characteristics are visible in the work of novice designers and new professionals. The presence of design sequences suggests that experience enables designers to mobilise contingency in different ways. Specifically, more experienced designers work *within* objectives to establish a solution, whilst novice designers work *for* or *against* them. The differences between levels of experience are revealed in design report presentation techniques. New professionals are not necessarily better at design by any measure, but they are more able to produce coherent reports. Experience is also a reflection of the ability to effectively satisfy university assessment criteria, and this is what appears to give rise to the different project sequences described in section 8.4.3 (see Fig. 8c). The ability to develop a design report that evidences a smooth transition between themes, the critical analysis of those themes in order to refine a design scheme, and the ability to document the relative implications of the design scheme are compensated for in iterative sequences by the use of precedents, which act as a substitute for underdeveloped presentation and analytical skills.

The findings suggest that the contested domain of sustainable design leads novice designers and new professionals to rely on precedents to mitigate risk. If parallels can be drawn between satisfying university assessment criteria and sustainability assessment criteria, as occurs in practice, these studies would serve to reinforce the truism that architecture is a dependent discipline in which creativity is secondary to rationalisation.

9.0 ESTABLISHED PRACTITIONERS: PERSPECTIVES ON SUSTAINABLE OBJECTIVES

This chapter examines the semi structured interviews with established practitioners in the construction industry. The chapter is structured as follows:

9.1 Interviews by Practice Type

Overviews of each interview are provided. These are organised by practice size and type. Each overview comprises two pages, including a thematic mapping and a written explanation.

9.2 Approaches to Sustainable Design in Practice

Identifies three approaches to sustainable design discussed by practitioners, namely; objectification, collaboration and communication, and best practice.

9.3 The Value of Assessment

The clients perception of objectives and the way in which this influences design activity is explored in this section.

9.4 Tensions in Commercial Practice

Summarises the findings and highlights the influence of the commercial value of sustainability assessment method criteria and the implications of this for design.

9.5 Conclusions

Reviews the conclusions that can be drawn from the findings.

9.1 INTERVIEWS BY PRACTICE TYPE

Within this section, responses from architectural practice are organised by size beginning with small practices (for RIBA definitions of practice sizes see, 3D Reid, 2010). Full details of the practices interviewed are provided in section 7.4, and a summary is provided below (Fig. 9a):

FIG. 9a
List of interviews as they are presented in this section

Section	Practice	Interviewees
9.1.1	Small Practices	
9.1.1.1	Architecture m	Mark Percival
9.1.1.2	Raynes Architecture	Lisa Raynes
9.1.2	Medium and Large Practices	
9.1.2.1	Wilson Mason	Derek Southworth Alan Williams
9.1.2.2	Austin-Smith: Lord (ASL)	Kal Gil-Faci Catherine Cosgrove
9.1.2.3	Feilden Clegg Bradley Studios (FCB)	Adam Chambers
9.1.2.4	3D Reid	Mike Hitchmough
9.1.3	Multidisciplinary Practice	
9.1.3.1	ARUP	Peter Budd
9.1.3.2	ARUP	Alistair Guthrie

Derek Southworth and Alan Williams were interviewed together and Kal Gill-Faci (ASL) expanded on answers obtained from Catherine Cosgrove by email.

Each interview is summarised with a thematic mapping and written evaluation. Themes are divided between three primary categories; practice; objectives and outcomes. The distribution of these categories is illustrated by dividing the thematic map in to three sections based on the proportional representation of each category within the transcript to illustrate which of these areas of design is thought by practitioners to be most significantly influenced by sustainability (also see section 7.5.2.2):

- **Practice** refers to the procedural, organisational and management activities of professional design practice.

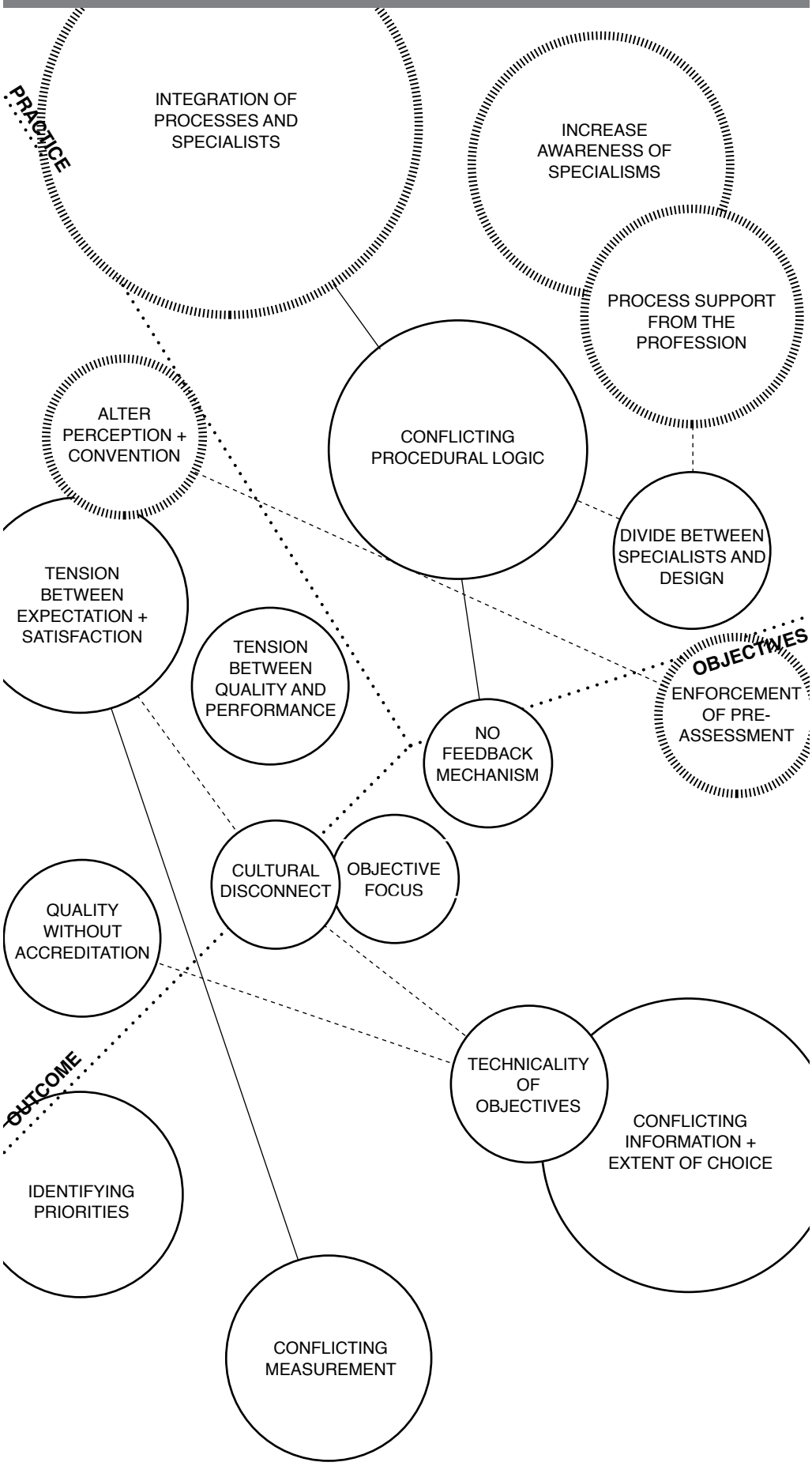
- **Objectives** refer to the criteria that informs design decision making. It tends to concern BREEAM (or other assessment method) criteria that is used to accredit sustainable design.
- **Outcomes** refer to the characteristics of the scheme, including visual, performance and functional characteristics. It also includes other outcomes, such as the clients' views on assessment methods such as BREEAM or LEED.

The thematic mappings are similar to similar to cluster diagrams; the size of the theme's 'bubble' indicates the frequency of the theme and thereby the emphasis placed on it. Connections are indicated with solid and dotted lines for explicit and implicit relationships, respectively.

9.1.1 SMALL PRACTICES

The RIBA defines a small practice as one comprising up to 10 staff (see, 3D Reid, 2010). The small practices interviewed as part of the present research mostly deal with bespoke residential projects. The practitioners interviewed here both have extensive past experience in a range of practice sectors.

9.1.1.1 ARCHITECTURE M



KEY

Proposal made by the participant

Theme concerning a statement about prevailing praxis

Themes discussed in relation to each other

Explicit links between themes

Implicit links between themes

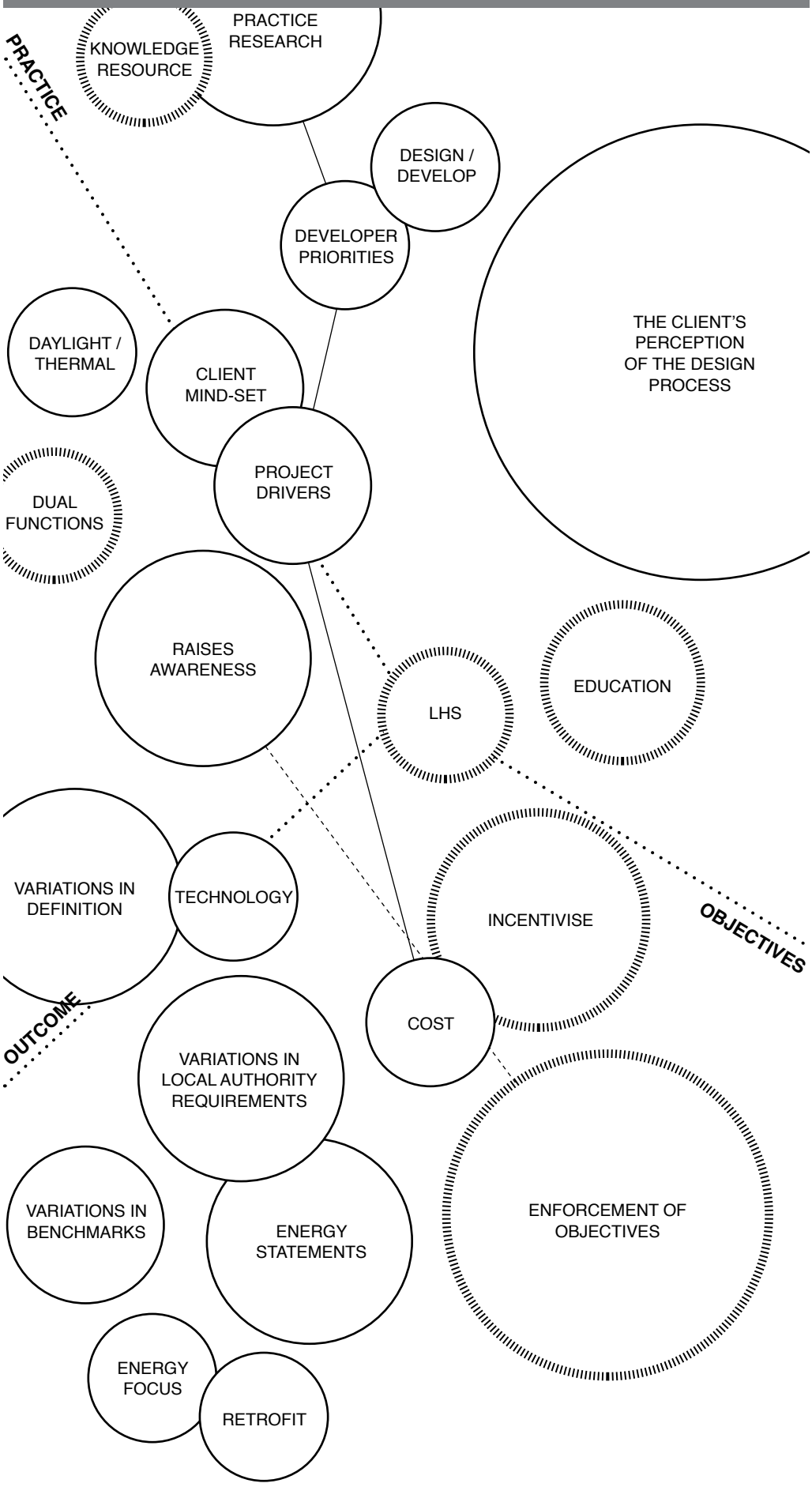
OBJECTIVES

Indicates the proportion of themes focussed on practice, objectives and outcomes.

Percival considers that sustainability is often seen as an additional layer or stage in design, and questions: “Why do we need it as a separate stage?” In his view, sustainability is integral to design and it should be represented as such throughout legislation and professional documentation. This suggests that disconnections between architectural practice and sustainable design are partly rooted in the profession. From this perspective, practice is a platform from which to enable integration: the prominence of themes relating to the *Integration of Specialists and Processes*, the need to *Increase Awareness of Specialismss* and *Support from the Profession*, throughout the transcript are evidence of this. The overarching message is that the range of disciplines involved with meeting and assessing BREEAM criteria can mean that it is perceived (particularly by clients) as a process isolated from design. Percival’s view is that architectural design should be an integrated “part of the course”. He highlights the importance of specialists, but proposes that the key to practice efficacy is the working organisation and relationship between them.

Sustainability objectives fuel disconnections between public perceptions of sustainable design. Percival states that sustainable assessment is “looking for both renewables and materials that have been granted a good rating in the green guide”. At the same time, an “abundance of contradictory information” is available, which can lead to misinformed clients and therefore conflicting expectations about the scheme and the design process. This is evidenced by connections between *Conflicting Information and Extent of Choice* and *Quality without Accreditation*. The latter theme refers to the perception that quality and accreditation are not always synonymous and that they heavily depend on client requirements.

9.1.1.2 RAYNES ARCHITECTURE



KEY

Proposal made by the participant

Theme concerning a statement about prevailing praxis

Themes discussed in relation to each other

Explicit links between themes

Implicit links between themes

OBJECTIVES

Indicates the proportion of themes focussed on practice, objectives and outcomes.

Client Mind-set and *Project Drivers* are two themes that border both practice procedures and the design scheme in the thematic mapping. This is because Raynes highlights the distinction between the drivers for clients involved with commercial and bespoke residential practice, and indicates that in each case design is formulated around these drivers. She suggests the key drivers for clients of bespoke housing projects are typically “budget, planning and building regs [...] Then you’ve got aspiration - usually design, layout, space. Then down the list, ... renewables, sustainability.” Cost, is a key influence on these drivers. Describing one client who had initially outlined requirements for an eco-home, Raynes explained that once the cost of the initial design was calculated “the [design] ideas were all dismissed. Budget/cost took it straight out.”

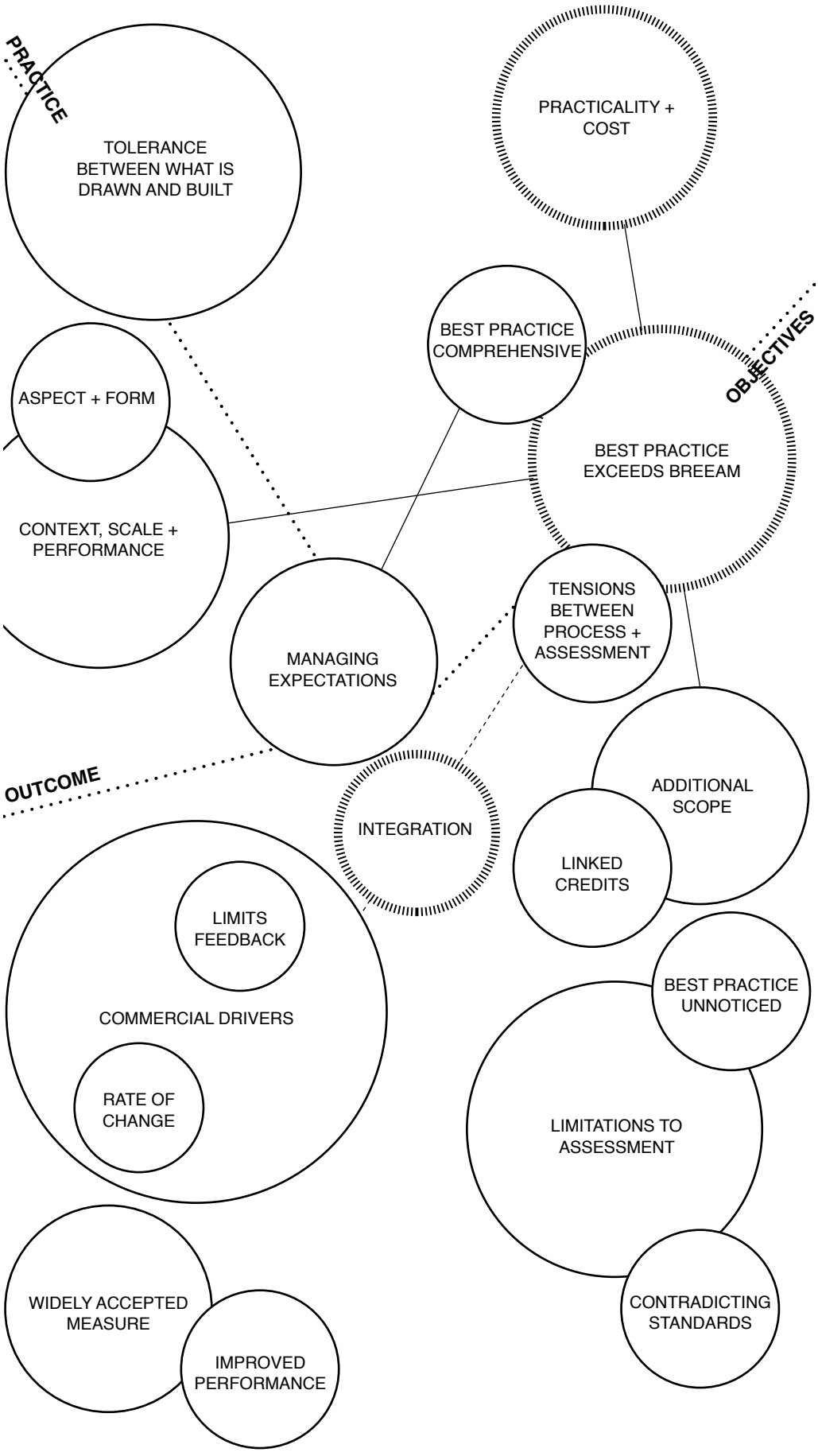
Raynes’ principal concern is the lack of encouragement for domestic clients to exceed legislative drivers for sustainability, especially in cases where such endeavours promise to provide long term value. One criticism in this context is the different agendas and requirements of local authorities. The link between *Enforcement of Objectives* and *Raises Awareness* in the thematic mapping above, indicates that greater consistency between local authority requirements for energy efficiency could lead to greater awareness of the issues and thereby inform the client’s drivers.

The *Client’s Perception of the Design Process* also tallies with this, in addition to being an important theme for Raynes who indicates that one of the difficulties is making the design process comprehensive for clients. The *Green Overlay to the Plan of Work* (RIBA, 2011) is one instance where Raynes suggests it is difficult to reconcile the complexity of the design process with the added value of sustainable approaches for clients who are principally concerned with how long it will be before they can start on site and how much their design aspirations will cost.

9.1.2 MEDIUM AND LARGE PRACTICES

A medium sized practice has around 11-50 employees and large practice comprises above 50 employees (see, 3D Reid, 2010). This section includes four interviews with practitioners from practices of this size. The nature work undertaken is typically commercial, including offices, retail, education, and social and private large scale housing. Where assessment and accreditation is mentioned throughout this section, it typically refers to BREEAM assessment and accreditation.

9.1.2.1 WILSON MASON



KEY

Proposal made by the participant

Theme concerning a statement about prevailing praxis

Themes discussed in relation to each other

Explicit links between themes

Implicit links between themes

OBJECTIVES

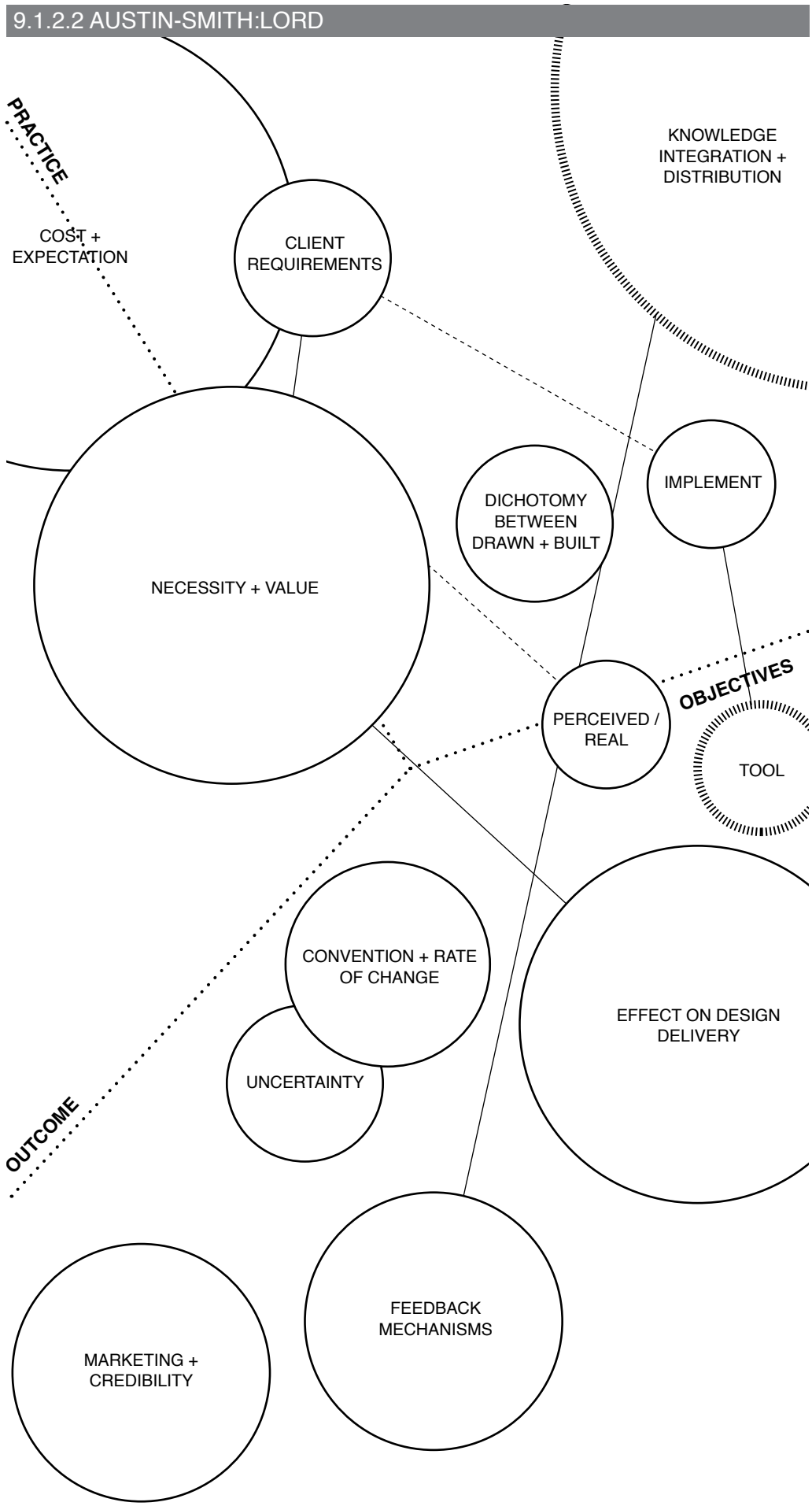
Indicates the proportion of themes focussed on practice, objectives and outcomes.

Southworth & Williams note tensions between what might be considered best practice in sustainable design and compliance with assessment method criteria. They assert; “you’re addressing a score rating”, particularly, one that can increase scope and costs “in order to make sure you get the score that is required”. A strong focus on objectives throughout the transcript reveals a host of commercial benefits that stem from BREEAM accreditation, but also some tensions in the process of implementing assessment criteria. The core message is that the cheif benefit of BREEAM is that it provides a benchmark that is widely recognised and accepted.

Southworth & Williams note that aiming to achieve BREEAM accreditation significantly changes practice procedures and organisation, in addition to the architect’s priorities. Central to this, is the need to manage user expectations “about what the building environment will be like”. For example, they explain that natural ventilation requires air paths that can facilitate acoustic transfer and temperature variation, which can affect comfort. One overarching distinction between best practice and assessment is that best practice in design appears to be displaced by assessment criteria. For example, site specific considerations such as aspect and form are excluded from assessment criteria.

The tolerance between what is drawn and built is a further issue. It is difficult to build with the precision to which details are drawn which can to discrepancies between intended and actual performance. The rate of change of approved materials and technologies is rapid as a result of the commercial forces supporting BREEAM. Southworth & Williams note that there appears to be a limited ability to provide feedback on any aspect of assessment, unless practices have the capital to invest in rigourous research.

9.1.2.2 AUSTIN-SMITH:LORD



KEY

Proposal made by the participant

Theme concerning a statement about prevailing praxis

Themes discussed in relation to each other

Explicit links between themes

Implicit links between themes

OBJECTIVES

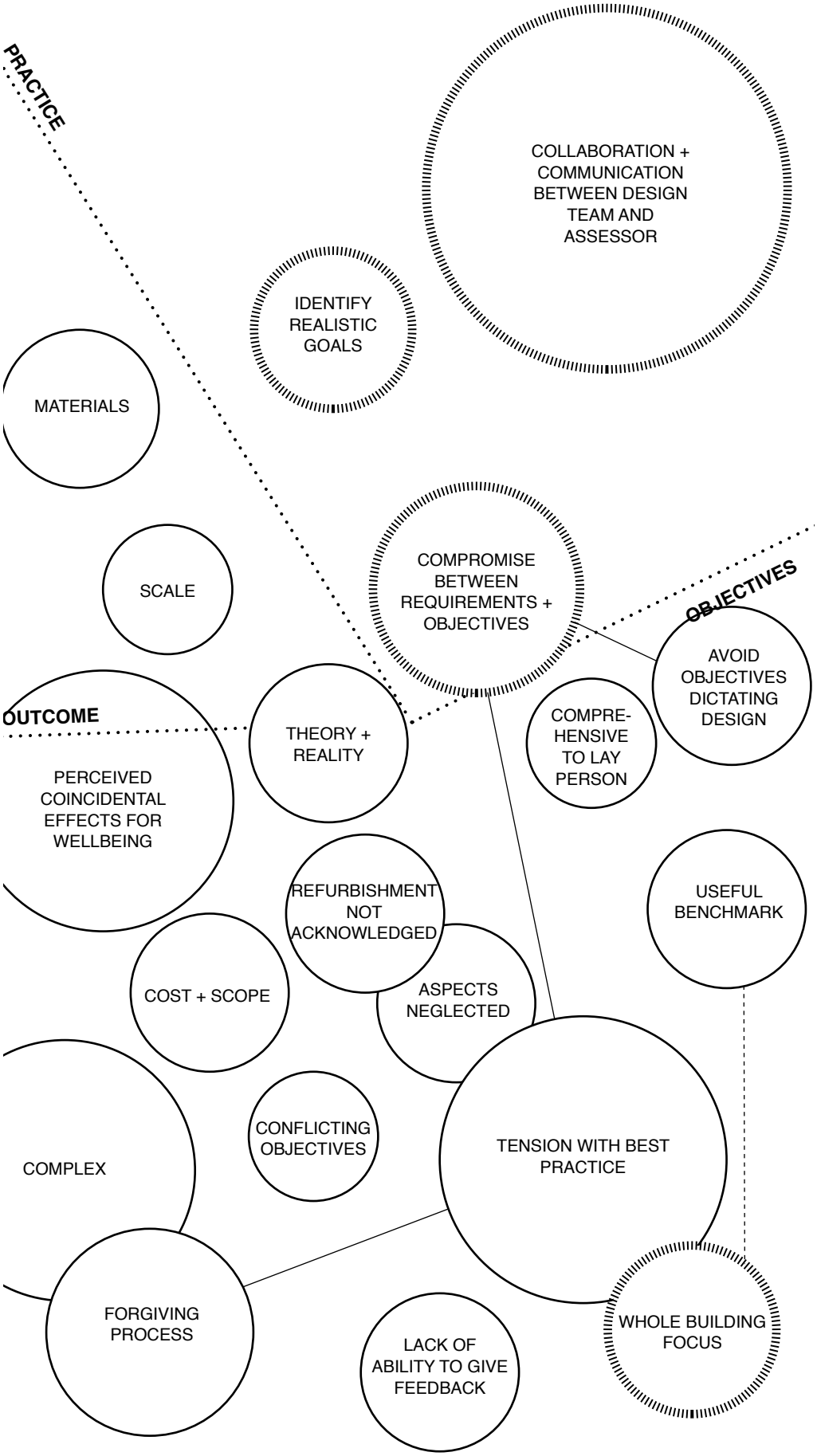
Indicates the proportion of themes focussed on practice, objectives and outcomes.

Here there is a focus on the relationship between practice and sustainable design objectives. Cosgrove & Gil-Faci point to tensions between *Necessity* and *Value*. That is, the difference between client requirements, seen as necessary project scope, and additional scope required by assessment criteria, which does not always provide added value from the client's perspective. An example of this, Gil-Faci explained, was the need to install additional showers on one project in order to meet assessment criteria, when it was clear that these would not be necessary for the client's purposes. Rather than being target driven in this way, Gil-Faci suggests "the aim should be delivering buildings that meet the client's requirements throughout the time that they occupy that building." This is to say that whole life design should be the focus of assessment criteria, rather than target driven design.

Cosgrove & Gil-Faci indicate that "sometimes [sustainability] is about educating the client." They suggest that practitioners should be able to advise clients on the most feasible approaches for each individual project. This relies on practitioners having access to all the necessary information to make recommendations, but also ensuring that the client is provided with all the relevant information to make an informed decision based on such advice, making *Knowledge Integration and Distribution* a pivotal aspect of architectural practice.

ASL have an internal mechanism for knowledge management called *Community in Practice*. Gill-Faci points out that there are some critical issues associated with facilitating such methods across the construction industry. She notes that it can be difficult to get practices to participate as their knowledge can be commercially sensitive. Additionally, research is only taken seriously if the technical data is supplied and not all practices have the capacity to do this.

9.1.2.3 FEILDEN CLEGG BRADLEY STUDIOS



KEY

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Themes discussed in relation to each other

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OBJECTIVES

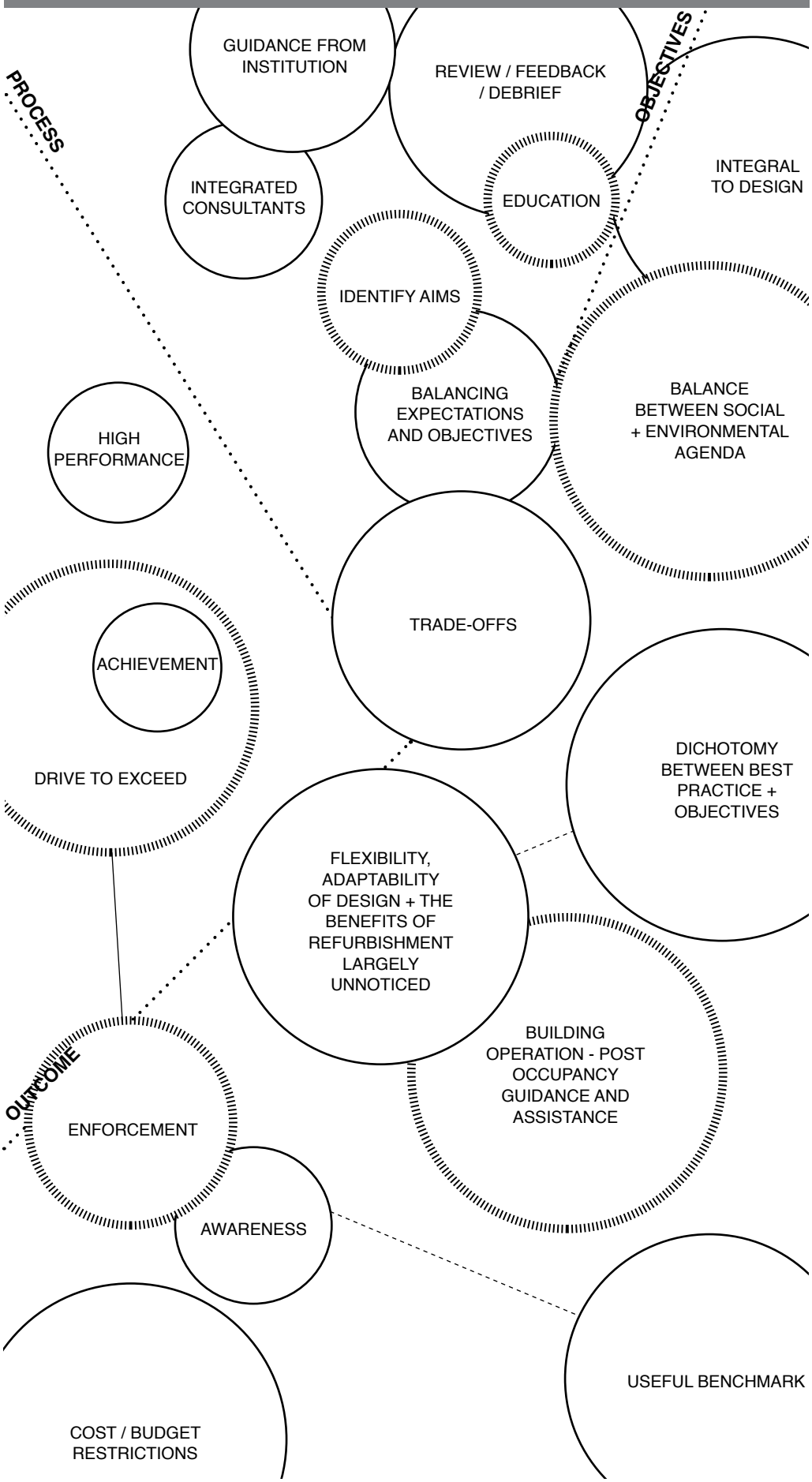
Indicates the proportion of themes focussed on practice, objectives and outcomes.

FCB Studios are the authors of *The Environmental Handbook* (2007). At the time of interview the practice had a BREEAM accredited project on site which included the refurbishment of an existing building in addition to a new build extension. Experiences from this ongoing project, led Chambers to reflect that BREEAM can neglect certain aspects of best practice and that the benefits of refurbishment over demolition are unnoticed by the BREEAM assessment method.

Chambers proposes that to get the most out of BREEAM realistic goals need to be identified at the project outset, and there needs to be close *Collaboration and Communication* "between [the architect] and everyone on board." This raises "awareness of what's going on [and] the criteria you have to achieve." He states, "where you're going through a box ticking exercise, you're not appreciating the overall picture" and suggests that without a collaborative approach, the assessment exercise can create tensions with best practice approaches. He notes; "you can go quite far along the line without necessarily giving consideration to orientation and natural light and things, but you can still end up with BREEAM excellent." He describes assessment as a "forgiving process" as despite setting minimum requirements, BREEAM allows missed credits to be compensated for in other categories.

To overcome the tensions between best practice and assessment criteria, Chambers proposes that in addition to close collaboration between the design team and the assessor, credits need to be issued for "basic principles", or best practices approaches. This would enable a *Whole Building Approach* that doesn't "offer you that kind of get out clause."

9.1.2.4 3D REID



KEY

Proposal made by the participant

Theme concerning a statement about prevailing praxis

Themes discussed in relation to each other

Explicit links between themes

Implicit links between themes

OBJECTIVES

Indicates the proportion of themes focussed on practice, objectives and outcomes.

With a BREEAM Outstanding project on site at the time of interview, Hitchmough explains that “everything we do now is so inextricably linked in terms of the various disciplines; the architect, the engineer, the mechanical engineer... Particularly when you’re going for BREEAM Excellent or Outstanding, the decision one of those parties makes, has an immediate knock on effect on everyone else’s piece of work. So, the higher the [BREEAM benchmark] you set yourself as a team, the more intertwined and interrelated work becomes.”

Inherent in an integrated design team, is the integration of assessment criteria within the design. This means avoiding the disjuncture between achieving credits and delivering a scheme that responds to social and cultural conditions, by considering credits as a fundamental part of the design, rather than a list of criteria that must be satisfied.

Referring to a project in which a decision was made to forfeit day lighting credits in lieu of a deeper floor plate that would prove adaptable in the future, led Hitchmough to criticise assessment methods for neglecting to recognise longevity as a fundamental factor of sustainability.

Following completion, the responsibility to maintain and operate a building in the way it was intended, passes on to the client. Hitchmough highlights the value of post-occupancy studies, not only for ensuring intended operation, but for informing and adapting assessment accordingly.

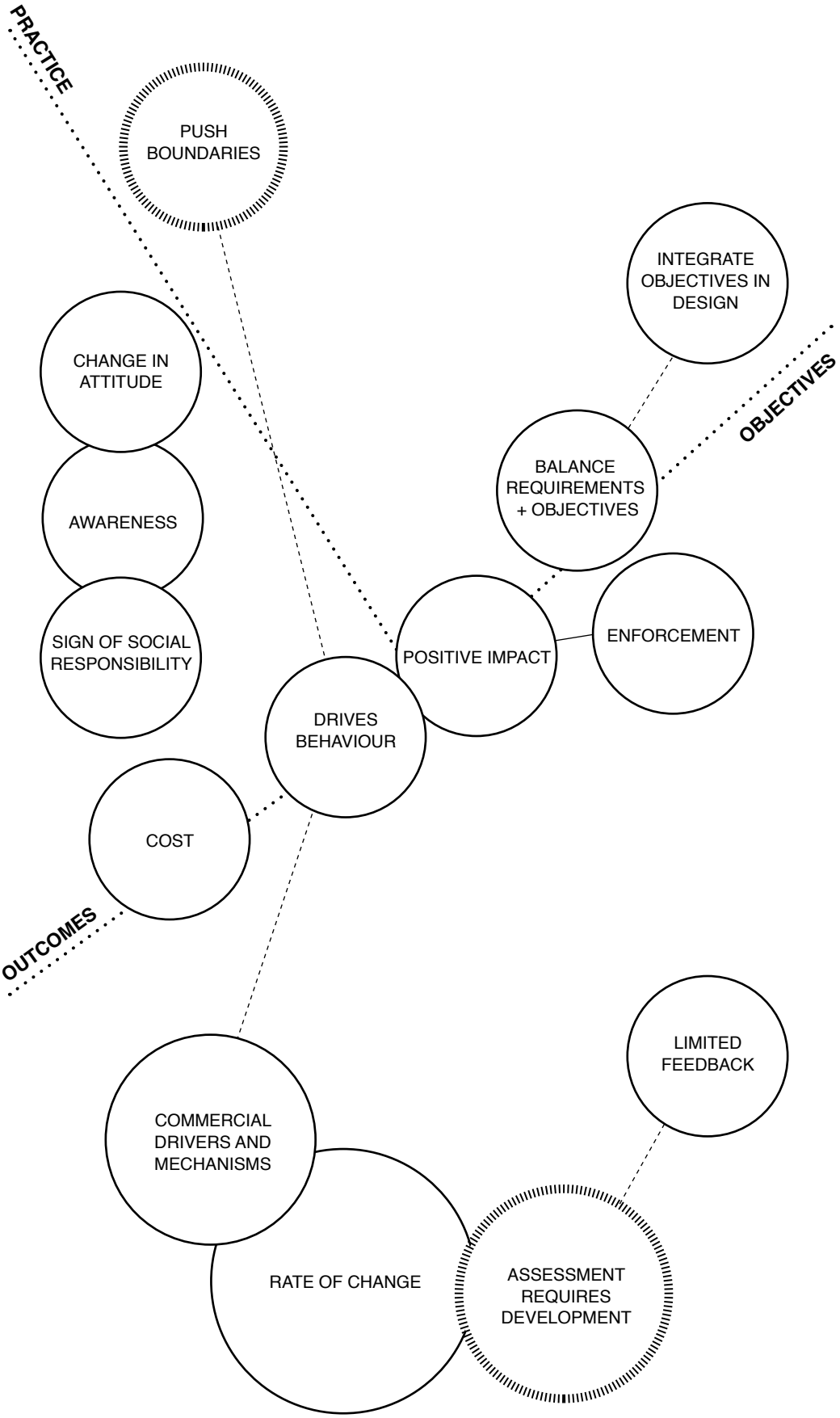
The indirect connection between benchmarks as a useful measure, and the drive to exceed benchmarking via enforcement, suggests that the enforcement of benchmarking might exploit the commercial nature of assessment and suggests that clients aim for high ratings because of the commercial value and publicity associated with it.

9.1.3 MULTIDISCIPLINARY PRACTICE

This section comprises two interviews from two directors at ARUP. The practice is “an independent firm of designers, planners, engineers, consultants and technical specialists offering a broad range of professional services” (ARUP, 2012). Amongst its many widely recognised feats in sustainable design is their role as consultants on Masdar City; a prototypical sustainable city on the periphery of Abu Dhabi. As an international practice its design schemes are often subject to LEED accreditation.

Although the sample is small, the practice is a leader in innovative and sustainable design, making the contribution invaluable.

9.1.3.1 ARUP: PETER BUDD



KEY

Proposal made by the participant

Theme concerning a statement about prevailing praxis

Themes discussed in relation to each other

Explicit links between themes

Implicit links between themes

OBJECTIVES

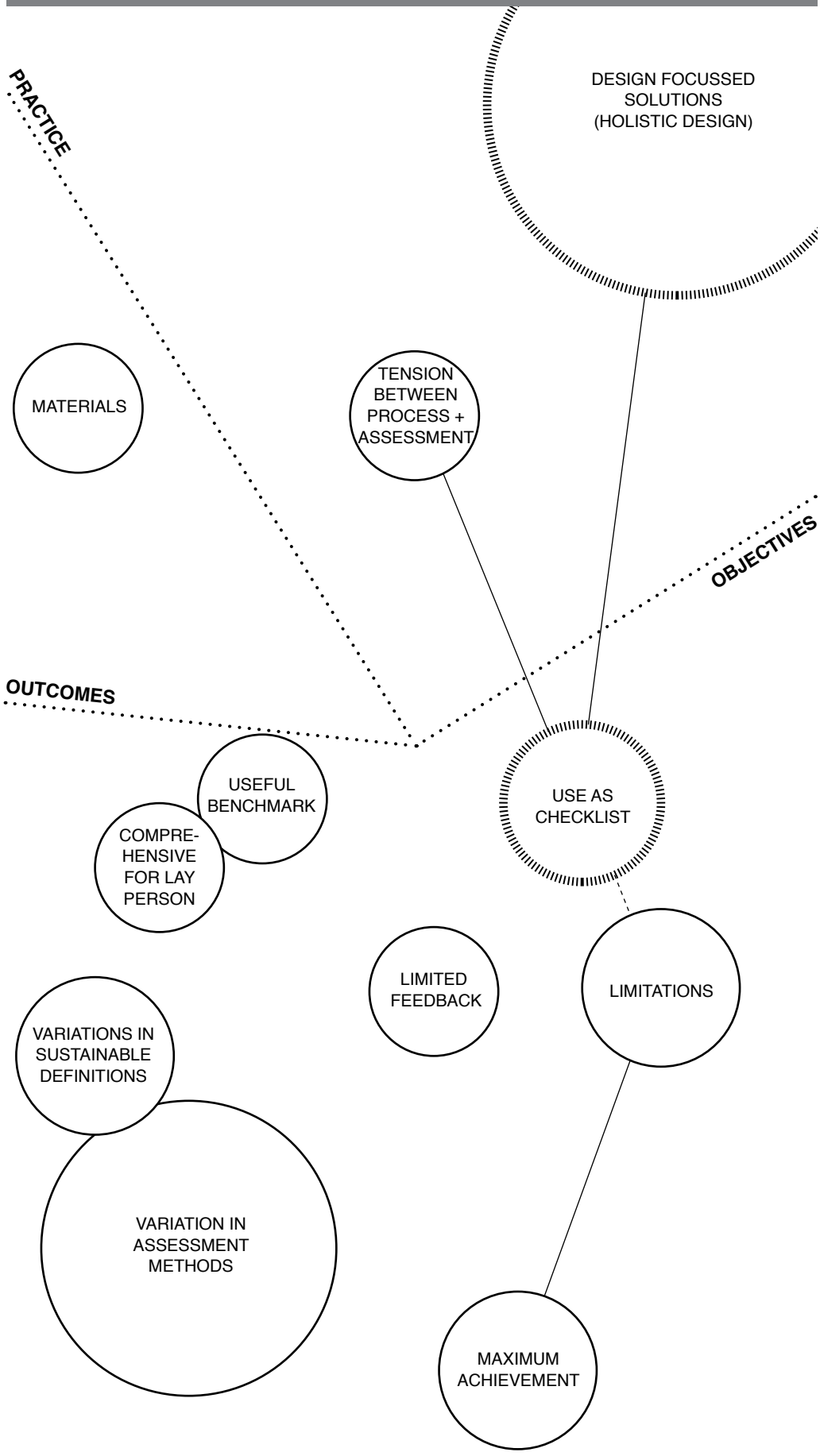
Indicates the proportion of themes focussed on practice, objectives and outcomes.

Reflecting on the popularity of assessment method ratings, Budd expresses that clients are increasingly becoming aware of the commercial value of environmentally sustainable buildings. With this he describes how “BREEAM and LEED is being actually built into [design] briefs” especially for “corporate clients who are building for themselves, whether that be Universities or large corporations.” This indicates that such benchmarking systems have the potential to assert the social responsibility of the client, as well as the ability drive behaviour through commercialisation.

The ability to drive behaviour is also inherent in design and Budd expresses this by describing ARUP’s philosophy that environmentally considerate design should encourage equally considerate use and occupation. Budd articulates that assessment methods have provided the means to evaluate how environmental performance is measured and as a result suggests that “the approach gives focus. It enables you to evaluate and compare schemes in a sensible way. [It means] you can compare the established best practice and you can measure compliance.” However, in order to be fruitful, assessment objectives have to be “introduced appropriately [...] it’s something that comes in right at the beginning of the design process and becomes itself a series of design determinates” that must be balanced with the clients requirements and objectives.

One crucial element to ensure the integration of assessment with design practice, is the development and improvement of assessment criteria parallel to developments in sustainable design knowledge. Budd suggests that “the [assessment] system has got to be dynamic, making sure that system becomes better and better year on year.”

9.1.3.2 ARUP: ALISTAIR GUTHRIE



KEY

Proposal made by the participant

Theme concerning a statement about prevailing praxis

Themes discussed in relation to each other

Explicit links between themes

Implicit links between themes

OBJECTIVES

Indicates the proportion of themes focussed on practice, objectives and outcomes.

9.1.3.2 ARUP: ALISTAIR GUTHRIE (cont.)

Ensuring that design is holistic and responds to both quantitative and qualitative issues, is of primary concern for Guthrie who suggests that it is imperative to begin a project by “thinking about what the best possible design might be; [taking] a holistic view of the building project and consider[ing] all the things that make for the best design possible on that site”, beginning with “considerations for orientation, natural ventilation, and carbon neutrality.”

Rather than informing design processes, Guthrie suggests that assessment criteria should be applied in their literal sense, with the design proposal preceding the intervention and application of assessment criteria. A holistic approach, Guthrie explains, would “aim to design carbon neutral buildings from the outset.”

Variations in what assessment methods measure is pivotal to understanding what they can offer. Underlining the fact that LEED is based on cost, rather than carbon, Guthrie indicates that while assessment provides useful benchmarks that are comprehensible, they also facilitate variations in the definition of sustainability. This can cause disconnections between important factors in design, and consequently reinforces holistic approaches which account for all perspectives. There is also a concern that in some areas of the construction industry, assessment methods can be seen as a maximum achievement. The limitations to what assessment methods measure (such as carbon or cost) emphasises that they are one of many contributors to sustainable design. To this end, Guthrie concludes that assessment methods “go a long way to encourage sensible approaches to design, the design should always take a holistic approach from the start because the assessment method doesn’t account for all aspects.” With this, he indicates that it is vital to develop assessment and objectives in such a way that encourages integrated approaches to design.

9.2 APPROACHES TO SUSTAINABLE DESIGN IN PRACTICE

Practice, objectives and outcomes are inherently interrelated. Practitioners adopt a number of approaches to design in order to integrate sustainability objectives in professional design practice. Three approaches in particular are revealed by this study;

- **Objectification**; the clear identification of objectives at the outset of a design project and the subsequent strategy making for delivering these objectives.
- **Communication and Collaboration;** bringing together stakeholders and the design team to establish appropriate and feasible outcomes.
- **Best Practice;** approaching design by focussing on the site and prospective users, and identifying how these conditions lend themselves to passive design solutions.

These approaches to the design process are by no means employed in isolation. Practitioners often describe elements of all three approaches in relation to the same design project, though some are employed with greater emphasis depending on the project drivers. Consequently, these variations often stem from the project type, the practitioners understanding of the client's perceptions of sustainability and design requirements as a result of this.

9.2.1 OBJECTIFICATION

Objectification refers to the manner in which objectives are integrated within the design process in order to facilitate compliance, rather than steer the design process. Depending on the project and the targeted level of accreditation, practitioners adjust the significance of the role of objectives. Higher targets tend to elevate the significance of assessment criteria. For example, Mike Hitchmough suggested that if "you're going for BREEAM outstanding, you can't afford to drop any points." As a result the design approach begins with a process of objective elimination, where credits that appear as wholly unrealistic are immediately

dismissed. The idiosyncrasy of design means that by default, there will always be some unattainable credits. The ability to determine the relative importance of credits, indicates that a working initial design must be in place, whether or not it is sketched, drawn or represented in any other format. The influence of objectives is then questionable, given that this appears to contravene the view that objectives and regulations are anathema to design (Ben-Joseph, 2005a). Instead, it reinforces the idea that the overall design scheme, perhaps with objectives in mind, is prerequisite to rigourous detailing and assessment.

Notwithstanding this, practitioners articulate that architects can become preoccupied with the finer details early in the project, which they note, can detract from 'the bigger picture'. Kal Gil-Faci describes it as "a checklist of things that your mind is automatically trained to start thinking about." This determines the need to focus on technical issues from an early stage in the project, which generates concerns over the domination of assessment criteria.

Identifying achievable criteria requires careful planning. Regardless of the project type (refurbishment or new build), the level of strategic planning relies on setting realistic requirements. Mike Hitchmough notes "the client's got to know from the outset what they want to achieve, whether they can achieve it, how realistic and viable is it? And once they've made their mind up, they've got to stick with it. But you have to know that from the outset because it informs more or less everything that you do."

9.2.2 COMMUNICATION AND COLLABORATION

Distributed decision making is at the centre of this approach. When practitioners discuss communication and collaboration, they describe it both as a mechanism independent and integral to achieving assessment method criteria. In the latter context, practitioners voice how objectives that incentivise collaboration can be abused. In such cases, rather than encouraging distributed decision making it can

result in increased project cost and ill-conceived design strategy. Practitioners that advocate communication and collaboration independently of assessment method objectives, refer to a way of practicing that endorses longevity as part of sustainability. The data suggests that in some project contexts, practitioners vehemently support collaborative working and the inclusion of end users in the design process as a means of generating the most suitable project strategy for the client, community and site.

Adam Chambers expressed the importance of involving anyone potentially concerned with a design project, early on in the process, otherwise “if you’ve issued information to go out to the contractor, you know it’s fixed, and then you have to start to look at if you can get points elsewhere.” He stressed the importance of “[setting] your targets early and [being] realistic about it, then everyone is aiming for the same goal.” This is also referred to as “capacity building”, and is a precursor to design in assessment methods. He stresses that “there’s much more of an impact in the design later on than there is if you’re working side by side all the way.”

Other themes of communication and collaboration include explanations of how the BREEAM process is geared towards appointing specialists during the production of a feasibility study. Without appointing the relevant specialists at the outset, it becomes difficult to ensure you achieve all the credits required to meet the standard aimed for. While this can be costly, Southworth & Williams note that “they’re [also] easy wins” in terms of scoring credits, but most importantly it is an approach that improves the design process, providing work is organised and conducted in tandem to ensure consistency. If these appointments aren’t in place and credits are missed, it is difficult to backtrack, “especially if you’ve issued information to go out to the contractor, you know, it’s fixed, and then you have to start to look to see if you can get points elsewhere” (Adam Chambers, FCB). Chambers also notes that benefits of the early involvement of a BREEAM

assessor in the design process “mean[s] that your awareness of what [is] going on, and the criteria you [have] to achieve, and the communication between you and everyone that is on board, is there from the outset.”

Practitioners clearly outline the value of consultation for strategy development. One principal distinction between practitioners dealing with BREEAM on a daily basis and those who deal with it less frequently is the parties involved in collaboration. Practitioners familiar with BREEAM demonstrate that other specialists and consultants are central to collaboration, whereas other practitioners express the value of information held by stakeholders and non-experts. Although BREEAM has mechanisms in place to ensure stakeholder consultation, the fact that practitioners do not draw attention to this suggests that such mechanisms are considered superfluous or subsidiary to the role of consultants and the technicalities of design.

9.2.3 BEST PRACTICE

Asking practitioners; *what techniques best facilitate sustainable design?*, unveiled tensions between the approaches they considered to be prudent and those driven by assessment methods. Adam Chambers observed that “you don’t really get many credits for [...] the base principles [of design].” It follows from this that professional acumen is critical to the delivery of sustainable design and in cases where the client is supporting, designers actively aim higher than objectives stipulate. Alistair Guthrie explained that it was best to “start off thinking about what the best possible design might be. We take a holistic view of the building project and consider all the things that make for the best design possible on that site. So, to begin ... we base the design on considerations of orientation, natural ventilation, and carbon neutrality. We aim to design carbon neutral buildings from the outset.”

Strategy is a further factor underpinning best practice. “Looking outside the red

line boundary" and "look[ing] at the wider context" or "the bigger picture" are all metaphors that support the procedures of best practice used by all types of practices interviewed. Central to a given strategy is the ability to identify dependencies and their implications. Equally, Mike Hitchmough noted "there's much more of an impact in the design later on than there is if you're working side by side all the way". Practitioners unanimously identify that strategies are not simply agendas to resolve environmental dependencies, but to recognise the effect of architecture and design on quality of life.

Quality of life was noted as a significant element of housing design. Mark Percival described it as "creating spaces for people to have decent quality of life in. Sustainability occurs in so many different areas [...] it's not just energy, it's actually making a house that's going to be good to accommodate the fluctuations of family time." Practitioners recognise that these considerations do form part of BREEAM and CSH, albeit in a quantitatively measured way. For practitioners this raises concerns about the subjective nature of these values; whether as a result of quantification they can be abused and that quantification may set standards and conventions for values that are typically qualitative and should be resolved by the designer in direct response to client and stakeholder requirements.

Objectives are often mistaken for strategies; when in fact they should be used as a checklist. As Alistair Guthrie intimated, it is important to have a strategy in place prior to assessing the scheme against objectives. From this perspective, the best practice approach follows a pattern of responding to context and requirements, involving detailed design as a secondary stage.

9.3 THE VALUE OF ASSESSMENT

The value of assessment refers to the way in which objectives are perceived by stakeholders as a measure of sustainable design and commercial value. Peter Budd stated: “I don’t think you can just rely on people doing the right thing for altruistic reasons.” With this he highlights the importance of objectives as for drawing attention to the cause. In line with this, Derek Southworth noted the commercial value of assessment, stating: “You need BREEAM, because it’s the only thing you can use to say you’re sustainable. It’s the only benchmark in this country that really has any street cred that gives you a sustainable badge.” Achieving the ‘badge’ is referred to by practitioners as a positive aspiration, but they also highlight that the intentions with which objectives are implemented can generate different outcomes.

The aspects of sustainable design practice highlighted in the preceding section are ancillary to sustainable design assessment methods. Practitioners depict two polar opposite ways in which different types of clients value sustainability assessment, these are;

- **Extraneous:** objectives are external to design and their benefits are either seen by clients as not conducive to sustainable design, or seen as too costly to pursue.
- **Indispensable:** objectives are crucial for demonstrating sustainability, and can be seen to have a number of additional benefits.

Paradoxically, where clients consider assessment to be extraneous to design, practitioners voice that the enforcement objectives would be beneficial. In contrast, where clients value assessment as indispensable, practitioners concentrate on ensuring that their best practice approaches are not restricted by objectives and that the design is not simply a response to the assessment method criteria. It follows from this that the relationship between the practitioner

and client is paramount to the delivery of sustainable design. The sections that follow explain in greater detail the reasons behind these perceptions and practitioners responses to manipulate them.

9.3.1 EXTRANEOUS

In dealing with bespoke housing projects, small practices identified that a lack of legislative impetus for objectives led to mixed beliefs amongst clients about the benefits of sustainable design for their approaches. Mark Percival's observations related to the public preference of tradition and convention, in terms of the formal and material qualities of housing. At this scale, affordability often dominates the concerns of clients. This is fuelled by the ability to secure a mortgage based on the proposed plans. Acknowledging these financial issues as a principal driver for self build clients, Percival suggests that there is a "time-lag between the people who you're borrowing money from and the acceptance of new building materials", which indicates that convention is deeply embedded in socioeconomic systems. This dissension highlights a cultural disconnection between the causal drivers of objectives and design outcomes, in addition to the market forces that influence preference.

Clients have a vested interest in the design outcome as an asset and typically try avoid any up-front costs associated with improving the design of their home in the long term. Lisa Raynes refers to a specific case in which investment was needed to upgrade the existing building envelope. Paradoxically, the client made cost allowances to ensure that a large area of glazing met thermal performance targets, including paying for the relative consultant to produce calculations to prove the design satisfied current building regulations, yet they declined to make any thermal improvements to the existing fabric. In this case, subjective spatial qualities appeared to be of greater value than any potential long term benefit in energy efficiency. Sustainable design has become associated with non-beneficial scope and increased cost. It is this view that leads practitioners

to suggest that certain sectors could benefit from stronger legislative impetus, but this is not to say that they indicate doing so would be synonymous with ‘good design’.

Objectives can also be extraneous for commercial clients whose business attitudes towards sustainability are incommensurate with the values of assessment methods. Southworth & Williams give an example of this where their client argued that “buildings are only 20%’ of their [business] outlook, 80% is the product.” In this case the business was predicated on delivering responsibly sourced products, and therefore the client discredited BREEAM assessment in favour of a broader sustainability strategy. From this perspective, a best practice approach prevails and through a well developed strategy architects often exceed environmental objectives, leading to implicit compliance with the regulations. An alternative way to consider this is that in certain commercial contexts, architects are provided with the opportunity to aim high in environmental standards, rather than perceiving limitations to creativity from the pressure to satisfy assessment rating criteria.

9.3.2 INDISPENSABLE

Practitioners themselves do not describe objectives as indispensable. However they do describe clients who acknowledge accreditation comes with added benefits and clients aiming for the highest levels of accreditation who view objectives as indispensable.

Referring to a BREEAM Outstanding building, Mike Hitchmough rhetorically questions “How much does it cost to go from excellent to outstanding?” With this he suggests that it is a common expectation that the added cost of accreditation is proportional to the level of accreditation met.

Three commercial benefits of assessment methods were highlighted from

the interviews, namely; social responsibility, marketing value and publicity. Reinforcing this, Peter Budd noted that the practice is “increasingly finding that clients who are commercially active, or for other reasons, are very keen for their projects to be seen as environmentally sensible and sustainable. [Consequently,] BREEAM and LEED is being actually built into their briefs.” Practitioners also indicate that this commercial impetus is not a phenomenon limited to the UK. From experience of international work, Budd stated that “it’s quite common to see both commercial and residential developments [...] all being marketed with their LEED grade; it really headlines on the marketing material.”

To counter the perception that additional scope and cost in relation to sustainable design are negative, one practitioner recounts how incurring additional up front costs is seen by some clients as a small price to pay for the publicity they receive from being identified as commissioners and users of a highly sustainable buildings. For these clients, accreditation demonstrates a company taking their social and environmental responsibilities seriously. The difficult question, Mike Hitchmough points out is; “what value does that [the assessment rating] have to the client? Can you put a value on that? If you can say your building is the highest scoring BREEAM building in the UK, or the highest scoring building for a business, then how do you put a value of the marketing power of that? How many newspapers will it be in? The Television?”

Whilst there is some suggestion that accreditation might be pursued as a symbol of social responsibility, practitioners also indicate that the marketing benefits of accreditation are more pervasive. In this context, one practitioner posed the question; are objectives being pursued with the intent to remedy a problem or as a secondary feature of commercial value?

9.4 TENSIONS IN COMMERCIAL PRACTICE

This section reviews the characteristics of design activities and the ways in which clients value sustainability assessment. It further explores the nature of value in design practice, specifically observing that practitioners reconcile different aspects of design practice in order to capitalise on the commercial value of assessment methods.

9.4.1 SUMMARY OF FINDINGS

The semi-structured interview approach revealed a rich source of data, which included practitioners experiences of implementing objectives for sustainable design. Content analysis was used to elicit themes in the data and thematic mapping was used to explore the relationship between these themes. The themes indicated two dominant elements affecting sustainable design practice, including; approaches to design activity and the value of assessment.

Section 9.2 reviewed three approaches to design activity that were observed in the data; objectification, communication and collaboration, and best practice. These are by no means isolated approaches to design and were often used by practitioners in varying intensities depending on the client and project circumstances. Accreditation is valued by clients as either extraneous or indispensable to design.

Depending on the extent to which clients embraced objectives, and how they demonstrated this, practitioner design activity responds through combined methods. The critical finding of this is that clients drive the way in which objectives are implemented. For example, where clients lay claim to the pursuit of objectives out of a need to attain accreditation for marketing purposes, implementing criteria becomes an ultimate goal. On the other hand, where a client's concern for objectives is the pursuit for publicity, then the building design becomes equally as important as objectives.

These scenarios require very different design strategies. The desire for publicity includes concerns for building aesthetics and thorough design justification, meaning that the practitioner engages best practice over objectification. A case in point would be a project described by Mike Hitchmough, where BREEAM accreditation was desired as proof of social responsibility, but the design process centred around the building users and creating a usable, adaptable, healthy environment. Where there is less of an interest in the building itself and its implications for users or the surrounding environment, it is suggested that design processes place greater emphasis on objectives. Clients who perceive objectives to be extraneous to design encourage practitioners to meet the targets as a secondary agenda, but in an equally target driven manner.

9.4.2 CLIENT - DESIGNER RELATIONSHIPS: SPEAKING THE LANGUAGE OF VALUE

Practitioners describe objective led sustainable design practice as a process of dynamic conflict: they are constantly seeking to understand the ways in which clients value accreditation, in order to deliver a best fit solution, but best endeavours can often seem to be displaced in light of the commercial value of assessment. The relationship between the client and the designer is therefore central delivering sustainability. A number of practitioners noted that their role involved educating clients about the processes and outcomes of sustainable design. Establishing good rapport with clients is therefore paramount to establishing a balance between how clients value objectives and design.

This leads practitioners to argue for the enforcement of objectives to encourage higher building performance standards in bespoke housing. Cost is a primary concern for clients of such projects, meaning that the design challenge is to balance client aspirations with minimal up front expenditure. Such views are often dictated by mortgage lenders and the influences of the wider property market. Aligned with this, the clients' design requirements tend to be heavily weighted

towards the layout and use of internal space, in addition to internal cosmetic finishes. Practitioners explain that expenditure on the building shell appears to be a secondary consideration to these clients, and therefore practitioners in this field tend to advocate legislative enforcement as a mechanism for ensuring the long term improvement of housing stock.

A contrasting example of a commercial project reveals that clients often capitalise on the marketing potential of accreditation. From this perspective, practitioners begin to identify different ways in which objectives can be used as a measure performance as part of a balance amongst other design drivers, or as an imperative design driver, which they suggest can happen, but this paradoxically challenges the social and cultural integrity of design as well as the longevity of the buildings use.

The greatest challenge for architects is to assist clients and users in the post-completion stages in order to ensure that occupational activity aligns with design intent. Peter Budd articulates: “Occupant behaviour is absolutely fundamental, because you can completely lose the basic design principles”, therefore it is incumbent on the design team to, “make sure that the information that the occupiers need to operate the building properly are actually passed on in a sensible way.” BREEAM Outstanding requires post-occupancy studies that evaluate how the building performs. Practitioners advocate this with the added benefit that it allows them to study the success of building hand-over and occupant operation, and fundamentally, to tighten the gap in knowledge development. Such processes extend the practitioners central role in the coordination of the design team and knowledge.

The different approaches to design activity demonstrate that the practitioner’s role in sustainable design is to reconcile the perceptible value of assessment criteria with the tacit value of the qualitative factors of design. This resonates

with recent discourses on the need for *alternative currents* in practice (see Fisher, 2008; Till, 2009; Till, et al., 2011), particularly ones that respond to the ecological and economic challenges represented by Buchanan (2011, 2012a, b, c).

Practitioners are in support of assessment methods. They argue that without a measure it is difficult to ascertain whether the volume of sustainable buildings is increasing. Despite this, conflicting views about the efficacy of assessment methods were revealed by tensions between practitioner design acumen (best practice) and the need to provide hard evidence for environmental performance. This is the nature of the practitioners challenge; to act in the capacity of an intermediary and reconcile the client's aspirations and values with the best outcome for the project.

9.5 CONCLUSIONS

The interview findings suggests that there are limitations to assessment methods for practices operating the in the commercial sector, these limitations are insignificant in relation to the commercial value it brings for clients. For smaller practices, working for individual clients, property value is unaffected by accreditation. Here the limitations to design are rudimentary in that, with an approach better integrated in design and a professional practice structure to support it, legislation could set the precedent for a shift in values.

Overall, it appears that design practice is dependent on accreditation to indicate conscious sustainable design, although some practices would exceed targets without referring to it. This reinforces the view that codes and regulations are "part of a non-creative process, somehow removed from architects' practices (or the practices of architecture)" (Imrie & Street, 2011: 7). Parallel with Imrie & Street's (2011) findings concerning the relationship between building regulations and architects' practices, the findings of these interviews suggest that assessment methods for sustainability are integral to the practices of architecture. This is evidenced by the way in which practitioners embrace the values of objectives in addition to the client's aspirations and values, yet manage design approaches to improve the opportunities available within them. In view of this, objectives appear to influence the design styles of experienced practitioners, who could be said to adapt and respond to their given circumstances in order maximise the design potential of the project. These reflexes appear to be sensitive to the way in which clients value the delivery of the commission. Consequently, styles of design practice are practitioner responses to the need to reconcile objectives with best practice approaches.

One significant aspect that this exposes, is that the relationship between regulation and architects' practices is not simply a question of potential conflict between the structure of regulations and the structure of design processes.

Rather, it is a question clouded by the demands and requirements of other stake holders in the design process, particularly the client. For practitioners, there is a sense that the determinacy provided by objectives is often a gratefully received measure which can be used to demonstrate the value of architecture. It is not always interpreted this way by clients, and instead the value of the bench mark is elevated, rather than the skill of the design team in conceiving and delivering a sustainable outcome.

Styles of design practice appear to be influenced by objectives regardless of whether they are a fundamental part of the design project or not. This is illustrated through the approaches to design activity described by practitioners in section 9.2. Objective approaches described ways in which objectives need to be integrated in the design process. This might apply to projects that are disconnected from objective measures, and may be a way for practitioners to ensure they deliver sustainable designs for disinterested clients. Communication and collaboration were said to provide a means for distributed decision making and responding to conditions on the ground. This refers to the way in which working organisation can facilitate design as much as the input of prospective occupants. Employing professional acumen and pursing best practice in design is a necessary approach. This approach is significant when objectives appear to contradict best practice, for example where deeper floor plates that marginally contravene day lighting criteria are employed with adaptability and flexibility in mind.

That these approaches appeared to be used with varying intensities in order to optimise a given situation, seems to suggest that they are a product of the commercial value of objectives. This concerns how much emphasis clients place on objectives in relation to the commercial value they perceive accreditation has. It follows from this that approaches to design practice are methods of reconciling the values of objectives and design.

One of the root causes of this might be a disconnection between the creation and implementation of objectives. This is emphasised where the assessment procedure was described in parts as linear, rigid and a checklist, and that there appears to be limited opportunity to provide feedback on the implementation of assessment.

Feedback and measurement are interrelated. Feedback is the ability to express experiences for the purpose of developing assessment methods such as BREEAM, in addition to more a general understanding of best practice in sustainable design and the objectives it might entail. It might constitute what Frayling (1993) coins; 'research into design', or more explicitly, research into the design process, specifically to evaluate the implications of objective implementation.

Interviews suggested that little feedback was possible for a number of reasons, but principally that practitioners were limited by the issues that they could provide clear and persuasive evidence for. Those who alluded to the possibility of providing feedback, suggested that a practice might have to be either commissioned separately to do so, in which case the subject of feedback was predefined, or have the capital to invest in their own research. Catherine Cosgrove noted that feedback required "technical data to back up the case", and in some cases architects would not be qualified to comment on technical issues. This latter view aligns with the self-perspective of BRE: on being asked to participate in this study by telephone call to BRE Global, their response was that as the producers of the assessment method objectives they were not qualified to comment on how the methods were implemented in practice. This suggests that BRE embeds a clear distinction between the technicality of objectives and the practicality of implementation, which indicates a disconnection between the technical agendas assessment methods are portrayed as, the procedures through which technical agendas are implemented, and the types of problems

practitioners face, including issues of procurement and facilitation. The emphasis on quantitative measurement suggests that only the technical, quantitative logic of assessment is valid.

As a consequence of the limited ability to feedback to the sources of assessment methods and objectives, cases of in-house, post-project review were highlighted in addition to collaboration with alternative disciplines to externalise knowledge. This suggests that a body of knowledge is being developed by practices in response to the divide between production and implementation of objectives, but that there is little opportunity to capitalise on this, or indeed inform the way in which objectives and practice evolve.

10.0 CREATING OPPORTUNITY WITHIN COMPLIANCE

This chapter summarises the studies presented in chapters 8.0 and 9.0 and compares the findings in relation to the two different design settings (and therefore level of design experience) of education and practice. Reflecting on issues of integration and feedback raised by practices in the interviews, the chapter contextualises the findings of the studies in the arena of contemporary architectural practice. This context is the cause for investigation about how the architectural profession should develop in parallel with prevailing social, economic, political and technological conditions (see; Building Futures, 2003; Building Futures, 2011). The chapter is set out as follows:

10.1 Research Summary

Provides a review of the research and findings.

10.2 Distinctions Between Education and Practice

Compares design lab and interview findings, looking in more detail at the structure of design problems in light of findings that reinforce the view that architecture is contingent on objectives for sustainable design.

10.3 Creating Opportunities

Reviews the way in which objectives are valued in the prevailing litigious society and examines the opportunities for architects within this. The section concludes by illustrating that academia and practice might be reconciled by two approaches that are driven to support the profession of architecture.

10.1 RESEARCH SUMMARY

For clarity, this section provides a brief review of the findings of the design labs and interviews.

10.1.1 REVIEW: DESIGN LABS

The design labs revealed three factors about the way in which participants represented their design projects in design reports:

- Participants coupled issues of sustainability at the outset of the design process, thereby **framing the design problem** as one of the following; socio-spatial, socio-economic, socio-cultural, eco-spatial, eco-technical. This is not considered a comprehensive list, but the themes evident in the data.
- Design projects conveyed a **solution or context focus**, meaning that some projects appear to 'treat the symptoms' by focussing on previously successful solutions, while other appear to 'search for the cause', by examining the proposed context for intervention.
- Design reports appear to follow **iterative, compositional, or observational sequences**. Sequences describe the way in which information and its influence on the resulting design scheme unfolds in design reports. An iterative sequence indicates that the design report appeared to present iterations of the same themes, which recurred in the design scheme. In a compositional sequence, design reports presented collections of information which were customised and reconfigured in the resultant design scheme. The observational sequence appears to be more commonly associated with context focussed design projects and illustrates greater critical analysis and interrogation in response to contextual problems.

Comparing the differences between the two levels of design experience, novice designers and new professionals, a number of differences in the design reports

could be seen:

- New professionals presented design reports with greater **report consistency**: Information was broken down into a comprehensive form that, in most cases, legibly lead on to the resultant design scheme.
- By comparison to novice designers, new professionals typically appeared to have superior skills in **critical analysis** and a more explicit awareness of the conceivable implications of design.
- Novice designers and new professionals appear to be largely **contingent** on pre-tested approaches to sustainable design in order to justify their design decisions and highlight the feasibility of design.
- Experience, demonstrated through design report consistency, critical analysis and the awareness of implications, appears to assist new professionals in finding opportunities in design.

The following conclusions can be drawn from these findings:

- Designers in education present pre-tested conceptions of sustainability.
- Pre-tested conceptions of sustainability provide contingency.
- Sequences represent different levels of dependence, with observational sequences being least dependent and iterative sequences being most dependent.
- Experience appears to be a function of being able to identify opportunities within the determinants that provide contingency.

10.1.2 REVIEW: INTERVIEWS

The descriptions of practitioners experiences from the interviews unveiled a number of approaches to design activity, which practitioners highlighted as significant for integrating objectives in design practice. Practitioners proposed that the following approaches were key to ensuring sustainable design:

- **Objectification:** the identification of objectives and requirements at the outset, and subsequently identifying strategies for achieving these in the context of the site.
- **Communication and Collaboration:** bringing together stakeholders and the design team at the outset to establish the best and most feasible outcomes for the parties involved.
- **Best Practice:** approaching the project from a best practice perspective, beginning with the site and prospective occupants and users, and identifying how site conditions may lend themselves to passive and energy efficient solutions to design.

Further to this, practitioners intimate that the way in which clients value accreditation has a strong bearing, not only on their requirements, but how they value the resultant design scheme. The way in which practitioners discussed objectives suggests that clients value sustainable design in the following ways:

- **Objectives are extraneous;** they are external to design and their benefits are either seen by clients as not conducive to sustainable design, or seen as too costly to pursue.
- **Objectives are indispensable;** they are crucial for demonstrating sustainability, and can be seen to have a number of additional benefits.

These attitudes appear to influence the way in which objectification, communication and collaboration, and best practice are employed by practitioners. For example, faced with clients who consider assessment objectives to be extraneous to design, Mark Percival suggests that “the pre-assessment [...] should be mandatory for all projects, because it illustrates that you’ve thought and considered it.” Where objectives are considered indispensable, practitioners ensure that they incorporate social responsibilities in addition to the environmental ones set out in assessment method objectives.

Practitioners hold different views about how rigorously they consider such measurements for sustainable design should be enforced in each of these cases. They explicitly express their support for assessment methods however, they also contest aspects of its determinacy, especially where it influences design processes. There are a number of conclusions to be drawn from this;

- Themes discussed in the interviews appear to align with the current consensus in the literature, which is that architects' practices are dependent on regulations and objectives (amongst other things such as professional conventions and social constructs). However, in many 'best practice' cases practitioners seek to deliver high environmental standards that implicitly comply with regulations.
- Contrary to the observation that practitioners resist dependency (see; Till, 2009; Cuff & Wreidt, 2010), this study suggests they embrace dependency, yet adopt design approaches that specifically aim to open up opportunities within them.
- In effect, practitioners behave diplomatically in order not to devalue the determinacy of such objectives, but in doing so this could be at the cost of devaluing architectural services.

10.1.3 ALIGNING FINDINGS

What do the combined findings of the design labs and interviews say about the implications of sustainable design objectives for design practice? Fig. 10a illustrates the relationship between the research findings and conclusions. Organising the findings in this way confirms the dependent relationship between design and objectives, and suggests that experience plays a role in how this dependency is managed. This understanding stems from the differences between the presentation techniques of novice designers and new professionals, and also by the way in which practitioners describe how they employ different approaches to generate a sustainable design scheme.

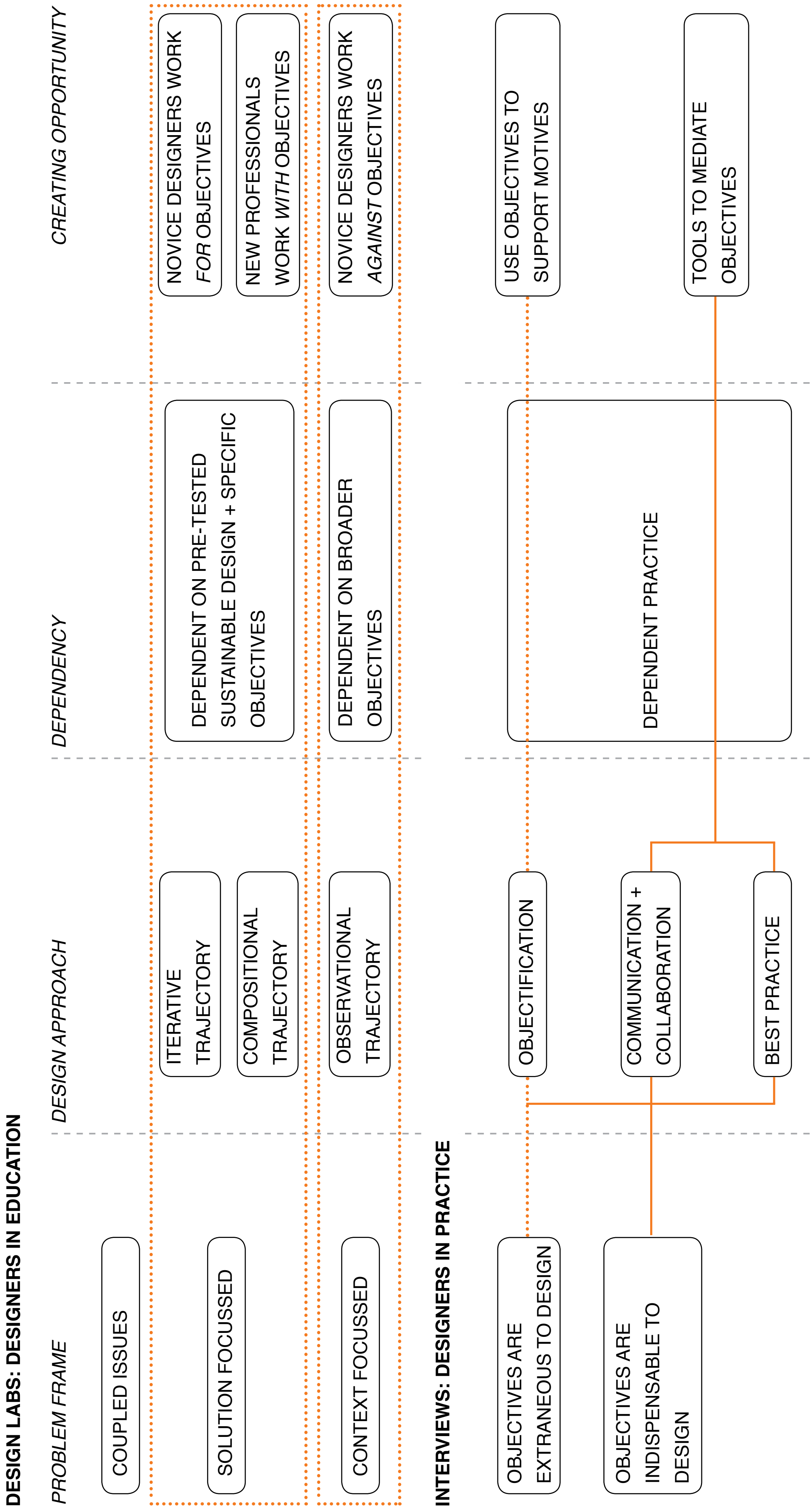


FIG. 10a
The diagram shows how different levels of experience unveil different techniques in managing contingency which are the result of different design approaches and specifically in design labs, a result of the clarity and brevity with which design reports were presented.

10.2 DISTINCTIONS BETWEEN EDUCATION AND PRACTICE

There are a number of similarities in the way in which designers in education and established practitioners manage dependency through approaches to design. In this section these will be discussed in light of the distinctions between the methods used to collect data and the three areas of comparison set out in the objectives of the thesis, as follows (also see section 1.2):

- **Problem Framing**; how design projects are initiated and briefs developed, taking specific note of the themes explored by designers and how they characterise sustainability.
- **Design Approach**; the methods used by designers to navigate design problems and deliver solutions.
- **Dependency**; whether designers are contingent upon objectives in the way that they frame problems or the design approaches they take and the types of objectives that designers are reliant upon.

10.2.1 PROBLEM FRAMING

One primary distinction between designers in education and established practitioners is the origin of the design problem. Designers in education are required to frame their own design problems. In practice, practitioners are presented with design problems by clients (Lawson, 2006). Established practitioners are subject to professional and commercial conventions. In education there is greater scope for polemical investigation and response, which stems from the pedagogical conviction that “to be really professional, [architects need] to conceive of problems of their field from an overall theoretical perspective; and that this [can] be best achieved in a setting that encourages abstraction and the analysis of hypothetical as well as real-life situations” (Gutman, 2010b).

For designers in education, the self-definition of the design problem meant that

participants were faced with wicked problems. Paradoxically, they were also at liberty to frame the problem in whatever way they thought appropriate. The design reports revealed that design lab participants tended to couple themes to provide context for design intervention. In contrast, practitioners were faced with problems in which the typology of the outcome is prerequisite. These problems are still wicked problems as sustainability is chimera (Biddulph, 2012) and requires the skilful management of client and user uncertainty and expectation:

> "Sustainability is an emergent property of appropriate interactions and relationships among active participants in the complex cultural, social, and ecological processes that constitute the twenty-first century"
> (Wahl & Baxter, 2008: 82),

This sets out a primary distinction between the problem frame for designers in education and practitioners. Established practitioners do not explicitly discuss the way in which the problem is framed (Lawson & Dorst, 2009), which is a product of the different methods of inquiry used, in addition to the distinctions between design practice and design process. Practitioners discuss problem frames in terms of objectives, whilst novice designers and new professionals communicate context or solution focussed proposals. Thus, practitioners' descriptions are more akin to problem structures than problem frames. This distinction bears some relation to Cuff's (1992) decision making and sense making dialectic. Problem frames are distinct from problem structures. The latter refers to how the relationship between problem components are defined (as discussed in chapter 5.0). The former (typically) refers to visual representations of the themes participants are responding to.

10.2.2 DESIGN APPROACH

The ways in which the data conveys design approaches is a product of the methods used to elicit the data in addition to the environment in which design

took place. Asked to produce design proposals during a short design project, the design approaches of novice designers and new professionals demonstrate the process of generating a proposal, informed by preparatory studies including desktop research. Questioned about the use of objectives in design practice established practitioners contrastively convey design approaches in relation to how they employed and implemented objectives in specific projects.

O*servational sequences* demonstrated by designers in education (see section 8.4.3.3) and *best practice* noted by practitioners (see section 9.2.3) share in common a moral endeavour to identify the core problem, rather than treat the symptoms. Observational sequences searched for core issues, and adapted ways in which those issues could be addressed through interdisciplinary exploration. Best practice approaches capitalise on passive technologies to respond in the least environmentally intrusive way to internal and external constraints (Lawson, 2006).

Iterative sequences (section 8.4.3.1) and *objective approaches* (section 9.2.1) are similar in that they focus on particular benchmarks to guide design, which are products of experience in addition to the environments that the two types of designers operate in. This is evidenced by findings which suggest iterative approaches are more common in the design reports of novice designers, and also by the fact that practitioners typically provide a service that responds to objectives (adopting them as a benchmark of design value as will be discussed in the following section), rather than challenging them, or indeed sharing insights that lead to new developments and improvements in objectives and the broader assessment method framework.

There are important similarities to be drawn between the *compositional sequences* of designers in education (see section 8.4.3.2) and the *communicative and collaborative approaches* of practitioners (see section 9.2.2). Whilst

designers in eduction resolve conflicts between normative sustainable technologies and forms in order to develop an appropriate solution, practitioners describe establishing design strategies through the tacit information of clients, stakeholders, occupants and other specialists and consultants. Designers in education may also have also operated in a communicative and collaborative capacity where design projects were undertaken in groups. However, the nature of the ex post facto study, in particular the self-directed nature of design development, means that group dynamics were not observed.

There are, however, two principal distinctions here. Firstly, the currency of the information with which designers in education and practice are dealing. Secondly, they way in which this information is then employed to develop a scheme proposal. The latter is manifest in experience and potentially the differences between conceptual design (in education) and live projects (in practice).

10.2.3 DEPENDENCY

Both designers in education and practice indicate signs of depending on benchmarks to provide a measure of the design intervention. For designers in education such benchmarks justify that they have met the marking criteria. Practitioners link benchmarks provided by assessment methods to the value of their services and provide clients with a comparable account of the credentials of the design scheme. Dependency, however, takes different forms, subject to the experience of the designer.

The requirements to teach elements of sustainability set out in the EU Directive on the free movement of professionals within the EU (2005/36/EC) are distinct from the requirement to meet a number of performance criteria in practice. The directive incorporates sustainability as a key feature of education, whilst meeting assessment method criteria in practice is a contractual or legislative obligation. The objectives manifest within these requirements are also distinct:

requirements to teach educational criteria indicate that graduates must have a good knowledge of the elements that comprise sustainability. This is informed by social constructs of sustainability, which have varying influence depending on the values of the institution and how they are integrated within the course curricula. If the mechanisms for this are embedded in active design investigation and exploratory studies, then the knowledge accumulated may be distinct from that acquired through a lecture series and examinations. Most courses demonstrate a mixture of the two at different stages during the course of education (Altomonte, 2012a). However, in the context of this inquiry, designers in education were asked to develop sustainability constructs through exploration and active design investigation.

With the greatest frequency of iterative sequences, novice designers demonstrate their inexperience through their strong dependence on social constructions of sustainability. It appears that through iterative sequences they demonstrate a semiotic approach to sustainability - using signifiers from established precedents to the point of simulacra. By comparison, the greater experience of new professionals means that their developed specialist knowledge aids selectivity of the benchmarks against which they are dependent. Established practitioners evaluate their work in relation to prevailing trends and breakthroughs in the industry, a context in which BREEAM leads (Parker, 2012).

Novice designers, new professionals and established practitioners alike, demonstrate that it is useful to have a source against which designs can be measured. For designers in education, marking criteria takes priority over sustainability objectives, which dominate practice benchmarks, but also as less experienced designers, they appear to be more contingent on precedents to lead by example. This reinforces the relevance and benefits of benchmarks for designers of any level of experience.

The dependence of designers on normative technologies and forms associated with sustainable architecture also reinforces the master-signifier, which detracts from further investigation into the evolving construct of sustainability and the new approaches and forms of design this could deliver.

10.3 CREATING OPPORTUNITIES

> "The necessary shift towards, more appropriate and sustainable modes of participation requires that design and education contribute to widespread increase in social and ecological awareness through transdisciplinary design dialogues."
>
> (Wahl & Baxter, 2008: 82)

Creating opportunities within compliance refers to the ways in which designers appear to diffuse the focus of objectives in order to establish the best all round design outcome. It is clear that sustainability is a wicked problem and that design practice needs to adapt and respond to this multidimensional dynamism. Dividing the factors and causes and considering their implications in isolation of the broader problem is one reason that current regulatory devices for sustainable design are dismissed. As Wahl and Baxter (2008) note, generating new ways with which to respond and adapt to wicked problems, requires participatory and transdisciplinary approaches. One of the first places to begin, is embracing the dualities of the profession and looking for ways in which to capitalise on these, rather than allowing them to facilitate tensions which detract from the key issue of generating sustainable architectural and urban form.

Notwithstanding the dependence of designers on normative technologies and forms associated with sustainable architecture, or that some established practitioners argue that such dependencies are constraining, *observational sequences* and *best practice approaches* suggest that some designers actively seek out opportunities within these constraints.

It is important to note that, because the design lab participants in this study were not obliged to meet a series of objectives, the resulting sequences are wholly determined by participants, and rather than being confined by objectives, some chose to justify their designs though the imitation of precedent forms and

technologies. Following a path of dependency, whether or not this is a conscious decision, reveals the power of social constructs of sustainability arising from convention (Guy & Moore, 2007).

Approaches that indicate the creation of opportunities within compliance is analogous to the difference between participants wishing to train in the design profession, and those wishing to explore the design territory with a view to questioning conventions and offer new insights. Participants who followed an observational process, seemingly chose to question conventions and explore the context to see if a better response to the self-defined brief could be found. Notably, participants who did this focussed on the overarching UK target to reduce harmful emissions by 80% by 2050 (Climate Change Act, 2008). This target is important, because it provides an overall sense of direction. It is noteworthy that despite this being a principal objective at the outset of almost all novice designer reports, the majority did not lay claim to meet this target, even partially. Rather, those that did not make claims to this, made links to constructs that connect wellbeing to social and environmental improvements, thereby reflecting the division between measurable and qualitative regulatory devices.

In contrast, the nature of architectural practice means that the selections made by practitioners are constrained to employing best practice processes, and subsequently delimiting the objectives that they consider achievable within the project requirements, context and budget. Identifying objectives in such a way is a recurrent theme throughout the interviews (see for example, Fielden Clegg Bradley Studios and 3D Reid in section 9.1.2). Outlining the parameters for design in this way generates opportunities for intervention.

Practitioners suggest that objectives predefine certain aspects of design, yet simultaneously demonstrate the skills and knowledge that have the potential

to create opportunities within these issues. Novice designers, as the least experienced, were anticipated to display the weakest characteristics of this. Whilst this is largely true, anomalies disprove this hypothesis in select cases. Professional conventions in architectural practice can be equally constraining: the active agendas of established practitioners to implement best practice within compliance, suggests that scenarios exist where design precedes convention and is post-rationalised to accommodate project and professional requirements.

The findings of this research advocate the well documented hypothesis that initiating dialogues is key to delivering sustainable architectural and urban form. It has shown, as others have, that regulatory frameworks are in fact integral to architects' practices and support the initiation of transdisciplinary dialogues (Imrie & Street, 2011). Whilst there is significant encouragement to promote and integrate transdisciplinary design dialogue for sustainability (Culter, 2009), the research findings of this thesis suggest that a more integrated dialogue in architectural practice needs to be manifest in order to reconcile the values of the profession. This is not to suggest that the dualities of the profession should be neutralised per se, but that they should be embraced and utilised to give rise to new modes of operation.

On this basis, this section outlines primary recommendations that are intended to reconcile the profession by synthesising disparities between education, practice and research. Ultimately this is intended not only to accept and facilitate different modes of practice within the profession, but also to integrate the production and implementation of regulations for sustainable design.

10.3.1 EDUCATION

Paradoxically, it appears that the dependent nature of sustainable design practice is intensified in the work of designers in education and with some exceptions they also show the least capability to critically analyse problems.

This appears to be a product of design experience, yet it amplifies the already established need for new pedagogical approaches to deliver better sustainable design education in architecture (Altomonte, 2012c).

There are three aspects to education: the institution, the curriculum and the delivery of education (Altomonte, 2012c). Within the context of the findings of this thesis, the delivery of education is at the crux of this dilemma. This stems from the dependence, observed in designers in education, on precedents and normative approaches to sustainable design. To encourage students to explore the nature of the problem, rather than address the symptoms, critical analysis needs to be promoted and encouraged.

10.3.2 PRACTICE

The commercial value placed on assessment method benchmarks by clients and stakeholders, added to the way in which architects respond to commercial demands, suggests that accreditation is more valuable than the formal attributes of architecture and any benefits it may have. This suggests that a connection between the currently disparate activities of the production of regulation and the implementation of it, needs to be established.

The goals set by objectives are subject to constant development and refinement in line with new research and technologies, however, this thesis proposes that the objectives themselves only account for one part of the regulatory process and it is observations of the way in which objectives are implemented that can also lead to innovation in the production and delivery of sustainable design.

10.3.3 RESEARCH

That regulations can expose contradictions does not necessarily have to be considered a barrier to best practice, providing that there are mechanisms in place to explore and analyse these contradictions, in order to develop ways

to resolve them, or open up areas of design requiring further investigation or a change in approach. At the core of the recommendations for education and practice outlined above is a requirement which echoes Fisher's (2010) argument for an integrated knowledge loop in the architectural profession.

Fisher (ibid) describes that unlike other professions, the dualities of the profession distance practice from academic research and in some cases education, despite a number of practitioners being committed to both teaching and practice [12]. In other professions, practice is directly linked to academia and education, and as such, when further knowledge is required in practice, researchers and academics establish inquiries to seek out the relevant knowledge. With this knowledge loop missing in architecture, the conditions requiring further research are often left undisclosed as practitioners often proclaim there is little time for research in practice.

It follows from this that making changes to the profession which facilitate a stronger knowledge loop, ideally one that encourages transdisciplinary review as Austin-Smith:Lord do (see section 9.1.2.2), has the potential to reconcile disparities in the profession and provide an informed context for the production and implementation of regulations in practice.

[12] The disconnection between practice and education lies between the curriculum and practice, rather than pedagogy and practice.

11.0 CONCLUSIONS

This thesis has explored the implications of sustainability for architectural education and practice in order to:

1. Develop an understanding of how sustainability is tackled in non-commercial design practice, where creative processes are liberated from the requirement to meet specific objectives in relation to sustainable design.
2. Explore how sustainability objectives are managed in commercial practice and, in particular, how practitioners perceive the implications of sustainability objectives for design outcomes in this context.
3. Examine the differences and similarities between creative processes and commercial practice to provide descriptions of how designers manage the requirement to produce sustainable designs in creative and commercial contexts.

11.1 A REVIEW OF THE RESEARCH OBJECTIVES AND HYPOTHESIS

In response to the question; *What are the implications of sustainability for design as both a creative process and commercial practice and what drives these implications?*, this thesis has elicited a better understanding of how *problem framing*, *design approaches* and *dependency* materialise in the design projects of designers in architectural education and practice. Through the comparison of designers of different levels of design experience, the thesis formulated a better understanding of the duality of the architectural profession that characterises the distinction between design activity and project delivery in architectural practice.

The overarching hypothesis of this thesis was that objectives are a burden on creative processes, and yet are facilitators in to the distributed decision making of commercial practice. This hypothesis was tailored to the range of levels of design experienced involved in this inquiry as follows:

- **Novice designers;** interdisciplinary designers without professional experience were expected to demonstrate design projects that are uninhibited by professional conventions and deliver designs that are unhinged from specific obligations to meet sustainable design objectives.
- **New Professionals;** it was anticipated that the intermediate position between professional practice and academic education may expose some conventions and preferences of practice, but also engage with the freedom provided by the academic setting to explore theoretical positions and operate in the fringes of architecture.
- **Established Practitioners;** objectives were expected to be a central focus of practitioner activity and with a lengthy experience of architecture, working towards specific client requirements whilst following practice conventions and working as part of an interdisciplinary design team, established practitioners were expected to be confined by them.

Explorations into the implications of sustainability objectives for design to date have principally concerned design solutions and building performance. Therefore, the purpose of this research was to begin to unpack the implications of objectives for design practice, with a view to identify future avenues for research that can assist the development and improvement objectives and practice combined.

11.2 EVIDENCE OF SATISFYING THE RESEARCH OBJECTIVES

Objective 1: Develop an understanding of how sustainability is tackled in non-commercial design practice, where creative processes are liberated from the requirement to meet specific objectives in relation to sustainable design.

Chapters 2.0 - 5.0 outlined four incremental narratives that build up a picture of the construct of sustainability and the limitations that emerge from its practical application through policy mechanisms, subsequently illustrating how, when integrated with the dualities of architectural practice, these mechanisms appear to have equally disparate implications. The four narratives are as follows:

- Sustainability is an evolving construct which reflects the social and environmental conditions it operates in, however, policy agendas encourage a narrow and deterministic view of sustainable design.
- Guidance and regulations advocate that design is significant in delivering sustainability to a greater or lesser extent.
- Regulations are shown to be auxiliary in design practice, yet detrimental to creative design processes.
- The structure of objectives is analogous with that of rational design methods, which are incommensurable with wicked design problems and have therefore been discredited for limiting creative processes.

Objective 2: Explore how sustainability objectives are managed in commercial practice and, in particular, how practitioners perceive the implications of sustainability objectives for design outcomes in this context.

Chapter 7.0 described a qualitative inquiry, divided into two methods which correspond to three different levels of design experience. The different levels of

design experience included novice designers, new professionals and established practitioners. The two methods of inquiry were designed to generate a better understanding of the implementation of sustainability objectives in education and practice and therefore reflected the distinctions between design and project delivery, as follows:

- An ex post facto study of the design reports of novice designers (second year, mixed-disciplinary art and design undergraduates) and new professionals (architectural postgraduates).
- Semi-structured interviews with established practitioners in the construction industry provided practitioner perspectives on the implications of sustainability assessment method objectives on design practice.

Chapters 8.0 and 9.0 described in detail the data and findings of these studies. These will be evaluated in section 11.3.

Objective 3: Examine the differences and similarities between creative processes and commercial practice to provide descriptions of how designers manage the requirement to produce sustainable designs in creative and commercial contexts.

Chapter 10.0 provided an evaluation of the similarities and distinctions between designers in education and practice in light of the different methods of inquiry. It placed these similarities and distinctions within the context of the literature described how objectives are valued in the prevailing litigious society, identifying opportunities for architects within this context.

11.3 RESEARCH FINDINGS

The overall finding of this thesis is that in architectural education and practice, designers are dependent on regulations for sustainable design to justify design proposals and to attest to the value of their designs. This contradicts common assumptions that architects resist such dependencies. Rather than resistance, established practitioners attempt to create opportunities within objective requirements. The approaches that designers adopt to achieve this depends on the level of design experience and the environment in which design takes place.

Underpinning this finding are observations documented through ex post facto studies and semi-structured interviews. These are summarised in Fig. 11a, which exposes three characteristics of sustainable design activity. The skills and processes observed in education and practice were distinct as a consequence of the methods of inquiry used because of the different contexts that designers in education and practice operate in; resemblances between these have been evaluated in chapter 10.0. The findings relate to the way in which designers; *frame problems*, *approach design*, and are *dependant* on objectives, as follows:

- **Problem framing** refers to the initiation of a design project and the identification of what the designer is responding to. Framing design problems happens under the influence of social norms (in education) and client requirements (in practice). At the beginning of a design project, this informs how objectives will be managed throughout the project; determining the extent to which objectives will be embraced and how they will be valued.
- **Design approaches** refer to design sequences and methods. Practitioners strike a balance between three approaches; *objectification*, *communication and collaboration*, and *best practice*, depending on which approach best mediates the requirements and objectives they face. The approaches of designers in education are strongly linked to how they justify their designs, whether this is on the basis of pre-tested conventions or broader objectives

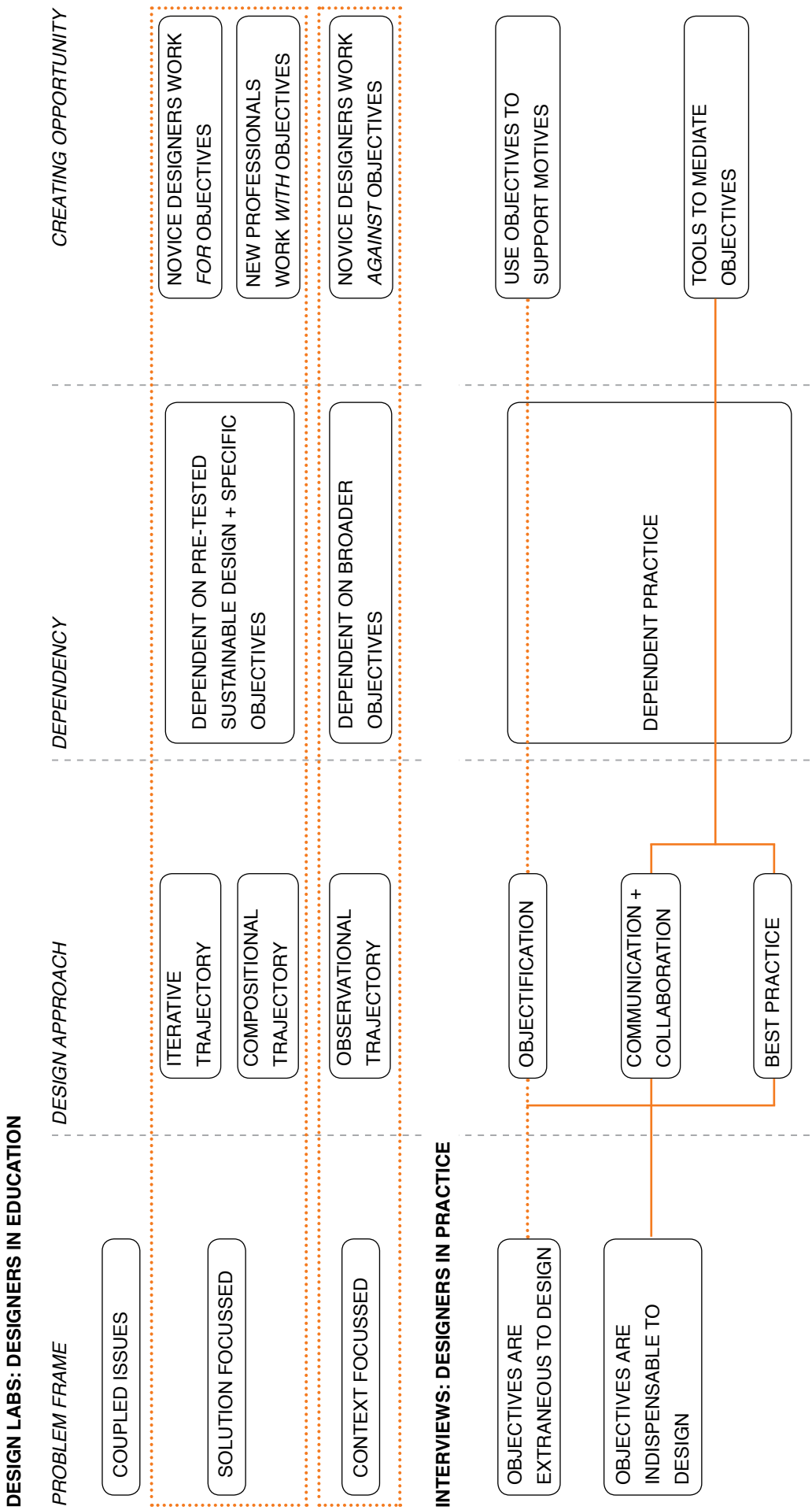


FIG. 11a
The alignment of the findings and conclusions (presented left to right) of the design labs and interviews. The diagram shows how different levels of experience unveil different techniques in managing contingency which are the result of different design approaches and specifically in design labs, a result of the clarity and brevity with which design reports were presented.

which allow for greater exploration of the design context and intervention possibilities.

- **Dependency** refers to whether designers are contingent upon objectives in the way that they frame problems or the design approaches they take and the types of objectives that designers are reliant upon.

These correspond to ways in which designers appear to diffuse the focus of objectives in order to engineer opportunities to establish the best all round design outcome within the constraints they face. Practitioners in particular suggest that objectives predefine certain elements of design, yet they simultaneously demonstrate the skills and knowledge that have the potential to create opportunities within these issues. As the least experienced, it was expected that novice designers display the weakest characteristics of this, yet the data suggests that the opposite appears to be true.

11.4 LIMITATIONS OF THE RESEARCH

This section will review the strengths and weaknesses of the methods and evaluate the implications of these for the research findings.

11.4.1 DESIGN LABS

Events were allowed to unfold naturally in design labs in order to give a true reflection of how design develops in the design studio setting. Design activity could not be observed concurrently over the twelve week period of design labs as the course included self directed study. The data collated demonstrates how students present and defend their work through design reports and it must be emphasised that this is largely post-rationalised rather than concurrent. Such post-rationalisation also takes place in professional architectural practice before practitioners present ideas to clients and when they describe their work during interviews. This similarity is advantageous for the comparability of data from the two research methods.

Not all participants in the design labs belonged to the design discipline of architecture. The disciplinary mix of novice designers meant that participants had diverse background knowledge which may have influenced problem framing and design approaches. Notwithstanding this, as Ho (2001) has previously suggested, it is the experience of design activity (or lack thereof), which directly influences the structure of problem solving. To this end, findings concerning the structure of design activity may be limited, however this does not detract from demonstrating the paradoxical effect of the freedom from professional and commercial reign.

The findings of the design labs are limited to the approach and values of the Birmingham School of Architecture (BSA). Section 7.3.2 discussed how different schools of architecture integrate sustainable design into course requirements in different ways. Some focus on developing computational skills and knowledge of

software and applications used in practice in order to analyse the performance of design schemes. It is worth noting however, that although generative algorithms are increasingly prevalent in design research, design concepts most frequently precede geometric manipulation and performance analysis. As sustainability is considered an integrated component of design within BSA and specific design methods were not prescribed, some generalisations can be made about the influence of sustainability on the development of design concepts. However, it is prudent to acknowledge that this research has focussed on a single school of architecture.

11.4.2 INTERVIEWS

This research included a limited sample of interdisciplinary practitioners, which limits the ability to make broad generalisations about architectural practice. The inclusion of the multidisciplinary practice, ARUP, was warranted on the basis that the practitioners interviewed provide the account of a leading practice. Their input also highlights that further research, from a much broader sample is required.

11.4.3 COMPARABILITY

Content analysis was used to mediate the contrast between the time based nature of design lab data and the reflective nature of interview data. The analytical processes of content analysis complemented the nature of the data acquired and the production of thematic mappings helped to illustrate the relationship between themes within the differences in the nature of the data. However, such methods only enable the identification of potential variables for further analysis and can not explicitly validate a hypothesis.

To this end, the research identifies key characteristics of design in creative and commercial contexts, between which similarities can be found in design approaches and the way in which contingency is managed. Approaches

to problem framing were also identified through the design labs and further research is needed to better understand problem framing under the commercial pressures of architectural practice.

11.5 CONTRIBUTION OF THE THESIS

This research has drawn on multiple fields to provide a better picture of the implications of sustainability for architectural design. In this arena, existing studies have presented a divided perspective of the implications of objectives for design creativity and practice. Studies of the former have suggested that increased numbers of objectives have a negative impact on creativity (Ostad-Ahmad-Ghorabi & Collado-Ruiz, 2010). On the contrary, studies of practice have suggested that regulatory objectives provide a contradictory setting for design (Ross, 2012), but that objectives are also part and parcel of architects practices, in particular assisting with risk management (Imrie & Street, 2011), and providing a level platform for distributed decision making (Carmona, 2009).

As interconnected processes, this research has simultaneously studied design in education (though ex post facto studies) and practice (through semi-structured interviews). It acknowledges how objectives may be seen as constraining, but through the provision of qualitative descriptions of design activity, it suggests that designers are dependent on these constraints to justify design proposals and to attest to the value of their designs. Additionally, rather than resisting dependency as Till (2009) suggests, designers engage with it, creating opportunities within it.

More generally, in response to the disconnection between the construct of sustainability as an evolving concept, and the reductive and deterministic epistemology on which sustainable design regulations are predicated, this research provides an understanding of the implementation of objectives and consequently serves as a platform to improve the ability of designers to respond to these complex and dynamic conditions, and to inform the steps that professional bodies might pursue to facilitate such improvements.

11.6 FUTURE WORK

The findings of the research serve as a platform from which to initiate further studies. With a broad interpretation of regulations and objectives, and an overview of the distinctions between design activity and project delivery, the research uncovers further areas for investigation, as follows:

- **How can critical analysis can be better incorporated and delivered in education?**

  The promotion of critical analysis for sustainable design in education has been documented elsewhere (Altomonte, 2012c). Altomonte (ibid) recognises that a poor understanding of how knowledge is acquired and applied is a major problem for improving education, which suggests that further, interdisciplinary research is required. As the design labs only indirectly incorporate sustainability objectives (particularly in the work of the novice designer), if graduates are to have a greater knowledge of how sustainability is implemented and assessed in practice, a better understanding of the implications of this for students' design work is required.

- **How can mechanisms for feedback be introduced and maintained?**

  All aspects of architectural practice are affected by the requirement to deliver sustainable buildings (RIBA, 2005). There is definite scope to research these areas in greater detail. Procurement routes have already been identified as one mechanism through which practice can improve the delivery of sustainable buildings (Menteth, 2012). As the research presented here gives an overview of three design approaches and the stages of design in which they are employed, a good place to start would be to examine how these approaches are implemented in practice and exploring and which aspects are most successful. A better understanding of this will facilitate the development of feedback mechanisms.

- **How can the knowledge loop be reinforced?**

  Limitations to time and resources may restrict the ability of practitioners to

engage in feedback. Strengthened links between academia and practice could facilitate this, but such mechanisms would need to be examined through further research. Ensuring any further research into the implications of implementing objectives for architectural design are disseminated directly to the sources that produce regulatory or assessment frameworks and objectives could begin to motivate the knowledge loop.

REFERENCES

3DReid (2010) *Architect's Handbook of Practice Management* (8th Edition) London: RIBA Publishing.

Alexander, C. (1966) *A City is not a Tree*. Design (2006), 46-55.

Alexander, C. & Chermayeff, S. (1963) *Community and Privacy*. Harmondsworth: Penguin.

Altomonte, S. (Ed.) (2012a) *State of the Art of Environmental Sustainability in Academic Curricula and Conditions for Registration*. Retrieved December 07, 2012, from EDUCATE: http://www.educate-sustainability.eu/downloads/state-of-the-art/EDUCATE%20State%20of%20the%20Art%20Academic%20Curricula.pdf

Altomonte, S. (Ed.) (2012b) *State of the Art of Environmental Sustainability in Professional Practice*. Retrieved December 07, 2012, from EDUCATE: http://www.educate-sustainability.eu/downloads/state-of-the-art/EDUCATE%20State%20of%20the%20Art%20Professional%20Practice.pdf

Altomonte, S. (Ed.) (2012c) *Sustainable Architecture In Education*. Retrieved December 07, 2012, from EDUCATE: http://www.educate-sustainability.eu/downloads/white-papers/EDUCATE%20White%20Paper%20-%20Sustainable%20Architectural%20Education.pdf

Altomonte, S. (2009) *Environmental Education for Sustainable Architecture*. Review of European Studies, 1 (2), 12-21.

Ambrose, G. & Harris, P. (2009). *Design Thinking: 8*. Worthing: Ava Publishing.

Anderson, J. (2010) *Architectural Design*. Worthing: AVA Academia.

Antrop, M. (2006) Sustainable Landscapes: Contradiction, Fiction or Utopia? *Landscape and Urban Planning*, 75, 187–197.

ARB (2009) *Architects Code: Standards of Conduct and Practice*. Retrieved December 03, 2009, from ARB: http://www.arb.org.uk/Upload/3293139b-4c34-4b2e-83a1-9e7a90cd2a60.pdf

ARUP (2000) *SPeAR*. Retrieved December 4, 2012, from ARUP: http://www.arup.com/Projects/SPeAR.aspx

Babbie, E. (2007) *The Practice of Social Research*. Belmont, CA: Thomson Learning.

Batty, M., & Marshall, S. (2012) The Origins of Complexity Theory in Cities and Planning. In J. Portugali, H. Meyer, E. Stolk, & E. Tan, *Complexity Theories of Cities have Come of Age* (pp. 21-46). London: Springer.

Batty, S. (2001) The Politics of Sustainable Development. In S. Batty, S. Divoudi, & A. Layard (Eds.), *Planning for a Sustainable Future* (pp. 19-32). London: Spon Press.

Bauman, Z. (1991) *Intimations of Postmodernity.* London: Routledge.

Bauman, Z. (1991) *Modernity and Ambivalence.* Cambridge: Polity Press.

Bayazit, N. (1993) Designing: Design Knowledge: Design Research: Related Sciences. In M. De vries, N. Cross, & D. Grant (Eds.), *Design Methodology and Relationships with Science* (pp. 122-134). London: Springer.

Bayazit, N. (2004) *Investigating Deign: A Review of Forty Years of Design Research.* Design Issues , 20 (1), 16-29.

Beer, S. (1981) *I Said You Are Gods.* Telihard Review , 15 (3), 1-33.

Ben-Joseph, E. (2005b) *The Code of the City: Standards and the Hidden Landscape of Placemaking.* Cambridge, MA: MIT Press.

Ben-Joseph, E., & Szold, T. (2005a) *Regulating Place: Standards and the Shaping of Urban America.* London: Routledge.

Bennetts, R. (2008) Reasserting the architect's position in pursuit of sustainability. In S. Roaf, & A. Bairstow, *The Oxford Conference: A Re-evaluation of Education in Architecture*. London: WIT Press.

Bentley, I. (1999) *Urban transformations: power, people and urban design.* London: Routledge.

Berglund, E. (2008) Exploring the Social and Political: Are architects still relevant to architecture? *Architectural Research Quarterly*, 12 (2), 105-111.

Bernard, H. (2000) *Social Research Methods: Qualitative and Quantitative Approaches*. London: Sage.

Best, G. (1969) Method and Intention in Architectural Design. In G. Broadbent (Ed.), *Design Methods in Architecture* (pp. 147-164). London: Lund Humphries.

BIS (2012) *Reducing the impact of regulation on business*. Retrieved December 23, 2012, from Gov.UK: https://www.gov.uk/government/policies/reducing-the-impact-of-regulation-on-business/supporting-pages/operating-a-one-in-two-out-rule-for-business-regulation

Blau, J. (1984) *Architects and Firms: a sociological perspective on architectural practice*. Cambridge, MA: MIT Press.

Bourdieu, P. (1990) *The Logic of Practice*. Stanford, CA: Stanford University Press.

Bousbaci, R. (2008) *'Models of Man' in Design Thinking: The Bounded Rationality Episode*. Design Issues , 24 (4), 38-52.

Boyko, C., Cooper, R., Davey, C., & Wootton, D. (2006) Addressing Sustainability Early in the Urban Design Process. *Management of Environmental Quality: An International Journal*, 17 (6), 689-706.

BPF, Spada, & Taylor Wessing (2010) *Hitting the Green Wall ... and Beyond*. Retrieved September 05, 2011, from http://www.taylorwessing.com/sustainability/docs/HittingTheGreenWall.pdf

Braithwaite, J. (2005) *Neoliberalism or Regulatory Capitalism*. Occasional Paper No. 5, Regulatory Institutions Network Research School of Social Sciences Australian National University Canberra.

Braithwaite, J. (2009) *Regulatory Capitalism: How it Works, Ideas for Making it Work Better*. London: Edward Elgar.

BRE (2005) *Putting a Price on Sustainability*. London: BRE.

BRE (2010a) *EcoHomes*. Retrieved September 21, 2011, from BRE: http://www.breeam.org/page.jsp?id=21

BREEAM (2010b) *Who Requires BREEAM?* Retrieved January 5, 2012, from BRE: http://www.breeam.org/page.jsp?id=344

BRE Global (2010) *Using BREEAM and the Code for Sustainable Homes in the Planning System*. Retrieved May 16, 2012, from BRE: http://www.breeam.org/filelibrary/BREEAM%20and%20Planning/PDF_-_Writing_BREEAM_and_CSH_into_planning_conditions.pdf

BREEAM (2011) *BREEAM New Construction: Technical Manual*. Retrieved May 18, 2012, from BREEAM: http://www.breeam.org/filelibrary/Technical%20Manuals/SD5073_BREEAM_2011_New_Construction_Technical_Guide_ISSUE_2_0.pdf%20

BRE (2012a) *BREEAM*. Retrieved May 16, 2012, from Building Research Establishment: http://www.bre.co.uk/page.jsp?id=829

BRE (2012b) *Code for Sustainable Homes*. Retrieved August 20, 2012, from BRE: http://www.breeam.org/page.jsp?id=86

BRE (2012c). *BREEAM Communities Technical Manual*. London: BRE.

BRE (2013a) *Planning Policy*. Retrieved May 01, 2013, from BRE: http://www.breeam.org/page.jsp?id=333

BRE (2013b) *Who Specifies BREEAM?* Retrieved February 03, 2013, from BRE: http://www.breeam.org/page.jsp?id=345

Brittain-Caitlin , T. (2008) On Alternate Currents. *Architectural Research Quarterly*, 12 (3-4), 204-205.

Broadbent, G. (1973) *Design in Architecture*. New York: John Wiley.

Broadbent, G. (1969) *Design Methods in Architecture*. (G. Broadbent, & A. Ward, Eds.) London: Lund Humphries.

Bryman, A. (2008) *Social Research Methods*. Oxford: Oxford University Press.

Buchanan, P. (2012, January). The Big Rethink: Towards a Complete Architecture. *The Architectural Review*.

Buchanan, P. (2012b, May). Transcend and Include the Past. *Architectural Review*, 80-87.

Buchanan, P. (2012c, September). Rethinking Architectural Education. *Architectural Review*. Retrieved 01 10, 2012, from http://www.architectural-review.com/academia/the-big-rethink-part-9-rethinking-architectural-education/8636035.article

Building Futures (2003) *The Professionals' Choice: The Future of the Built Environment Professions*. London: RIBA Publishing.

Building Futures (2011) *The Future for Architects?* London: RIBA.

Butcher, L. (2011) *The Architecture of The Profession*. Manchester Metropolitan University. MA Thesis.

CABE (2007a) *Sustainable Design*. Retrieved 01 29, 2010, from CABE: http://www.cabe.org.uk/sustainability/sustainable-design

CABE (2007b) *Sustainable Design: Climate Change and the Built Environment*. Retrieved December 10, 2012, from Desgn Council CABE: http://www.designcouncil.org.uk/Documents/Documents/Publications/CABE/sustainable-design-and-climate-change.pdf

CABE (2009b) *Hallmarks for a Sustainable City*. London: CABE.

Carmona, M. (2001) *Housing Design Quality: Through Policy, Guidance and Review*. London: Spon Press.

Carmona, M. (2004) PPS1: Six of One and Half a Dozen of the Other. *Town and Country Planning*, 73 (3), 105.

Carmona, M. (2009) Design Coding and the Creative, Market and Regulatory Tyrannies of Practice. *Urban Studies*, 46 (12), 2643-2667.

Carmona, M., & Dann, J. (2007) Design Codes. *Urban Design* (101), 16-37.

Carmona, M., Blum, R., Hammond, L., Stevens, Q., Dann, J., Karkski, A., et al. (2006a) *Design Coding in Practice: An Evaluation*. London: DCLG.

Carmona, M., Marshall, S., & Stevens, Q. (2006b) Design Codes: Their Use and Potential. *Progress in Planning*, 65, 205-289.

Cash, P., Elias, E., Dekoninck, E., & Culley, S. (2012) Methodological Insights from a Rigorous Small Scale Experiment. *Design Studies*, 33, 208-235.

Chan, C.-S. (2001) An Examination of the Forces that Generate a Style. *Design Studies* , 22, 319-346.

Clayton, A., & Radcliffe, N. (1996) *Sustainability: a systems approach*. London: Earthscan.

Clevenger, C., & Haymaker, J. (2011) Metrics to Assess Design Guidance. *Design Studies*, 32, 431-456.

Coleman, A. (1985) *Utopia On Trial: Vision and Reality in Planned Housing*. London: Hilary Shipman Ltd.

Coleman, N. (2005) *Utopias and Architecture*. Oxon: Routledge.

Colquhoun, A. (1969) Typology and Design Method. *Perspecta*, 12, 71-74.

Conklin. (2005) *Dialogue Mapping: Building Shared Understanding of Wicked Problems*. London: Wiley.

Cooper, R., Evans, G., & Boyko, C. (Eds.). (2009) *Designing Sustainable Cities*. London: Blackwell Publishing Ltd.

Cross, N. (1999) Design Research: A Disciplined Conversation. *Design Issues*, 15 (2), 5-10.

Cross, N. (2004) Expertise in Design: An Overview. *Design Studies*, 25, 427-441.

Cross, N. (2007) Forty Years of Design Research. *Design Studies*, 28 (1), 1-4.

Cross, N., Dorst, K., & Christiaans, H. (1996) Introduction: the Delft Protocols Workshop. In N. Cross, K. Dorst, & H. Christiaans (Eds.), *Analysing Design Activity* (pp. 1-14). John Wiley & Sons Ltd.

Cross, N., Dorst, K., & Roozenburg, N. (Eds.). (1992) *Research in Design Thinking*. Delft: Delft University Press.

Cross, N., Naughton, J., & Walker, D. (1981) Design Method and Scientific Method. *Design Studies*, 2 (4), 195-201.

Cuff, D. (1992) *Architecture: The Story of Practice*. Cambridge, MA: MIT Press.

Cuff, D., & Wreidt, J. (Eds.). (2010) *Architecture from the Outside In: Selected Essays by Robert Gutman*. New York: Princeton Architectural Press.

Cutler, T. (2009) *Designing Solutions to Wicked Problems: A Manifesto for Transdisciplinary Research and Design*. Melbourne: RMIT Design Research Institute.

Davidson, M. (2010) Sustainability as an Ideological Praxis: The Acting Out of Planning's Master-signifier. *City*, 14 (4), 390-405.

DCLG (2007) *Building a Greener Future: A Political Statement*. London: HMSO.

DCLG (2010) *Code for Sustainable Homes: Technical Guide*. Retrieved May 18, 2012, from DCLG: http://www.planningportal.gov.uk/uploads/code_for_sustainable_homes_techguide.pdf

de Roo, G. (2007) *Actor Consulting: A Model to Handle Fuzziness in Planning*. In G. de Roo, & G. Porter (Eds.), Fuzzy Planning: The Role of Actors in Fuzzy Governance Environment (pp. 131-152). London: Ashgate.

de Roo, G. (2010) Being or Becoming? That is the Question! Confronting Complexity with Contemporary Planning Theory. In G. de Roo, & E. Silva (Eds.), *A Planner's Encounter With Complexity*. Aldershot: Ashgate.

de Roo, G., & Porter, G. (Eds.). (2007a) *Fuzzy Planning: The Role of Actors in Fuzzy Governance Environment*. London: Ashgate.

de Roo, G., & Porter, G. (2007b) The End has no Merit... In *Fuzzy Planning: the Role of Actors in Governance Environment* (pp. 1-20). Aldershot: Ashgate.

de Roo, G., & Silva, E. (Eds.). (2010) *A Planner's Encounter with Complexity New Directions in Planning Theory*. London: Ashgate.

de Roo, G., Hillier, J., & Wezemael, J. V. (Eds.). (2012) *Complexity and Planning: Systems, Assemblages and Simulations*. London: Ashgate.

DECC (2009) *The Low Carbon Transition Plan: National Strategy For Climate & Energy*. Retrieved 09 14, 2010, from Department of Energy and Climate Change: http://www.decc.gov.uk/assets/decc/White%20Papers/UK%20Low%20Carbon%20Transition%20Plan%20WP09/1_20090724153238_e_@@_lowcarbontransitionplan.pdf

DECC (2010) *The Green Deal: A Summary of the Government's Proposals*. London: DECC.

DECC (2011) *The Carbon Plan: Delivering Our Low Carbon Future*. London: DECC.

DEFRA (2008) *Climate Change Act 2008*. London: OPSI.

Denzin, N., & Lincoln, Y. (Eds.). (2005) *The Sage Handbook of Qualitative Research* (3rd Edition ed.). London: Sage.

Dickens, P. (2004) *Society & Nature: Changing Our Environment, Changing Ourselves*. Cambridge: Polity.

Dorrian, M. (2012) Regulating Architecture. *Architectural Research Quarterly*, 16 (03), 200-204.

Dorst, K. (1996) The Design Problem and its Structure. In *Analysing Design Activity* (pp. 17-34). London: John Wiley & Sons.

Dorst, K. (2003) *The Problem of Design Problems*. In N. Cross, & E. Edmonds (Eds.), Expertise in Design (pp. 135-147). Sydney: Creativity and Cognition Studios Press.

Dorst, K., & Christiaans, H. (1992) An Empirical Study into Design Thinking. In N. Cross, K. Dorst, & N. Roozenburg (Eds.), *Research in Design Thinking* (pp. 111-118). Delft: Delft University Press.

Dorst, K., & Cross, N. (2001) Creativity in the Design Process: Co-evolution of Problem Solution. *Design Studies*, 22 (5), 425-437.

Dovey, K. (2007) *Framing Places: Mediating Power in Built Form* (2nd ed.). London: Routledge.

Dryzek, J. (1997) *The Politics of the Earth: Environmental Discourses*. Oxford: Oxford University Press.

Dubberly, H. (2004) *How do you design? A Compendium of Models.* Retrieved November 15, 2010, from Dubberly Design Office: http://www.dubberly.com/wp-content/uploads/2008/06/ddo_designprocess.pdf

Egan, J. (1998) *Rethinking Construction: Report of the Construction Task Force*. HMSO.

Elvins, R. (2013) A Review of Computational Optimisation methods Applied to Sustainable Building Design. *Renewable and Sustainable Energy Reviews*, 22, pp230-245.

European Commission (2005) *Directive 2005/36/EC*. Retrieved January 04, 2013, from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2005L0036:20110324:EN:PDF

Fisher, T. (2009) Developing Architecture's Knowledge Loop. *Architectural Research Quarterly* (14), pp17-19.

Fishman, R. (2012) Urban Utopias in the Twentieth Century. In S. Fainstein, & S. Campbell (Eds.), *Readings in Planning Theory* (3rd ed.). London: Routledge.

Flyvbjerg, B. (2011) Case Study. In N. Denzin, & Y. Lincoln (Eds.), *The SAGE Handbook of Qualitative Research* (pp. 301-317). London: Sage.

Frayling, C. (1993) *Research in Art and Design*. London: Royal College of Art.

Ferguson, L. M., Yonge, O., & Myrick, F. (2004) Students' Involvement in Faculty Research: Ethical and Methodological Issues. *International Journal of Qualitative Methods*, 3(4), Article 5. Retrieved May 15, 2014 from http://www.ualberta.ca/~iiqm/backissues/3_4/pdf/ferguson.pdf

Gann, D., Wang, Y., & Hawkins, R. (1998) Do Regulations Encourage Innovation? The Case of Energy Efficiency in Housing. *Building Research & Information*, 26 (5), pp. 280-296.

Garde, A. (2009) Sustainable by Design? *Journal of the American Planning Association*, 75 (4), 424-440.

Gelder, J. (2012) Integrated. Dis-integrated. Coordinated. Re-integrated. *Architectural Research Quarterly*, 16 (3), 253-260.

Gething, B. (2011) *Green Overlay to the RIBA Outline Plan of Work*. London: RIBA.

Gleeson, B., & Low, N. (Eds.). (1999) *Global Ethics and Environment*. London: Routledge.

Gloster, D. (2010). *RIBA Validation Criteria at Part 1 and Part 2*. Retrieved June 17, 2011, from RIBA: http://www.architecture.com/files/ribaprofessionalservices/education/validation/ribavalidationcriteriafromseptember2011parts1,23.pdf

Goel, V., & Pirolli, P. (1992) *The Structure of Design Problem Spaces*. Cognitive Science , 16, 395-492.

Goldschmidt, G., & Porter, W. (Eds.). (2004). *Design Representation*. London: Springer.

Gomm, R. (2004) *Social Research Methodology: A Critical Introduction.* Hampshire, England: Palgrave Macmillan

Goodbun, J. (2012a, April) *An Ecology of Mind*. Architectural Review , 22-23.

Goodbun, J. (2012b) Flexibility and Ecological Planing. *Architectural Design*, 218, 52-55.

Gunder, M. (2005) The Production of Desirous Space: Mere Fantasies of the Utopian City? *Planning Theory*, 4 (2), 173-199.

Gunder, M. (2006) Sustainability: Planning's Saving Grace or Road to Perdition? *Journal of Planning Education and Research* , 208-221.

Gunder, M., & Hillier, J. (2009) *Planning in Ten Words or Less*. London: Ashgate.

Gutman, R. (1988) *Architectural Practice: A Critical View*. New York: Princeton Architectural Press.

Gutman, R. (2001) Critical Issues for Practice ... and a Missed Opportunity. *Architectural Research Quarterly*, 5 (2), 105-108.

Gutman, R. (2010a) Architecture: The Entrepreneurial Profession. In D. Cuff, & J. Wriedt (Eds.), *Architecture from The Outside In: Selected Essays by Robert Gutman* (pp. 32-42). New York: Princeton Architectural Press.

Gutman, R. (2010b) Educating Architects: Pedagogy and the Pendulum. In D. Cuff, & J. Wriedt (Eds.), *Architecture from The Outside In: Selected Essays by Robert Gutman* (pp. 258-286). New York: Princeton Architectural Press.

Gutman, R. (2010c) Professions and their Discontents: The Psychodynamics of Architectural Practice. In D. Cuff, & J. Wriedt (Eds.), A*rchitecture from the Outside In: Selected Essays by Robert Gutman* (pp. 43-60). New York: Princeton Architectural Press.

Guy, S. (2000) Sustainable Buildings: Meanings, Processes, Users. *Built Environment*, 28 (1), 5-32.

Guy, S., & Farmer, G. (2000) Contested Constructions: The Competing Logics of Green Buildings and Ethics. In W. Fox (Ed.), *Ethics and the Built Environment* (pp. 73-88). London: Routledge.

Guy, S., & Farmer, G. (2001) Reinterpreting Sustainable Architecture: The Place of Technology. *Journal of Architectural Education*, 54 (3), 140-148.

Guy, S., & Moore, S. (2007) Sustainable Architecture and Pluralist Imagination. *Journal of Architectural Education*, 15-23.

Habinteg Housing Association (2011) *Lifetime Homes*. London: IHS BRE Press.

Habraken, N. J. (1998) *The Structure of the Ordinary*. Cambridge, MA: MIT Press.

HCA (2010, June) *HCA Proposed Core Housing Design and Sustainability Standards Consultation*. Retrieved June 18, 2013, from http://cirencester.pegasuspg.co.uk/intranet/Consultation%20HCA%20new%20standards.pdf

Hillier, B. (1996) *Space is the Machine*. Cambridge: Cambridge University Press.

Hillier, B., & Hanson, J. (1984) *The Social Logic of Space*. Cambridge: Cambridge University Press.

Ho, C. H. (2001) Some Phenomena of Problem Decomposition Strategy for Design Thinking: Differences Between Novices and Experts. *Design Studies*, 22, 27-45.

Howard, E. (1898) *Garden Cities of To-morrow*. London: Swan Sonnschein & Co.

Hrivnak, J. (2007) Is Relative Sustainability Relevant? *Architectural Research Quarterly*, 11 (2), 167-176.

Huber, J. (2004) *New Technologies and Environmental Innovation*. Cheltenham: Edward Elgar.

Huber, J. (1998) Sustainable Development as a Concept of Ecological Modernisation: Towards Industrial Ecology. *International Workshop on Ecological Modernisation* 10-13 September. Helsinki: University of Helsinki, Finland.

Imrie, R. (2003) Architects' Conceptions of the Human Body. *Environment and Planning D: Society and Space* , 21, pp. 47-65.

Imrie, R. (2007) The Interrelationships Between Building Regulations and Architects' Practice. *Environment and Planning B*, 34, 925-943.

Imrie, R., & Street, E. (2006) *The Attitudes of Architects Towards Planning Regulation and Control*. Project Paper 3.

Imrie, R., & Street, E. (2009) Risk, Regulation and the Practices of Architects. *Urban Studies*, 46 (12), pp. 2555-2576.

Imrie, R., & Street, E. (2011) *Architectural Regulation and Design*. London: Blackwell-Wiley.

Jacobs, J. (1993) *The Death and Life of Great American Cities* (3rd edition ed.). New York: Random House.

Jamison, A. (2003) The Making of Green Knowledge: The Contribution From Activism. *Futures* (35), pp. 703-716.

Jarzombek, M. (2003) Sustainability and Architecture: Between Fuzzy Systems and Wicked Problems. *Blueprint*, pp. 6-9.

Jenks, C. (2005) *The Iconic Building: The Power of Enigma*. London: Frances Lincoln.

Jenks, M., & Dempsey, N. (2005) The Language and Meaning of Density. In M. Jenks, & N. Dempsey, *Future Forms and Design for Sustainable Cities* (pp. 287-309). London: Architectural Press.

Johnson, J., Alexiou, K., & Zamenopoulos, T. (2010) Embracing Complexity in Design: Emerging Perspectives and Opportunities. In T. Inns (Ed.), *Designing for the 21st Century Volume 2: Research Methods & Findings* (pp. 87-100). London: Ashgate.

Johnson, P. (1994) *The Theory of Architecture: Concepts Themes & Practices*. London: Wiley.

Jones, J. C. (1992) *Design Methods*. New York: John Wiley & Sons.

Julier, G. (2009) Designing the City. In G. Julier, & L. Moor, *Design and Creativity: Policy, Management and Practice* (pp. 40-56). Oxford: Berg.

Knox, P. (2007 [1987]) The Social Production of the Built Environment. In M. Carmona, & S. Tiesdell (Eds.), *Urban Design Reader* (pp. 114-125). London: Architectural Press.

Knox, P. (2011) *Cities and Design*. London: Routledge.

Kolarevic, B. (2003) Computing the Performative in Architecture. In *Proceedings of the 21th eCAADe Conference: Digital Design*. Graz, Austria (pp. 457-464).

Kostof, S. (1999a) *The City Shaped. London*: Thames & Hudon.

Kostof, S. (1999b) *The City Assembled*. London: Thames & Hudson.

Latham, M. (1994) *Constructing the Team*. London: HMSO.

Lawson, B. (1972) *Problem Solving in Architectural Design*, PhD Thesis. Aston University.

Lawson, B. (2006) *How Designers Think: The Design Process Demystified* (Fourth Edition). Oxford: Elsevier.

Lawson, B., & Dorst, K. (2009) *Design Expertise*. London: Architectural Press.

Le Corbusier (2000) *The City of Tomorrow and its Planning*. New York: Dover.

Lefebvre, H. (1991) *The Production of Space*. London: Wiley-Blackwell.

Levi-Faur, D. (2005) The Global Diffusion of Regulatory Capitalism. *The ANNALS of the American Academy of Political and Social Science* (598), 12-32.

Levi-Faur, D. (2009) Regulatory Capitalism and the Reassertion of the Public Interest. *Policy & Society*, 27, 181-191.

Levi-Faur, D., & Jordana, J. (2005) *The Rise of Regulatory Capitalism: The Global Diffusion of a New Order*. London: Sage.

Llewelyn Davis (2007) *Urban Design Compendium 2*. Urban Design Alliance.

Lombardi, R., Caserio, M., et al. (2011) Elucidating Sustainability Sequencing, Tensions, and Trade-offs in Development Decision Making. *Environment and Planning B: Planning and Design* , 38, 1105-1121.

Lynch, K. (1981) *A Theory of Good City Form*. London: MIT.

Maher, M., Poon, J., & Boulanger, S. (1996) Formalizsng Design Exploration as Co-evolution: a Combined Gene Approach. In J. Gero (Ed.), *Advances in Formal Design Methods for CAD*. London: Chapman & Hall.

Maldonado, T. (1972) *Design, Nature and Revolution: Toward a Critical Ecology*. Harper & Row.

Marshall, S. (2009) *Cities, Design & Evolution*. London: Routledge.

Marshall, S. (2011) *Urban Coding and Planning*. London: Routledge.

Marshall, S., & Batty, M. (2009) The Evolution of Cities: Geddes, Abercrombie and the New Physicalism. *Town Planning Review*, 80 (6), 552-574.

Marvin, S., & Guy, S. (1999) Understanding Sustainable Cities: Competing Urban Futures. *European Urban and Regional Studies* 6 (3), 268-275.

McEwan, I. K. (2004) *Vitruvius: Writing The Body Of Architecture*. Cambridge, MA: MIT Press.

McLennan, F. (2004) *The Philosophy of Sustainable Design*. Ecotone Publishing Company LLC.

Menteth, W. (2012) *Building Ladders of Opportunity: how reforming construction procurement can reform growth in the UK economy*. London: RIBA Publishing.

Mol, A., Spaargaren, G., & Sonnenfeld, D. (Eds.). (2009) *The Ecological Modernisation Reader: Environmental Reform in Theory and Practice*. London: Routledge.

Moore, S. (2007) *Alternative Routes to the Sustainable City*. Plymouth: Rowman & Littlefield.

Moore, S., & Wilson, B. (2009) Contested Construction of Green Building Codes in North America: The Case of the Alley Flat Initiative. *Urban Studies*, 46 (12), 2617-2641.

Mumford, L. (1961) *The City in History: Its Origins, its Transformations and its Prospects*. San Diego: Harcourt, Brace and Company.

Murray, C. (2012, November 15) *Does Architectural Education Need an Overhaul?* Retrieved November 15, 2012, from AJ: http://www.architectsjournal.co.uk/comment/does-architectural-education-need-an-overhaul/8638620.article

Neumayer, E. (2003) *Weak versus Strong Sustainability*. Cheltenham: Edward Elgar .

Newell, A., & Simon, H. (1972) *Human Problem Solving*. Englewood Cliffs, NJ: Prentice-Hall.

Ostad-Ahmad-Ghorabi, H., & Collado-Ruiz, D. (2010) Influence of Environmental Information on Creativity. *Design Research*, 31, 479-498.

Parker, J. (2012) *The Value of BREEAM*. Retrieved January 03, 2013, from Schneider Electric: http://www.schneider-electric.co.uk/documents/buildings/breeam/The_Value_of_BREEAM.pdf

Patterson, L., & Rossetta, F. (2010) *Is there any Bite to BREEAM?* RIBA Journal, 117 (5), 56.

Pianka, E. (1999) *Evolutionary Ecology* (6th Edition). Benjamin Cummings.

Picon, A. (2004) The Ghost of Architecture. The Project and its Codification. *Perspecta*, 35, 8-19.

Protzen, J. P., & Harris, D. (2010) *The Universe of Design: Horst Rittel's Theories of Design and Planning*. London: Routledge.

PRP (2011) *Low Carbon Domestic Retrofit Guides*. Retrieved January 06, 2012, from PRP: http://www.prparchitects.co.uk/our-work/research/research-publications/2011/low-carbon-domestic-retrofit-guides.html

QAA (2010) *Subject benchmark statement: Architecture*. Retrieved June 17, 2011, from QAA: http://www.qaa.ac.uk/Publications/InformationAndGuidance/Documents/architecture2010.pdf

Oxman, R. (2008) Performance-based Design: Current Practices and Research Issues. *International Journal of Architectural Computing*, 6 (1), pp. 1-17

Ratti, C. (2004) Space Syntax: Some Inconsistencies. *Environment and Planning B*, 31, 487-499.

Redclift, M. (1991) *Development and the Environmental Crisis: Red or Green Alternatives?* London: Routledge.

Redclift, M. (1989) *Sustainable Development: Exploring the Contradictions.* London: Routledge.

Rees, W. (1999) *Achieving Sustainability*. (D. Satterthwaite, Ed.) London: Earthscan.

Rees, W. (1992) Ecological Footprints and Appropriated Carrying Capacity: What Urban Economics Leaves Out. *Environment and Urbanisation*, 4, 121-130.

Rees, W., & Wackernagle, M. (1996) Urban Ecological Footprints: Why Cities Cannot be Sustainable and Why They are Key to Sustainability. *Environmental Impact Assessment Review*, 16, 223-248.

RIBA (2005) *Constructive Change: A Strategic Industry Study into the Future of the Architects' Profession*. Retrieved May 03, 2010, from Architecture.com: http://www.architecture.com/Files/RIBAProfessionalServices/Practice/Constructionbuildings/SummaryofConstructiveChangeReport.pdf

RIBA (2011a) *Climate Change Toolkits*. Retrieved May 18, 2012, from Architecture.com: http://www.architecture.com/FindOutAbout/Sustainabilityandclimatechange/ClimateChange/Toolkits.aspx

RIBA (2011b) Education and Careers: Becoming and Architect. Retrieved July 22, 2012, from RIBA: http://www.architecture.com/EducationAndCareers/BecomingAnArchitect/Becominganarchitect.aspx

RIBA (2012) *Leading Architecture: The RIBA's Strategy 2012-2016*. Retrieved February 25, 2013, from RIBA: http://www.architecture.com/Files/Strategy/LeadingarchitectureTheRIBAsstrategy2012-2016.pdf

RIBA (2007) *Outline Plan of Work*. Retrieved May 12, 2011, from Architecture.com: http://www.architecture.com/Files/RIBAProfessionalServices/Practice/OutlinePlanofWork(revised).pdf

RIBA (2005) *RIBA Constructive Change: A strategic industry study into the future of the Architects' Profession*. Retrieved May 18, 2011, from RIBA: http://www.architecture.com/Files/RIBAProfessionalServices/Practice/Constructionbuildings/SummaryofConstructiveChangeReport.pdf

RIBA, CIBSE, Aedas, UCL, AECOM, BRE, et al. (nd) *CarbonBuzz*. Retrieved March 2013, from http://www.carbonbuzz.org

Rittel, H. (1972) On the Planning Crisis: Systems Analysis of the 'First and Second Generations'. *Bedrifsøkonomen* (8), 390-396.

Rittel, H., & Webber, M. (1973) Planning Problems are Wicked Problems. *Policy Sciences*, 4, 155-169.

Roaf, S., & Bairstow, A. (2008) *The Oxford Conference: A Re-evaluation of Education in Architecture*. London: WIT Press.

Ross, L. (2012) On Contradictory Regulations. *Architectural Research Quarterly*, 16 (3), 205¬209.

Rowe, P. (1996) Architectural Practice in the 1990s. In W. Saunders (Ed.), *Reflections on Architectural Practice in the Nineties* (pp. 2-7). New York: Princeton Architectural Press.

Rowe, P. (1991) *Design Thinking*. Cambridge, MA: MIT Press.

Rudofsky, B. (1972) *Architecture Without Architects: A Short Introduction to Non-pedigreed Architecture*. London: Academy Editions.

Rydin, Y. (2010) *Governing for Sustainable Development*. London: Earthscan.

Saint, A. (1983) *The Image of the Architect*. London: Yale University Press.

Sarfatti-Larson, M. (1993) *Behind the Post-Modern Facade: Architectural Change in Late Twentieth-Century America*. London: University of California Press.

Sarfatti-Larson, M. (1977) *The Rise of Professionalism: A Sociological Analysis*. Berkeley: University of California Press.

Satterwaite, D. (1997) *Sustainable Cities or Cities that Contribute to Sustainable Development?* Urban Studies , 34, 1667-1691.

Schön, D. (1987) *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Profession*. San Fancisico: Jossey Bass.

Schön, D. (1983) *The Reflective Practitioner: How Professionals Think in Action*. London: Temple Smith.

Schumacher, P. (2008) *Parametricism as Style - Parametricist Manifesto*. Presented and discussed 11th Architecture Biennale, Venice. Retrieved May 15, 2014, from Patrick Schumacher: http://www.patrikschumacher.com/Texts/Parametricism%20as%20Style.htm

Scruton, R. (1979) *The Aesthetics of Architecture*. New Jersey: Princeton University Press.

Sentman, S. (2009) Healthy Buildings: Green Building Standards, Benefits, and Incentives. *The Journal of Israel Innovation* (Special Supplement: Israel Edition of the Journal of BioLaw & Business) , 12 (1), 1-4.

Silverman, D. (2006) *Interpreting Qualitative Data* (3rd edition). London: Sage.

Simon, H. A. (1973) The Structure of Ill-Structured Problems. *Artificial Intelligence*, 4, 181-201.

Simon, H. (1962) The Architecture of Complexity. *The Proceedings of the American Philosophical Society*, 106 (6), 467-482.

Simon, H. (1999) Can there be a Science of Complex Systems? In Y. Bar-Yam (Ed.), *Unifying Themes in Complex Systems* (pp. 3-14). Cambridge, MA: Perseus.

Slater, D. (1989) Corridors of Power. In D. Silverman, & J. Gubrium (Eds.), *The Politics of the Field of Research: Sociology Beyond Enlightenment.* London: Sage.

Steadman, J. (1983) *Architectural Morphology*. London: Pion.

Steadman, P. (2008) *The Evolution of Designs: Biological Analogy in Architecture and the Applied Arts*. London: Taylor & Francis.

Stevens, G. (1998) *The Favoured Circle: the social foundations of architectural distinction*. Cambridge, MA: MIT Press.

Street, E. (2007a) *Architecture and the Regulation of Design: A Review*. Kings College London, Department of Geography. London: AHRC.

Sustainable Buildings Task Group (2004) *Better buildings - better lives.* Retrieved July 08, 2010, from Guardian: http://image.guardian.co.uk/sys-files/Society/documents/2004/05/17/SustainableBuildings.pdf

Sweett, C. (2005) *Sustainability Costs*. Retrieved June 16, 2010, from Building.co.uk: http://www.building.co.uk/data/sustainability-costs/3050602.article

Talen, E. (2005) *New Urbanism and American Planning: The Conflict of Cultures*. London: Routledge.

Talen, E. (2009) Design by The Rules: The Historical Underpinning of Form-Based Codes. *Journal of the American Planning Association*, 75 (2), 144-160.

Teal, R. (2010) Developing a (Non-Linear) Practice of Design. *JADE* , 29 (3), 294-302.

Till, J. (2001) Research and Design in Academia. *Architecture Research Quarterly*, 5 (1), 5-9.

Till, J. (2003) Comment. In *Building Futures, The professionals' choice The Future of the Built Environment Professions* (p. 97). London: Building Futures.

Till, J. (2008) Architecture and Contingency. *Field*, 1 (1), 120-135.

Till, J. (2009) *Architecture Depends*. Cambridge, MA: MIT Press.

Till, J., & Schneider, T. (2012) Invisible Agency. *Architectural Design* (218), 38-43.

Trogal, K., & Care, L. (2007) A Quick Conversation about the Theory and Practice of Control, Authorship and Creativity in Architecture. *Field*, 1 (1), 136-145.

UK GBC (2007) *Report on Carbon Reductions in New Non-Domestic Buildings*. London: DCLG.

Ulieru, M., & Doursat, R. (2011) Emergent Engineering: A Radical Paradigm Shift. Int. J. *Autonomous and Adaptive Communications Systems*, 4 (1), 39-60.

Urban Task Force (1999) *Towards a Strong Urban Renaissance*. Retrieved July 03, 2009, from Urban Task Force: http://www.urbantaskforce.org/UTF_final_report.pdf

Urban Task Force (2005) *Towards a Strong Urban Renaissance*. London: Urban Task Force.

van Bakel, A. (1995) *Styles of Architectural Designing: Empirical Research on Working Styles and Personality Dispositions*. Eindhoven: Reproduktie Technische Universiteit Eiindhoven.

Vitruvius. (1960) *The Ten Books on Architecture*. (M. H. Morgan, Trans.) New York: Dover.

Wahl, D. C., & Baxter, S. (2008) The Designer's Role in Facilitating Sustainable Solutions. *Design Issues*, 24 (2), 72-83.

Wentworth Thompson, D. (1992) *On Growth and Form* (1st Edition 1917). Cambridge: Dover.

Williams, D. (2007) *Sustainable Design: Ecology, Architecture, and Planning*. New Jersey: John Wiley & Sons.

Williams, K., & Lindsay, M. (2007) The Extent and Nature of Sustainable Building in England: An Analysis of Progress. *Planning Theory & Practice*, 8 (1), 31-49 .

Williams, K., Burton, E., & Jenks, M. (2000) *Achieving Sustainable Urban Form*. London: E & FN Spon.

Williams, K., Jenks, M., & Burton, E. (2001) *Achieving Sustainable Urban Form*. London: Taylor and Francis (Routledge).

Williamson, T., Radford, A., & Bennetts, H. (2003) *Understanding Sustainable Architecture*. London: Spon Press.

Wilton-Ely, J. (2000) The Rise of the Professional Architect in England. In S. Kostof (Ed.), *The Architect: Chapters in the History of the Profession* (pp. 180-208). London: University of California Press.

Yaneva, A. (2009) *Made by the Office of Metropolitan Architecture: An Ethnography of Design.* Rotterdam: 010.

Yates, A., & Halewood, J. (2010) *An Introduction to Judging the Viability of Sustainability Standards*. Retrieved July 28, 2012, from Environment Centre: http://www.environmentcentre.com/content/page/3933/An%20introduction%20to%20judging%20theviability%20of%20sustainabilitystanda.pdf

Zizek, S. (2006) *Interrogating the Real*. London: Continiuum Press.

APPENDIX

APPENDIX A: DESIGN LAB BRIEF

Introduction

In the depths of subjectivity lurks utopia and in the fringes of political agenda for the C21 loiters the utopian desire for 'sustainability'. The insurgence against political contingency in design related circumstances can be seen in the total autonomy of Kowloon Walled City while notions of total control are evident in the dictatorship of the New Urbanist agenda: two contrasting ideals.

The aim within this unit is to consider the various objectives and parameters that decipher the fragmented boundaries of what 'living sustainably' entails. Using a question that emerges from the outset of current UK government sustainability targets we intend to develop an interdisciplinary polemic for the ideal sustainable city.

What is your ideal sustainable city?

"At the outset of the C20 10% of the population lived in cities. In 2000, around 50% of the world population lives in cities. In 2025, the number of city dwellers could reach 5 billion individuals."

Given the increasing density of cities, combined with the UK government requirement for domestic buildings to incur the reduction of 80% of C02 emissions by 2050, there is a fractal dimension between the realisation evolutionary urban development and the adaptation of existing urban syntax to perform in a manner that satisfies political indemnity.

Policy and Reality

Examining the context of sustainable targets enables the realisation of an absolute scale: The following extract identifies the percentage of existing housing stock still in use by the Climate Change Act target deadline (2050) and the resultant response by designers producing new housing stock.

Total no. of houses to date = B

Total of houses in 2050 = 0.75*B + N, where N is the number of new houses

Carbon emitted by one house = a

Today's carbon emissions are therefore B*a

In 2050 there will be (0.75*B+N)*a emissions.

Policy requires emissions in 2050 to be 20% of today's value, meaning:

Emissions 2050 = 0.2 * Today's emissions.

$$(0.75*B+N)*a = 0.2 * B*a$$

$$0.75*B+N = 0.2 * B$$

$$N = (0.2-0.75)B$$

$$N=-0.55B$$

This means at today's rate of emissions per house (a) the increase in the number of houses in 2050 actually decreases. Effectively, the total number of houses in 2050 will need to be 45% of today's total. If we express the emissions of a house in 2050 as a percentage of today's we can say:

$$0.75Ba+Npa=0.2Ba$$

$$Np=-0.55B$$

Design Intervention

By examining the domesticity of the urban fabric on various intervening scales, within the boundaries of your disciplinary concerns, devise an intervention that encompasses the desire for 'living sustainably'. Example scalar interventions might address 'The City' (macro scale), 'Building' (meso scale) or 'Domestic objects/products' (micro scale).

It is envisaged that each individual/group will engage and interpret the brief on different levels; allowing morphogenic creativity between disciplines. Cross-disciplinary reading will feature; it is expected that you will introduce the unit to significant texts within your discipline that will evoke new understandings of

other disciplines and their perception of ‘sustainability’: If ideal is singular, Utopia is universal – expand your knowledge to develop the concept of visualising the polemics of utopia.

The Design Vehicle

Design interventions will steer towards the following competition entry:

http://www.d3space.org/competitions/

“Exploration of housing typologies reveals vast the potential of overlaying urban, contextual, cultural, social, and life cycle flows toward determining new architectonic strategies for the future. The d3 Housing Tomorrow Competition invites architects, designers, engineers, and students to collectively explore, document, analyze, transform, and deploy innovative approaches to residential urbanism, architecture, interiors, and designed objects.

The competition calls for transformative solutions that advance sustainable thought, building performance, and social interaction through study of intrinsic environmental geometries, social behaviours, urban implications, and programmatic flows. Special emphasis may be placed on housing concepts that investigate dialogues including engagement of internal/external socio-economic diversity, change/adaptability over time, public/private realm connectivity, and permanence/impermanence of materiality. d3 challenges participants to rethink strategies for investigating residential design from macro-to-micro scales ranging from urban—promoting broader physical interconnectivity; communal—exploiting an interaction of units with shared facilities; and internal—examining the interior particularity of the unit, individual, or family in housing design toward promoting identity, ownership, and intimacy.

An architecture of emergence suggests that design expression requires purpose beyond formal assumption and aesthetic experimentation itself. Concurrent with sustainable thought, the d3 Housing Tomorrow Competition assumes that

architecture does not simply form, but rather perform various functions beyond those conventionally associated with residential buildings. Accordingly, design submissions must be environmentally responsible while fostering inventive conceptual living solutions for today and tomorrow. Although proposals should be technologically feasible, they may suggest fantastical architectural visions of a sustainable residential future.

The d3 Housing Tomorrow Competition allows designers freedom to approach their creative process in a scale-appropriate manner, from large-scale master planning endeavours, to individual building concepts, to notions of the interior realm. Although there are no restrictions on site, scale, program, or residential building typology, proposals should carefully address their selected context."

Studio

The framework of this competition is indented to be derived from policy driven dys/u(topia). Through a series of workshops we will investigate how design is policy driven, and whether, as designers we can utilise such regimentation to flourish creativity, while adopting the overall aims of policy. As designers from various disciplines, this is also an opportunity to test the boundaries of policy objectives that accredit the term sustainable to products of design to see whether their limits hold fast or shear under interrogation.

Within this unit we will endeavour to examine the effect of control both centralised and decentralised and the perceived reflexive dialogue between society and urban syntax.

The unit is designed to give you freedom to explore vested interests. As such you are not anticipated to be taught but to share, explore and discuss each others understanding of sustainable design.

Week	Activities
1	Introductory Presentation Question: What is sustainability? SDS: Reading + Individual philosophical disposition – 5 slide format.
2	Workshop: Policy & Decision Making Presentation on sustainability policy Question: What is your favourite piece of policy? SDS: Visualise (through any media / medium) the total impact/realisation of your chosen piece of policy.
3	Workshop: Mathematical intervention Question: What are the social and economical impacts of implementing rigorous policy constraints? SDS: Devise a system of rule making for the purpose of framing design principles.
4	Workshop: Rhetorical questions Review rule making strategies SDS: Post rationalise rule-making strategies, consider and map the potential outcomes.
5	Workshop: GAMEtheory Group exercise of working though each other's policy devising / decision making strategies. SDS: Write a set of objectives based on the outcomes deciphered by your game theories.
6	PDR Break
7	Workshop: Presentation Present as a series of 10 slides your design rules SDS: Visualise (through any media / medium) the total impact/realisation of your game theory results. Compare with your policy visualisation. Identify precedents for the objectives highlighted in both visualisations.
8	Workshop: Utopian comparison presentation Present in up to 10 slides your comparison, analysis and identified precedents for the objectives highlighted. Discuss.
9	Workshop: small questions BIG answers… Utilising your initial proposition of 'what sustainability is' and your questions devised by decision making / game theory devise a simple polemic for the design vehicle. Produce a sketch and accompanying polemical statement as the basis for your design intervention. SDS: Develop your design intervention and statement of intent, produce a 5 slide presentation to show development.
10	Workshop: progress report… Report to the group your developed design – revealing design strategies, calculated methodologies and intent. SDS: Based on group feedback continue to develop your scheme
11	Workshop: progress report… Present in rapid, draft format the design boards and statement of design you intend to submit for the competition.
12	Welcome to Utopia. Presentation of project / display your final designs for group discussion.

*SDS - Self Directed Study

APPENDIX B: DESIGN LAB MARKING CRITERIA

BIRMINGHAM City University **B.A. (Hons.) Marksheet**	**BIAD** **ELECTIVES PROGRAMME**	**ACADEMIC YEAR 2009-2010** **LEVEL 5** **TERM 1**
Student's Name: **(in full)**		**B.A.(Hons.) Course**
Student's ID No.		
Module Title:		**IVE** (circle for IVE students)
Title of Project		**Date**

RESEARCH						
Relevant knowledge of topic						Lack of knowledge of topic
Wide scope of sources used						Limited sources
Relevant theory investigated						No evidence of theory
Relevant examples identified						No or limited examples
Good illustrations found						No illustrations found
THINKING						
Relevant response to brief						Little relevance to brief
Clear line of argument						No argument / overly descriptive
Independent thought						Little or no independent thought
Engagement with sources						No reference to sources
Good analysis of examples/ ills.						Little/no analysis of examples/ills.
PRESENTATION						
Well planned / logical structure						Lacking in coherence
Clear written/oral presentation						Badly written / lacking clarity
Factual info. clearly established						Facts inadequately established
Good referencing/bibliography						No/poor referencing/bibliography
High quality illustrations						Poor or lacking illustrations
Required length						Too short / too long

General comments / recommendations

Retrieval		**Late submission capped 40%**		**Extenuating Circs. Apply**		**AGREED FINAL MARK**
Ist Class: 70% and above **2:1**: 60-69% **2:2**: 50-59% **Pass**: 40-49% **Fail**: 39% & below						
Tutor: (print name) **Moderator:** (print name) …….. **NB: ALL MARKS ARE PROVISIONAL UNTIL AFFIRMED BY AN EXAM BOARD.**						

APPENDIX C: THEMES IN INTERVIEW DATA

Themes	Definition
Accumulation	Ideas relating to small changes have magnified implications.
Appearance	Inferences pertaining to the visual implications of specific objectives.
Assessment Limitations	Relating to aspects of design considered best practice which are not recognised or acknowledged by assessment methods.
Awareness	The prominence of sustainability assessment and are considered to have raised public awareness about issues of sustainability.
Benchmark Variations	Distinctions in methods of measurements employed by different assessment methods, which leads to incomparable ratings.
Best Practice in Construction	Traditional methods seen to be simple and comprehensive, with contractors knowing and understanding how these can be built and improved. Includes inferences concerning distinctions, beyond tolerable measure, between drawings and products.
Building Flexibility and Adaptability	Importance of considering the adaptability of design as an aspect of sustainability, including references to the neglect of this in assessment methods.
Coincidental Wellbeing	Relates to the perception that well designed, environmentally friendly buildings should incidentally prove to be healthy environments for people.
Commercial Drivers	Concerns regarding the commercial motives of assessment methods and that this poses limitations for feedback processes. Including references made to the implicit link between improvement and investment.
Conflicts and Contradictions	Difficulties experienced in meeting both assessment method objectives and prevailing legislation in specific areas of design.
Coordination of Specialists	References to the multiple specialists now engaged in design and the compromise required to coordinate design in light of this. References to the tensions that can arise as a result of this and actions necessary for integration.

Cost and Expectation	The generation of additional scope connected meeting the objectives of assessment methods. Links to consequential costs and the need for designers to manage client expectations,as well as identifying whether the additional cost and scope is beneficial for the project and stakeholders.
Dependencies	The necessity to identify and design according to dependencies in process and outcomes.
Drives Behaviour	Design as a mechanism to influence sustainable activity.
Duality of Function	The dual functions of objectives and the benefits of these.
Education	Relating to a focus on the need to better integrate sustainability in design education, including arguments for architects leading the sustainable agenda, rather than assessors and disconnected specialists as a product of education.
Energy & Performance	Focus on energy and performance within assessment method objectives. Inferences that these are sensible approaches, but emphasise measurable aspects of design.
Enforcement	References to the legislative enforcement of objectives and the otherwise lack of impetus to incur additional scope.
Expectations	Observations regarding distinctions between objectives and client's expectations.
Best Practice Approaches	Approaches explicitly mentioned in relation to best practice in sustainable design.
Feedback	References to feedback, the ability to give it, and the ability to conduct research for it.
Flexibility of Objectives	The ability to compensate for missed objectives in one assessment method category of design with objectives in an alternative category.
Identification of Aims	The need to identify realistic goals at the outset of a project, including examining the benefits of meeting objectives.
Incentive	References to incentives for sustainability, such as FiT's (Feed in Tariffs).
Inflexibility of Objectives	The restrictive nature of objectives in terms of the accepted approaches and standards they require.

Integration of Objectives	Observations about the need to integrate objectives from the outset of a project.
Knowledge Resources	References to knowledge systems and exchange as a support for sustainable design.
Linked Objectives	Observations concerning the need to satisfy one or more incidental objectives in order to meet a principle objective. Such as renewable energy provision for supporting heat pumps.
Local Authority Influence	References to the role of the local authority in enforcing assessment and the inconsistencies between authorities.
Long-term Value	Whole life costing can give a good indication of the benefit of meeting objectives.
Materials	Prominence of materials in assessment method objectives, including references to the frequent change of such objectives.
Maximise Objectives	Importance of meeting all possible objectives.
Objective Layout	Observations concerning the comprehensiveness of objectives to the lay person.
Building Operation	Concerns regarding the proper operation of highly specified and technical, sustainable buildings.
Priorities of Developers and Contractors	Distinctions between what is drawn and what is built, with specific reference to the profit focussed practice of developers.
Process vs Checklist	Contrasts and conflicts between the complex design process and the linear strategy of objectives.
Process	Lack of clarity concerning design process, including the role of the professional institution in facilitating a comprehensive plan of work which integrates sustainability.
Project Drives	Observations concerning project drivers excluding objectives.
Project Strategy	References to the need for a strategy for design to be in place prior to addressing objectives.
Public Perception and Convention	Issues concerning varying perceptions of sustainability and contentions concerning unconventional building methods.
Rate of Change	Difficulties staying up to date with the rate of change in knowledge, technology and objective emphasis.

Recognition	Objectives and ratings as a credible scheme that provide an indication of success and achievement, and as socially accepted standards signify social responsibility.
Refurbishment and Retrofitting	References to the environmental benefits of refurbishment and retrofitting and the lack of recognition provided by assessment methods.
Requirements vs Objectives	Various distinctions and conflicts highlighted between clients requirements for usable space and objectives.
Research Limitations	Concerns over the challenges for smaller practices to conduct and contribute to research.
Scale of Implications	Approaches which have benefits beyond the micro, building, scale; such as using Rapeseed Oil as a fuel.
Scales of Design	Sustainability as a response to scale, the acknowledgement of distinctions in context and the identification of the best approaches to each circumstance.
Use of Benchmark	The benefits of benchmarks to raise awareness, including concerns that existing systems require improvement.
Value of Objectives	Influence of objectives on design outcomes and the necessity to avoid objectives dictating design.
Waste Management	The prominence of issues of waste affect construction practice on site and the supply chain and delivery of goods.