An investigation of the ‘soft’ features of sustainable and healthy housing design: Exploring stakeholder preferences and their provision in new housing developments.

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Abstract

Despite the widely recognised importance of the impact that built environment has on health and well-being, the concept of sustainable housing is still regarded largely in terms of environmental sustainability. However, given the urgent need to increase the quantity and sustainability of new homes in the UK, it is essential that the design and delivery of sustainable housing does not neglect health and well-being aspects that are essential for enhancing the quality of life and the development of sustainable communities.

This study focuses on the ‘soft’ features of sustainable housing, that is, the non-technological components of housing and neighbourhood design that can affect occupants’ health and well-being as well as their satisfaction with their homes. The research aims to conceptualise and identify these ‘soft’ features of housing design and establish whether the opinions of housing users regarding their importance are aligned with those of the housing providers. Using a case study approach, the study also assesses the extent to which such features are being provided by new housing developments.

The research begins with a review of literature of the sustainable housing and healthy housing concepts, which lead to the development of a framework for sustainable housing design with an emphasis on health and well-being. Building on this foundation, three phases of the methodology were developed to address the aims of the research: Firstly, a content analysis of sustainable housing standards is carried out, followed by a survey to ascertain the relative importance that housing stakeholders attach to these ‘soft’ features, and lastly, six housing developments are evaluated with regards to their provision of these features.

The findings reveal that housing user preferences are not always aligned with those of housing providers, and indeed, a number of notable differences in opinion are also found between the private sector and social housing providers. Lastly, assessment of the six case studies indicates a low level of provision of such features new housing developments. These findings indicate that a more comprehensive approach is necessary for addressing and providing for the softer features of housing and neighbourhood design.

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I feel very fortunate to have had the opportunity to carry out a PhD on a part-time basis, which has not only allowed me to gain a vast research experience but also progress my career at the same time. However, a part-time PhD does not equate to a part-time challenge as this option also prolongs the process, with its inherent stresses and worries, to six years. While this may not seem like a very long time in the grand scheme of things, six years in the PhD world feels like an aeon! As such, I am keenly aware that a number of people have put up with me, my questions and my struggles for twice as long as they should have had to – and it is to them that I offer my humble gratitude:

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List of acronyms and abbreviations

ALO	Architectural Liaison Officer
ANGSt	Accessible Natural Greenspace Standard
BfL 12	Building for Life 2012 standard
BRE	Building Research Establishment
BREEAM	Building Research Establishment Environmental Assessment Methodology
CABE	Commission for Architecture and the Built Environment
CASBEE	Comprehensive Assessment System for Built Environment Efficiency
CO	Carbon monoxide
CO2	Carbon Dioxide
COPRAS	COmplex PRoportional Assessment
CPDA	Crime Prevention Design Advisor
CSH	Code for Sustainable Homes
DAS	Design and access statement
DBERR	Department for Business, Enterprise and Regulatory Reform
DCLG	Department for Communities and Local Government
DECC	Department for Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DETR	Department for Environment Transport and the Regions
DPH	Dwellings per Hectare
EA	Environment Agency
EC	European Commission
EMS	Environmental management system
GBCA	Green Building Council Australia
GHG	Greenhouse gas
GIA	Gross Internal Area
GLA	Greater London Authority
HA	Housing Association
HCA	Homes and Community Agency
HMSO	Her Majesty's Stationery Office
HQE	High Quality Environmental standard
HVAC	Heating, Ventilation and Air Conditioning
IAQ	Indoor Air Quality
ICC	Intra-class correlation coefficient
iiSBE	International Initiative for a Sustainable Built Environment
IRR	Inter-rater reliability
IUCN	International Union for Conservation of Nature
K-S	Kolmogorov-Smirnov test
LARES	Large Analysis and Review of European Housing and Health Status
LEED	Leadership in Energy and Environmental Design
LSS	London Space Standard
MCDA	Multi-Criteria Decision Analysis
NHBC	National House Building Council
NPPF	National Planning Policy Framework

NW	North West
ODPM	Office of the Deputy Prime Minister
OECD	Organisation for Economic Co-operation and Development
ONS	Office for National Statistics
RIBA	Royal Institute of British Architects
SBD	Secured by Design standard
SDC	Sustainable Development Commission
SES	Socioeconomic Status
TSO	The Stationary Office
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
VOC	Volatile Organic Compounds
WCED	World Commission of Environment and Development
WHO	World Health Organization
WM	West Midlands
WWF	World Wide Fund for Nature

Chapter 1: Introduction

"The real question facing consumers, the Government and the housing industry generally is whether the product, both the individual house and the neighbourhood, is fit for purpose" (Neale and RIBA, 2009; p.4).

1.1. Background to the study

The UK today is facing the challenge of having to build around 300,000 new homes each year to address the current housing shortage and meet the needs of its population (Royal Institute of British Architects (RIBA), 2012). In light of this challenge, the quality and 'fitness for purpose' of new housing has become a highly pertinent issue as in the rush to achieve these targets there is also danger that the quality of new homes might suffer and mistakes of the past, where badly designed housing gave rise to a plethora of societal problems, could be repeated (Neale and RIBA, 2009; Sustainable Buildings Task Force, 2004).

But what exactly is good quality and fit for purpose housing? While intuitively the answer may seem obvious – designing and delivering such housing may not be as straightforward given the pervading subjectivity and the differing priorities and opinions of different housing stakeholders. This research utilises the concept of sustainable development as a framework to conceptualise such housing as *sustainable housing*. As such, given that the quality of human life is at the core of the sustainable development concept (Department for Environment, Food and Rural Affairs (DEFRA), 2005; Hopwood, Mellor and O'Brien, 2005), it follows that the fundamental purpose of sustainable housing (or good quality and fit for purpose housing) should be about improving the quality of life of current and future generations while taking into account wider social, environmental and economic contexts (Brown and Bhatti, 2003; Chiu, 2004; Mateus and Bragança, 2011; Priemus, 2005).

However, quality of life cannot be addressed without taking into account the health and well-being of people. This is especially pertinent within the topic of housing and the built environment as the impact that the design of dwellings and neighbourhoods has on health and well-being has been widely recognised (Commission for Architecture and the Built Environment (CABE), 2009). The way a dwelling is designed and constructed, as well as its relationship with the immediate built and natural environments, can impact health in a multitude of direct and indirect ways, making housing a key social determinant of health (Braubach, 2011; Shaw 2004).

1.2. The research problem

Despite the recognised importance of housing on health and well-being, the concept of sustainable housing is currently regarded largely in terms of environmental sustainability (Carter and Fortune, 2007, Winston and Pareja-Eastaway, 2008; UN-Habitat, 2012). Indeed, it is common to see the phrase ‘sustainable housing’ used interchangeably with ‘green’ housing (Turcotte, 2007). The construction industry’s focus on environmental matters as a priority for sustainable buildings is made clear in its latest *Strategy for Sustainable Construction* (Department for Business, Enterprise and Regulatory Reform (DBERR), 2008). The strategy outlines sustainable construction in terms of the *means* (procurement, design, innovation, people and better regulation) that are necessary to achieve the *ends*, which are presented as environmental targets of climate change mitigation, climate change adaptation, and conservation of water, biodiversity, waste and materials. A similar observation can be made with regards to the Code for Sustainable Homes - one of the key drivers for the delivery of sustainable housing in the UK (Department for Communities and Local Government (DCLG), 2012a; Pickvance, 2009a). The Code consists of nine sustainable housing criteria, seven of which are entirely environmental, and only one devoted to health and well-being (albeit in a limited scope).

While dwellings are indeed a notable source of pollution and negative environmental impact, which necessitates urgent improvement in their environmental performance, housing cannot be regarded as sustainable if only this one dimension of sustainability is taken into account (Mateus and Bragança, 2011). There is a danger that a disproportionate focus on the environmental dimension of sustainability can lead to other aspects, especially social (such as health and well-being) components being largely overlooked (Giddings, Hopwood and O’Brien, 2002). Indeed, healthy housing proponents and public health commentators have expressed concern regarding insufficient consideration of health and well-being issues by the housing industry. The wealth of empirical evidence and conceptual work exploring the housing and health relationship has led to a good understanding of the principles that make a healthy home, however not enough of this knowledge is being implemented in practice (Bonnefoy, 2007; Braubach, Jacobs and Ormandy, 2011). Construction and refurbishment of housing tend to be driven by regulations and building codes that are primarily based on technological and engineering principles, with limited reference to health concerns (World Health Organisation (WHO), 2010).

However, when such references are made, they typically focus on features that have a direct effect on physical health such as basic safety from accidents, lighting, ventilation systems and adequate heating provision. Yet housing can also impact health and well-being in less clearly defined, observable and measurable ways. In her 2004 seminal review of the housing and public health relationship, Shaw made a distinction between the 'hard' and the 'soft' factors of housing that can impact health. The 'hard' features were regarded primarily as the material conditions that affect physical health, whereas the 'soft' factors related to "*housing [being] seen as a component of general well-being, ontological security, and the perception of social status in both individual and community contexts*" (Shaw, 2004; p. 397). While a few years earlier, in their discussion about the development of Agenda 21 for sustainable construction by the International Council for Research and Innovation in Building and Construction, Sjöström and Bakens (1999) observed that;

> *"the understanding of the significance of the nontechnical issues is growing and it is realised that these so-called soft issues are at least as crucial for a sustainable development in construction [as technical issues]" (p. 350).*

Thus, the idea of 'soft' features of housing design that impact health and well-being is not new. Many of these factors, such as access to greenspace, safety from crime and residential density have been explored by researchers at an individual level. However, as yet, no studies can be found that pulls these diverse features together and presents them in a systematic way as distinct components of sustainable housing. Admittedly, this is not a simple task as in terms of design such features tend to be subjective, difficult to define and therefore measure, and as a result, often fall under the catch-all, and rather nebulous, concept of 'good design'. Yet this is also an important task because these features are crucial for a good quality of life and therefore for the development of sustainable housing and healthy communities.

To bridge this gap, this research focuses on such non-technological 'soft' components of sustainable housing that impact health and well-being, but which are generally not stipulated by building regulations and are largely neglected by sustainable housing standards. It utilises sustainable housing literature together with the broad field of housing and health research to develop a framework for sustainable housing with an emphasis on health and well-being. By reviewing some of the key sustainable housing standards against this framework, it demonstrates that such 'soft' features that are underrepresented in comparison to environmental aspects.

Furthermore, this study seeks to address the dearth of studies within the sustainable housing literature that investigate the level of importance attached to such 'soft' design features by different housing stakeholders. While there are studies that have explored the views and preferences of housing users (e.g. Bender *et al*., 2000; CABE, 2005b; Ipsos Mori and RIBA, 2013) and housing providers (e.g. Brennan and Cotgrave, 2014; Gallent and Carmona, 2004) separately, as far as the author is aware at the time of writing, no published research can be found that compares the opinions of these two key groups of housing stakeholders.

1.3. The research question

The context for this particular research problem is framed by the increasing pressure to build sustainable housing. The problem itself stems from the currently disproportionate focus on environmental and largely technical features of sustainable housing and the inadequate attention being paid to the 'softer' features that can affect health and well-being.

Given the above shortcomings, this research will seek to address the following question: *what are the 'soft' non-technological features of housing design that impact on health and well-being, and are these features regarded equally in importance by both housing users and housing providers?* Furthermore, the study seeks to elucidate *to what extent such features are being provided by new housing developments*.

1.4. Aims and objectives

In order to address the research question, the following three aims and associated objectives have been established:

Aim 1: To conceptualise and identify the 'soft' features of housing design that can impact health and well-being.

→ *Objective i*: Carry out an in-depth literature review to establish a holistic understanding of sustainable housing that encompasses the broad spectrum of health and well-being impacts of housing.

→ *Objective ii*: Using this broad understanding of sustainable housing, establish the extent to which each of the sustainable housing features are addressed by current industry best practice.

Aim 2: ***To establish whether the opinions of housing users are aligned with those of housing providers in terms of the importance of these features***.

→ *Objective iii*: Ascertain the level of importance that key housing stakeholders attach to these 'soft' features in order to enable comparison of priorities between these stakeholder groups.

Aim 3: ***To assess the extent to which such features are being provided by new housing***.

→ *Objective iv*: Develop an assessment methodology for the 'soft' features that could be applied for the evaluation of housing developments.

→ *Objective v*: Select six housing developments, and using the assessment methodology (developed in objective iv) evaluate their provision of the 'soft' features.

→ *Objective vi*: Using the results of the evaluation (objective v) and level of importance attached to these features by stakeholders (objective iii), apply a suitable multi-criteria analysis technique to rank the six developments in terms of their performance according to stakeholder priorities.

1.5. Design and structure of the thesis

An overview of the thesis structure is outlined in figure 1, which schematically illustrates the relationship between the research question, aims and objectives and the different research stages. The process was not linear, because the research question, and therefore the aims, were refined following the initial literature review. Initially, it was envisioned that the study would investigate stakeholder opinions and assess provision of all sustainable and healthy housing features. However, during the literature review and the development of the framework (for sustainable housing with an emphasis on health and well-being), it became apparent that such endeavour would be beyond the scope and resources of a doctorate thesis. It was therefore decided to refine the research question to focus on the 'soft' features of sustainable and healthy housing as their importance, yet underrepresentation within the sustainable housing discourse became evident.

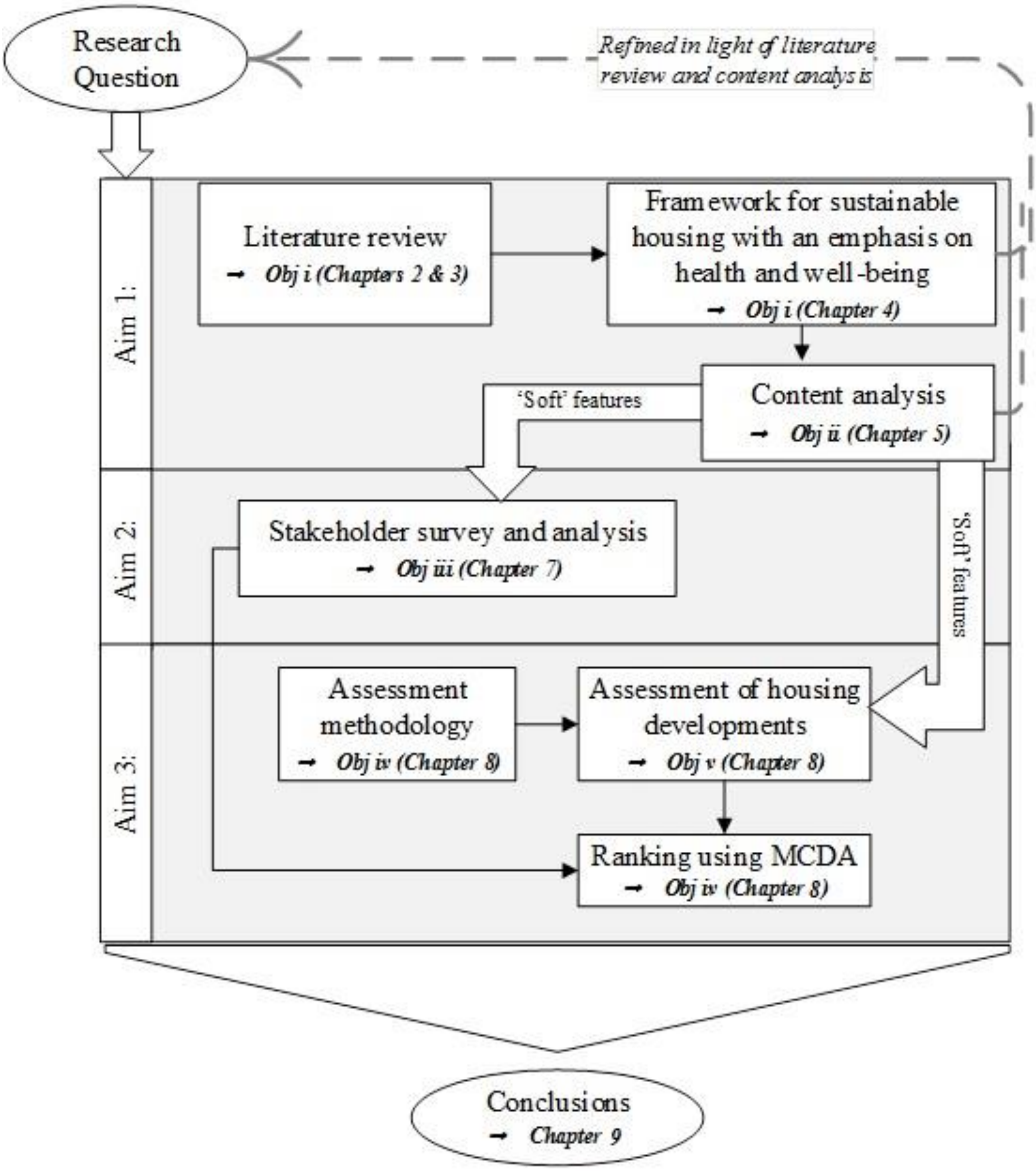

Figure 1: An overview of the research aims and objectives in relation to the research problem and research question (Source: self-study).

1.6. Overview of thesis chapters

Chapter 1 introduces the context of the study and research problem, outlining the research questions, aims and objectives, the structure of the thesis as well as the original contribution to knowledge.

Chapter 2 focuses on the sustainable housing literature in order to develop a holistic understanding of the concept as well as of the current situation within the UK with regards to sustainable housing drivers, barriers and levels of implementation. It establishes the interconnectedness between sustainable housing, quality of life and health and well-being, before moving on to review some of the key drivers at policy and implementation levels. The chapter also looks at barriers to sustainable housing development and seeks to identify the extent to which such housing is being implemented in the UK. Lastly, the chapter focuses on the key stakeholders - housing providers and housing consumers - exploring some of their characteristics and their role in delivering sustainable housing.

Chapter 3 delves into the vast body of literature on the housing and health relationship in order to better understand the nature of impacts that housing has on health and well-being. Maslow's Hierarchy of Needs (1946) and the Settlement Health Map (Barton and Grant, 2006) are used to demonstrate that housing's role as a key social determinant of health and well-being. While some of the shortcomings of the housing and health literature are acknowledged, the chapter highlights that housing impacts health and well-being at the 'home', 'dwelling' and 'neighbourhood' levels.

Chapter 4 builds on the findings of chapters 2 and 3 to develop a framework for sustainable housing with an emphasis on health and well-being. The chapter identifies 28 design features for inclusion into this framework based research evidence found in the literature.

Chapter 5 outlines the methodology adopted for this study, which is guided by a pragmatic approach to the research problem. The chapter describes the three phases that comprise the empirical section of the thesis: Phase 1 involved a content analysis of sustainable housing standards to investigate the extent to which each of the 28 features of the framework for sustainable housing with a focus on health and well-being were being addressed. The 11, under-represented 'soft' features were then used in Phase 2, which consisted of a survey-based methodology to ascertain the level of importance that housing stakeholders attach to these features. Lastly, the development of an assessment ‘toolkit’ and application of multiple-criteria decision analysis (MCDA) in Phase 3 enabled the evaluation of the provision of such soft features within new housing developments.

Chapter 6 presents the content analysis of 8 sustainable housing standards each of the 28 criteria of the framework for sustainable housing with an emphasis on health and well-being (developed in chapter 4). The aim was to determine the level of coverage that each of these features receive by industry’s best practice. The results revealed that while environmental criteria and features that can have a direct impact on health (i.e. ‘hard’ features) had a high and medium level of coverage, the ‘soft’ criteria generally received the lowest level of coverage by the standards.

Chapter 7 focuses on the data analysis of the questionnaire with the four stakeholder groups to establish the level of importance that these stakeholders attach to each of the 11 ‘soft’ housing design features. A series of non-parametric analyses are carried out to explore the differences in opinion regarding their importance among the four respondent groups followed by a discussion of the results.

Chapter 8 is in two parts; the first section develops an assessment ‘toolkit’ for the 11 features by adapting suitable methods found in housing standards and literature. These methods are then used to evaluate the provision of these features within 6 new housing developments. The second section utilises the multicriteria analysis approach (COPRAS) to assess the performance of 6 housing developments against the ‘soft’ criteria using the weights assigned by housing stakeholders. The outcome if this stage is a ranking of these housing developments according to the level of ‘soft’ feature provision.

Chapter 9 is the concluding section of the thesis. It reviews the findings of the literature review chapters with regard to sustainable housing, healthy housing and the framework for sustainable housing with an emphasis on health and well-being. It also reviews and discusses the results from the empirical phases; the content analysis, the outcomes of the survey findings of importance attached to the ‘soft’ features by the different stakeholders, their significance and how they relate to findings from existing surveys. The performance of the six housing developments with regard to their provision of these features is also discussed. Lastly, the chapter outlines some limitations, options for further research and the study's significant contribution to knowledge.

1.7. Significant contribution to knowledge

This thesis makes a significant and original contribution to knowledge in a number of ways: Firstly, by using quality of life as a common denominator, it links together the sustainable housing and healthy housing concepts, which are commonly regarded individually. Secondly, by defining and demarcating the 'soft' features as part of holistic sustainable housing, this research demonstrates a systematic approach to conceptualising and identifying such features. While some of these features are subject to previous academic study, as far as the author is aware, there have been no attempts to integrate them as distinct elements of sustainable housing. Thirdly, the comparison of different stakeholder opinions, namely those of housing users and housing providers, is an original approach and at the time of writing, no published studies can be found using such method. Fourthly, by developing a 'toolkit' of methodologies, the study demonstrates how the performance of housing developments in terms of provision of these 'soft' features can be evaluated. Lastly, multi-criteria analysis approach is utilised to rank the developments' performance according to the opinions of different stakeholders, which is a novel application of the technique.

Chapter 2: Sustainability of current housing

> *"The design of our homes contributes to the happiness of our lives, the success of our relationships and the education of our children, yet it is rarely discussed" (RIBA, The Future Homes Commission, 2012; p. 30).*

2.1. Introduction

The aim of this chapter is two-fold; to gain a holistic understanding of the meaning of 'sustainable housing' and to present an up-to-date situation with regards to the implementation of such housing in the UK. To achieve the first part of the aim, the chapter begins by reviewing the meaning of sustainability. It then narrows the focus on the meaning of 'sustainable housing' in the holistic context of sustainable development, and introduces the reasons why health and well-being are crucial aspects of such housing.

The chapter then moves on to investigate house building trends from sustainability point of view in the UK today. Starting with some of the key policy drivers and governmental initiatives that act as the drivers, influencing the quality and sustainability of dwelling design, some of the barriers to sustainable housing are also explored. The chapter then focuses on the key stakeholders, housing providers and housing consumers, exploring some of their characteristics and their role in delivering sustainable housing.

2.2. What is sustainable housing?

2.2.1. Defining the concept of 'sustainable development'

While there are a number of definition variants for sustainable development, the one used perhaps most commonly was established by the World Commission of Environment and Development (WCED) report 'Our Common Future' (also known as the Brundland Report). The Report defined sustainable development as development that meets the *"needs of the present generation without compromising the ability of future generations to meet their own needs"* (WCED 1987; p. 8). Based on this definition, sustainable development is widely understood to entail societal, environmental and economic components within the context of intra- and inter-generational equity.

However, given that the WCED definition focuses on generational, i.e. human needs, its perspective on sustainable development can be regarded as largely anthropocentric (Hopwood, Mellow and O'Brien, 2005). Indeed, the quality of human life is seen as the core of the concept (DEFRA, 2005) and there have been proposals to redefine the concept of sustainable development with human well-being as its focus (Giddings, Hopwood and O'Brien, 2002). One such example is the strategy report Caring for the Earth published in 1991 by International Union for Conservation of Nature (IUCN), United Nations Environment Programme (UNEP) and World Wide Fund for Nature (WWF), which defines the concept of sustainable development as a process that improves *"the quality of human life while living within the carrying capacity of supporting ecosystems"* (IUCN, UNEP and WWF, 1991; p.10).

2.2.2. Defining the concept of 'sustainable housing'

Housing is widely regarded as an essential component for achieving sustainable development (Chiu, 2004; Carter and Fortune, 2007; Edwards, 2000; Winston and Pareja Eastaway, 2008). Indeed, Barton, Grant and Guise (2010) argue that housing (on the neighbourhood scale) can be seen as an essential link in the development of sustainable settlements as the neighbourhood unit is small enough to have a significant effect on people's life-style and quality of life (including health and well-being), yet is large enough to impact the natural environment and economic conditions.

The last few decades have seen a growing interest in the sustainability of urban neighbourhoods among researchers, with a particular focus around defining this concept (Williams and Lindsay, 2007; Turcotte and Geiser, 2010; Luederitz, Lang, and von Wehrden, 2013; Zuo and Zhao, 2014; Winston, 2009; 2010). However, despite the growing interest in the subject, we are still far from a widely accepted single definition and there have been criticisms that not enough has been done to conceptualise the meaning of sustainable housing (Brown and Bhatti, 2003; Priemus, 2005; Winston, 2010).

There are a number of reasons put forward for the difficulty in establishing a definitive understanding of sustainable housing, perhaps the main one being the broad and vague nature of the WCED definition for sustainable development itself: Firstly, it has been noted that the multidimensional nature of sustainability offered by WCED may have discouraged researchers from using this definition in the first place (Eastaway and Støa, 2004). Secondly, given the multiple dimensions of the sustainable development concept, researchers and different housing stakeholders tend to attach greater emphasis on one particular aspect of sustainability due to their personal worldview (Giddings, Hopwood and O'Brien, 2002). For instance, end users might view health and comfort issues as more important, while those financing a housing project might focus more on the economic aspects (Mateus and Bragança, 2011). While in the research arena, different researchers have been noted to stress and focus on the importance of different aspects of sustainability as being fundamental to sustainable housing, (Luederitz, Lang, and von Wehrden, 2013). Lastly, as the nature of sustainability is context specific, what is needed to make a building sustainable in one place may be different in another location and so there can be no universal 'best practice' on which a definition could be based (Williams and Lindsay, 2007; Choguill, 2007).

Taking a very global overview of the academic literature, researchers discussing sustainable housing tend to fall into two groups with regards to defining the concept: those that treat sustainable housing as environmentally superior dwellings and those that attempt to adopt a more holistic view. Arguably, the former approach has been more predominant. Buildings with a reduced impact on the environment are often described simply as 'sustainable' (e.g Zuo and Zhao, 2014; Svane, 2002; Bergman, Whitmarsh and Kohler, 2008), and while some authors do acknowledge the wide spectrum of sustainability, they still revert to the more narrow focus on environmental sustainability in their work (e.g. Brown and Bhatti, 2003; Banfill and Peacock, 2007; Edwards, 2000; Pickvance, 2009; Priemus, 2005).

However, it should be noted that the focus on environmental issues as a proxy for sustainability is not confined to the housing topic. Giddings, Hopwood and O'Brien (2002) observed that priority is given to the environment (or to economy) in most discourses on sustainable development. The authors caution that a consequence of this separation is the tendency to adopt a "*technical fix approach to sustainable development issues"* (p. 189).

This situation has particularly important implications for the housing sector as it has been widely observed that the focus on the environmental features of sustainable buildings has led to other aspects, especially social (e.g health), economic and cultural factors, being largely overlooked (Banfill and Peacock, 2007; Carter and Fortune 2007; Giddings, Hopwood and O'Brien, 2002; Mateus and Bragança, 2011; Turcotte and Geiser, 2010; Winston, 2010; Winston and Pareja Eastaway, 2008). However, a technical 'fix' that addresses the environmental aspects of housing, such as enhancement of energy efficiency though insulation or use of small-scale renewables to reduce greenhouse gas emissions, does not necessarily create a sustainable house that will by default enhance the quality of life of its occupants. This is not simply a conceptual issue: A dwelling with enhanced environmental performance cannot be regarded as sustainable if users' quality of life is negatively impacted by factors such as layout restrictions, lack of natural lighting or by the need to move to a different home if their circumstances change. While preservation of the environment is important, Chiu (2003) argues that the primary aim of a sustainable housing development should be to meet the needs of the people rather than to preserve the environment. It is not just the basic needs, but an improvement of the liveability of both internal and external environments.

In any discourse on sustainable housing, it is also important to consider the longevity of dwellings. Life cycle analysis evidence suggests that, from sustainability perspective, enhancing the longevity of existing buildings is often a more favourable approach than replacement with new stock (de Jonge, 2005; Klunder, 2005; Thomsen and van der Flier, 2008). Yet a proportion of new build housing will always be required not only to replace dwellings that are at the end of their physical and functional lifespan, but also because of changing demographic needs (e.g. increase in smaller households) and changing consumer preferences that cannot be provided for through refurbishment and alteration of existing stock (Adams, Watkins and White, 2005). If these new buildings are to be designed to last much longer than the current stock, it is imperative that housing design embraces a holistic approach, including factors such as adaptability and community building, to ensure that quality of life is not compromised as the dwellings age.

The type of approach adopted by authors who take a more holistic view to sustainable housing tends to suggest that a framework is a more appropriate way to define and discuss the concept of sustainable housing (Turcotte and Geiser, 2010; Winston, 2010; Williams and Lindsay, 2007). As such, it has been pointed out that the broad and vague nature of the WCED definition for sustainable development should be regarded as an asset for housing research rather than a hindrance. For instance, Eastaway and Støa (2004) suggest that the diverse research dimensions provided by the sustainable development concept can be used as an analytical framework – providing *"research perspective or a normative background for interpretation"* (p.2). Similarly, Chiu

(2004) maintains that the concept of sustainable development *"offers potentially a holistic and integrative approach to housing issues"* (p.75).

Table 1 presents a few examples of such analytical frameworks for sustainable housing found in literature. Large variation can be noted in the selection and scope of features, however all necessitate aspects to improve environmental performance of housing in terms of energy, water and resource efficiency, reduction of pollution etc. (i.e. 'green design'). Socio-economic features are more varied but include factors such as quality, preservation of cultural heritage, participation and availability of local services.

EXAMPLES OF ANALYTICAL FRAMEWORKS FOR ASSESSING SUSTAINABLE HOUSING		
Winston (2010):	Williams and Dair (2007c):	Turcotte and Geiser (2010):
Environmental sustainability: ➞ Sustainable land-use planning ➞ Higher residential densities ➞ Sustainable construction (e.g. energy efficiency, local renewable materials) ➞ Design for sustainable use (e.g. energy use, water recycling and treatment, waste recycling) ➞ High standards of energy efficiency ➞ Waste recycling ➞ Sustainable management & maintenance ***Social/Economic sustainability:*** ➞ Housing quality ➞ Access to green space ➞ Attractive, clean & safe residential environment ➞ Housing affordability ➞ Tenure mix & social mix ➞ Social resources ➞ Emphasis on renovation rather than demolition ➞ Partnership with residents ➞ Social supports for vulnerable households	***Environmental sustainability:*** ➞ Minimise use of resources ➞ Minimise pollution ➞ Protect biodiversity ***Economic sustainability***: ➞ Enable businesses to be efficient and competitive ➞ Support local economic diversity ➞ Provide employment ***Social sustainability:*** ➞ Adhere to ethical standards during the development process ➞ Provide adequate local services and facilities to serve the development ➞ Provide housing to meet needs ➞ Integrate the development within the locality ➞ Provide high quality, liveable developments ➞ Conserve culture and heritage if appropriate	***Environmental sustainability:*** ➞ Incorporate green design ***Economic sustainability:*** ➞ Encourage affordable & equitable distribution/ consumption of housing resources ➞ Support financial viability for housing producers ***Social sustainability:*** ➞ Provide safe internal conditions ➞ Maximize access to healthy environments and support services ➞ Support worker well-being ➞ Preserve cultural and housing heritage ➞ Foster participation and harmonious decision-making ➞ Social/Economic: ➞ Promote occupant-neighbourhood linkage ➞ Increase adaptability and flexibility

Table 1: Examples of analytical frameworks for assessing sustainable housing.

Taking the idea that quality of human life is at the core of the sustainable development concept and applying it to housing, implies that the fundamental aim of sustainable housing should be about enhancing the quality of human life. In other words, sustainable housing should ensure a better quality of life for current housing-users as well as future generations while taking into account wider social, environmental and economic aspects (Brown and Bhatti, 2003; Mateus and Bragança, 2011; Chiu, 2004; Priemus, 2005).

2.3. Linking sustainable housing to health and well-being

The Rio Declaration on Environment and Development during the 1992 UN Conference on Environment and Development (UNCED, also known as the 'Earth Summit') set out 27 guiding principles for sustainable development. Human health is regarded by the very first principle as central to sustainable development:

> ***"Principle 1****: Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature." (UNCED, 1992a)*

The centrality of health to sustainable development is reverberated in Agenda 21, the action plan for sustainability in the 21st century adopted during the UNCED. Chapter 6 of the document specifically addresses the protection and promotion of human health, however over 200 references to health and well-being are made throughout the remaining 40 chapters, placing them at the very core of Agenda 21 (WHO, 1997a). Human health and sustainable development are interconnected not only at the conceptual level, but also through the sharing of fundamental principles and practical processes, such as equity, importance of action at the local level, public participation, and the need for a holistic and interdisciplinary approach (*ibid*).

The same interconnectedness can be extrapolated to health and sustainable housing as the two agendas are ultimately about enhancing the quality of human life within the wider socio-economic and environmental contexts. As Barton, Grant and Guise (2010) point out, health can be regarded as *"the touchstone for sustainability"* (p.15) given that the fundamental principles provide common ground for both, as healthy neighbourhoods will also likely be sustainable neighbourhoods. The principles connecting health and sustainable housing are discussed in greater depth in the next chapter.

2.4. Policy drivers for sustainable housing in the UK

2.4.1. Housing within the Government's sustainable development agenda

The UK's sustainable development policy has been developed within the framework of global strategy for sustainable development. Following the 1992 UNCED, UK was one of the first countries to produce its national sustainable development strategy in 1994 known as '*Sustainable Development: The UK Strategy'*. The strategy was updated in

1999 ('*A better quality of life – a strategy for sustainable development for the United Kingdom*') and then again in 2005, when it was entitled *'Securing the future - delivering UK sustainable development strategy'* (DEFRA, 2005). In 2011, the Coalition Government published an update, '*Mainstreaming sustainable development – The Government's vision and what this means in practice*', where it confirmed its commitment to the principles outlined in the 2005 document (DEFRA, 2011).

In the UK's sustainable development strategy, housing was discussed primarily in the context of energy efficiency and sustainable communities: Housing ('Households and energy efficiency') was presented as one of the six key sectors to be tacked in order to reduce carbon emissions. The Government committed to increasing the average energy efficiency of domestic homes by improving standards and updating the Building Regulations. The development of a 'Code for Sustainable Buildings' was also introduced as a step towards improving the resource efficiency of new buildings. While social and private landlords were to be encouraged to improve energy efficiency through insulation and heating.

Decent and affordable housing was described as an essential component of sustainable communities. A five-year plan, '*Sustainable communities: Homes for all*' (Office of the Deputy Prime Minister (ODPM), 2005a), was set out which sought to achieve higher dwelling densities, development of brownfield land and protection of greenbelts, alongside tackling issues of housing demand, affordability and quality of rental homes. The importance of the planning system was also acknowledged as key in achieving sustainable development, while planning authorities were required to undertake Sustainability Appraisals in their review of Regional Spatial Strategies.

2.4.2. Sustainable construction strategy

The first strategy for sustainable construction was published in 2000 entitled '*Building a Better Quality of Life: A Strategy for more Sustainable Construction*' (Department for Environment Transport and the Regions (DETR), 2000). As indicated by the title, the strategy places a great focus on quality of life by acknowledging the significant contribution that the industry can make in improving it. Construction industry's role in achieving sustainable development aims were seen not only in terms of its own profitability and environmental protection (such as energy and natural resource conservation), but also through fairer treatment of its stakeholders, and crucially by *"delivering buildings and structures that provide greater satisfaction, well-being and value to customers and users"* (DETR, 2000; p.8).

The latest sustainable construction strategy, '*Strategy for Sustainable Construction*', was developed by the Government jointly with industry and published in 2008 (DBERR, 2008). The aim of this strategy was firstly to provide clarity to business on the Government's position relating to sustainability; set and commit to higher standards; and lastly, make specific commitments by both industry and the Government to take the sustainable construction agenda forward. The document contains 11 chapter headings forming the strategy for sustainable construction by outlining the 'Means' (procurement, design, innovation, people and better regulation) that are meant to achieve the 'Ends' (climate change mitigation, climate change adaptation, and conservation of water, biodiversity, waste and materials).

Interestingly, the 2008 sustainable construction strategy does not place the same explicit focus on improving quality of life as the 2000 strategy did. Quality of life is implied through, for instance, design and quality of buildings meeting stakeholder needs and the mention of Building for Life 12 (BfL12) criteria (discussed below). However, unlike the earlier strategy, the vision of sustainable construction presented in 2008 is very much in terms of economic and environmental sustainability, with no mention of quality of life, well-being, and little reference to community engagement. An interesting question arises – was this is a reflection of a changed direction within the Government or the influence of the construction industry who were the 'co-authors' of the 2008 strategy? Either way, lack of explicit acknowledgement of the role that the construction industry has on the quality of life is a concern, particularly with regard to the implications this might have in the design of homes and neighbourhoods.

2.4.3. Sustainable communities and the role of housing

UK's sustainable development agenda links housing to quality of life, health and well-being within the broader concept of sustainable communities. Sustainable communities have been defined as;

> *"...places where people want to live and work, now and in the future. They meet the diverse needs of existing and future residents, are sensitive to their environment, and contribute to a high quality of life.*

They are safe and inclusive, well planned, built and run, and offer equality of opportunity and good services for all." (ODPM, 2005b; p 6)

The sustainable communities agenda was first introduced by the Government in 2003 (ODPM, 2003). While sustainable communities were inextricably linked to provision of decent and affordable housing, it was also maintained that sustainable communities are more than just about dwellings. While there cannot be a single template for sustainable communities, table 2 shows their expected characteristics as outlined in the UK's sustainable development strategy (DEFRA, 2005) and the Bristol Accord (agreed at the 2005 European Ministerial Informal meeting in Bristol (ODPM, 2005b; p.7) as well as the areas that housing and neighbourhood design can influence. While one of the principles specifically focuses on housing and neighbourhood design, the table seeks to show that good design can contribute to all 8 principles. Furthermore, it is also worth noting that housing and neighbourhood design features need not be complex or technological in nature to have a substantial contribution to the development of sustainable communities.

Characteristics of sustainable communities:		***Housing and neighbourhood design:***
Active, inclusive & safe	✓ *Strong local culture and other shared community activities.* ✓ *A sense of community identity and belonging.* ✓ *Tolerance, respect & engagement with people from different backgrounds.* ✓ *Friendly, co-operative and helpful behaviour in neighbourhoods.* ✓ *Opportunities for cultural, leisure, community, sport and other activities, including for children and young people.* ✓ *Low levels of crime, drugs and anti-social behaviour.* ✓ *Social inclusion and good life chances for all.*	➞ Community and public spaces ➞ Integrated design reflecting the area's cultural heritage ➞ Easy access to amenities ➞ Secure design
Well run	✓ *Effective and inclusive participation, representation and leadership.* ✓ *Effective engagement with the community at neighbourhood level.* ✓ *Strong, informed and effective partnerships that lead by example.* ✓ *Strong, inclusive, community and voluntary sector.* ✓ *Sense of civic values, responsibility and pride.*	➞ Common /public areas amenable for management and maintenance by the community (e.g. children play areas, joint gardens)
Well connected	✓ *Good transport services and communication linking people to jobs, schools, health and other services.* ✓ *Facilities to encourage safe local walking and cycling.* ✓ *Appropriate level of local parking facilities.* ✓ *Widely available and effective telecommunications and Internet access.* ✓ *Good access to communications networks.*	➞ Walkable neighbourhoods
Well served	✓ *Public, private, community and voluntary services are appropriate to people's needs and accessible to all.* ✓ *Well-performing local education institutions.* ✓ *High quality local health care and social services.* ✓ *High quality services for families and children.* ✓ *Service providers who think and act long term and beyond their own immediate geographical and interest boundaries.*	➞ Easy access to amenities

Environ-mentally sensitive	✓ *Places for people to live that are considerate of the environment.* ✓ *Actively seek to minimise climate change.* ✓ *Protect the environment by minimising pollution.* ✓ *Minimise waste.* ✓ *Efficient use of natural resources, encouraging sustainable production and consumption.* ✓ *Protect and improve bio-diversity.* ✓ *Enable a lifestyle that minimises negative environmental impact and enhances positive impacts.* ✓ *Create cleaner, safer and greener neighbourhoods.*	➞ Greenspace provision ➞ Design employing renewables ➞ Design facilitating environmentally responsible behaviour (e.g. provision of space for compositing, waste sorting and recycling, rainwater harvesting)
Thriving	✓ *Wide range of jobs and training opportunities* ✓ *Sufficient suitable land and buildings to support economic prosperity.* ✓ *Dynamic job and business creation.* ✓ *Strong business community with links into the wider economy* ✓ *Economically viable and attractive town centres*	➞ Easy access to amenities (e.g. transport links, job opportunities) ➞ Space for home office
Well designed & built	✓ *(→) Featuring quality built and natural environment* ✓ *(→) Sense of place (a positive 'feeling' for people & local distinctiveness)* ✓ *(→) User-friendly public and green spaces* ✓ *(→) Sufficient range, diversity, affordability and accessibility of housing within a balanced housing market* ✓ *(→) Appropriate size, scale, density, design & layout, including mixed-use development complementing the distinctive local character of the community* ✓ *(→) High quality, mixed-use, durable, flexible and adaptable buildings, using sustainable construction materials* ✓ *(→) Buildings and public spaces which promote health, designed to reduce crime & make people feel safe* ✓ *(→) Jobs, key services & facilities accessible by public transport, walking & cycling*	
Fair for everyone	✓ *Recognise individuals' rights and responsibilities.* ✓ *Respect the rights and aspirations of others to also be sustainable.* ✓ *Regard for the needs of future generations in current decisions & actions*	➞ Community engagement ➞ Opportunities to get involved

Table 2: Eight principles of sustainable communities (DEFRA, 2005; ODPM, 2005b) and examples of housing and neighbourhood design features that can contribute to the development of such communities.

2.5. Key drivers for sustainable housing development in the UK

While UK Government's commitment to sustainable housing is outlined within the national housing strategy, in practice, the development of sustainable housing in the UK is primarily driven by the planning policy, Building Regulations and building standards such as the Code for Sustainable Homes (CSH) (DCLG, 2012a; Pickvance, 2009a) – all of which are briefly discussed below:

2.5.1. National housing strategy

In 2011, the UK Government released its latest housing strategy entitled '*Laying the Foundations: A Housing Strategy for England*' (DCLG, 2011a). The overall aim of this strategy was to stimulate the housing market and by doing so boost local economies, employment and to provide greater opportunity for people to own a good quality home (*ibid*). While the strategy focused on increasing house building and supply, crucially it stressed that good quality, sustainability and design of homes were just as important as the quantity.

The Strategy regarded good design as having the following characteristics;

- Attractive, i.e. housing that reflects local character and identity.
- Functional, i.e. promotes well-being by balancing needs for privacy, community and economic activity. The importance of housing on health and well-being was also acknowledged.
- Light, spacious and quiet homes
- Adaptable, which should apply to indoor and outdoor spaces
- Community amenities, including green spaces
- Improving safety and security of homes and neighbourhoods
- Durable and economic to maintain (DCLG, 2011a).

To achieve these aims, the Government placed a strong focus on simplifying the national planning policy and giving communities and local authorities greater responsibilities in housing and neighbourhood design. The strategy committed to funding the Design Council to help communities influence the design of their homes and neighbourhoods, improve energy efficiency, and to protect green belts. Also, reaffirmation was made of the Government's commitments to the Zero Carbon Homes standard for new homes by 2016. Local authorities were given greater responsibility for the financial and strategic management of their council homes - the latter also embodied by the Localism Act 2011, in which housing was one of the key areas of focus (DCLG, 2011b).

2.5.2. National Planning Policy Framework

One of Government's commitments set out in the national housing strategy was to streamline the planning system. In line with this, the National Planning Policy Framework (NPPF) was published in 2012 condensing over a 1000 pages of previous policy guidance into approximately 50 pages (DCLG, 2011a). Achieving sustainable development, which is regarded in its holistic sense and entailing social, environmental and economic aspects, is presented at the core of the NPPF. However instead of issuing specific guidance, the NPPF provides a framework for moving towards sustainability with the intention that communities and councils get involved and develop plans that reflect local needs and priorities (DCLG 2012a).

2.5.3. Building regulations

New housing and building alterations in the UK must comply with the Building Regulations, which seek to limit the environmental damage associated with the industry and ensure that buildings are safe and accessible. The Regulations comprise of 14 technical ‘Parts’ each with an associated supporting ‘Approved Document’. First introduced in 1965, the nature of the Building Regulations has changed over the years from a set of highly prescriptive stipulations to become more flexible and supportive of innovation whilst improving the quality of buildings and efficiency of the building regulations system (DCLG, 2012b).

2.5.4. Key sustainable building standards

2.5.4.1. Code for Sustainable Homes

In 2003, stimulated by a perception that progress in developing sustainable buildings was inadequate, the UK government established the ‘Sustainable Buildings Task Group’ to identify ways in which sustainability of buildings could be enhanced (Williams and Dair, 2007b). In 2004, a report produced by the Task Group highlighted the need for a code for sustainable buildings among its recommended steps for speeding up the development of a more sustainable built environment (Sustainable Buildings Task Group, 2004).

The Code for Sustainable Homes (CSH) was launched in 2006 and adopted in England in April 2007. Replacing the EcoHomes scheme, the CSH is an assessment rating method that aims to *“improve the overall sustainability of new homes”* (DCLG, 2008; p.4). While Building Regulations represent the minimum regulatory standard, CSH requirements go above the regulations and represent good or best practice. The Code is a voluntary standard and is only mandatory in cases where it is specified as a requirement by local authority planning policy or the housing is funded by Homes and Communities Agency (HCA). Sellers of new homes however are required to provide information on whether the dwelling has been rated against the Code, and if it has, which level was achieved.

The Code measures sustainability against nine different categories: energy/carbon; water; waste; materials; surface water run-off; health and well-being (the performance standards with mandatory criteria) as well as pollution; ecology; and management. While it labels itself as a standard for 'sustainable housing', it can be argued that its focus is primarily on environmental sustainability as seven out of the nine categories exclusively address environmental issues. While 'management' covers environmental ('home user guide', 'considerate constructors scheme' and 'construction site impacts') and social aspects ('considerate constructors scheme' and 'security'), 'health and well-being' is the only category that focuses directly on the occupant's quality of life. However, this category contains only four criteria ('daylighting', 'sound insulation', 'private space' and 'lifetime homes'). Not only do health and well-being issues affected by housing go far beyond these four considerations (as elaborated in chapter 3), but crucially, lack of criteria covering indoor air quality has been regarded as a particular shortcoming given the potential for inadequate air quality within energy efficient buildings (Bone, Murrey and Meyers, 2010).

2.5.4.2. Building for Life

Building for Life is the Government-endorsed industry standard for good urban design of new housing developments. First launched in 2003, it has been developed by CABE (at the Design Council, Design for Homes) and the Home Builders Federation, with the support of Nottingham Trent University. The latest (third) version Building for Life 12 (BfL12) released in 2012 is based on the NPPF, and the standard's 12 questions intend to reflect a vision that new housing developments should be attractive, functional and sustainable places (Birkbeck and Kruczkowski, 2015). The 12 topics are organised under 3 broader categories as follows:

Integrating into the neighbourhood:	***Creating a place:***	***Street and Home:***
1. Connections	5. Character	9. Streets for all
2. Facilities and services	6. Working with site & its context	10. Car parking
3. Public transport	7. Creating well defined streets & spaces	11. Public & private spaces
4. Meeting local housing requirements	8. Easy to find your way around	12. External storage & amenity space

2.5.4.3. HCA's Housing Quality Indicators

The HCA's predecessor, the Housing Corporation, set out ten design and quality indicators required for new homes that receive public funding (Housing Corporation, 2008):

1. Location
2. Site – visual impact, layout and landscaping
3. Site – open space
4. Site – routes and movement
5. Unit – size
6. Unit – layout
7. Unit – noise, light, services and adaptability
8. Unit – accessibility within the unit
9. Unit – sustainability
10. External environment (Building for Life)

These Housing Quality Indicators are used to score developments, and a score above a set minimum threshold is necessary to qualify for funding. The current 2011-15 Affordable Homes Programme is subject to these standards as was the previous programme (2008-2011 National Affordable Housing Programme). However the next tranche of funding, 2015-18 Affordable Homes Programme will not be subject to the same standards following the Housing Standards Review (see below).

2.6. Housing standards review

The existence of multiple sustainable building standards, while useful in encouraging good quality dwellings, has also been criticised for causing confusion and inconsistent application (CABE, 2010a; 2010b; RIBA, 2012; DCLG, 2014a). The Housing Standards Review was launched in October 2012 taking into consideration all the standards currently relevant to housebuilding, such as the CSH, Secured by Design (SBD), Lifetime Homes and the HCA’s Housing Quality Indicators. The aim of the review is to streamline the multiple standards and reduce their number from 100 to under 10 in order to save local authorities and developers time and cost (DCLG, 2014a).

Following the end of the consultation period in October 2013, an addendum (HCA 2014a) was published in March 2014 to the 2015-2018 Affordable Homes Programme prospectus outlining the following changes to the standards that publically funded homes need to adhere to:

- ***CSH***: No requirement to meet any specific level of the CSH.
- ***Energy efficiency***: Compliance with the relevant standards set out in Building Regulations Part L
- ***Water efficiency***: No requirement to meet targets higher than 110 (litres per person per day) and no requirements for rainwater or grey water harvesting (as per Building Regulations).
- ***Security***: Housing proposals should be based on Publically Available Specification (24:2012) for doors and windows.

- ***Accessibility***: No additional requirements above Part M (Access to and use of buildings) of the Building Regulations
- ***Space standards***: Housing proposals will be benchmarked against the requirements of the Level 1 Space Standard set out at the consultation stage of the Housing Standards Review.
- ***Internal layout:*** Data on bedroom size and storage space will be gathered at proposal submission stage.
- ***External elements***: Proposals need to report score achieved against BfL12.

Thus, one of the key outcomes of the Review is that many requirements will be addressed by the Building Regulations and the accompanying Approved Documents. Furthermore, in September 2014, the Government issued a consultation on its proposal to consolidate the currently multiple standards into a core of five standards to address security, space, water efficiency, and age friendly- and wheelchair user housing (DCLG, 2014g).

2.7. Barriers to sustainable housing

Barriers to sustainable housing implementation have been investigated by a number of researchers (e.g Brennan and Cotgrave, 2014; Williams and Dair, 2007b; Winston, 2010). While many of these barriers are interconnected, necessitating a multi-pronged approach for tackling them, the identified key challenges are highlighted here:

2.7.1. Informational/conceptual

Lack of information, awareness or expertise among developers as well as consumers has been found to be an important barrier to the development of sustainable housing (Williams and Dair, 2007b; Winston, 2010; RIBA, 2012). Brennan and Cotgrave's (2014) enquiry using housing industry focus groups found a lack of proactive engagement among construction industry professionals with regard to training and professional development opportunities. The authors suggested lack of client demand and the associated risks as possible reasons, but this reluctance could also be down to behavioural and culture of the organisations (see below).

However inadequate knowledge or understanding is not limited to design standards or technology. As discussed earlier, lack of a common conceptual agreement on what sustainable housing is, means that there is a focus on one aspect of sustainability, usually environmental, while the importance of other (usually socio-economic) factors is neglected (Winston, 2010). At best, this will result in environmentally (as opposed to holistically) sustainable housing, but in a worst case scenario, it will lead to a numerous new energy efficient dwellings that are detrimental to the social and physical well-being of its occupants. Furthermore, lack of agreement on the definition of sustainable housing also hinders the development of a single, coherent performance assessment measure (Williams and Lindsay, 2007).

2.7.2. Institutional

Williams and Dair (2007b) research found that the most common reason for not implementing sustainability measures was that it was simply not considered by the housing provider unless it was a regulatory or policy requirement. Häkkinen and Belloni (2011) argued that sustainable building is primarily hindered by the organisational and procedural factors among housing providers, rather than by any lack of technology, information and assessment methods. The authors maintain that adopting new methods of house building and technologies entails a level of risk and requires changes to the established processes, thus making the industry reluctant to take up sustainable house building wholeheartedly. Bergman, Whitmarsh and Kohler (2008) described the residential building sector as 'locked in' current unsustainable practices. Some environmental measures are often perceived as too experimental by house builders who tend to be reluctant to implement them believing the house buying public is easily put off by such features (Townshend, 2005).

2.7.3. Financial

High costs and/or limited available resources feature as an important barrier identified in the literature (Williams and Dair, 2007b; Winston, 2010; Pitt et al., 2009). However, it has been observed that the perception or over-estimation of high costs among housing providers can be just as important (Brennan and Cotgrave, 2014).

2.7.4. Regulatory/policy

Conflicts among different policy aims, even within the sustainably remit, can also be a problem. For instance, *Secured by Design* guidance stipulates limited access which can be at odds with planning policy's desirability for permeability (Townshend, 2005), or the well-being benefits of access to greenspace versus those of higher density developments. A consequence of this is the potential for developers to trade one sustainability objective for another such as provision of more housing at the expense of natural habitats (Williams and Dair, 2007a). Yet there is also evidence of a perception among some construction industry professionals that legislation is the only way for enhancing sustainability within the sector, however unrealistic the introduction of such legislation may be (Brennan and Cotgrave 2014).

2.7.5. Market demand

As the construction industry is client driven, market demand is a major driver or barrier for sustainable building (Opoku and Fortune, 2011). Lack of market demand for sustainable housing has been observed as another important barrier to the achievement of sustainable housing for a number of years now (RIBA 2012; Sunikka, 2003; Pitt et al., 2009; Williams and Dair, 2007a). Consumer demand for sustainable housing is crucial for improving the standard of housing design as well as the supply of high quality dwellings and neighbourhood (RIBA 2012). However, negative attitudes to higher residential density and social mix, scepticism towards green housing measures has become engrained among developers and nimbyism tends feed developers' reluctance to adopt sustainability features or guidance standards (Winston, 2010; Townshend, 2005).

Engaging stakeholders such as local communities and the general public (as potential consumers) has been found to be a key factor in enhancing construction company profitability as well as increasing managers concern about sustainability issues (Rodriguez-Melo and Mansouri, 2011). This implies that demand must be there in the first place to stimulate such effects. However, it has also been pointed out that the typical supply-and-demand model may not always be applicable to the housing market. As Lovell (2005) notes, the UK private sector house building industry has been slow to respond to the growing consumer demand for low energy housing.

2.7.6. Social/psychological barriers.

Psychological barriers at the individual level such as over-discounting the future, egocentrism, positive illusions, presumed and incorrect associations as well as misinformation can become particularly prominent once any technical and economic barriers are overcome (Hoffman and Henn, 2008). As these barriers apply to different housing stakeholders, they will also be contributing and influencing the other barriers discussed above, such as the institutional and regulatory factors as well as market demand.

2.8. Levels of sustainable housing today

Given the various drivers and barriers at play, a pertinent question to ask is; what is the current situation with regards to sustainable housing implementation in the UK? In an attempt to answer this, this section first looks at the current house building trends in the country followed by a closer analysis of the actual sustainability of housing.

2.8.1. Current house building trends in the UK

There is a widely acknowledged shortage of housing in the UK. This was highlighted in the 2004 Barker review of housing supply (Barker, 2004), yet the situation has not improved since. Analysis of the recent 2011 census data, revealed the need for approximately 240,000-245,000 homes each year to meet the demand created by the growing number of households (projection until 2031) (Holmans, 2013). RIBA, taking into account the shortage backlog, argued that this number should be higher – at least 300,000 new homes need to be built per year (RIBA, 2012). However, the current home building is approximately a third of these projections:

The UK housing market has suffered the consequences of the economic downturn in 2007 (Madeddu, 2012). The construction industry was one of the sectors hit hardest by the recession, with an average annual decrease of 3% during the 2008-2012 years (Construction Industry Training Board, 2014). In the 12 months leading to September 2013, 108,290 houses were completed in England, which is 39% below the peak level of completions in 2007 (DCLG, 2014c). The decrease was experienced by both private and public sectors with 3% and 21% fewer completions respectively than previous year (ibid).

Despite the public sector cuts in funding, the house building industry in the UK is showing signs of a recovery. Construction Industry Training Board's 5 year forecast in 2014 predicts an average of 2.2% annual growth for public housing and 4.6% for private housing (Construction Industry Training Board, 2014). Nevertheless, these projections still fall short of delivering the minimum of 240,000 homes needed each year to tackle the housing shortage.

2.8.2. Quality and sustainability of new housing

Prior to the introduction of the CSH in 2007, Williams and Lindsay (2007) attempted to quantify the extent and describe the nature of sustainable building in England. The authors concluded that there was inadequate information to carry out such a review, despite taking a very inclusive approach and using a loose definition for sustainable building (which allowed the review to consider buildings with only environmental criteria). They highlighted that the majority of sustainable house building was either government led or undertaken by individuals or interested groups – the performance of the private sector house builders in particular was poor. Unsurprisingly, the focus of such building activity was primarily on environmental sustainability.

Williams and Lindsay followed on from Barton's (2000) analysis of sustainable housing developments, which (at the time) also found a poor record of progress and implementation of sustainability in practice. At the time of writing, no follow up review of Williams and Lindsay's (2007) work for England or the UK could be found, presumably because data on CSH certification is now provided by the DCLG (see below). However this is a notable gap in the literature, because while detailed statistics on homes built under CSH criteria are available, there is a lack of peer-reviewed academic analysis of such data. For instance, little examination can be found of the trends in the context of the recession, or systematic analysis of which CSH (non-mandatory) criteria are being implemented more readily over others. Furthermore, lack of a follow up review of the type conducted by Williams and Lindsay in 2007 indicates a complacent acceptance of the CSH definition for 'sustainable housing' despite its clearly biased focus towards environmental sustainability.

Between the launch of the Code in 2007 and June 2013, a total of 305,500 CSH certificates have been issued (design stage and post construction stage) (DCLG 2013b), which represents approximately half (46%) of all new build completions during that period[1]. While this may be regarded as a relatively high figure, it does not necessarily indicate a good level of sustainability in the UK housing sector for a number of reasons:

[1] This estimate was calculated as follows: First certificates were not awarded until 2008 (because it takes 1.5 -2 years to design and build a Code home (DCLG 2013b) Total number of new dwellings built between 2008 and 2013 in England, Wales and Northern Ireland was 667,010 (i.e. 751,510 in UK minus 84,500 built in Scotland) (DCLG 2013d), hence 305,500/667,010 = 0.458 or 46%.

Firstly, it is important to remember that the majority of certified homes are built by social housing providers who are obligated to build to the specifications of the Code in order to receive public funds. As shown by table 3, approximately two thirds of certificates can be attributed to the public sector and a third to the private sector. Taking also into consideration that some 80% of dwellings are built by private sector house builders (see table 4 in section 2.9), these figures demonstrate the relatively low prevalence of the Code among new housing stock. Secondly, most of the certification is for 3-star ratings (136,749 dwellings at the design stage) with most of the remaining (42,290 dwellings) receiving a 4-star rating, which means that not all categories of the Code will have been incorporated to their optimum levels.

	Private sector:	**Public sector:**	**Certificates (total):**
Post construction:	29,271	92,692	**121,963**
Design stage:	67,909	115,629	**183,538**
Total:	97,180 (32%)	208,321 (68%)	**305,501 (100%)**

Table 3: CSH Certificates awarded between 2007 and June 2013 (DCLG, 2013b).

Using CSH adoption as an indication of the level of sustainable housing reveals a relatively low level of sustainability, particularly among housing delivered by the private sector. However, as mentioned earlier, the CSH is not necessarily the best indicator for sustainable housing due to its bias towards environmental sustainability. To supplement CSH and gain a more complete picture with regards to sustainable housing, it is worth looking into other audits and reviews that seek to assess housing quality and sustainability in broader terms.

CABE has carried out a number of audits of social and private sector housing using the BfL12 criteria. For private sector housing, they assessed 293 developments across three regions in England between 2005 and 2007, and found that only 18% of developments could be rated as ‘good’ or ‘very good’ (scored 70% or higher), 53% were ‘average’ (score of 50%-70%), and 29% were ‘poor’ (scored below 50%) (CABE, 2011). Using the same methodology, CABE also carried out an audit for the HCA in 2007 of 218 social housing schemes funded under the Affordable Housing Programme. The findings were similar to the private sector results with 18% of schemes found to be either ‘good’ or ‘very good’ 61% were ‘average’ and 21% assessed as ‘poor’ (HCA, 2009).

2.9. Key housing stakeholders

A stakeholder can be defined as someone with a vested interest in a problem or issue because i) they are mainly affecting it; ii) they are mainly affected by it; or iii) they both affect it and are affected by it (Banville *et al*., 1998). A stakeholder can be an individual, group or an organisation (Brugha, 2000) and for the housing sector, their interest can fall under any life cycle stage of housing, such as policy/regulation, planning provision and use (figure 2).

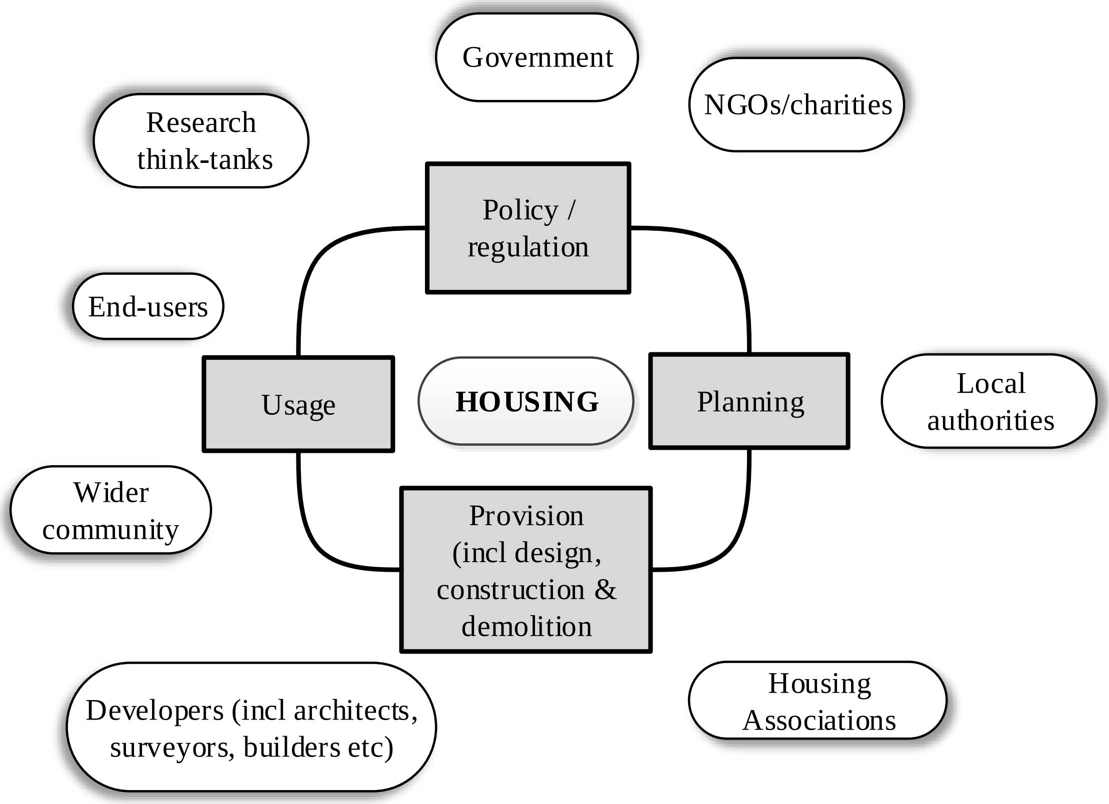

Figure 2: Main groups of housing stakeholders. Each type of stakeholder is placed next to the main stage of the housing life cycle they will mainly (but not necessarily exclusively) be affected by or be responsible for. For instance, developers are mainly responsible for the provision of housing, but they may also affect policy and regulation through government's consultation exercises. (Source: self-study).

The multifaceted nature of sustainable housing means that no single organisation has the expertise or ability to deliver sustainable housing (Miller and Buys, 2012). This means that achieving sustainability in the housing sector will require a positive influence from multiple stakeholders. However stakeholder influence will be shaped by factors such as personal and cultural views and opinions, level of understanding and access to information, as well as any conflicts of interest that may exist. Furthermore, none of the stakeholder groups act in a vacuum and will have an influence on each other:

End-users are crucial in creating market demand for sustainable housing in the first place (RIBA 2012), but also affect how efficient such housing is (e.g. appropriate use of environmental technologies). Ideally, housing-users and communities will have a say in the planning and design stages and so will play a significant part in conceptualising and applying the concept of sustainable housing to their location. While the government is responsible for setting out the housing policy and specifying building regulations, it will be under the influence of voters, lobby groups, pressures exerted by other policies, and will seek consultation with other housing stakeholders who will therefore influence policy. Similarly, while local councils are responsible for setting out their region's housing strategy, planning guidance and have the authority to grant or reject planning proposals, they will be under the influence of housing users (as their constituents), industry groups and other policy pressures. Housing providers, whether private or public sector, will be under the influence of customers, market forces, regulation and financial pressures.

The focus of this study is at the 'frontline' of housing delivery (i.e. new build) – the key housing stakeholders of interest in this case are therefore housing providers and housing end-users. According to the latest English Housing Survey (2012-13), the majority of housing in the UK is privately owned either by owner occupiers (65%) or privately rented (18%) (DCLG 2014b). In the remaining social housing sector, while housing associations are responsible for the greater proportion of the social housing stock (11%), local authorities still maintain a sizeable 7% (table 4). However when it comes to provision of new housing, the vast majority (approximately 78%) is provided by the private sector, with housing associations building the majority of the social housing.

	Dwelling stock:		**Dwellings built 2008-2013:**	
	Number	%	Number	%
Private sector:	19,075,000	82%	583,290	78%
Housing Associations:	2,479,000[2]	11%	159,500	21%
Local Authorities:	1,682,000	7%	8,800	1%
Total:	23,236,000	100%	751,590	100%

Table 4: Proportion of housing stock and dwellings built by the three main housing providers (DCLG 2014d; e).

[2] This figure includes 'private registered providers and 'other public sector' (DCLG 2014e)

2.9.1. Private sector house builders

As mentioned above, private sector house builders are responsible for approximately 80% of new homes in the UK, and while there are some 20,000 builders registered with the National House-Building Council (NHBC), the industry is dominated by a relatively small number of large companies (Calcutt, 2007). For example, the top three companies (Barratt Developments, Taylor Wimpey, and Persimmon) accounted for nearly half (48,773) of all new housing completions in 2012-2013 (Home Builders Federation, 2014). While these companies are regarded as national house builders, they tend to operate along regional lines. However, this strong regional-based command structure is more about enabling a better grasp of local land market than about catering for local tastes or delivering vernacular styles (Neale and RIBA 2009).

Given the relatively small number of main house builders, significant in-roads could be made into sustainable housing by changing their practices (Williams and Lindsay, 2007). However, the sector is generally regarded as conservative in nature, risk averse and slow to adapt to change (*ibid*). Ever since the 1992 Earth Summit, sustainability within the construction sector has always lagged behind other sectors (Myers, 2005). Its low investment in research and development is not helped by the current economic climate and decreased governmental support for exemplar developments (NextGeneration 2013). Reflecting its conservative nature, Pickvance (2009a) pointed out that the industry prefers change to be introduced via the Building Regulations not only because this is more likely to ensure a level playing field (as opposed to different regional standards established by local authorities), but also because change through Regulations also entails a slower paced change and the consultation process ensures that the industry has a higher level of influence than it would if changes were introduced through the planning policy.

Although Section 106 agreements often stipulate that developers must produce a certain number of ‘affordable’ homes in a housing development, the majority of new homes built by private sector homebuilders are nevertheless intended for the owner occupation. This means that the main objective for many builders is to maximise profits from the sale of new homes (Nelson 2011). This prioritisation of short term financial gain and the nature of the sector itself mean a number of implications for the design quality of new homes:

Firstly, volume house builders tend to adopt standard designs to keep building costs down. While these designs are enhanced with internal features and external modification to appeal to prospective buyers, the focus on the unit means that little attention is paid on creating a sense of place (Carmona, Gallent and Sarkar, 2010). Furthermore, as post occupancy evaluation tends to focus on energy use, it has been suggested that developers are missing out on the potential to collect useful information regarding development design such as use of public spaces, community integration features as well as satisfaction of homeowners with environmental technologies (NextGeneration, 2013).

Secondly, the highly competitive process of land acquisition means that developers are incentivised to increase density and reduce amounts spent on design and build quality (Neale and RIBA 2009). There is already a low uptake of sustainability guidance standards such as the BfL12 standard (Next Generation 2013). Yet, due to the current economic situation, many developers cannot achieve the sales necessary that would justify the prices paid for many sites, and as a consequence there is growing concern that housing design standards might deteriorate as developers try to minimise costs while needing to maintain delivery levels (Neale and RIBA, 2009).

However this is not to say that the industry is against sustainable development, and there is evidence for their willingness to engage is sustainable construction practices (Brennan and Cotgrave, 2014). Yet, while improvements in energy performance have been increasing, achieving sustainable housing in the more holistic sense (i.e. beyond energy targets) remains a recognised challenge for the industry (NextGeneration 2013). The 2013 report produced by NextGeneration, an organisation supported by the HCA who benchmark sustainability performance of the residential development sector, observed that while the overall industry average has improved, scores relating particularly to the quality of design, investment in research and development as well as a broader post occupancy evaluation remain weak.

2.9.2. Housing Associations

The origins of the modern housing association sector can be traced to a number of distinct points in history - a comprehensive review of which can be found in Mullins and Pawson (2010). While some associations can trace their roots to philanthropic housing companies of the 19th century or even medieval almshouses, many were established in the 1970s to undertake inner city regeneration. This was largely underpinned by the Housing Act 1974, which essentially provided 100% public funding for capital spending by housing associations. This continued until the Housing Act 1988, which changed the situation so that private borrowing became the main source of funding new build and development of existing properties. This shift in funding model has led to suggestions (albeit contended) that the culture of housing associations has become focused more on property than on people (*ibid*).

Nevertheless, the decades since 1980s have seen a major transfer of social housing from local authorities to housing associations, and it is the latter rather than local authorities that have been responsible for building most of publicly funded housing in recent years (see table 4). According to their representative body, the National Housing Federation, housing associations provide 2.5 million homes for more than 5 million people across England (National Housing Federation, 2014). Prior to the recession, housing associations were also responsible for 10% of residential construction, which increased to 20% as the private sector shrunk during the economic downturn (Neale and RIBA 2009).

In terms of sustainability, housing associations are seen as at the forefront of sustainable housing provision for a number of reasons. Firstly, HCA funding requires housing associations to take into consideration a number of sustainability and quality standards such as the CSH, HQI and BfL12. Incidentally, as the private sector is not subject to these requirements, it has been suggested that the majority of private sector housing consumers do not necessarily benefit from the same level of quality that is stipulated for social housing and that regulation of basic quality standards should therefore be extended to all housing providers (Madeddu 2012). Secondly, unlike private housing developers, housing associations do not have to sell housing and are therefore less susceptible to variations in marketability and price if sustainability features are integrated into the design of the dwelling (Pickvance 2009a). While the recession has caused many housebuilders to be quite conservative, housing associations are regarded to be well placed to lead in driving innovation in the sector (Neale and RIBA 2009).

Yet this sector is not without its challenges. The level of support for sustainable housing features varies greatly among housing associations depending on their size, available resources and expertise as well as whether they are building new housing or primarily managing existing stock (Pickvance 2009). Also, higher capital costs and lower in-house expertise have been identified as important barriers to the greater use of sustainable construction techniques and materials (Dewick and Miozzo 2004).

2.9.3. Local Authorities

Local authorities play a crucial role in the delivery of sustainable housing as they are responsible for setting the housing strategy and planning policies which influence the level and type of housing development that takes place within their jurisdiction. Local authorities are also a provider of social housing; albeit this role is becoming increasingly diminished due to large scale handover of their housing stock to housing associations in the recent decades.

It has been suggested that rather than simply advised to implement sustainable development, local authorities should be required to implement sustainable housing (Williams and Dair, 2007b; Winston, 2010). This role has been highlighted in NPPF as well as the Government's White Paper, *'Strong and Prosperous Communities'* which states that the "*strategic housing role [of local authorities] is at the heart of achieving the social, economic and environmental objectives that shape a community and create a sense of place*" (DCLG, 2006b; p. 41). In 2011, the Localism Act has further boosted the importance of local councils as a housing stakeholder through greater devolution of power and responsibility for local development from central government to local authorities (DCLG, 2011b).

While this is a good opportunity for local authorities to act as a catalyst in encouraging the development of sustainable housing, it is not to say that this opportunity is without obstacles for many councils. Firstly, the lack of financial support from the central government is recognised as a potential barrier and one that will require councils to use innovative ways to fuel this development (e.g. use of local authority pension funds) (RIBA, 2012). Secondly, many councils currently find community opposition a major barrier to new housing developments (Local Government Association, 2012). Survey research indicates that it is the perception of poor quality homes that leads to low acceptance and opposition to new housing by existing communities (RIBA, 2012). A 2011 survey of public attitudes to housing in England found that only 28% of respondents were supportive of new homes being built in the local area, while 46% were opposed. However, the opposing respondents said they would be supportive if new developments brought more jobs, green spaces and improved transport links

(DCLG, 2011c). This reiterates the importance of local authorities in promoting holistically sustainable housing design.

Lastly, it is recognised that local authorities may need support to implement the sustainable housing agenda. Pickvance (2009a) for instance argues that the Government should provide greater support for innovative and proactive councils when it comes to leading the way in sustainable housing, particularly as the conservatism of the private sector house builders is an obstacle to reform of housing.

As mentioned earlier, since 1980s there has been a substantial transfer of social housing from local authorities to housing associations, such that by 2008 only half of local councils in England held onto their role as a landlord (Mullins and Pawson, 2010). In 2013, local authorities across England owned 1.68 million properties – a steady declining trend continuing from over 3.6 million in 1994 due to Right to Buy and large-scale voluntary transfer to Private Registered Providers (DCLG, 2013a). However, what is left is still a significant proportion representing 42% of the overall social housing stock, which is typically targeted at tenants who are regarded to be in greater need.

2.9.4. Housing end-users

Evidence from consumer satisfaction surveys would suggest that there is a generally high level of satisfaction with the quality of homes. For instance, the latest English Housing Survey (2012-2013) revealed that 95% of owner occupiers were very or fairly satisfied with their homes, while among those in private or social rental sectors, the satisfaction rates were 84% and 81% respectively (DCLG, 2014b). The latest National New Homes Survey carried out by NHBC with new home buyers also indicated high satisfaction rates in the private sector: 89% were satisfied with the overall quality of their new home, 93% were satisfied with the internal design and 88% were satisfied with the external design (NHBC, 2014). Satisfaction with social housing is also high with 96% of housing-users scoring their home 4 or 5 (out of maximum five points), with a national average score of 4.65 (HCA, 2014b).

However, the overall picture is not as straightforward as it may seem given that other surveys yield less positive results. A report commissioned by RIBA found that people living in new build homes were more dissatisfied than those living in older properties (Ipsos Mori and RIBA, 2013). The survey reported high energy bills (49%), lack of space (32%) and lack of natural light (20%) as the three most cited causes of dissatisfaction. Interestingly, high energy bills were cited as the main cause of dissatisfaction by those living in a property for less than 2 years, while lack of space was an issue for those living in their homes 3 to 10 years. While the 2007 CABE's report on housing-users' satisfaction with new homes found a high proportion of satisfaction (91%) with the home itself, satisfaction was much lower with the wider housing development (76%). Levels of satisfaction also dropped when respondents were asked about specific aspects of their homes, such as quality (CABE, 2007).

As housing is not a typical consumer product, it is important to note several caveats pertaining to housing consumer satisfaction surveys. Firstly, high satisfaction rates found in post-occupancy studies conducted with homeowners who have recently moved in need to be treated with caution. This is because such respondents may not only be under the influence of the 'honeymoon effect' of a new home (Neale and RIBA, 2009), but also exert a biased opinion as a rationalisation of a very large financial commitment (Leishman et al., 2004). Secondly, as most industry based consumer satisfaction surveys are carried out with recent home purchasers, it offers an incomplete picture with regards to older properties. Since housing affects society as a whole (CABE, 2010b), more research is needed into consumer preferences of all potential homeowners, not just those that have recently bought a home or are actively looking (Neale and RIBA, 2009). Thirdly, observers have pointed out that we still have a rather incomplete understanding of the drivers behind the consumer housing choices, and in particular, how different factors are traded off before arriving at the final choice (Leishman et al., 2004). Lastly, it has been pointed out that industry satisfaction surveys tend to focus primarily on the dwelling as a product, rather than the wider quality of the neighbourhood, and as such, provide an incomplete picture regarding the quality of the overall housing developments (CABE, 2007).

While establishing a clear level of consumer satisfaction with new homes may be a contentious issue, research into new build housing quality tends to suggest a general preference for older properties fuelled by a common perception that new properties often lack adequate provision of certain key design features (Adams, Watkins and White, 2005; Neale and RIBA, 2009). These features, collated from a variety of surveys in table 5, appear to be particularly important to housing users, and are often regarded as areas that could be improved. Research carried out most notably by CABE, RIBA and HCA reveals these features to be pertinent both in social and private sector housing.

Feature:	Evidence and reasons for importance:
Internal space availability & layout	Common areas for eating, socialising as a family and entertaining visitors, need for private space for family members to personalise and retreat; adequate storage space
Natural light	Related to feelings of well-being, particularly by those living in urban areas
Private outdoor space	For socialising, entertaining, relaxation, wellbeing and as a safe play area for children.
Accessibility	Particularly important for the elderly, people living with a disability or families with young children
Noise	Perceived to be a problem in new builds, reduced sense of comfort, well-being and privacy.
Energy efficiency	Cost and comfort; can be perceived as a trade-off between desirable period features and cost of heating.

Table 5: Key design features that have been found to be particularly important to housing users (CABE, 2005a; CABE, HATC and Ipsos Mori, 2009; HCA, 2014b; Ipsos MORI and RIBA, 2012).

Housing consumer behaviour and preferences have a number of important implications on the development of sustainable housing:

Firstly, market theory would dictate that poor quality design should not persist as customers reject such housing. However, there are a number of reasons that enable poor quality housing to remain on the market: As UK housing consumers have a deep desire to buy property as an investment, young people keen to get on the property ladder and the general lack of supply means that (until recently) even low quality homes would sell (CABE, 2007; Neale and RIBA, 2009). Also, consumers will also often be limited to a geographical radius and will therefore need to settle for a home within that area, which means they may need to compromise on quality aspects depending on the local availability of housing (CABE, 2005a).

Secondly, design and development of sustainable housing cannot and should not rely entirely on consumer preferences. Homebuyers rarely have perfect and complete knowledge regarding housing characteristics that would enable them to make a fully informed comparison, and therefore, decision to buy the better quality property while rejecting one that is inferior. Some blame for this inadequate information can be laid on the housing industry, which, in the UK for instance, continues to use the number of bedrooms to value and market internal space rather than the total internal area and actual room dimensions. Yet, people also cannot be expected to have knowledge or experience of alternative designs that improve housing quality. For example, research carried out by Ipsos MORI and RIBA (2012) highlighted a lack of awareness of flexible layout designs that are found in homes in other countries.

Thirdly, lack of consumer demand is often blamed for the slow delivery of sustainable housing (Birkeland, 2008; Opoku and Fortune, 2011; Sunikka, 2003; Williams and Dair, 2007a), yet delivery of such housing cannot afford to wait until strong demand materialises. In his discussion of various pressure groups influencing sustainable housing policy in the UK, Pickvance (2009a) noted that there was no mass public movement around this issue beyond the take up of micro-renewables among some affluent households. Indeed, the tendency to define sustainable housing in environmental (and especially energy) terms may act as a barrier to creating such demand in the first place. Gabe, Vale and Vale (2009) suggest that building codes and regulations can disincline consumers from considering choices that improve the technical function (e.g. energy efficiency) of a home, because buyers assume that such regulations ensure adequate provision of technical function and that going beyond would entail excessive costs. Consumer perception seems to be that exceeding building standards on technical performance may not add to the market value of a dwelling the same as improving its look and feel (Gabe, Vale and Vale, 2009).

Lastly, while there is certainly the need to raise consumer awareness to increase demand for sustainable housing (Pitt et al., 2009), it should be recognised that even if consumers have perfect knowledge, it does not mean that they will make a fully rational choice. Buying a home is an emotion-laden experience, and emotions can overrule practical considerations – energy efficiency for instance, while often seen as desirable (due to comfort and lower costs), may be traded-off for ‘period’ features of older properties (Ipsos MORI and RIBA, 2012). Indeed, there is evidence that consumer preferences can be at odds with environmental sustainability of housing. For instance, a number of researchers have found housing-users showing a preference for low density living (Howley, Scott and Redmond, 2009). While investigating social housing resident satisfaction with their new homes built with environmental sustainability features, Pickvance (2009b) found that the main reasons given for moving were largely the ‘softer’ design features of the new homes, for example private garden, two bedrooms or a more attractive housing estate. Environmental sustainability features came secondary in terms of satisfaction with the new dwelling (although many were also dissatisfied with these).

2.10. Summary of chapter findings

- The aim of this chapter was to gain a holistic understanding of the meaning of 'sustainable housing' and to present the current situation with regards to the implementation of sustainable housing in the UK.

- Given that quality of human life is at the core of sustainable development concept, sustainable housing can therefore be broadly defined as housing that enhances the quality of life for current housing-users as well as future generations (Priemus, 2005; Chiu, 2003) within the wider social, environmental and economic contexts (Brown and Bhatti, 2003; Chiu, 2003; Mateus and Bragança, 2011). However, given the complex and multifaceted nature of the sustainable housing concept a framework-based definition is more suitable in practice.

- Health and sustainable housing are inextricably linked as the two agendas are ultimately about enhancing the quality of human life within the wider socio-economic and environmental contexts. The same fundamental principles provide common ground for both, as healthy neighbourhoods will also likely be sustainable neighbourhoods (Barton, Grant and Guise, 2010)

- UK's sustainable development agenda links housing to quality of life, health and well-being within the broader concept of sustainable communities. Good housing and neighbourhood design is identified as essential in facilitating the development of sustainable communities. It is also evident from the UK's Housing Strategy, NPPF and the multiple housing standards that there is a strong aspiration among policy makers to embed sustainability within housing and neighbourhood design in its holistic sense. However the strength of these top-level drivers to encourage sustainable housing implementation in practice is questionable. There should also be some concern over the construction industry's potential to deliver such design given that the 2008 sustainable construction strategy does not explicitly mention quality of life, well-being, and makes little reference to community engagement.

- Barriers to sustainable housing include informational/conceptual, institutional, financial, market demand challenges as well as potential psychological barriers at the individual level that can exacerbate these challenges.

- Overall, the evidence offered by available CSH and BfL12 data points to a relatively low level of sustainable housing being built in the UK today. While the aspiration seems to be there, the extent to which holistic sustainability is being embedded within the widespread housebuilding in practice is debatable.

- There is a widespread recognition that the quality of new build homes in the UK needs to improve (CABE, 2010a; RIBA 2012). Regarding which aspects need to improve, consumer satisfaction surveys and CABE audits tend to focus particularly on design features such as internal space and layout, private outdoor space and public space, natural light, neighbourhood design. These can be described as ‘soft’ features as they are non-technological, and according to some authors, tend to fall more into the realm of social and economic areas of sustainability (Bragança, Mateus and Koukkari, 2010).

- While there are numerous housing sector stakeholders, housing providers and housing end-users are selected as the focus in this study. The housing providers are represented by private sector developers, housing associations as well as local authorities.

Chapter 3: Housing and health – Research and evidence

“Housing affects health in a myriad of relatively minor ways, in total forming one of the key social determinants of health” (Shaw, 2004; p. 397).

3.1. Introduction

Building on the findings in chapter 2, the overall aim of this chapter is to investigate the impacts that housing has on the health and well-being of occupants, and by extension, the wider community. The chapter is broadly organised into two thematic halves – the first seeks to establish the conceptual context for the housing and health relationship, while the second half focuses on the pathways between housing and health.

The chapter begins by exploring the definitions of health and housing in order to establish a holistic understanding of what is meant by ‘healthy housing’. A number of conceptual frameworks are then presented that illustrate the importance of the relationship between housing and health. The chapter moves on to provide an overview of the current state of knowledge regarding the housing and health research and outlines the impacts that housing has on health and well-being.

3.2. What is healthy housing?

To define ‘healthy housing’, it is helpful to begin by establishing a clear understanding of its constituent elements - namely health, well-being and housing.

3.2.1. Health

Perhaps the most widely accepted definition of health is outlined in the preamble to the constitution of the WHO, which defines health as *“a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”* (WHO 1946). While it has been subject to criticism over the years, its inclusion of physical, mental and social domains in essentially a ‘positive state’ is an advancement over prior definitions that focused solely on the absence of disease symptoms (Huber *et al*, 2011).

Huber *et al* (2011) elaborates on these three health domains as follows: The physical health aspect of the definition involves the ability to maintain physiological homeostasis and mount a defence in response to any potential damage (through infection, injury etc.) leading to a return to (even if altered) homeostatic balance. Mental health has been described as pertaining a "*sense of coherence*" (Huber *et al*, 2011; cited therein), which allows coping with difficult situations, ability to manage subjective well-being and may have a role to play in the interaction between mind and body. Lastly, social health includes people's ability to fulfil their potential, retain a level of independence (despite any medical conditions) and participate in social activities.

3.2.1.1. Well-being

Well-being is a broad concept that encapsulates how people feel (happiness, anxiety, etc.), how they function (sense of competence and connection to those around them) and how they evaluate their lives (i.e. level of satisfaction with their lives as a whole) (Michaelson, Mahony and Schifferes, 2012). The level of well-being will therefore be determined by a number of internal (e.g health, self-esteem, optimism, resilience) and external (e.g. income, housing, education) factors – both of which determine how well an individual functions when interacting with the world and therefore how good they feel on a day-to-day and overall levels (*ibid*).

3.2.2. Housing

In its broadest sense, the concept of 'housing' can be divided into three components – 'home', 'the dwelling' and 'the neighbourhood':

The idea of a '*home'* refers to the social and psychological aspects relating to housing - the "*psychosocial, economic and cultural construction created by the household*" (Braubach, Jacobs and Ormandy, 2011; p. 1). While it is an intangible component of housing, it is essential to psychological well-being as it represents a sense of refuge and protection from the outside world (Bonnefoy, 2007). Home is also an object of attachment and identity, it acts as the "*central reference point of human existence*" (Bonnefoy, 2004; p. 419 cited therein). While represented by the physical structure of a dwelling, this is a distinct element of housing as the notion of a 'home' is the same among groups that may have very different forms of dwelling, such as nomadic groups (Fullilove and Fullilove, 2000). Pearson (1998) describes home as being more than the total of its parts, since a house can be healthy but lack the spirit of a home where people can be themselves. The '*dwelling'* is the physical structure and its design and characteristics provide shelter and protection for its occupants. The '*neighbourhood'* can be defined as the immediate physical area around a dwelling or the residential environment. The quality of the neighbourhood is strongly linked to the health and well-being of its occupants as well as socio-economic aspects such as job creation and social capital. Some authors (e.g. Bonnefoy, 2007; Fuller-Thomson, Hulchanski and Hwang, 2000; Braubach, Jacobs and Ormandy, 2011) further distinguish two parts within this level – the community and the immediate environment. The community element comprises of the social elements that impact on health (e.g. social cohesion and interactions, socio-economic conditions), while the immediate housing environment refers to the quality of the physical elements of the urban design. For the purposes of this study, the term 'neighbourhood' will include community issues and immediate environment, which is consistent with other researchers (e.g. Fullilove and Fullilove, 2000; Shaw, 2004).

3.2.3. Healthy housing

The nature of how both health and housing are defined and understood has important implications for the development and implementation of healthy housing policies. Historically, housing improvement policies were primarily based on the narrow biomedical definition of health whereby a particular housing feature was linked to a specific and often acute health condition, such as damp conditions leading to respiratory illness. This led to targeted action on that housing feature to minimise the source of the particular negative health impact. While this has greatly diminished or eliminated very poor quality housing (especially in developed countries), some public health policies relating to housing have had inadvertent negative health impacts, such as planning practices contributing to car-dependency (discussed below).

The concept of health is increasingly viewed as entailing not only the physical, but also psychological and social well-being aspects - a shift that is also reflected within public health policy (Barton and Tsourou, 2000; Stewart, 2005). Housing is now increasingly being understood as a determinant of health not only in terms of physical symptoms, but through numerous direct and indirect pathways, affecting also mental health and social well-being.

While there is no commonly agreed definition for 'healthy housing' (Bonnefoy, 2007), examples found in literature increasingly tend to embrace this holistic approach to defining health. The WHO definition for instance entails physical, mental and social well-being elements;

> *"Healthy housing" covers the provision of functional and adequate physical, social and mental conditions for health, safety, hygiene, comfort and privacy. A healthy home therefore is not a specially designed house, it is more a residential setting for a household that is including all standards and "best practice" knowledge that has been gained over centuries of dwelling construction and immediate environment design. (WHO, 2004; p.1)*

Other authors, such as Ranson (1991) and Bluyssen (2010), include the proviso that healthy housing should not be limited to the prevention of illness, but contribute to an environment that improves health in its broad context. A healthy building should therefore be "*capable of fostering health and comfort of the occupants during its entire life cycle, supporting social needs and enhancing productivity*' (Bluyssen, 2010); p. 808).

In this study, healthy housing is therefore understood as housing that is designed and built in a way that not only avoids the negative health impacts, but also contributes positively towards healthy life-styles within the physical, mental and social well-being domains of health. While it is recognised that the use of broader meanings of health and housing add to the methodological complexities of this research field (Carr-Hill, 2000; Fuller-Thompson, Hulchanski and Hwang, 2000), it nevertheless reduces the risk of important issues being neglected and overlooked as when a more narrow understanding of these concepts is adopted (Lawrence, 2010).

3.3. Conceptual relationship between housing and health

Given the multitude of pathways that housing can impact on health and well-being, it has been described as "*a catch-all for the myriad and multidimensional ways in which our conditions of living can affect health*" (Shaw, 2004; p.414). Two seminal frameworks, Maslow's Hierarchy of Needs and the Settlement Health Map are presented here to help conceptualise this complex relationship and illustrate the importance of housing impacts on health and well-being.

3.3.1. Maslow's hierarchy of needs and the role of housing

In his seminal paper published in 1943, Maslow identified a hierarchy of human needs that comprise of physiological, safety, love, esteem and self-actualisation needs (figure 3). He argued that for each level of need to be felt, the needs of the previous level must be met adequately. For example, at the very basic level if all needs are unsatisfied, organisms will be dominated by their physiological needs (food, air, water, etc.), but if these basic needs are gratified, the next set of needs, safety needs, will become dominant. Once these safety needs are met, then the next set – love needs, become prevalent, and so on until self-actualisation or fulfilling one's capabilities needs at the top of the hierarchy.

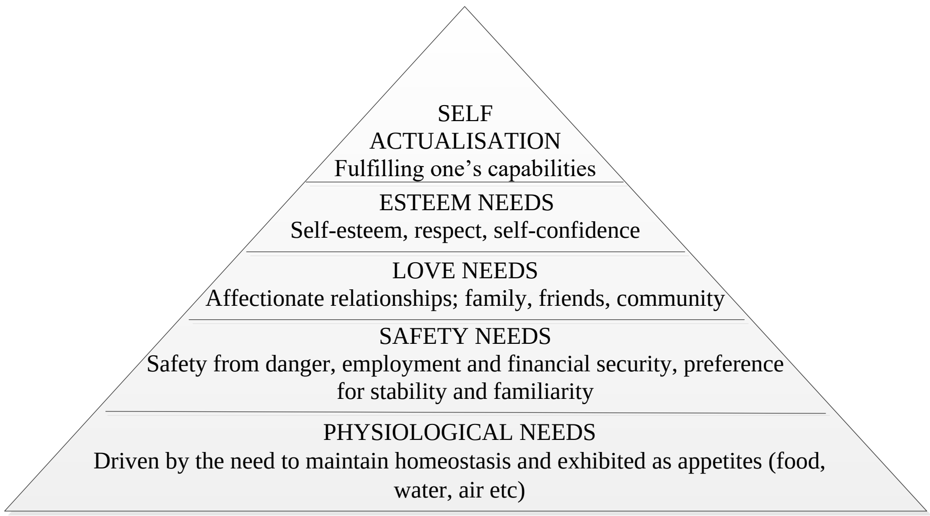

Figure 3: Maslow's hierarchy of human needs. (Source: Maslow, 1943)

Considering Maslow's hierarchy of human needs, housing can contribute at three of the five levels of needs. Firstly, at the most fundamental level, the structure of a dwelling is essential in providing physical safety from weather and physical dangers, thus helping to meet human safety needs. Also relevant to this level is the concept of a 'home' and its role in providing a sense of security, which is important to the psychological well-being as discussed earlier. Secondly, while housing cannot establish relationships, it can facilitate their creation and preservation through design features within the dwelling and the neighbourhood, thereby contributing to the love and relationship needs level. For example, sufficient indoor space for family meals and for entertaining visitors, and easily accessible communal areas centred around social activities (gardening, sports, playgrounds, etc.) can bring people together and help develop friendships and sustain existing relationships. Finally, as perhaps the greatest material asset for most people, housing can act as 'psychosocial symbol' of achieved status

(Howden-Chapman, 2004; Macintyre et al., 2003) thereby contributing to the self-esteem level of needs.

3.3.2. Settlement Health Map and the role of housing

The built environment is widely regarded as one of the major determinants of health and wellbeing (Barton, Grant and Guise, 2010; Shaw, 2004). A widely used framework to illustrate this complex interaction of health and well-being determinants in neighbourhoods is the 'Settlement Health Map' (figure 4). Developed by Barton and Grant (2006), the Health Map is an ecosystem model that is based on an earlier public-health version created by Dahlgren and Whitehead (1991) and influenced by the Bruntland definition of sustainable development (see section 2.2.1).

'People' are represented at the core of the model as health is fundamentally pre-determined by factors such as gender, age and genetics. This core is surrounded by 'layers' of social, economic and environmental aspects of the urban environment that influence health and well-being either directly, or indirectly by influencing each other.

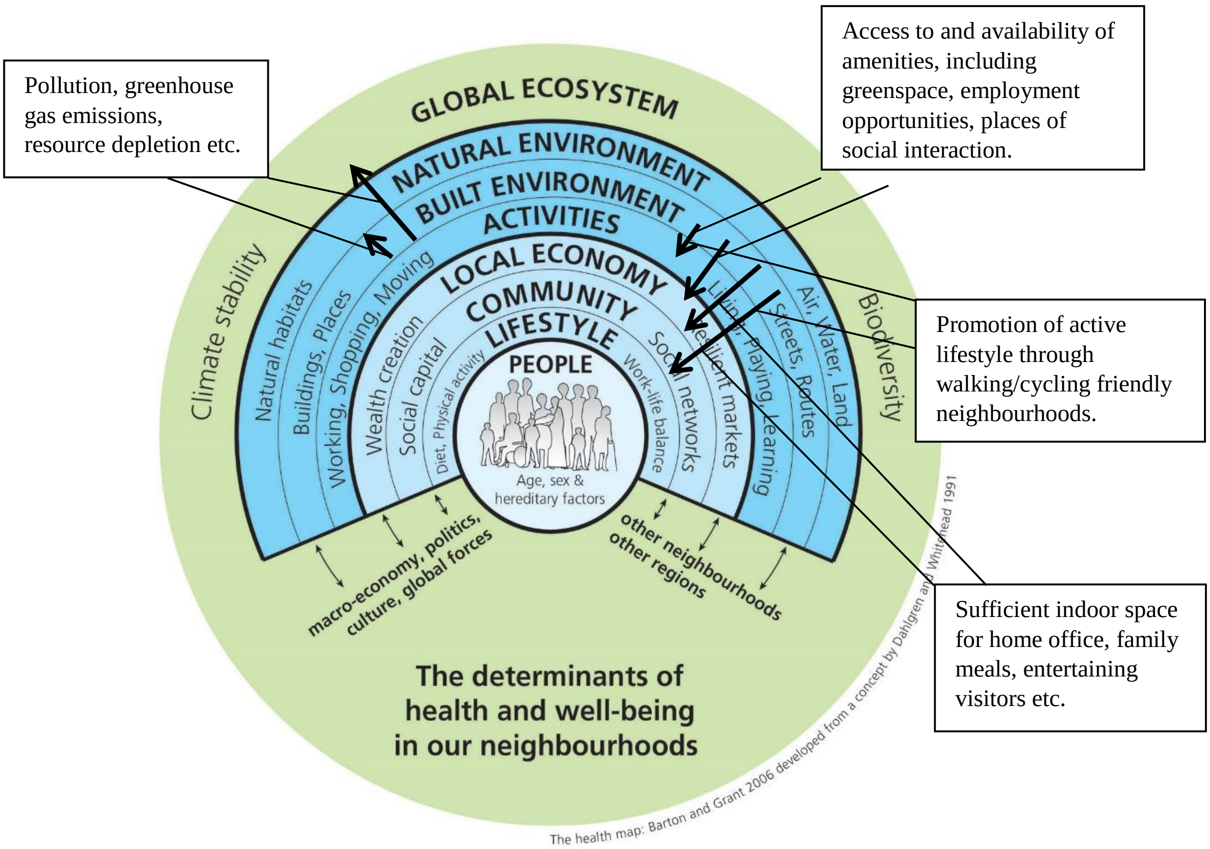

Figure 4: The Settlements Health Map (Source: Barton and Grant, 2006; Dahlgren and Whitehead 1991) showing the influence (represented by black arrows) of housing/built

environment on each of the health determining 'layers' (Barton, Grant and Guise, 2010) and examples in boxes (Source of examples: self-study).

As illustrated by figure 4, housing (within the built environment layer) affects health and well-being of people either directly or indirectly by influencing any of the following health determining 'layers':

Impact on natural environment and global ecosystem: Environmental impacts of housing can range from local impacts such as air, water and soil pollution and waste production to more global effects of wide scale pollution, resource depletion and greenhouse gas emission. The health and well-being effects of these environmental impacts are wide ranging and can include disease due to toxins as well as respiratory illness and mental health effects associated with degradation of the natural environment.

Impact on activities and local economy: Design of neighbourhoods and housing developments will impact activities through the provision of amenities as well as the accessibility of these amenities. In turn, this can influence the extent of active lifestyles (for example through access to greenspace, short walking distance to shops and children play areas) and economic vitality of urban settlements (e.g. employment opportunities).

Impact on community: Supportive social networks may be encouraged by the design of homes and communities with meeting spaces. Many of the local social networks are influenced by the existence of common activities, and urban planning has a role in facilitating and enhancing those networks through provision of such common meeting places (Barton and Tsourou, 2000). This is particularly important for less mobile social groups such as the elderly or disabled.

Impact on lifestyle: Design of housing developments and dwelling itself can influence an individual's behaviour in a number of ways. For instance, easy access to greenspace and amenities may encourage walking and cycling (as opposed to car use). While spacious and appropriately designed kitchen facilities may encourage people to prepare home cooked meals, thereby leading to a more nutritious diet (Drury, Welch and Allen, 2009). Sufficient indoor space may also encourage exercise, easier socialising or offer the possibility to work from home (thus reducing the need to commute).

3.4. Health consequences of poor housing design – evolution of the problem

3.4.1. A shift in health concerns relating to housing

In the UK, public health concerns relating to poor housing can be traced back to early 19th century when observations were made that linked poor living conditions of the working classes with the prevalence of diseases such as typhoid and cholera. While living in Manchester, Friedrich Engels recorded one of the earliest detailed accounts of the state of housing in his publication '*The Condition of the Working Class in England'*. Engels described not only the poor quality of the physical dwellings, but also of the neighbourhoods, drawing attention to the poor design that prevented adequate ventilation and basic hygiene. Interestingly, he not only linked housing conditions to communicable diseases such as typhus, but also recognised their influence on other societal 'ills' such as widespread alcoholism (Engels, 1845).

Around the same time, Edwin Chadwick, appointed by the Royal Commission to investigate the efficacy of the Poor Laws, published an account of *The Sanitary Condition of the Labouring Population* (1842). Chadwick saw the influence of housing, or the 'state of the cottages' as a major factor in determining people's health, even correlating the importance of childhood living conditions to health in later life. These observed links between the prevalence of acute infectious diseases and the unsanitary, over-crowded and poor quality housing led to the first Public Health Act in 1848, which identified housing as one the major issues affecting health (Calman 1998).

Subsequent systematic improvements in planning, infrastructure and quality of housing led to a speedy and effective control of once prevalent communicable diseases such as cholera, typhoid, dysentery and tuberculosis (Bird and Grant, 2011; Perdue, Stone and Gostin, 2003). However, while the incidence of such diseases in developed countries has diminished, the influence of housing on health and well-being has not disappeared. The focus has now shifted to the impact that built environment has on mental health and psychosocial impacts (Clark and Kearns, 2012) as well as on non-communicable physiological diseases such as obesity, asthma, type 2 diabetes and cardio-vascular illnesses (Bird and Grant, 2011).

3.4.2. Consequences of early public health and housing initiatives

While the early public health initiatives to control communicable diseases associated with poor housing greatly diminished or eliminated the prevalence of infectious disease (in developed countries), they have also inadvertently contributed to a number of today's health-adverse housing designs. For instance, the view that high concentration of population and proximity between businesses and domestic housing were not healthy led early 20th century urban planning to zone industry, commerce and residential neighbourhoods into separate areas (Perdue, Stone and Gostin, 2003). Post war neighbourhood planning continued this trend, particularly accentuating car transport (minimum standards parking), low density (less than 20 dwellings per hectare (dph)), and mono-functional zoning (Stevenson and Williams 2000). This has facilitated the development of many unsustainable communities living in environmentally degraded and economically stifled neighbourhoods with excessive car reliance contributing to reduced physical activity and heightened air pollution (Barton, Grant and Guise, 2010).

Another unintended consequence relating to the success of the early housing initiatives has been the decoupling of public health from housing design and policy. As the rates of acute and infectious diseases associated with poor housing declined, the links between urban planning and health became undervalued (Barton and Tsourou, 2000) with the interest and research into the relationship between poor health and poor housing diminishing (Dunn, 2002). In many cases housing and planning issues have been largely excluded from the remit of health ministries, being covered solely by housing/construction or environment ministries (Bonnefoy, 2007), led by professions (e.g. architects, town planners, engineers) for whom health is not the primary focus (Bird and Grant, 2011).

3.5. Re-emergence of health as a priority for the built environment

3.5.1. New Public Health

The importance of the built environment on health and well-being is again being increasingly recognised. This is perhaps best illustrated by the acknowledgement of its importance within the New Public Health agenda. The current era of New Public Health is focused on health promotion, which is generally defined as "*the process of enabling people to increase control over, and to improve, their health*" (WHO 1986).

The 1986 Ottawa Charter for Health Promotion that set out the principles of new public health identified five key action areas for health promotion: Build a healthy public policy, create supportive environments for health, strengthen community action for health, develop personal skills, and re-orient health services (WHO 1986). Housing, in its broadest sense, features in three of these actions: Firstly, creation of supportive environments for health promotion entails development of "*living and working conditions that are safe, stimulating, satisfying and enjoyable*" (ibid). Secondly, the Charter also acknowledged the importance of community involvement in decision making and planning strategies. Lastly, it recognised that the action on developing personal skills, that is enabling people to learn about health conductive choices and coping with illness, needs to be facilitated at home, school, work and community settings.

3.5.2. Main housing and health priorities in the UK

The 2010, Government's white paper *Healthy Lives, Healthy People* (HM Government, 2010a), recognised that neighbourhood and dwelling design can support well-being, resilience as well as mental and physical health throughout different stages of life. The importance that improving housing and the living environment can have in helping people to proactively improve their health and well-being was also acknowledged:

> *"When the immediate environment is unattractive, it is difficult to make physical activity and contact with nature part of everyday life. Unsafe or hostile urban areas that lack green spaces and are dominated by traffic can discourage activity" (HM Government, 2010a, p. 20).*

In the UK, there are currently three key health issues that urban planning and design are recognised to potentially have a particular influence on; two of these are direct health conditions of obesity and mental well-being and third is the wider issue of health inequalities (Barton, Grant and Guise, 2010; Sustainable Development Commission (SDC), 2008). The Marmot Review of Health Inequalities recommended the creation and development of '*healthy and sustainable places and communities*' (Marmot, 2010; p 126) as one of six core policy objectives for reducing health inequalities.

3.6. Impacts of housing on health - understanding the relationship

3.6.1. Characteristics of existing literature

The long history of research into the health impacts of housing, particularly relating to substandard housing, has produced a substantial body of literature exploring this relationship. This literature has been collated and reviewed by numerous authors (Krieger and Higgins 2002; Fuller-Thomson, Hulchanski and Hwang, 2000; Shaw 2004; Lawrence 2005; Bonnefoy 2007; Bashir 2002; Bonnefoy et al. 2003; Brugge, Vallarino et al. 2003; Bonnefoy et al. 2004; Rauh, Landrignan and Claudio, 2008). The size of the literature has grown to the extent that even systematic reviews are too numerous, and 'systematic reviews of systematic reviews' are now becoming necessary to draw conclusions about the housing and health relationship (Egan et al., 2008; Gibson et al., 2011).

A number of authors have attempted to categorise this large housing and health literature (e.g. Fuller-Thomson, Hulchanski and Hwang, 2000; Turkington, Leng and Wright, 2010) leading to 4-5 thematic groups into which the literature can be broadly divided (table 6). Most of the existing research has focused on the impacts of housing at the dwelling level, particularly the physical health effects of chemical, biological and physical exposures relating to housing, the impacts associated with dwelling characteristics as well as the social, economic and cultural aspects of housing that impact health and well-being. At the residential neighbourhood level, effects of design characteristics, particularly in relation to aspects such as access to green space, perception of safely and their impact on health and well-being are a notable subject of many academic articles. Literature investigating how these various impacts affect vulnerable social groups (such as the elderly, children and homeless) may be regarded as a distinct thematic group in its own right (Fuller-Thomson, Hulchanski and Hwang 2000).

<table>
<tr><th>'Home/dwelling' level:</th><th colspan="2">Residential environment level:</th></tr>
<tr><td>→ Chemical, biological and physical exposures (e.g. lead, asbestos, dampness, mould, dust mites)
→ Dwelling characteristics (e.g. safety, building type, indoor air quality, "sick building" syndrome, cold and heat)</td><td rowspan="2">→ Design characteristics: Access to services, traffic pollution, access to open space, feelings of safety, security.</td><td rowspan="2">→ Impacts on vulnerable social groups; e.g. the elderly, homeless</td></tr>
<tr><td>→ Social, economic and cultural characteristics (e.g. tenure, satisfaction, affordability, overcrowding)</td></tr>
</table>

Table 6: Broad categorisation of housing and health literature (based on Fuller-Thomson, Hulchanski and Hwang, 2000; Turkington, Leng and Wright, 2010).

3.6.2. *Current state of knowledge*

Within these thematic groupings, a distinction can be made between accepted relationships and associations for which empirical evidence is growing (Bonnefoy, 2007; Lawrence, 2005). For instance in 2006, WHO carried out an extensive review and evaluation of evidence for 25 housing risk factors. At the time, the report concluded that half of these (12) had sufficient evidence for estimating burden of disease, and included the impacts of physical (heat, cold, energy efficiency, radon exposure, noise), chemical (environmental tobacco smoke, lead) and biological factors (mould, dust mites), building related factors as well as social aspects (multifamily and high-rise housing). Another half (11) of the relationships were deemed as having some evidence for estimating burden of disease. These included impacts of ventilation and volatile organic compounds (VOCs) on respiratory and allergic conditions, pests as well as the impacts of social conditions such as fear of crime and crowding. Two of the risk factors investigated, namely lighting and particulate matter, were found with insufficient evidence to estimate the burden of disease at the time (WHO 2006).

3.6.3. *Gaps and shortcomings of existing literature*

Despite the long tradition of housing and health research and the vast body of literature exploring this relationship, the complexity, multi-dimensionality and ethical issues have all obstructed the establishment of definitive causal relationships within the housing and health research field (Turkington, Leng and Wright, 2010). The body of literature has also been criticized for its shortcomings, particularly relating to methodological design, scope and quality. Common criticisms of studies in this field include:

- Small sample sizes
- Focus on very specific localities and/or very defined populations (often without adequate comparison groups)
- Variations in measurements of health (e.g. doctor, researcher diagnosed or self-diagnosis)
- Variations in measurements of housing quality
- Inadequate control groups
- Lack of cohort and longitudinal studies

- Insufficient repeat studies to ensure comparison and consistency of findings
- Studies tend to be sectoral, that is they focus on separate issues such as noise or indoor air quality or they examine a single health effect rather than assessing combined housing risks (the 'cocktail effect') (Thomson, Petticrew and Harrison, 2001; Shaw 2004; Thomson et al. 2009; Turkington, Leng and Wright, 2010; Saegert et al., 2003)

The inconsistencies and disjointed nature of the literature make the task of synthesizing and comparing findings a difficult one (Shaw, 2004). Some of the more important shortcomings and their implications on the state of knowledge are as follows:

3.6.3.1. Fragmented and narrow focus

A number of authors have noted the tendency of the housing and health research to focus on single risk factors leading to a body of work that is fragmented and narrowly focused in nature (Bonnefoy et al. 2003). Two reasons have been presented to explain this. Firstly, prevalence of the biomedical definition of health focused the research agenda on symptom-based causation models. Secondly, the complex interaction between housing and health present methodological difficulties that make establishing holistic interpretations challenging. As a result, the vast majority of research has focused on singular interaction between one feature of housing and its impact on health, while studies taking a more holistic or 'ecological' approach have been rare (Lawrence 2005).

However, as understanding of the mechanisms that determine the housing and health relationships is a conceptual as well as empirical task (Fuller-Thomson, Hulchanski and Hwang, 2000), there have been many calls of a more holistic approach when investigating this relationship (Carr-Hill, 2000). Given this insufficient holistic treatment of the subject, while progress to understand the complex mechanisms has been made, significant gaps remain in our knowledge to understand the complex pathways that operate between housing conditions and health, including any cumulative impacts of housing on health that lead to an allostatic load.

3.6.3.2. Focus on negative health impacts

Although idealistic (Lawrence 2005) and methodologically problematic (Carr-Hill 2000), it is important to note that the widely accepted WHO definition of health focuses on a positive state of health. However the main focus of housing and health research has been on disease and ill-health effects of housing (Fuller-Thomson, Hulchanski and Hwang, 2000; Srinivasan, O'Fallon and Dearry, 2003). Recognising this, there are now calls for the housing and built environment to be designed in a way that not only minimises the negative health effects or prevents illness, but proactively enhances physical and mental health and well-being (Barton and Tsourou 2000; Lawrence 2005). As our knowledge of the multiple levels at which the built environment can impact health emerge, so do the opportunities for planning to be designed to promote health and well-being.

3.6.3.3. Need for a more multidisciplinary approach

Both housing and health are multidimensional subjects, and as such, interdisciplinary and transdisciplinary approaches are essential for understanding interrelations between the two (Fuller-Thomson, Hulchanski and Hwang, 2000; Lawrence, 2005). As Braubach (2011) observed, health-focused experts have been the main professional body contributing to this particular field, with not enough input from professionals such as engineers and architects who arguably have a greater influence on the design of healthy housing.

While it is recognised that the availability of information and evidence for the health and housing relationship has increased significantly, implementation of this knowledge is still weak and the key current challenge is to transfer this knowledge into practice (Braubach 2011). The research evidence needs to be transferred to builders, designers and users of homes in order to capitalise on this knowledge and create healthier homes (Barton, Grant and Guise, 2010; Jackson, Dannenberg, and Frumkin, 2013). This would require greater input from health experts as building codes and regulations are mostly based on the experience of the construction industry.

3.7. Housing impacts on health and well-being

As a complete review of the housing and health literature is beyond the scope of this study, this section will seek to demonstrate the main connections between housing and health by utilising some of the key literature review papers and large scale studies. The section will begin by outlining some existing models developed to illustrate and explain the housing and health relationship. Taking into consideration the existing models, it will then move on to develop a ‘map’ of housing design features that can influence health. The main purpose of this map is to guide the development of a more detailed framework for sustainable housing with an emphasis on health and well-being.

3.7.1. Existing models for illustrating the housing and health relationship

Theoretical models are essential in guiding the analysis of the housing and health relationship, and when adopted, need to consider the direct and indirect effects (Howden-Chapman 2004). One encompassing model of such interaction has been developed by Shaw (2004) and is shown in figure 5. Shaw distinguishes between indirect ('soft') and direct/material ('hard') pathways that housing interacts with human health. The direct consequences primarily include impacts on physical health such as respiratory conditions (affected by cold and damp), toxicity (from lead pipes, CO, radon) and injuries. While the indirect ways that housing can impact health manifests through its role as an integral component of the socioeconomic mechanism and the wider built environment, such as the meaning of home, housing tenure and social networks.

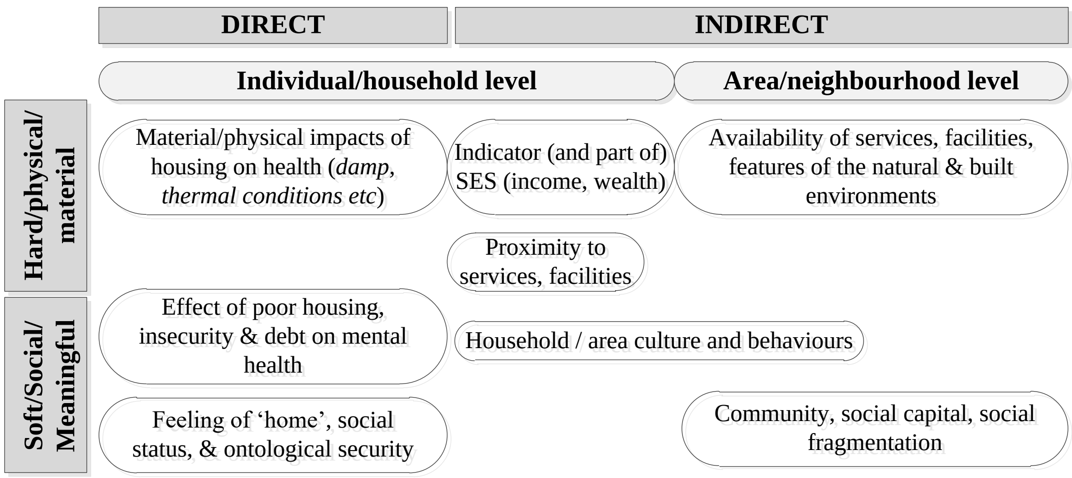

Figure 5: Mary Shaw's (2004) model of housing impacts on health (Source: Shaw, 2004).

While Shaw's model is very useful in distilling a broad set of interactions between housing and health, it is important to remember that this simplified matrix masks complex (and often multiple) relationships. This point can be illustrated with an example using the conceptual model proposed by Sandel and Wright (2006) to explain the increasing prevalence of childhood asthma. The authors note that the physical characteristics of housing, such as pollution, allergens and dampness, have been extensively researched but cannot alone explain the increasing prevalence and the social disparities behind childhood asthma. They propose that the physical as well as the 'meaningful' (e.g. residential satisfaction, lack of control, sense of security) housing factors that contribute to psychological stress need to be taken into account. As such, they present emotional and physical housing conditions in their model on equal footing, but as can be seen from the schematic of the model (figure 6), there are multiple pathways through which these factors influence the housing stress and asthma relationship as well as each other. Adding on another layer of complexity are the effects of different confounding elements that influence the physical and emotional housing factors. In Shaw's model, this relationship would be *primarily* placed under individual/household level but under both 'soft' and 'hard' impacts.

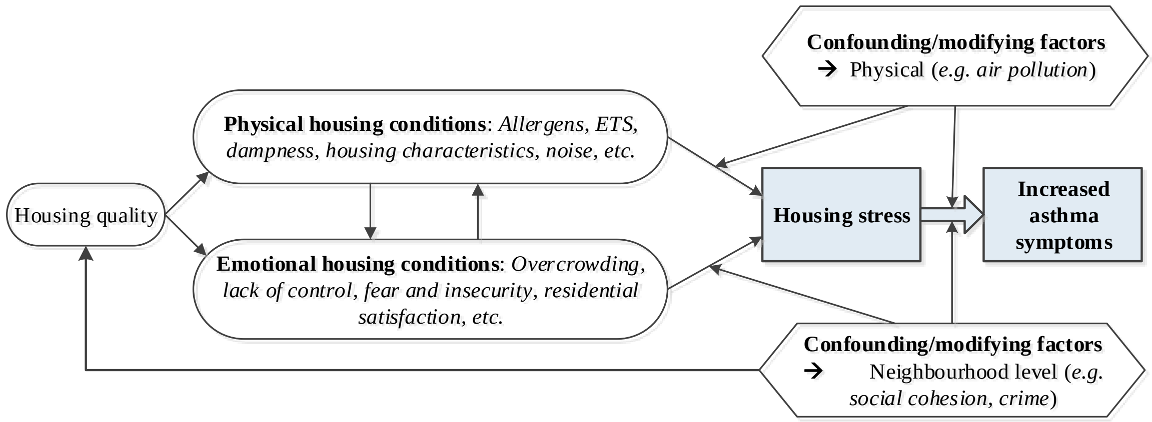

Figure 6: A proposed conceptual model for the complex housing-asthma relationship (Source: Sandel and Wright, 2006).

3.7.2. Generic pathways of impact on health

Housing is a potential source of external stress factors, the extent and severity of which will depend on the characteristics of the dwelling and the surrounding area. As discussed using Shaw's (2004) model above, these stressors can be 'hard' (physical/material), such as indoor air pollutants, dampness, inadequate light availability, sub-optimal thermal conditions, or 'soft' (social/meaningful) such as community conditions, greenspace availability, sense of place and home. Besides immediate and direct physical impacts such as accidents and injury, these external stressors can impact on physical and/or mental health by affecting one or more of the key human body systems - the nervous system, the immune system and the endocrine system (Blyussen 2010).

As illustrated by figure 7, health impacts mediated by the nervous and endocrine systems include various sensory discomfort complaints (e.g. noise, light, thermal comfort), systemic effects (e.g. fatigue), and psychological impacts (e.g. depression, anxiety) – all of which can be influenced by the condition of the immune system. Impacts associated with the endocrine and immune systems include skin and respiratory irritations, chronic illness as well as infectious diseases – these conditions can be affected by the conditions of the nervous system. It is important to note that many of these health conditions will be aggravated if nervous, endocrine or immune systems are compromised or vulnerable, which can be likely in individuals such as the elderly, the very young, and those who are ill.

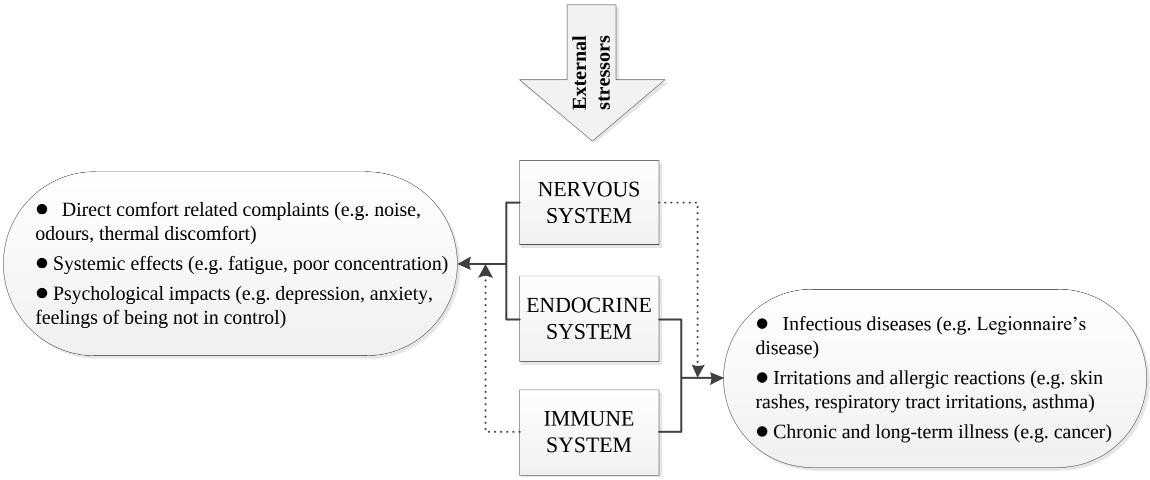

Figure 7: The health impacts of external stressors acting through the nervous, endocrine and immune systems (Adapted from: Blyussen, 2010).

3.7.3. Housing-health impacts 'map'

As mentioned earlier, the overall housing-health relationship is too complex and multi-dimensional to be fully described here. Any attempt to fully illustrate it would need to take into account that housing factors that can affect health in numerous ways: Firstly, a factor may relate to the dwelling or the wider residential environment/neighbourhood. Secondly, the 'nature' of these factors may vary – they might have a physical, emotional or psychosocial impact thus affecting one or more dimensions of health. Thirdly, housing factors may impact health directly, that is regardless of an individual's behaviour, or indirectly by influencing their behaviour (SDC, 2008). For example greenspace can have a direct effect on health through its restorative function (Kaplan and Kaplan, 2003) but also indirectly improve their health by encouraging more physical activity (Cohen et al., 2003; Giles-Corti et al., 2005; Pretty et al., 2007).

To illustrate the housing-health relationship in a more manageable way, a simple schematic of housing factors that influence health and well-being has been developed and is shown in figure 8. Given that the focus of this study is on design characteristics that are influenced by housing providers, the schematic shows design factors that can be the cause of negative or positive impacts on health and well-being together with the interconnections between the three components of housing. The schematic utilises the broad definitions of housing and health and was used as a guide for the development of the framework for sustainable housing with an emphasis on health. This framework, outlined in chapter 4, provides greater detail of the health impacts of various housing features, while the remainder of this section provides an explanation and rationale for the housing and health schematic.

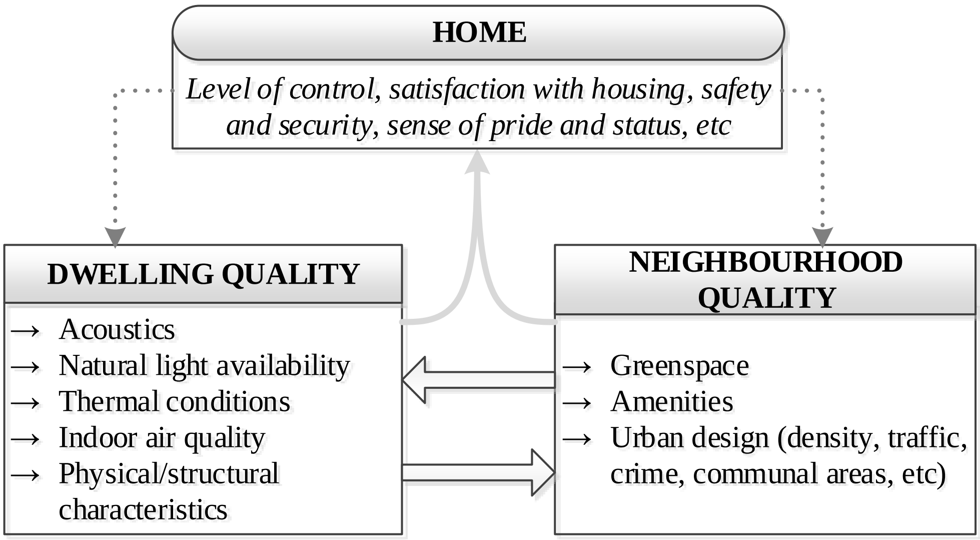

Figure 8: Schematic 'map' of the housing and health relationship (Source: self-study).

3.7.3.1. Key health impacts of housing at the dwelling level:

The indoor environment is typically regarded as comprising of four factors: acoustics, illumination, thermal conditions and indoor air quality (IAQ) all of which can have a discernible impact on health (WHO, 1990; Crump, Dengel and Swainson, 2009). In addition to these four sources of impact, the physical/structural characteristics of a dwelling are included in the schematic to cover features such as indoor layout and space, type and orientation of the dwelling, which are also known to impact health and well-being.

3.7.3.2. Key health impacts of housing at the 'neighbourhood' level

The impacts of the neighbourhood on health have been explored by many researchers (Gibson et al., 2011; Clark and Kearns, 2012; Bonnefoy et al., 2004). Indeed, Turkington, Leng and Wright (2010) have noted that the research on the residential environment impacts has been more holistic in its approach than that focusing on the dwelling impacts. While there are numerous aspects involved in the neighbourhood and health relationship, at this stage of the study, the housing-health map distils these neighbourhood level sources of impact into three broad features; greenspace, amenities and urban design.

There is substantial evidence for the importance of greenspace for health and well-being. As reviewed by a number of authors (e.g. Abraham, Sommerhalder and Abel, 2010; Royal Commission on Environmental Pollution, 2007; SDC, 2008), access to natural elements can have positive impacts on health by promoting physical activity, reducing stress levels, lowering air pollution and increasing social interaction. Availability and access to amenities can contribute to socioeconomic well-being through greater social interaction and community development and availability of local jobs. While urban design covers aspects such as residential density, availability of communal areas, safety and security design considerations – aspects that can lead to and influence factors such as air quality, noise, walkability, social interaction and even crime and anti-social behaviour within a neighbourhood.

It is worth noting that in very broad terms, these neighbourhood features can impact health and well-being through two types of pathways. Firstly, health and well-being can be directly affected by the physical features of the neighbourhood, as, for example, availability of greenspace and natural features which can lead to greater levels of physical activity and stress reduction (SDC, 2008). However, neighbourhood features may also affect the health and well-being of its housing-users by contributing to the overall satisfaction with the residential environment and perceptions of its quality. A link between the perception of neighbourhood quality and self-reported health status, chronic conditions, and emotional distress has been observed by a number of authors (Wilson et al. 2004; Poortinga, Dunstan and Fone, 2008). In light of such associations, it has been recommended that health policy should target places as well as people, since policies improving housing quality, access to amenities, neighbourhood safety and social cohesion may contribute to a reduction in health inequalities (Poortinga, Dunstan and Fone, 2008).

3.7.3.3. Key health impacts of housing at the 'home' level:

As discussed at the beginning of this chapter, the concept of home plays an important ontological role by providing a safety refuge and instilling a sense of autonomy and social status for an individual (Kearns et al. 2000). As a 'haven' from outside threats and stressors, the protective environment of a home, where one can feel safe and able to express their views and beliefs, is crucial to psychological health and well-being (Fullilove and Fullilove 2000; Bashir 2002; Braubach, Jacobs and Ormandy, 2011).

In their seminal paper on the meaning of home and its role in establishing a sense of ontological security, Dupuis and Thorns (1998) outlined four conditions that need to be met to maintain such role. A home must;

1. be a site of constancy;
2. provide a setting for the necessary daily human activities and routines;
3. be where people feel most in control of their lives by providing protection from surveillance of the outside world; and,
4. provide a secure environment for the development of personal identities.

This relationship is illustrated by figure 9. Formulation of a resident's concept of home will be mediated by the features of the dwelling, behaviour of other members of the household and socioeconomic factors such as tenure. The interplay between these factors creates a sense of 'home' that will have either a positive or a negative impact on mental health and well-being. The psychological impacts, particularly in prolonged cases, can manifest into physical symptoms – for instance, chronic psychological housing stress has been linked to asthma expression through physiological reactions to hormones released during stress (Sandel and Wright 2006).

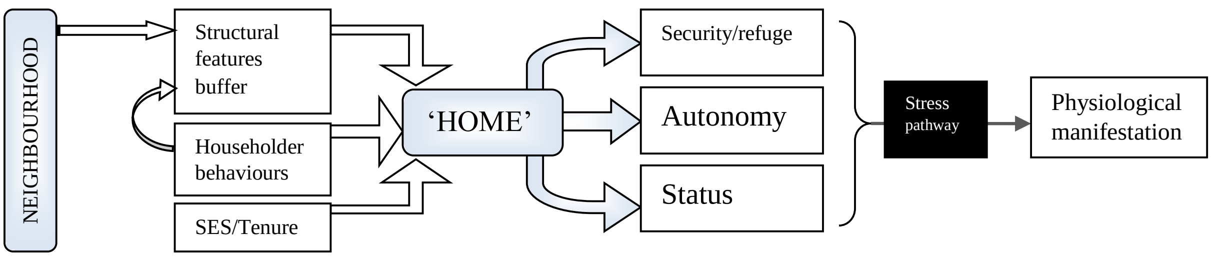

Figure 9: Health and well-being impacts of 'home' *(Source: self-study).*

Structural features of a dwelling are important contributors to the concept of home, because the protective role of housing will only have a positive psychological impact if there are no actual or perceived intrusions from the outside (Bashir, 2002). Such intrusions can result from poorly designed housing (e.g. noise, 'scrutiny') and/or the breakdown or poor quality of 'buffer' zones (Bonnefoy, 2007). The latter are common spaces that act as buffer areas, and feelings of intrusion can result from neighbours using these areas as personal spaces. Poor quality housing that does not offer protection from outside noise, scrutiny or other intrusion can be a lead to substantial psychological discomfort that can manifest in anxiety, depression, irritability, paranoia and other psychological conditions (Bonnefoy, 2004). Furthermore, as a strong symbol of self-identity and achieved status, poor quality housing may lead to feelings of inadequacy, and worry about maintenance, hazards and safety (particularly in relation to childcare), financial burdens and lack of control over features of poor housing can add to stress and lower the overall quality of life (Braubach, Jacobs and Ormandy, 2011; Evans, 2003; Howden-Chapman 2004). It is becoming increasingly clear that both the quality of the physical dwelling and the characteristics of the neighbourhood can impact on mental health through interfering with these protective functions of a 'home'.

However, even if a dwelling provides protection from the outside world, it should be noted that the protective role of a 'home' will be negated if the internal environment is hostile, such as in the case of abusive households (Shaw 2004). Structural features may only in some cases provide a temporary protective relief for householders, for instance through provision of personal space or restorative areas such as a garden. On the other hand, internal design of common areas such as dining space may make it easier and comfortable for families to spend time together.

The role of home also encompasses the important factor of personal control. Evidence for the association between health and personal control has been reviewed by Easterlow, Smith and Mallinson (2000). The authors highlight the issue of personal control as a possible model to explain the observation of varied health effects of housing renewal programmes on housing-users. While personal control is more important to some than others, it is the opportunity to exercise control that seems to have a relationship with health outcomes by reducing stress in some cases.

3.7.3.4. The interconnections between home, dwelling and neighbourhood

The schematic housing-health map also illustrates the interconnections between the three housing components that act to influence health and well-being impacts. There is a link between the 'dwelling' and 'neighbourhood' as the quality of one can influence the actual and perceived quality of the other. For instance, poorly constructed dwellings that are difficult and/or expensive to maintain can become quickly dilapidated decreasing the overall quality of the neighbourhood. On the other hand, insensitive urban design of the neighbourhood that places too much emphasis on car travel, inappropriately high density levels and insufficient greenspace can exacerbate health damaging aspects within the dwelling such as noise, IAQ and natural light availability.

Through their design and quality, both dwelling and neighbourhood can influence the development and maintenance of the ‘home’ concept. High quality housing and the residential environment can contribute to feelings of safety and security, control, pride and enable occupants to express themselves. The schematic also shows a conceptual connector (represented by a dashed line) from the ‘home’ component to the dwelling and neighbourhood elements, because housing-users with a greater sense of control and ontological security awarded by this component will conceivably express greater care for the quality of their dwellings and neighbourhoods, more so than those without a firm sense of a ‘home’.

3.7.4. Sustainable housing and neighbourhood design features that impact health and well-being

While a full account of the health and housing relationship is beyond the scope of this thesis (as mentioned earlier), this review, together with the findings from chapter 2 has enabled the identification of housing design features than can impact on occupants’ health and well-being. Originally, 32 such features were identified which were subsequently narrowed down to 28 that were then developed into a framework for sustainable housing design with a focus on health and well-being. The next chapter will provide a detailed justification for the inclusion of each feature together with an explanation of the framework structure as well as why some of the features were excluded.

3.8. Summary of chapter findings

- The aim of this chapter was to investigate the housing and health relationship to gain a better understanding of how housing impacts health.

- Housing is one of the key social determinants of health and wellbeing (Barton, Grant and Guise, 2010; Shaw, 2004). Its fundamental impact on health and well-being can be demonstrated through conceptual frameworks such as Maslow’s hierarchy of needs (Maslow, 1943) and Settlement Health Map (Barton and Grant, 2006).

- There is a long history of study into the housing and health relationship in the UK dating back to the works by Friedrich Engels and Edwin Chadwick in the mid-19th century. While early interventions were highly successful in eliminating communicable diseases linked to poor housing, many of the early policies had unintended negative consequences on the built environment in relation to health and well-being. These include zoning practices, which placed great emphasis on private car (Barton, Grant and Guise, 2010) and the decoupling of public health from housing design and planning (Barton and Tsourou, 2000; Bonnefoy, 2007).

- The importance of housing on health and well-being is again being raised through the New Public Health agenda, and in the UK, the potential for addressing obesity, mental well-being and health inequalities through the design of the built environment are of particular interest (Barton, Grant and Guise, 2010; Marmot, 2010; SDC, 2008).

- The long history of housing and health studies has produced a vast body of literature in this field. However, the complexity, multi-dimensionality and ethical issues have all obstructed the establishment of definitive causal relationships within the housing and health research field (Turkington, Leng and Wright, 2010). As a result, there are numerous criticisms directed at this literature, including its lack of consensus and being too focused on single and specific factors (Lawrence 2005), too focused on negative health issues (Srinivasan, O'Fallon and Dearry, 2003) and lacking in multidisciplinarity (Braubach, 2011). Nevertheless, sufficient knowledge and evidence for the creation of healthy homes is now available, but the implementation of this knowledge is still weak and the real challenge currently is the transfer of this knowledge into practice (Braubach 2011; Jackson, Dannenberg and Frumkin, 2013).

- As a full review of housing and health relationship is beyond the scope of this chapter and study, a simplified schematic ‘map’ has been developed to illustrate some of the key impacts at home, dwelling and neighbourhood levels of housing. However, these impacts, together with some of the findings from chapter 2, are reviewed in greater detail in the next chapter in the form of a framework of sustainable housing design with a focus on health and well-being.

Chapter 4: Framework for sustainable housing with a focus on health and well-being

4.1. Introduction

As mentioned in chapter 2, it has been suggested that a framework based approach is a more appropriate way to define and discuss the concept of sustainable housing (Turcotte and Geiser, 2010; Winston, 2010). Following this approach, this chapter builds on the findings of chapters 2 and 3 to develop a framework for sustainable housing that places a particular focus on housing-users' health and well-being. In total, 28 housing characteristics are identified as components of this framework given their importance to healthy and sustainable housing. For clarity, the chapter begins with a brief explanation of how the features were identified and an overview of the 28 features, before moving on to review the evidence that justifies the inclusion of each component into the framework.

4.2. Identification of sustainable housing design features that can have an impact on health and well-being

The framework and its constituent 28 design features were derived from the review of sustainable housing and healthy housing literatures. Each feature was selected based on the empirical evidence for its importance and/or predominance within published literature – and a justification for the inclusion of each is provided throughout this chapter.

Initially, some 32 sustainable housing and neighbourhood design characteristics were identified given their relevance to health and well-being. However, 4 of these were excluded from the overall framework as these are in essence covered by other components of the framework and their inclusion would therefore result in duplication. Nevertheless, an overview of their importance to sustainable housing, health and well-being is provided towards the end of this chapter (section 4.4) together with an explanation how these 4 components are covered by other features of the framework.

The resulting 28 components of the framework are listed in table 7. The numbering does not imply any kind of order of importance; rather, components have been grouped thematically according to sustainability scope and type of health impact. Most of the housing characteristics pertain largely to either health and wellbeing or environmental ‘themes’ of sustainability, however there are also a number that overlap with the broader societal and socio-economic scopes.

Nevertheless, all of the housing characteristics have some level of impact on health and well-being, including the ones that are classified as primarily of environmental sustainability scope. Terminology from Shaw’s (2004) framework and Settlements Health Map (Barton and Grant, 2006; Dahlgren and Whitehead 1991) discussed in chapter 3 have been used in describing these impacts. For instance, features such as thermal comfort, indoor air quality and noise will have largely direct or ‘hard’ impacts on health, while components such as suitable indoor space, access to greenspace, and adaptability will have a more indirect or ‘soft’ impact. Features with environmental impacts can effect health and well-being through more ‘global’ routes – for instance climate change and wider air, water and soil pollution.

Scope	Type of health impact	No	Sustainable housing feature:
Health and well-being	**Direct / ‘hard’**	1	Thermal comfort
		2	Indoor air quality
		3	Noise prevention
		4	Daylight availability
		5	Toxicity of construction and furnishing materials
		6	Humidity/dampness prevention and control
		7	Safety from injury and accidents
	Indirect / soft/ meaningful	8	Suitability of indoor space design and layout
		9	Access to high quality open greenspace
		10	Attractive views to the outside
		11	Compatibility with local heritage and cultural style
Societal & Socio-economic		12	Private outdoor space
		13	Adaptability of dwelling to suit future needs
		14	Features for social interaction
		15	Design contributes to perception of safety
		16	Engagement and consultation
		17	Management and controllability
		18	Higher density /compact developments
		19	Proximity to amenities
Environmental	**‘Global’**	20	Energy efficiency of dwelling
		21	Sustainable transport
		22	Water conservation and efficient use
		23	Greenhouse gas emissions
		24	Low pollution (surface water runoff, light, NO_x)
		25	Low environmental impact of materials & furnishings
		26	Low environmental impact of construction
		27	Ecology and land use
		28	Facilitates environmentally sustainable behaviour

Table 7: List of sustainable housing features with a focus on health and well-being.

4.3. Sustainable housing features

4.3.1. Thermal comfort

Thermal comfort is a result of a complex interaction between climate, the dwelling and its occupants. It is essentially a subjective value defined by BS EN ISO 7730:2005 as "*that condition of mind which expresses satisfaction with the thermal environment"*. It is largely determined by six environmental and personal factors; air temperature, radiant temperature, air velocity, humidity, clothing insulation and metabolic heat of the occupant (British Standards Institution, 2005).

Adequate temperature for health and well-being is commonly regarded as 21°C in main living areas and 18°C in other occupied rooms (e.g. DCLG 2006a). Under conditions of appropriate clothing, insulation, humidity, radiant temperature, ventilation, and stable physiology, no health risk can be demonstrated for healthy people with sedentary living between 18 °C and 24°C (WHO 1990). According to the WHO (2004; 2007) temperature below or above this range for a prolonged period of time can have a number of physiological effects, particularly on vulnerable population groups (elderly, young children and individuals with cardiovascular problems). Prolonged lower temperatures are associated with higher prevalence of respiratory illness and conditions such as acute bronchitis and pneumonia, allergies, asthma, bronchospasms, wheezing in children. Cold air can impact respiratory tract and affect the immune system reducing resistance to infection, while chilling of the body has been linked to increased risk of upper respiratory tract infections. On the other hand, higher temperatures can be associated with dehydration, while 24°C and higher throughout the night may lead to cardiovascular strain with higher risk of stroke.

While there is no direct reference to thermal comfort in the Building Regulations (Part J on Combustion Appliances only refers to discomfort that may be caused by cold draughts), the Decent Homes Standard (DCLG 2006a) includes thermal comfort as one of the four criteria that a dwelling needs to provide in order to be considered as 'decent'. An estimated 24,000 excess winter mortality occurred in England and Wales during 2011/12 winter (Office for National Statistics (ONS), 2012) and while not all can be directly attributed to housing, significant links have been established between low indoor temperatures and higher excess winter mortality (Wilkinson et al., 2001). Given that currently 19% of UK homes have been classed as fuel poor (Department of Energy and Climate Change (DECC), 2013), provision of adequate thermal comfort is an important feature of sustainable and healthy homes. There is growing evidence that improvements in energy efficiency of dwellings can lead improvements in the health of housing-users (Maidment et al., 2014).

As thermal comfort is highly dependent on the occupants' behaviour, age, health and economic status, the contribution that housing providers can make is limited to the provision of dwellings that are adapted to the regional climatic conditions and designed for optimal thermal performance. Furthermore, occupants must be able to easily adjust and maintain indoor thermal conditions to match their comfort levels without significant associated costs. In line with this, the Decent Homes Standard uses provision of effective insulation and efficient heating as measures required to meet the thermal comfort criterion (DCLG 2006a).

4.3.2. Indoor Air Quality

Indoor air quality (IAQ) is widely considered a key determinant of health and well-being. Europeans spend an estimated 90% of their time indoors where concentrations of certain pollutants have been found to be higher than outdoors (Bonnefoy, 2007; European Commission (EC), 2003). IAQ is determined by the presence and concentration of indoor air pollutants as well as the rate of air exchange (i.e. effectiveness of ventilation). Pollutants can be gaseous, liquid or biological matter originating from a broad range of sources including outdoor air, ground, resident behaviour and the building and furnishing components of the dwelling (WHO 1990). In terms of health impacts, of particular concern are the respiratory effects (esp. asthma) and carcinogenic properties of common VOCs. A more detailed overview of key indoor pollutants, their sources, health impacts and solutions for mitigation are presented in table 8.

Despite its importance, public health awareness and research into indoor air pollution has lagged behind that of outdoor air pollution (WHO 2010). However, the increasing worldwide incidence of asthma, particularly among children, has drawn attention to possible links to indoor air pollution, particularly as asthma prevalence has not dropped with the reduction of some outdoor pollutants (Brugge et al 2003; Miles and Jacobs, 2008). Research carried out by the European Commission estimated that up to 20% of the European population is affected by asthma and other allergic conditions due to exposure to indoor pollutants (EC 2003a). WHO has guidelines for nine compounds, however not all of these are equally significant in all countries. For instance, in Nordic countries most of the substances on the list are no longer relevant, but new compounds are becoming of increasing concern (e.g. phthalates, TXIB, 2-ethyl-1-hexanol) for which toxicological analyses are inconclusive despite the existence of epidemiological evidence (Sateri, 2012). Of particular concern is the effect these substances may have when acting together even in low doses (the so called cocktail effect) (Pearson 1998; Sateri 2012). However, there is currently limited empirical data in the health impacts associated with co- or multiple exposures to air pollutants (WHO 2010).

Pollutant:	Source:	Health impact:	Design Solutions*:
Radon	Natural (radioactive decay of ground-source uranium)	Lung cancer; Increasing evidence of association with other cancers e.g. leukaemia.	Radon filter; Avoid using radon bearing materials (gypsum, granite etc.)
NO_2	Gas-fired appliances (cooking hobs, boilers, heaters); external sources (e.g. road traffic)	Respiratory health (increased bronchial reactivity, airway inflammation, bronchoconstriction); decreased immune defence.	Installation of proper gas pipes and chimneys for combustion appliances; Use of fuels other than gas.
Tobacco smoke	Behavioural	Asthma and other respiratory illness (esp. in children); Lung cancer; Asthma; Sudden Infant Death Syndrome.	Maintenance charge higher for smokers; features to encourage smoking outdoors (balconies away from intake air vents)
Formal-dehyde (VOC)	Furniture, paints, building materials, plastic wall materials	Eye irritations; Sensory irritation (odour); Carcinogenic	Low emitting building materials, furnishings and products.
Benzene (VOC)	Solvent use (hobbies, cleaning), building materials and furnishings, furniture, heating and cooking systems, ETS, attached garages, external sources (petrol stations, certain industries)	Acute myeloid leukaemia (sufficient evidence on causality); Genotoxicity	If located in high pollution area, locate fresh air inlets on least polluted side.
Allergens	Biological (Acarids, insects, pets, fungi, rodents, pollen)	Skin irritations, respiratory symptoms	Moisture control, type of furnishings
Moisture	Structural, behavioural low lack of adequate heating.	Mould growth, leading to allergies, eczema, rhinitis, irritations; asthma; lower respiratory symptoms.	Avoid sources of moisture such as humidifiers, tumble dryers. Such appliances should vent outside.
CO	Outdoors (traffic), heating and gas-burning systems, ETS, incense burning.	Acute exposure-related reduction of exercise tolerance and increase in symptoms of ischaemic heart disease	Safe and well maintained heating systems.

*Table 8: Key indoor air pollutants, their effects on health and possible dwelling design solutions to mitigate them. Based on Bonnefoy (2004), Evans et al (2000), Jaakkola, Verkasalo and Jaakkola (2000) Roulet et al (2006), WHO (1996; 2010), Braubach, Jacobs and Ormandy (2011) (*excluding ventilation).*

A growing concern regarding energy efficient homes is that the air tightness of the build together with potentially inadequate ventilation may have a negative effect on the indoor air quality and therefore the occupants' health. In highly insulated, air tight homes, passive ventilation is generally inadequate for a suitable rate of air exchange and a mechanical system with heat recovery is necessary to ensure healthy indoor air environment (Crump, Dengel and Swainson, 2009; Bone, Murray and Meyers, 2010). However, while such systems can enhance the air quality by filtering out certain pollutants coming in from the outside, in addition to maintaining energy efficiency of the dwelling, their effectiveness relies on correct operation and maintenance (such as filter replacement). VOC levels have been found to be higher in new homes than in older dwellings due to better air-tightness and off-gassing from the building materials (Crump, Dengel and Swainson, 2009; WHO 2010).

A number of design and construction solutions can be employed to reduce the indoor pollution as listed in table 8. Roulet et al (2006) argue that because buildings should be designed and built for the occupants, the only internal source of pollution should be the activities and behaviour of the occupants themselves (e.g. through smoking, cleaning activity).

4.3.3. Noise prevention

Noise is defined as an unpleasant or undesirable sound, or a combination of such sounds, which can interfere with desired sound features (such as speech, silence, music), cause irritation and reduce sleep efficiency (WHO, 1990). The significance of noise on health and well-being is demonstrated by its inclusion in the WHO guidelines for healthy housing as well as UK Government's Housing, Health and Safety Rating System under the 'psychological requirements' category. According to Braubach, Jacobs and Ormandy (2011), noise, together with air pollution, may be an underestimated environmental risk factor to health. While not enough data exists to quantify health impacts associated with noise other than that from traffic sources, long term exposure to road traffic noise has been linked to ischaemic heart disease as noise is an unspecific stressor that stimulates the autonomous nervous system and the endocrine system. Exposure to persistent noise, particularly during night time, has been linked to hypertension (Weinmann *et al* 2012) and is the leading cause of exogenous cause of sleep disturbance (Bonnefoy, 2004).

WHO's Large Analysis and Review of European housing and health Status (LARES) study looked at the strength of association between environmental noise (traffic and neighbourhood) and the health impacts it can induce through sleep disturbance and annoyance (Niemann *et al.,* 2006). In this study, 'annoyance' was defined as a feeling of discomfort caused by adverse influence on an individual, group, substance or circumstance. The epidemiological results confirmed increased health risks caused by chronically strong noise that lead to annoyance and sleep disturbance. In adults, increased risks of pathological changes were found in the respiratory system, the cardiovascular system, musculoskeletal system and depression. Elderly people were found to have a more significant risk of stroke in the presence of strong noise that induced annoyance, while children exposed to strong noise induced annoyance were found to have greater incidence of respiratory illnesses.

The study's results show the necessity of improving sound insulation of residential buildings, particularly in panel block buildings where noise-related health and well-being problems tend to be most prevalent. There are a number of indoor noise-reducing approaches that can be implemented during planning, design and construction stages, for instance, introduction of noise absorbing material to reduce internal reverberation and echo, while influx of external noise can be reduced through avoiding sound leaks and contact sound transmission (Blyussen 2010). In the UK, technical guidance for noise mitigation is specified by the Part E (Resistance to sound) of the building regulations –homes can be built exceeding the sound insulation requirements of the building regulations with virtually no additional cost (RIBA 2012).

4.3.4. Daylight availability

The importance of daylight to health and well-being is perhaps best illustrated by the negative effects it has when it is lacking. The WHO LARES study found that missing daylight was one of the key factors of poor quality housing that had a particular impact on mental health, increasing the chance of depression and chronic anxiety (Bonnefoy, 2007; Brown and Jacobs, 2011). The researchers also found that lack of natural light was associated with increased falls. The conclusion drawn was that increasing the availability of natural daylight was an inexpensive way of reducing these two negative health impacts.

Suitable lighting is required not only for vision, but also for regulating the internal biological clock as well as a number of other essential body functions (Roulet *et al.,* 2006). Daylight should be used for lighting as much as possible for the following health, well-being and environmental reasons:

- Human eye has evolved with sunlight and people therefore prefer natural light over artificial light (Roulet *et al.*, 2006).
- The spectrum of daylight is ideal for biological stimulation. Research comparing impacts of artificial light and natural light has shown that outdoor light led to 50% reduction in depressive symptoms compared to artificial light (Wirz-Justice *et al*., 1996).
- No cost
- Smallest heat load per lux (1W for 100lux) (Roulet *et al*., 2006).

Indoor daylight availability will depend on a number of dwelling features such as the number, type and size of windows, room structure and amount of reflective surfaces. A number of design features can be integrated into building design to maximise use of daylight, including vertical windows, roof lights and light ducts. Artificial light is necessary to supplement natural light, but their installation should prioritise high efficiency light sources, those that provide good light spectrum, and if possible, with a daylight responsive system. It is important to remember that well designed lighting system can be more comfortable even if it yields less lux than poorly designed lighting offering higher lux levels (*ibid*).

4.3.5. Toxicity of construction and furnishing materials

Products used in construction, refurbishment and decorating are often major contributors of indoor pollutants such as VOCs (e.g. benzene, formaldehyde, trichloroethylene) (WHO, 2010), whose impact on health is outlined in section 4.3.2. Examples of such VOC-containing materials include;

- Flooring (can contain vinyl, PVC, rubber floorings, nylon carpets, flooring adhesives)
- Furniture (can contain particleboard furniture, plywood, fibreglass pressed wood products; insulating materials)
- Decoration items (can include paints, varnishes, wood panelling, caulking, paint removers, glues, adhesives, other DIY materials) (WHO, 2010).

Consequently, newly constructed or refurbished dwellings can have higher than average levels of certain indoor pollutants, which depending on initial concentrations and the rate of ventilation, dissipate over period of time ranging from days to years (WHO, 2010). UK Building regulations (Part D and Workmanship and Materials) require precautions to be taken to avoid permeation of toxic fumes from cavity wall insulation, and stipulate that adequate and proper materials are used in the building work.

4.3.6. Humidity/damp prevention and control

Damp housing is characterised by excessive moisture whether that is damp air, surface condensation or greater humidity levels of furnishings and other materials (WHO 2009). Indoor humidity and dampness is strongly affected by climatic conditions and the problem can be particularly prevalent in regions that experience high levels of rainfall. High indoor humidity can affect physical health through two pathways. Firstly, the inability to keep clothing and soft furnishings dry can cause general discomfort and skin irritations. Secondly, excess moisture provides favourable growing conditions to mould, and as certain fungi can increase availability of food source for mites, damp housing often also exhibits high dust mite concentrations (Custovic and Woodcock, 1998). High concentrations of microorganisms (fungi, mould, bacteria) and dust mites reduce indoor air quality by emitting potential allergens such as spores, cells and cell fragments and other organic material. Consequently, the most notable health impacts of damp housing are respiratory symptoms and infections as well as skin conditions, such as allergies and eczema (Evans *et al*., 2000; WHO, 2009).

Indoor humidity and dampness can also have economic and emotional well-being impacts on a household. Damp homes are typically more difficult, and therefore costly, to heat, which means that occupants are more likely to spend higher proportion of their income to achieve thermal comfort. This can contribute to fuel poverty and the associated health impacts (Liddell and Morris, 2010). Furthermore, damp, cold, mouldy homes may contribute to social isolation as housing-users are reluctant to invite people over, thereby reducing the health-promoting development of social networks (Page, 2002).

While occupant behaviour will impact the level of dampness (and to some extent mould growth through level of cleaning activity), mould growth can be reduced through design of building features and materials (Loftness et al, 2007). UK Building regulations (Part C2 on Resistance to Moisture) stipulate precautions against moisture from the ground and outline requirements for the resistance to condensation and mould growth. Typically, causes of damp housing can be attributed to housing features outlined in table 9.

Housing feature:		**Effect:**
Inadequate structural design, construction or maintenance	⇨	Moisture penetration
Dense building materials and construction methods that lead to greater heat loss and poor thermal insulation	⇨	Higher incidence of condensation particularly in colder climates.
Lack of or defected damp proof courses	⇨	Moisture through floors/walls
Poor housing design, construction, insulation, ventilation	⇨	Condensation
User behaviour (crowding, laundry drying, low ventilation)	⇨	Increased moisture in air

Table 9: Common housing design features that encourage damp indoor conditions (WHO 2004).

4.3.7. Safety from injury and accidents

Injury at home is still a major environmental health burden in many countries. According to the Royal Society for the Prevention of Accidents, 2.7 million people are injured and 5,000 people die in the UK due to accidents in the home (Royal Society for the Prevention of Accidents, 2013). In Europe, twice as many fatal injuries occur at home (22 in 100 000) than on the road (10 in 100 000) with young children and the elderly being particularly susceptive to such injuries (Braubach, Jacobs and Ormandy, 2011; cited therein). Although behaviour is an important cause of accidents, the design and fit-out of dwelling can be major contributors to injury. A number of features can be included to reduce the risk of injury and death, such as:

- Working smoke alarms
- Fencing around pools, ponds and other water-bodies
- Pre-set safe temperature hot water heaters
- Features to prevent falls (hand rails, window guards, better lighting)
- Better design fire escape routes

A recent WHO study (Braubach, Jacobs and Ormandy, 2011) found that installation of low cost safety features such as smoke detectors and window guards on second and higher floor windows could potentially prevent 7500 deaths and 200 000 disability adjusted life years. However, as with many domestic housing features, regulation of space that is private property is unpopular and many regulators are reluctant to make stipulation for such features (*ibid*). Fire safety and protection from falling, collisions and impact are however covered by the UK Building Regulations (Parts B and K respectively).

4.3.8. Suitability of indoor space

Perception of crowding and the lack of privacy has been shown to affect mental health and psychological well-being, with evidence indicating that women (Gabe and Williams, 1986) and children (Evans, Lercher and Kofter, 2002) are particularly affected. Inadequate space can contribute to impacts on well-being that are more difficult to quantify than overcrowding. Those who cannot afford or are not able to move to dwellings with more space will be the ones to experience the negative effects of inadequate space.

Inadequate space may manifest in difficulties to socialise, prepare nutritious meals, enjoy hobbies, keep a pet and maintain the house in a desirable way, all of which can contribute to the discomfort and low satisfaction with one's dwelling (Drury, Welch and Allen, 2009). The WHO LARES study confirmed that perception of inadequate privacy was linked to increased prevalence of mental health symptoms (Bonnefoy, 2007). Research evidence suggests that inadequate space can also affect educational outcomes of children, individual well-being and family relationships (RIBA, 2011).

Possible impacts of inadequate space and layout include:

- Difficulty socialising with household members and guests.
- Negative impact on diet and nutrition due to inadequate space for food preparation.
- Lack of privacy for working, studying, relaxing and leisure.
- Lack of space for sorting and recycling household waste.
- Difficulties to adapt if household circumstances change.
- Reduced options for arranging furniture in a desirable manner.
- Negative affect on children's ability to make friends in a safe environment.
- Negative affect on educational achievement among children (e.g. lack of quiet space for study).
- Depression, anxiety and stress among parents associated with inability to provide a comfortable environment for children.
- Reduced opportunities for pursue certain hobbies or keep a pet (CABE, HATC and Ipsos MORI, 2009; Carmona, Gallent and Sarkar, 2010; Drury, Welch and Allen, 2009; RIBA, 2012).

As there are no regulatory requirements to record the floor area, homes in the UK are commonly marketed by the number of bedrooms rather than floor space. However, more bedrooms do not always equate to adequate and suitable space provision. Indeed, recent research reveals that the average floor space of privately built homes has been decreasing and is now one of the lowest in Western Europe (RIBA 2011; DCLG, 2014b). A recent survey commissioned by RIBA found that residents of newer properties (less than 10 years) were more dissatisfied with space availability than those in older properties, and were more likely to consider moving or making alterations to their homes (Ipsos Mori and RIBA, 2013). A sample of newly built homes revealed that the average new build in the UK was 92% of the recommended minimum size, with one-bedroom and three bedroom homes missing $4m^2$ and $8m^2$ respectively (RIBA 2011). In 2012, UK households had an average total usable floor area of $92m^2$, ranging from $105m^2$ for owner occupiers to $74m^2$ for private renters and $63m^2$ for both local authority and housing associations (DCLG, 2014b).

Comparing new builds to older homes, the 2012 English Housing Survey (DCLG, 2014f) revealed that the average total floor area of new homes (built since 2002) at $96m^2$ was slightly higher than the average for older homes was $92m^2$. However, the Survey authors note that the high average for new homes was boosted by some very large homes. Perhaps a more revealing statistic is that a higher proportion (44%) of new builds had a useable floor space under $69m^2$, compared with 35% of older dwellings. This trend of decreasing floor sizes can perhaps be traced back to the ending of Parker Morris standards in 1980, which had stipulated minimum house sizes for specific dwelling types (DCLG, 2014b).

4.3.9. Private outdoor space

Gardens, patios, terraces and even balconies of sufficient size have been found to improve occupants' quality of life and contribute to the positive psychological concept of a home. Benefits of gardens tend to be dependent on cultural values, however depending on their size, private gardens often offer opportunities for creativity and self-expression, exercise and restoration from stress, personal satisfaction from sense of achievement, relaxation, socialising, and food production (van den Berg and Custers, 2011; Dunnett and Qasim, 2000; Kingsley, Townsend and Hernderson-Wilson, 2009). Gardens have also been proposed as a source of ontological security in the face of increasing environmental risk (Bhatti, 1999). The physical and mental health benefits associated with contact with nature have also been widely documented (see section 4.3.12), and for many people living within towns and cities, private gardens will be the most frequently used outdoor space and the primary source of contact with nature (Dunnett and Qasim, 2000).

Some people view private outdoor space as an important extension of the main living and social space of a home as well as a space for carrying out domestic tasks such as drying laundry and storing household waste (Ipsos MORI and RIBA, 2012). Private gardens can be especially beneficial for particular demographic groups; gardens can provide psychological, social and health benefits for older people (Bhatti, 2006) and for young families a safe and healthy place for children to play (Ipsos MORI and RIBA, 2012). Gardens can also have wider environmental and economic benefits such as improving the ecological value of built environments (Davies et al., 2009) and increasing the perceived quality of neighbourhoods (Dunnett and Qasim, 2000).

Overall, a relatively large proportion of homes in the UK have a private garden. According to 2012 statistics, 94% of owner occupied dwellings had a private front and/or back garden, although this proportion is smaller in rental and social housing with 67% privately rented, 61% local authority and 63% housing association dwellings having private gardens (DCLG, 2014b). Although no accurate statistics can be found, it is estimated that domestic gardens in the UK cover approximately 430,000 ha (Davies et al., 2009; Bhatti, 1999), which is around 1.8% of the total area of the country.

4.3.10. Adaptability of dwelling to suit future needs

Suitable dwelling design must not only provide for day-to-day living comfort, but also offer the flexibility to adapt a dwelling in a cost-effective way to match the changing circumstances of the occupants (CABE 2009). Internal space and layout should be designed in a way that would allow areas of the dwelling to be adapted, converted and extended thereby enabling a greater lifespan. The inability to adapt a home can have a negative impact on the quality of life due to crowding, lack of privacy, reduced mobility and the generally reduced ability to fully participate in day-to-day activities such as food preparation. Design restrictions to upgrades and modernisation can also lead to reduced comfort and pride in one’s home.

As with the available indoor space and layout, impact of these restrictions will be particularly felt by those who cannot afford to move. However, those who are able to move home to meet their space needs, negative consequences can include disrupted social relationships, greater financial strain and the stress of moving. This has important implications for social capital in a residential area or community, which has been found to be one of the key predictors of community health as household mobility often acts as a barrier to local social networks and bonds (Rauh, Landrigan and Claudio, 2008).

It is unrealistic to expect a consensus for the layout of a home because different types of households have different needs (figure 10), which may change according to circumstances such as age, health and family size (Ipsos MORI and RIBA, 2012). Indoor environments can therefore be more supportive if housing-users are able to adjust and adapt housing space to match their changing requirements (Lawrence 2005). Consideration should also be given to ensure that certain features for environmental efficiency objectives (e.g. showers and no baths as described in Pickvance 2009b) do not preclude a dwelling to be adapted to match the changed occupant needs.

Part M of the building regulations (‘Access to and use of buildings’) requires ‘reasonable provision’ to be made for people to gain access and use the dwelling as well as the provision of a WC in the entrance floor. A more comprehensive list of design features that enable dwelling adaptability is provided by the Lifetime Homes standard. However, while there is evidence that some local authorities are making it mandatory in their design guides (e.g. the London Plan adopted the full standard as planning policy for all new homes in London) and it has been incorporated into the CSH (mandatory for Code level 6), it nevertheless remains a voluntary standard.

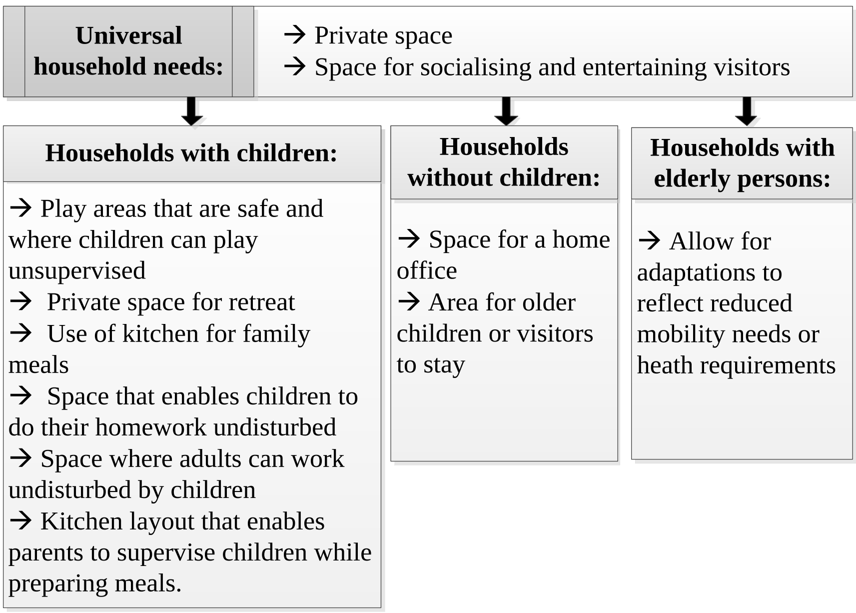

Figure 10: Housing space and layout needs of different household types (adapted from: Ipsos MORI and RIBA, 2012).

4.3.11. Compatibility with local heritage and cultural styles

The exterior design of housing is not merely a personal matter of aesthetic preference. As a component of a culture (Chiu, 2004), housing is in part a public good that becomes a part of the landscape and the heritage of a nation (Neale and RIBA, 2009). By helping people to identify with the past and their heritage, it can foster a sense of belonging and help enhance the quality of life (Stubbs, 2004; Barton, Grant and Guise, 2010). While internal space will be defined by socio-cultural values and customs, over the years the external housing design is shaped by factors such as local resources, climatic conditions and the aesthetic values of communities (Chiu, 2004). Such vernacular housing is therefore important in providing communities with a sense of cultural continuity and cultural identity (*ibid*). Conservation of cultural heritage in an appropriate manner (that is, not at the expense of high sustainability value unless it can be justified) is listed as one of the core planning principles by the NPPF. The Framework maintains that designs sensitive to the local or regional architectural styles and cultural contexts are more likely to foster a sense of place and identity (DCLG, 2012a).

However, the pursuit of maintaining heritage in the design should be done within reason and with care that it is not at the expense of good design appropriate for the 21st century household needs. Sustainable Urban Neighbourhoods Network observed that because most homes in large developments are built by volume house builders, there is a bias towards traditional designs, particularly the Victorian style (Falk and Carley, 2012). Conversely, they observed that few homes looked to be built for modern day needs – for instance, providing good outdoor spaces (e.g. balconies), storage and natural lighting (*ibid*). Not only does this limit choice for the consumer, but 'neo-vernacular' designs also tend to be more expensive, requiring greater detail as opposed to more contemporary designs that can be built using more cost-effective materials and building techniques (*ibid*). Banfill and Peacock (2007) also note that as the climate temperatures in UK are predicted to increase, designs of future housing will need to take into account the impact of solar gain on indoor air temperatures. Design elements that would need to be introduced (e.g. orientation, thermal mass, shading and ventilation strategy) may have an impact on the accepted local vernacular.

4.3.12. Access to high quality open green space

There is a substantial and growing body of research establishing the evidence base for a positive impact that natural environments have on physical and mental health and well-being. After reviewing the available evidence, the 2007 Royal Commission on Environmental Pollution report on the Urban Environment concluded that; *'the evidence is sufficiently strong to warrant amending planning guidance to recognise the health benefits of green space and to build green space into new and existing developments.'* (p. 47).

As this topic has been reviewed extensively by a number of authors (e.g Abraham, Sommerhalder and Abel 2010; Lee and Maheswaran 2011; SDC 2008; Ward Thompson 2011; Ward Thompson et al. 2012) and so it will not be repeated here beyond a summary overview of key research:

The relationship between greenspace and health and well-being is complex and not clearly defined (Lee and Maheswaran, 2011). It is believed however that natural landscapes, which can include residential public greenspace, have a positive impact through a number of mechanisms (Vries et al., 2003). Firstly, easily accessible and good quality greenspace can have a direct benefit on physical and mental health by encouraging active outdoor recreation such as walking, jogging or cycling (Cohen et al., 2007; Giles-Corti et al., 2005; Pretty et al., 2007). Although not all studies are able to find a positive relationship between amount of greenspace and level of exercise (e.g. Foster, Giles-Corti and Knuiman, 2010; Maas *et al*., 2008), the relationship will be highly dependent on accessibility, safety and quality of the greenspace (Abraham, Sommerhalder and Abel, 2010).

Secondly, access to greenspace has been demonstrated to have a positive effect on mental health and well-being by providing a restorative function from stress and enhancing positive emotions (Kaplan and Kaplan, 2003; Ward Thompson *et al*., 2012; White *et al*., 2013). Indeed, there has been evidence suggesting that the positive mental health impact of greenspace may be greater than that of physical health due to the restorative effects of natural environments (Sugiyama *et al.*, 2008).

Thirdly, green spaces such as parks, woodland, nature trails and community gardens can enhance well-being by facilitating social interaction. A study in the Netherlands found that less green space within the residential environment was associated with feelings of loneliness and with a perceived shortage of social support (Maas *et al.*, 2009).

While quality and accessibly are widely acknowledged as crucial factors in mediating the relationship between greenspace and health (Abraham, Sommerhalder and Abel, 2010), there is conflicting evidence as to the ideal distance of greenspace to yield health and well-being benefits. For instance, van den Berg and colleagues (2010) observed a moderating effect of health for greenspace within 3km, but not 1km, within the home. The authors postulated that this may be due to these being larger greenspace areas that might have a greater level of restoration from stress. On the other hand, a Danish study found that people living more than 1 km away from the nearest green space reported poorer health and health-related quality of life (Stigsdotter *et al*., 2010). Irrespective of the actual distance, access to a green public space will be important particularly to those who lack private outdoor space (Ipsos MORI and RIBA, 2012).

4.3.13. Attractive views to the outside

The large scale WHO LARES study found that bad views from the dwelling was one of the four key housing problems that were linked to increased prevalence of mental health symptoms (other factors were missing daylight, noise, and inadequate privacy perception) (Bonnefoy, 2007). It is acknowledged that it would be unrealisic to expect highly attractive views from all rooms of a dwelling in a typical housing development – not only due to practicallity issues, but also because perceived quality of scenery is a highly subjective matter. However there is evidence that views of nature or natural features are associated with a higher sense of well-being and a more positive perception towards the quality of the overall neighbourhood (Kaplan, 2001; Kearney, 2006). Conversely in dense developments, windows overlooking other homes can intrude on people's sense of privacy (Ipsos MORI and RIBA, 2012).

One explanation of the observed preference of views to more natural settings rather than built features is offered by Kaplan's (2001) attention restoration theory and its resorative function. Another explanantion is presented by Driver, Brown and Peterson (1991), who refered to the idea of a 'temporary escape', a passive activity such as gazing out of the window at a pleasant view of the garden. Such 'escape' seems to be closely associated with control that enables a person to better cope with and reduce stress – a person is able to 'escape' any stressful or negative conditions thereby taking control of the current situation (Marcus, 1999).

Natural views can also impact the physiological state. Seminal research carried out by Ulrich in the early 1980s investigating a number of psychophysiological responses (such as alpha amplitude, heart rate, and emotional states) to natural and urban scenes, showed that views to nature had more positive influences than urban scenes (Ulrich, 1981). Later work done on hospital environments, demonstrated greater exposure to daylight, views of natural environments that are geneally perceived as more attractive had a positive impact on reducing stress and depression through the effects of serotonin (Hartig and Marcus 2006; Ulrich 2006; Dijkstra, Pieterse and Pruyn, 2008).

4.3.14. Features for social interaction

The relationship between positive social interaction and its beneficial impacts on health and well-being has received substantial investigative attention in recent years (Cornwell and Waite, 2009). Research over the last several decades has produced evidence for strong links between positive social support and reduced risks of mortality as well as positive impacts on mental health mood, anxiety and stress levels (Kawachi and Berkman, 2001). Conversely, there is indication that social isolation and non-supportive ties may lead to higher rates of morbidity and mortality as well as infection, depression and cognitive deterioration (reviewed by Cornwell and Waite, 2009). Loneliness and its health effects are of particular concern among older people (Luanaigh and Lawlor, 2008).

The design of neighbourhood can influence the levels of social interaction and the sense of community (Rogers and Sukolratanametee, 2009). While housing design cannot guarantee the development of social networks, provision of certain features both in the design of the dwelling and the neighbourhood can facilitate growth of interactions and support existing ones. As Biddulph (2007) argues:

> *“Children need places to play. Youths need places to ‘hang out’. Adults-including physically disabled people and the elderly – need attractive and safe outdoor spaces to sit and socialise with friends and neighbours” (p. 9).*

Inclusion of communal facilities such as seating and play areas, green gyms, picnic sites, allotments and communal gardens can help bring people together and facilitate interaction in a positive way. These places have been described as ‘third places’ of social interaction after the home and workplace (Hickman, 2012). By facilitating greater social interaction, such features can not only contribute to the above mentioned health benefits, but by promoting the growth of social capital, they can also contribute to the development of strong and sustainable communities (Falk and Carley, 2012; Winston, 2009).

4.3.15. Design that contributes to perception of safety

Significant associations have been found between fear of crime and health and well-being, particularly relating to mental distress and the impacts from social exclusion (Green, Gilbertson and Grimsley, 2002). Clark and Keans (2012) found that improvements to home security had the largest positive effect on residents' perceptions of home quality, more so than warmth and internal improvements. Impacts on physical health have also been studied, for instance, body mass index has been found to be higher among housing-users with lower levels of perception of safety in their neighbourhoods (Fish et al. 2010), while data from WHO LARES survey revealed that likelihood of exercise was linked to the perception of safety, particularly among women (Shenassa, Liebhaber and Ezeamama, 2006).

Housing and neighbourhood quality and design can contribute to the factors that influence levels of crime, perceptions of safety and fear of crime (Austin, Furr and Spine, 2002; Cozens, Saville, and Hillier, 2005). Structural elements of the dwelling and neighbourhood can exacerbate such perceptions through windows that do not close properly, poor boundary design, inadequate lighting and management of public areas and inability to overlook the street from the house (Bonnefoy, 2007). The type of residential area has also been found to have an influence on perceptions of safety with housing-users of panel block estates or multifamily dwellings exhibiting lower perceptions of safety than those living in an area of single-family detached homes (Shenassa, Liebhaber and Ezeamama, 2006). Housing-users in neighbourhood with more walkable designs have been found to feel safer (Foster, Giles-Corti and Knuiman, 2010).

4.3.16. Resident engagement, participation and opportunity to manage living environment

Meaningful community engagement is an important factor in a housing development as it communicates residents' concerns and opinions, instils a sense of pride in the neighbourhood, increases the sense of ownership and helps to build social capital

(Barton, Grant and Guise, 2010; Aboelata, Ersoylu and Cohen, 2011). As well-being is higher when people feel they have control over their surroundings, lack of consultation over housing developments or participation that is not meaningful can lead to perceived lack of control and feelings of helplessness (Allen, 2000; Kaplan and Kaplan, 2003; Evans, 2003). These in turn can reduce levels of residential satisfaction and impact on an individual's perception of 'home'. Clark and Keans (2012) study of social renters found that dissatisfaction with communication and relations with the landlord had a negative effect on the perceived quality of homes and on the psychosocial benefits. The authors noted that this could have a detrimental effect on any well-being benefits achieved through housing improvement works.

However, Choguill (2007) stressed that the involvement of community is an area where policy needs to be developed in order to achieve sustainability in the housing sectors. Community engagement in this context can take form in two ways; engagement of existing community established in proximity to a new housing development and engagement of the new housing-users of the development. It is becoming recognised that developers can support the establishment of community governance structures that would enable residents to participate in the management of the neighbourhood, thereby instilling a sense of ownership and pride in the area (RIBA 2012).

4.3.17. Management and controllability

Research into the 'sick building syndrome' and office environments revealed that people tend to feel more comfortable and satisfied if they are able to control their environment (Levin, 2003; Nicol and Humphreys, 2002). Perceived control of noise and thermal conditions, followed by lighting, were found to be closely associated with comfort and productivity. Similarly for residential dwellings, occupants must be able to easily manage environmental control features such as windows, heating, ventilating, and air conditioning (HVAC) systems and lighting installations in order to adjust the indoor environment to their comfort needs. Clark and Kearns (2012) found that housing improvements led to psychosocial benefits through the mediating effects of perceptions of home quality rather than a direct route. Improvements to security and the internal layout, space and decoration contributed to the feelings of control and status among the occupants.

The ability and ease with which the indoor environment can be controlled are becoming an increasingly pertinent issue given the increasing complexity of heating, cooling and ventilation mechanisms associated with energy efficient housing. Research with occupants of energy efficient homes found that controls can be confusing and too complex for housing-users to manage the heating systems in the most efficient and effective way (Bell *et al* 2010, NHBC Foundation, 2012). As proper management and maintenance of such systems and technologies is essential for ongoing good performance of a building, engagement with, and if necessary training of, the occupants to use these systems is therefore key.

Inability to adequately manage and control HVAC systems can have a number of important implications on the health and well-being of the housing-users as well as the intended environmental sustainability of the dwelling. Firstly, poor operation of the HVAC system can negatively affect the IAQ of a dwelling, increasing the risks of adverse physiological health impacts from higher concentrations of indoor pollutants. Secondly, lack of control of any features of one's home can also impact on mental health and well-being through stress, frustration and disruption of the ontological security associated with the concept of 'home' due to feelings of inability to control one's immediate surroundings (Dunn, 2002; Evans, 2003; Stevenson and Williams 2000).

4.3.18. Higher residential density

The issue of density within the sustainable housing context is complex and contentious. As defined by Barton, Grant and Guise (2010), density may relate to;

- Residential density; the immediate housing environment that includes dwellings, gardens and immediate access spaces.
- Neighbourhood density; includes the above as well as any amenities within the neighbourhood area.
- Urban density; will apply to the entire built up area including any industrial and commercial areas.

While more compact densities are often regarded as more sustainable forms of the built environment (Burton, 2003; CABE, 2005c; Barton, Grant and Guise, 2010), some argue that the extent and nature of benefits associated with higher densities are less clear cut and higher density urban forms may produce trade-offs between the core elements of sustainability (Bramley and Power, 2009).

As outlined in table 10, there are numerous potential advantages and disadvantages of higher densities. The environmental benefits of a compact urban form include lower land resource requirements, improved energy efficiency and more sustainable modes of travel (Barton, Grant and Guise, 2010). A compact city can also potentially enhance social equity through lower levels of social segregation and car dependency (Burton, 2003), better access to services (Bramley and Power, 2009) and potentially greater development of social capital due to greater social interactions within communities. Health benefits associated with higher density may include greater physical activity due to walking and cycling becoming a more attractive method of travel as well as improved outdoor air quality due to reduced use of the private car.

On the less positive side, high density neighbourhoods have been noted to suffer from social problems such as crime, social alienation and lower levels of satisfaction with the neighbourhood (Bramley and Power, 2009). The environmental benefits described above may also be negated by lower biodiversity levels, lack of urban greenspace, higher concentrations of air pollution and fewer viable opportunities for renewable energy technologies and rainwater harvesting due to lack of space. Compact cities may also suffer from lack of decent sized homes that are affordable (Burton, 2003) and have generally been found to lack approval and preference of housing-users and the wider public (Howley, Scott and Redmond, 2009; Winston, 2009).

Advantages:	Disadvantages:
Easier and more economically viable access to services and facilities	Lack of decent-sized homes that are affordable.
Greater opportunities for spontaneous interaction, can lead to a greater sense of community	Dissatisfaction with neighbourhood
Lower dependency on car travel - lower fuel consumption and better air quality,	Aesthetics – some indication of preference towards low-density suburban designs
Greater incidence of walking and cycling as modes of travel, leading to associated health benefits	Greater noise and congestion
Mixed/less segregated communities, promotion of social equity	Concentration of environmental problems
Protection of open spaces and countryside	Increased perception of overcrowding
Increased productivity	Lack of access to open and green space.

Table 10: Potential advantages and disadvantages of higher density communities (based on Burton 2003; Bramley and Power 2009; Dempsey, 2010).

However, proponents of higher density housing argue that previous failures are the result of underlying social problems and management issues. For instance, CABE’s 2005 report ‘*Better Neighbourhoods: Making higher densities work*’ argues that good design and careful consideration of site characteristics are essential if compact urban forms are to deliver the environmental and social advantages. Evidence indicates that many homebuyers are attracted to low-density suburbia because of relative affordability and perceived desirable lifestyle associated with suburban characteristics. However, these characteristics can be replicated at higher densities by including features such as open spaces, lower height dwellings, high levels of natural light, low levels of traffic and private gardens (MJP Architects, 2005)

4.3.19. Proximity to amenities

Easily accessible local amenities can be associated with a number of social, economic and health benefits (Barton, Grant and Guise 2010). Destinations to amenities such as shops, entertainment, healthcare, education and other facilities have been found to correlate with walking and moderate-intensity physical activity (Lee and Moudon 2008). Also, casual or planned interactions facilitated by local amenities can encourage the formation and reinforcement of social networks and the sense of local community, while reduced number of car trips help reduce air pollution and congestion (Barton, Grant and Guise 2010).

It has been suggested that 20th century planning policies promoting zoning and lower density population concentrations may have contributed to some of the prevalent chronic health conditions of today (Perdue, Stone and Gostin, 2003). Greater distances to amenities have led to an ever greater reliance on private car transport, which in turn has contributed to lower levels of physical exercise, sedentary lifestyles as well as air pollution. The nature of the house building industry has also been noted as a contributor – as many of the UK’s developers specialise in single-use markets such as housing, leading to a lack of mixed use developments (Nelson, 2011).

Mixed use is one of the core planning principles promoted by the NPPF for larger residential developments. According to the Framework, they can encourage social interaction, reduce car reliance and the need to travel and contribute to the development of vibrant and inclusive neighbourhoods (DCLG 2012a).

4.3.20. Energy Efficiency

In 2013, domestic energy use accounted for over one quarter (29 %) of all energy consumption in the UK (DECC, 2014). This is typical for most developed countries where the building sector is a significant consumer of energy accounting for 25-40% of final energy use (Organisation for Economic Co-operation and Development (OECD), 2003). In terms of lifecycle energy use, the operation of buildings (especially space and water heating and appliances) far outweighs the construction and demolition stages. During the building use stage, over half of energy consumption is used for space heating (58%), followed by water heating (25%) and then electrical appliances (14%) (Utley and Shorrock, 2008). Recent research has shown that for the three most common types of residential housing, detached, semi-detached and terraced, the operation stage contributes to 90% of global warming potential, with construction stage and the end-of-life stage contributing 9% and 1% respectively (Cuéllar-Franca and Azapagic 2012). However, despite the relatively high current energy consumption, the overall domestic energy use in the UK has been decreasing. Since 2000, the energy usage has dropped by 7% despite the 9% increase in population and 11% increase in the number of households (DECC 2012).

As energy consumption in housing is responsible for greenhouse gas emissions, the policies and initiatives introduced by the government to improve energy efficiency of new housing in particular are discussed in the next section.

4.3.21. Greenhouse gas emissions

While greenhouse gases (GHG) include carbon dioxide (CO_2), methane, nitrous oxide and water vapour, CO_2 is the most significant gas related to energy use in homes (Palmer and Cooper, 2012). The CO_2 associated with housing includes that emitted during heating as well as the carbon released by power stations producing electricity consumed by domestic users. Carbon emissions of residential housing are therefore inextricably linked to energy efficiency of the dwelling fabric and appliances. While yearly emissions vary in relation to the severity of winters, overall there has been decrease of CO_2 emissions since 1990 despite the increase in household numbers and changed expectations for thermal comfort (*ibid*). In 2011, CO_2 emissions from the UK residential sector were 67 Mt, representing approximately 15% national CO_2 emissions (DECC 2012). According to the Intergovernmental Panel on Climate Change, the residential and commercial building sector has the greatest potential for cost-effective reduction of GHG emissions by 2020 (Levine *et al* 2007).

4.3.22. Sustainable transport

The aim of sustainable transport is to reduce the reliance on fossil fuel-powered private cars through the encouragement of low carbon modes of travel such as walking, cycling and the use of public transport. Domestic transport accounts for 20% of total UK GHG emissions, with cars and taxis accounting for 58% of these emissions (Department for Transport, 2009). While recent decades saw the introduction of more fuel efficient vehicles, these benefits have been partly negated by the increase in private motoring emissions, which can be related to an increase in travel by car (DEFRA 2012). In addition to GHG emissions and road congestion, a reduction in car travel would also have a positive impact on health and well-being by reducing air pollution and promotion of higher levels of physical activity (Rojas-Rueda, de Nazelle et al. 2011).

4.3.23. Water conservation

Water use in households has been on the increase since the mid-20th century and today accounts for over half (52%) of the total public water supply with the average person in England using 150 litres of water per day (l/p/d) (DEFRA 2008). The most water intensive activities in the home are toilet flushing (approximately 30%) and washing activities such as showers, washing machines and taps (Waterwise 2013). Encouragingly, in metered households it is significantly lower at 127 l/p/d, falling well within the Government's target to reduce household consumption to 130-120 l/p/d by 2030 (DEFRA 2008).

The significance of this is that while water is a renewable resource, its regional availability is dependent on climatic and weather conditions, and certain areas of the UK (especially the south and south-east) have been experiencing significant water scarcity in recent years. Furthermore, due to the energy associated with water treatment, the water industry accounts for about 1% of total UK GHG emissions (DEFRA, 2008).

4.3.24. Pollution

The construction industry is responsible for several hundreds of pollution incidents every year, making it a significant source of environmental pollution (Environment Agency (EA), 2012). As outlined by the EA's '*Pollution Prevention Guidelines'* (PPG6), pollution can affect water, land/ soil, air and people (through vibration as well as light and noise pollution). Silt and oil are the most common water pollutants associated with construction sites (EA 2012). Also, other common substances such as diesel, paints, solvents and other chemicals also can lead to water and soil/land pollution. Dust and particulate emissions arising from construction sites are also pollutants of air quality that can negatively impact human health.

Pollution associated with housing can occur during various on-site construction activities, including storage, use, excavation, construction, demolition, deliveries as well as associated off-site activities such as transport (EA 2012). However pollution can also be caused by dwellings during their life-time. Life-time impacts can include surface water run-off, inappropriate night-time lighting systems that contribute to light pollution and NO_x emissions from fossil-fuel based domestic heating systems (DCLG, 2008).

4.3.25. Environmental impact of materials and furnishings

The construction industry is a major consumer of raw materials. It accounts for 24% of raw materials extracted worldwide globally, and the associated extraction, processing, transportation, installation and eventual disposal contribute to a significant environmental impact (EC, 2011). In the UK, the construction industry uses more than 400 million tonnes of materials and consumes 90% of non-energy minerals extracted annually, making the sector the most resource intensive in terms of raw material use (UK Green Building Council, 2014). As building materials, components and furnishings can have a significant environmental impact by the way they are extracted, manufactured/processed, used and disposed of, this impact can be significantly reduced if materials are reused and recycled (*ibid*).

4.3.26. Environmental impact of construction

The process of construction, while relatively short in terms of building life cycle, has a noteworthy environmental impact. Waste is of particular concern as the construction sector makes the largest contribution to UK's total waste generation (DEFRA, 2015). Construction and demolition waste is also one of the largest waste streams generated across the EU, accounting for 25-30% of all EU waste and predicted to rise (OECD 2003). Definitions of construction and demolition waste differ across many of the EU countries, but such waste generally arises from materials removed during demolition, refurbishment and surplus materials during construction stage, but can also result from damage (by mishandling, weather and inadequate storage), vandalism, rework, lack of recycling facilities and over ordering (Jones and Greenwood, 2003).

While it is generally difficult to reduce the amount of materials used, much can be done to recycle or re-use through waste minimisation initiatives adopted by the construction companies and the general increase in the life-cycle of buildings (OECD 2003). Many of the waste minimisation initiatives can be quite simple and involve on-site segregation of waste, better storage and inventory practices and use of reclaimed materials (Jones and Greenwood, 2003). While increase of building lifecycle can be achieved through the following three key steps (OECD 2003):

- Increased buildings' durability
- Improved maintenance of buildings
- Improved adaptability potential so buildings can meet users' needs for longer.

4.3.27. Impacts on land resources

Housing impacts on land resources in two ways; firstly by physically taking up space, and secondly, through the negative impact that built environment has on ecological systems. According to 2011 statistics for England, 9% of the total 13 million hectares of land is developed (DCLG 2013c). To prevent urban sprawl, approximately 40% of land is designated as Green Belt or falls under designated environmentally protected area (e.g. National Park) (*ibid*). However, the current housing shortage is creating an ever-greater pressure on the land resource, including Green Belt areas, to meet housing needs (Green Balance, 2011). Construction of housing can have a significant impact on the ecology of the area through loss of natural habitat and local species, fragmentation, loss of potential for urban greenspace, reduced biodiversity, wetland drainage and recharging of water tables (*ibid*).

The impact of housing on land use and ecology can be minimised through developments on brownfield land and areas that have already been built on. A report for Campaign to Protect Rural England estimated that there is sufficient brownfield land suitable for 1,494,070 dwellings (Green Balance, 2011). Building on brownfield land can reduce pressure on natural habitats, and if appropriately designed and maintained, can improve the ecological value of such land. Also, building on or near existing developments means that necessary infrastructure (electrical grids, lighting, sewerage systems, roads etc.) can be reused or need only be extended further minimising land requirement.

4.3.28. Promotes and facilitates environmentally sustainable behaviour

The way a dwelling and the wider housing development are designed can facilitate or impede environmentally sustainable behaviour by its housing-users, as summarised in table 11. Within the dwelling, provision of features such as composting facilities, adequate space for sorting waste and recycling, energy display devices, and clothes drying space can promote energy conserving and waste minimising behaviour among occupants. While walkable neighbourhoods, access to amenities, provision of greenspace can encourage more sustainable modes of travel and promote the development of stronger communities.

Housing design feature(s):		Sustainable behaviour:
Efficient heating system including user controls	⇨	Lower and more efficient use of energy
Water recycling systems (grey and rain water), duel flush toilets	⇨	Lower and more efficient use of water
Space for sorting recycling waste and composting	⇨	Recycling and composting
Private and public open green spaces	⇨	Maintenance, appreciation and enhancements of ecologically richer urban habitats and biodiversity.
High density (e.g 30-60dph), mixed-use developments, space for home office	⇨	Fewer and shorter journeys with inefficient modes of transport (e.g. private car)
As above, plus walkable neighbourhoods and public transport links	⇨	More environmentally sustainable mode of travel
As above, plus adaptable housing and variety of dwelling types.	⇨	Participation in community, building of social capital
As above, plus design features that enhance security and feelings of safety.	⇨	Use of local services, businesses and amenities

Table 11: Summary of housing and neighbourhood design features that can support and facilitate environmentally and socio-economically sustainable behaviours (Based on Williams and Dair, (2007b).

4.4. Excluded features

This section explains why several housing and neighbourhood design features pertinent to sustainable housing, health and well-being have been excluded from the above framework:

4.4.1. Accessibility

The importance of housing accessibility is expected to increase with the growing proportion of aging population in many European countries (Bonnefoy 2004). The WHO LARES survey found that 90% of people with some form of functional limitation could not make normal use of their dwelling, while in total only 27% of all residential housing were assessed as ‘easily accessible’ by their occupants. Health impacts of limited accessibility are especially pertinent to the elderly as limited activity, restricted participation and social isolation can lead to potentially negative effects on mental health (stress, depression etc.) as well as physical health (e.g. osteoporosis) (*ibid*).

Mobility barriers such as stairs, thresholds and narrow doorways can limit accessibility to certain areas of the dwelling and therefore reduce its usability. Considering these implications to health and well-being, 'accessibility' can therefore be encompassed by the wider concept of dwelling '*usability'* (Iwarsson and Ståhl 2003). In this study, 'usability' is addressed by the two criteria of '*Suitability of indoor space*' and '*Adaptability of dwelling to suit future needs*'. Having a separate criterion for 'accessibility' was therefore considered to have been superfluous.

4.4.2. Walkability

Walkability is an important element of sustainable urban design that contributes to the development of sustainable communities (Glanz, Nam and Tang, 2012). Mixed-use neighbourhoods that are of higher neighbourhood density and with good street connectivity tend to be positively related to the higher incidence of moderate levels of physical activity, primarily walking (Frank *et al*., 2005). Reduction of walking due to the reliance on private car is now increasingly being acknowledged as the primary cause of the obesity epidemic in the UK (Davis, Caroline and Fergusson, 2007). In addition to the health benefits, neighbourhood design features that facilitate walking are also beneficial in terms of lowering traffic congestion, air pollution, crime rates and increasing social capital (Barton, Grant and Guise, 2010).

Within the context of this framework, the walkability element is addressed by multiple criteria: Namely, '*access to high quality open green space*' and '*proximity of amenities*' (both of which focus on walking as the primary means of accessibility) as well as '*higher residential density*', which is a key feature of a walkable neighbourhood. '*Design that contributes to perception of safety*' and '*features for social interaction*' are two additional features that would likely contribute to neighbourhood walkability.

4.4.3. Affordability and tenure

Affordable housing and mixed-tenure developments are regarded as important components of sustainable housing and communities (ODPM, 2005b; Winston, 2010). Promotion of mixed tenure neighbourhoods is seen as a method that can contribute to countering the high levels of social deprivation and environmental, social and economic problems often associated with single-tenure social housing areas (Sautkina, Bond and Kearns, 2012). The NPPF regards provision of mixed tenure and affordable housing as a condition for the widening of opportunities for home ownership and creation of *"sustainable, inclusive and mixed communities"* (DCLG, 2012a; p.13).

The relationship between housing tenure and health has also been investigated by a number of researchers leading to evidence for a positive relationship between home ownership and health (e.g. Rohe and Lindblad 2013, Windle, Burholt and Edwards, 2006, Macyntire et al, 2003). Rohe and Lindblad (2013) provide a summary of the literature regarding the possible explanations for the relationship between tenure and health, which include that homeowners;

- are able to afford better quality health care due to wealth creation afforded by home ownership,
- tend to stay in their homes longer than renters leading to more stable communities, which lead to better educational performance of children, greater levels of social capital and public participation,
- tend to enjoy better quality of housing and neighbourhood than renters,
- typically have greater control over their homes, which contributes to a greater sense of ontological security, social status and personal accomplishment.

In addition to the observed links between home ownership and health and well-being, providing a mix of housing types and tenures is considered as essential in order to meet the needs of different households (Barton, Grant and Guise, 2010; DCLG, 2012a). In 1990, Town and Country Planning Act introduced a mechanism enabling the use of planning agreements to facilitate the provision of affordable housing by private sector developers (Monk et al 2006). This legal mechanism, known as 'Section 106 agreements', allows local authorities to negotiate with developers to provide affordable housing as part of granting of planning permission (Madeddu, 2012). Although not without criticism, Section 106 agreements have been responsible for a significant proportion of affordable housing provision since its introduction (Monk et al 2006).

While their importance to sustainable communities and health and well-being are recognised, the issues of tenure and affordable housing were not included in this framework. This is because the intended focus of the framework is on the design features of housing and neighbourhoods that are strongly dependent on housing providers, rather than on financial and legal constructs shaped by political and market factors.

4.4.4. Lifetime Neighbourhood

The idea of the 'lifetime neighbourhood' can be viewed as an extension of the adaptable homes concept, and is particularly pertinent to the sustainability of communities given the increasing proportion of older people in the population of the UK and other developed countries. Bevan and Croucher, who were commissioned in 2011 by the DCLG to explore and develop this concept, identified the following key components that define a lifetime neighbourhood:

1. Resident empowerment; structures are in place that support residents to plan, develop and evaluate features of their neighbourhoods.
2. Access; residents are enabled to access and engage with other people and amenities in the neighbourhood and beyond.
3. Services and amenities; the mixed use neighbourhoods offer a range of accessible amenities and services.
4. Built and natural environments; environments that offer safe access to amenities and services, contain open spaces that promote social interaction, and allow access to greenspace.
5. Social networks/well-being; available opportunities and activities for people to interact and reflect the needs of different age, ethnic and cultural groups.
6. Housing; a range of affordable homes whose design is able to provide for the needs of residents throughout different stages of life.

The concept of lifetime neighbourhoods is important to sustainable housing, but it was not included in the above framework as it was felt that the key features defining such neighbourhoods are largely covered by other criteria. Thus, resident empowerment is largely addressed by *'Resident engagement, participation and opportunity to manage living environment'*; access, services and amenities by *'Proximity to amenities'*; built and natural environments by features including safe design, and proximity to greenspace and amenities; social networks/well-being by a number of features including '*Features for social interaction'*; and housing by '*Adaptability of dwelling'*

4.5. Chapter summary

- Building on the findings of chapters 2 and 3, this chapter develops a framework for sustainable housing with an emphasis on housing-users' health and well-being.

- 28 housing characteristics were identified using existing literature as components of this framework and range from direct impacts on health and well-being through to indirect and global effects.

Chapter 5: Methodology

5.1. Introduction

This chapter describes the overall research approach and methods chosen to address the research question. Creswell (2014) regards the 'research approach' as a strategy for research that ranges from broad assumptions shaped by philosophical worldviews or paradigms, through to "*detailed methods of data collection, analysis, and interpretation*" (p. 3). Following this line of thought, the chapter begins with the some of the major philosophical paradigms that shape research, and explains why this study is underpinned by the pragmatic research paradigm. It then moves on to discuss the overall research approach followed by the more detailed research methods.

5.2. Research paradigm

The widely held set of beliefs that guide a particular field within science studies is commonly referred to as a 'paradigm' (Morgan, 2007). Creswell (2014) uses the term 'worldview', while others have referred to it as an 'epistemological stance' or simply the shared beliefs within a particular research field' (as reviewed in Morgan, 2007). As the research paradigm is a guide for action, and therefore choice of methods, it is worthwhile to consider the nature of the main paradigms in order to provide a broad context for the research strategy chosen for this study.

The main research paradigms that currently dominate the approach to social research can be grouped into four philosophies; post-positivism, social constructivism, transformative approach and pragmatism (Creswell, 2014). Post-positivism is the theoretical view that has evolved from positivism – a research paradigm that emphasises the importance and relevance of applying natural sciences' methods of enquiry to social science, and hence seeks to *explain* human behaviour (Bryman, 2012). Post-positivism attempts to address some of the criticisms directed at positivism, namely by acknowledging uncertainties and that it is impossible to establish the absolute truth although it is possible to refute false theories (Bhattacherjee, 2012). Nevertheless, it maintains the positivist emphasis on adopting natural science approaches and focusing on *"careful observation and measurement of the objective reality that exists "out there" in the world*" (Creswell, 2014, p7).

Social constructivism, also known as interpretivism, focuses on the subjective meanings that individuals develop about the world (Creswell, 2014). This philosophical worldview sees reality as a social construct, thereby regarding the notion of an 'objective' reality as something that cannot be directly accessible to researchers (Robson, 2011). The third paradigm, the transformative approach is one that arose in the 1980 and 1990s from researchers "*who felt that the post-positivist assumptions imposed structural laws and theories that did not fit marginalized individuals in our society or issues of power and social justice, discrimination, and oppression that needed to be addressed*" (Creswell, 2014; p. 9). As such, it includes researcher groups such as feminists, ethnic minorities, homosexuals and people with disabilities (*ibid*). Lastly, the pragmatist philosophy focuses on the problem itself and on solutions most suited for addressing the problem (Robson, 2011). It is therefore "*not committed to any one system of philosophy and reality*" (Creswell, 2014; p11).

5.2.1. Pragmatism as the guiding research paradigm for this study

The *level of importance* that stakeholders attach to particular housing design features lies at the core of this study together with what features are being provided. Therefore, it cannot be approached entirely by post-positivist ideals as it does not seek to explain human behaviour nor to measure some 'objective reality'. The same research design may be applied elsewhere yielding different results from this study, yet this would not mean that results here or in other studies are invalid or faulty: Instead, the study recognises that perceptions of importance will be highly subjective, influenced by stakeholders' personal views and ethos, which will in turn be shaped by external forces such as cultural, demographic and political factors. However, despite this recognition, neither does it subscribe to the constructivist view, because the nature of the problem necessitates a broader approach: The social constructivist approach typically focuses on the individual (Robson, 2011). However, as this study is carried out in the broader context of enhancing sustainability of the built environment, the focus needs to be *beyond* the individual. Thus, the social 'unit of measure' deemed appropriate for this research is a group of stakeholders within a regional demarcation rather than the individual.

This study therefore adopts a largely pragmatic worldview in its research approach. This is because it focuses entirely on the research question, seeking to provide answers, insights and models that can contribute to the development of a solution to address the research problem. It not only acknowledges the inherent subjectivity, complexity and different views of opinion inherent in the research problem, but specifically chooses methods able to cope with these factors. The study approach recognises that the problem is embedded in the real world, and will be shaped by social, historical, political and cultural contexts (Creswell, 2014).

5.3. Research approach

Social research can adopt quantitative, qualitative or mixed methods approach (Creswell, 2014; Robson, 2011; de Vaus, 2002; Bryman, 2012). The post-positivist research paradigm has been typically linked with quantitative methods, while social constructivist with that of qualitative approaches. Quantitative research tends to rely largely on numerical data, using statistical manipulation to draw conclusions and is often associated more with the deductive, or theory-testing, approach. Such deductive methods typically begin with a theory and utilise techniques to check whether the observations (empirical data) behave in a way predicted by that theory. Qualitative methods on the other hand tend to focus more on meaning, the subjectivity of human values and contexts. Such methods are largely based on non-numerical forms of data collection and are more often aligned with the inductive, or theory-building, process, whereby empirical observation often acts as a starting point from which theory can be developed.

While deductive and inductive approaches are different, de Vaus (2002) maintains that the two approaches are "*not alternative ways of arriving at good theories, but represent two stages with two starting points*" (p.9). This is illustrated by the logic of the research process developed by de Vaus (2001; 2002) and shown in figure 11, which also indicates which chapters are linked to which stages of this process.

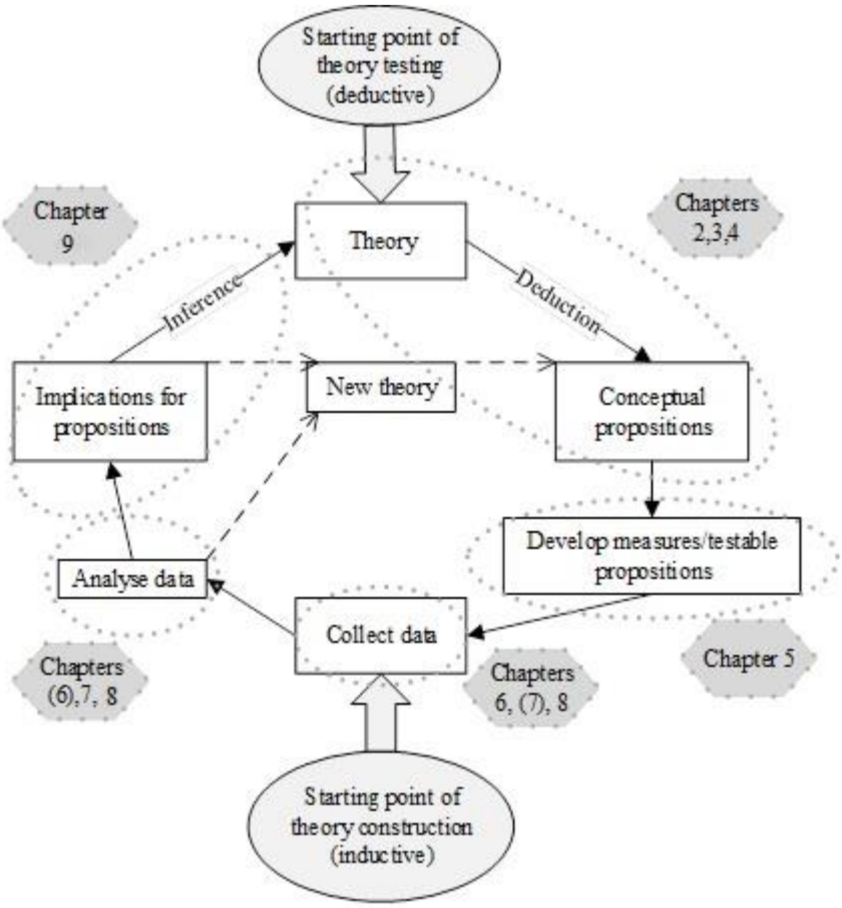

Figure 11: The logic of the research process showing the contribution of deductive and inductive approaches (from de Vaus, 2001; 2002). The dotted eclipses around the different stages are used to indicate which chapters these stages are linked to (Source of annotations: self-study).

As this study adopts a pragmatic approach, methods were selected based on what works best for the particular research problem (Brannen, 2005; Robson, 2011). Thus, while the methods chosen to address the research problem are more quantitative in nature this choice was not driven by post-positivist philosophy, rather by the pragmatic stance, which necessitates the use of most appropriate methods to address the research question.

5.4. Research Design

Design of the research methodology was guided by the objectives of the research derived from the research question (see chapter 1). The empirical part of the overall study consists of three phases – a detailed description of these is provided in the sections below and an overview is shown schematically by figure 12.

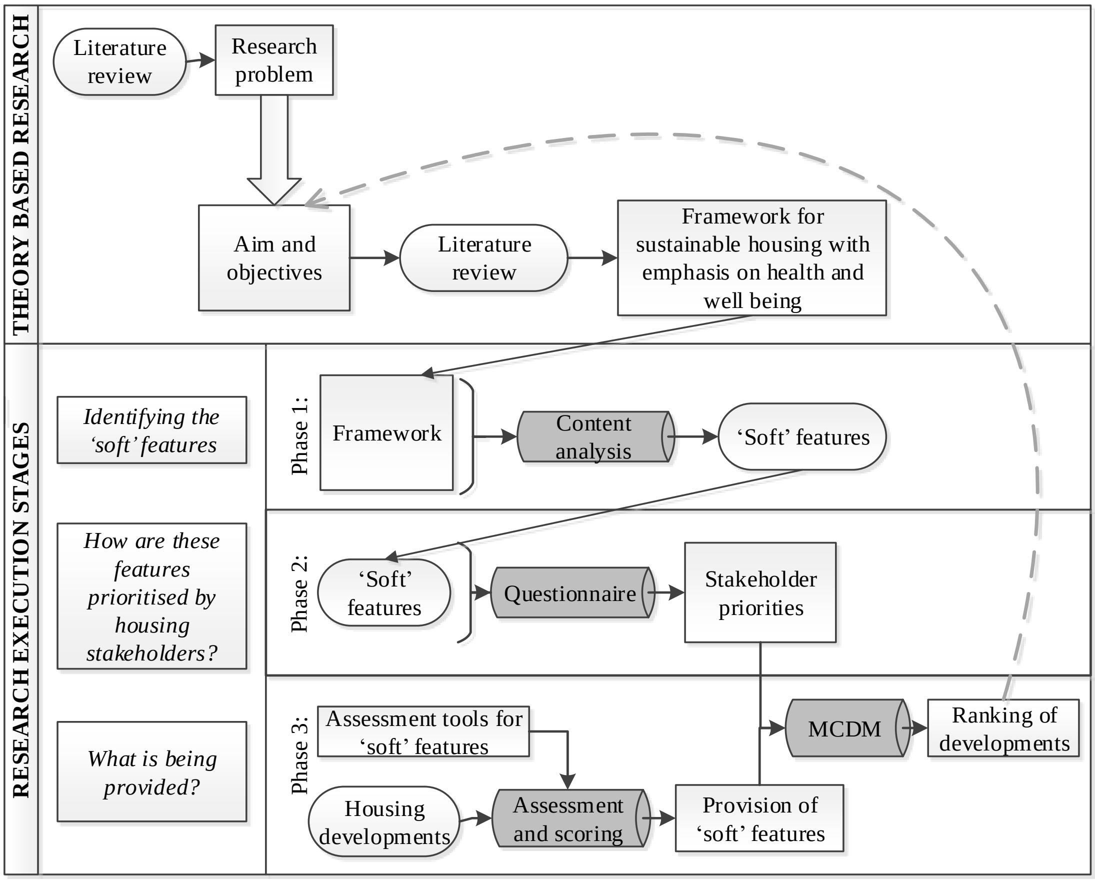

Figure 12: Overview of the research design (Source: self-study).

5.5. Literature review

While relevant literature was consulted and taken into account throughout the study in order to enhance the researcher's knowledge, refine the research question as well as analyse and interpret the data, a critical review of literature was carried out during the initial stage of the research. According to Saunders, Lewis and Thornhill (2012), critical review of the literature is a process through which relevant published work is critically analysed to assess what is known and what is unknown about the particular research topic. To achieve this, the authors recommend maintaining a focus on the research question and ask how far does the existing body of research goes in answering it.

As discussed in the introductory chapter, the focus of this study are the 'soft' features of sustainable and healthy housing design and the level of importance attached to these by key housing stakeholders. Given the topics of the research questions, the literature review was conducted in three stages that subsequently evolved into three chapters

(chapters 2, 3 and 4). The focus of the first stage was on sustainable housing, and in particular, the current understandings of the term in political, academic and philosophical contexts: How do these affect and explain the current trends and practices in building sustainable housing today? The second stage sought to explore the importance of housing to health and well-being. There is a vast body of research on the topic of healthy housing, and the literature review at this stage aimed to gain an understanding of the current state of knowledge about the link and delve deeper beyond the more obvious risks such as the effects of poor indoor air quality, dampness and cold on physical health.

It should be noted at this stage that while holistic discussions of sustainability traditionally involve environmental, social and economic aspects, the economics of housing are not specifically covered in the literature review. This is because the focus of the thesis is on the *design* features of sustainable housing with a particular regard for health and well-being. Economics, affordability and housing markets change throughout the years, however the design of housing and its immediate neighbourhood remain largely the same (or at least the feasibility or extent of any changes are determined by those initial designs), affecting residents' relationship with their homes, communities, health and well-being for decades and even centuries to come. While the extent to which economic theory and current economic conditions influence the design of housing would be an interesting thesis on its own, the topic is beyond the scope of this study. While economic aspects are touched upon in the literature review chapters in terms of housing longevity (section 2.2.2.), the financial capacities of housing providers (section 2.9) as well as tenure (section 4.4.3), the focus is on the 'softer', non-technological design elements and on importance attached to these by housing stakeholders.

The two stages described above were carried out more or less simultaneously as this allowed a more critical review of the 'sustainable housing' and 'healthy housing' topics. For instance, to what extent do health and well-being aspects feature in the current understanding and implementation of sustainable housing? And how does the holistic concept of sustainable housing fit into the broad field of housing and health? These two stages helped to focus and further refine the research question as well as inform the methodology strategy. The third stage of the literature review was the progression of the first two stages. Its aim was to present the necessary components of sustainable housing but with an emphasis on health and well-being.

In terms of the actual method of the literature review, the first stage of the process involved searching relevant databases (e.g. ScienceDirect, JSTOR) for peer-reviewed articles using search terms such as ‘sustainable housing’ and ‘healthy housing’ and their variations. Subsequently, the search was expanded by using the reference lists of relevant articles to access more thematically specific publications. Peer-reviewed articles and books were also supplemented by research and statement publications issued by Government departments, charities, think-tanks as well as non-governmental and inter-governmental organisations.

5.6. Phase 1: Content analysis of sustainable housing standards

The aim of this phase was to evaluate the extent to which different sustainable and healthy housing features are being acknowledged by the construction industry’s best practice, thereby identifying the under-represented aspects of sustainable housing. Content analysis - a form of documentary analysis was utilised to achieve this.

Content analysis has been defined as a “*research technique for making replicable and valid inference from texts (or other meaningful matter) to the contexts of their use”* (Krippendorff, 2004; p18). It is regarded as an unobtrusive and objective form of research (Bryman, 2012), which is an advantage because unlike interviews or surveys, the subject material is produced for a different purpose (i.e. not research) and is therefore not influenced by the research process itself (Robson, 2011). Another advantage is that the data is in permanent form and can therefore be reanalysed for reliability (*ibid*). However, content analysis relies on the quality of the documents, and so it is important that source material is authentic, credible and representative (Bryman, 2012).

The adopted method for this phase closely follows the steps laid out for content analysis by Robson (2011);

1. Start with the research question
2. Decide on a sampling strategy
3. Define the recording unit
4. Construct categories for analysis.
5. Test the coding on samples of text and assess reliability
6. Carry out the analysis.

5.6.1. Research question linked to Phase 1 (the content analysis)

The research question for this particular phase of methodology can be formulated thus:

> *Using a holistic understanding of sustainable housing, to what extent are each of the sustainable housing features addressed by current industry best practice?*

5.6.2. Sampling strategy of sustainable housing standards

In order for the sustainable housing standards to broadly represent industry best practice, the sampling frame for this stage had to be expanded beyond the UK to include standards used abroad. Standards were selected according to three criteria: Firstly, the climatic conditions of the standard's country of origin was to be largely similar (even if only seasonally or regionally) to that of the UK. Secondly, priority was given to standards that cover domestic housing, thus BREEAM Domestic Refurbishment version was chosen instead of BREEAM Multi-residential, as the latter applies to non-domestic multi-occupancies such as student halls, sheltered housing and care homes. Finally, standards chosen where largely those that are widely implemented and adapted in countries beyond that of the authoring state (e.g. BREEAM, SB Tool, Green Star, LEED). A more detailed description of each standard is provided in section 6.2.

Eight sustainable housing standards were chosen for review (table 12). Initially, an Internet search was carried out to identify standards in existence. A number of issues had to be considered when selecting a sample of such standards for review. Firstly, care had to be taken over the terminology used because some standards refer to 'environment', 'eco' or 'green' in their titles, but in actuality focus on wider issues than just the environment. Conversely, while some standards may be referred to as a 'sustainable housing' standard, their focus may only be on the environmental sustainability. Thus, energy performance only standards such as the Passivhaus were excluded from the review as they were not designed to encompass the wider, overarching housing sustainability. Secondly, many national standards stem from a single standard (e.g. BREEAM) that has been adapted to the country, and so care had to be taken to avoid multiplicity. Lastly, an attempt was made to investigate standards from non-English speaking countries as well, however, unfortunately this was somewhat restricted by limited resources of the study.

No:	Standard:	Country:	Type of housing:	Year version used:
1	CSH	UK	Any	2010
2	BREEAM	UK	Domestic	2012
3	R-2000	Canada	Domestic	2012
4	HQE	France	Domestic	2012
5	CASBEE	Japan	Residential (detached)	2007
6	SB Tool	International	Any	2012
7	Greenstar	Australia	Domestic	2011
8	LEED	USA	Domestic	2013

Table 12: Sample of sustainable housing standards used for content analysis.

5.6.3. The recording unit and categories for analysis

Perhaps the most commonly used recording unit in content analysis is an individual word, but depending on source material this can also be number of stories, pictures, headings, etc. (Robson, 2011). In this study, the recording unit was the presence of a housing characteristic or feature. Because different standards go into different level of detail and description, counting the number of words mentioned would not have been a consistently accurate reflection of the depth to which the particular topic was dealt with by each the standard. Content analysis requires the construction of categories that are preferably exhaustive and mutually exclusive (Robson, 2011). The categories used in this case were the 28 sustainable housing features developed in chapter 4.

5.6.4. Carrying out the analysis

The stage of testing the coding (step *v*) listed by Robson (2011) was deemed not applicable to this study, because the coding categories, in this case sustainable housing features, were developed prior to the selection of the standards. In other words, the purpose of this content analysis was to establish how well the standards fit the framework developed in chapter 4, rather than develop categories from the standards.

For the analysis itself (step *vi*), each standard was firstly carefully read and analysed for the presence or absence of each of the 28 features. As mentioned above, the aim of the content analysis was to ascertain whether a feature was addressed by the standard and so it was important to identify whether the *concept* (of the feature) was present rather than the number of times key words might have been mentioned (as is often the practise in content analyses). At times it was therefore necessary to take into account that different wordings that might be used to describe a particular feature: For example some standards described ‘noise prevention’ (feature nr 3) as ‘quietness’ or ‘acoustic levels’ – in such cases, these alternative descriptions are explained under each feature in the following chapter 6.

If a feature was present it was marked as a 'yes' and if it was not present as a 'no' in table 17 in chapter 6. The *extent* to which each feature was present was not taken into account simply because the style of the 8 standards differed, that is, some standards used brief descriptions of criteria (e.g. CSH, R-2000) while some described and justified criteria in much greater detail (e.g. CASBEE). It would have therefore not been an accurate reflection of the importance or degree to which a feature was taken into account by a particular standard.

A detailed account of which standards the 28 sustainable housing features were present in is presented in chapter 6, while full outputs of the analysis (i.e. the relevant sections of these standards) can be found in Appendix I.

5.7. Phase 2: Opinion survey of housing stakeholders

5.7.1. Research question linked to Phase 2

The research question for the second phase of methodology has two parts:

(i) *What level of importance do housing-users and housing providers attach to each of the 11 soft criteria, and;*

(ii) *How does the rating of importance differ between the groups?*

The overall aim of this phase was to establish the level of importance that different housing stakeholders attach to each of the 11 'soft' features of housing design identified in the content analysis (Phase 1). To address the first part of the research question, a questionnaire-based approach was deemed as most appropriate, particularly given the time and budgetary restraints of the study. The statistical analysis of this data would then enable the second part of the research question to be addressed.

5.7.2. Survey development

5.7.2.1. Sample selection

The different strategies used for sample selection can be categorised into probability and non-probability sampling. Probability sampling is based on a random selection where each member of the population has an equal chance of being selected – such sampling is commonly preferred because it is more likely to be representative of a population. A sampling frame that is the list of the whole population is therefore necessary for the production of a simple random sample (Robson, 2011).

However, this type of selection is not always feasible (e.g. where sampling frames are unavailable or resources are lacking), or indeed, necessary (e.g. when piloting, developing scales or hypothesis generating) (de Vaus 2002). In these cases, non-probability sampling can be utilised, which means that some people have a greater chance of being selected than others. It has been noted that the incidence of such sampling in social science is increasing (Punch 2005).

5.7.2.2. Sampling plan

The geographical focus of the survey was West Midlands (WM) with parts of North West (NW) regions of England. More specifically the focus was on the north of WM (Staffordshire) and south of NW (Cheshire, Liverpool, south Manchester), however it was expected that responses would ‘spill over’ into wider WM and NW. There were two major reasons for this geographical focus: first of all, it was desired to keep the cultural, socioeconomic and any historical factors that might influence preferences as constant as possible. The second reason was that in the later phase 3, housing case studies were to be selected from a preferably single or at least neighbouring local authority areas (see 5.8.3). In this case, this was to be Staffordshire and/or Cheshire area due to the location of the author’s work place.

Housing-users group:

Due to resource constrains, it was not feasible to obtain a full sampling frame for the housing-user group as this would entail a list of the entire population of the above mentioned geographical areas. Instead, the approach was based on purposive sampling utilising two databases. Desk-based research was used to collate a list of 44 Resident and Community Associations within WM and southern counties of NW. It is recognised that such associations will likely be comprised of individuals with strong interests in their housing and neighbourhood environments. This list was supplemented by a second list of 116 contacts involving staff from a West Midlands based University as well as social media (LinkedIn) contacts. Individuals were then invited to fill in the survey and forward the email with the link to other members of associations, or contacts.

Housing Associations:

Sample frame and contact database of housing associations was developed utilising Associations’ websites, publically available databases and housing providers’ directories such as HousingNet. The list was screened to select organisations operating primarily in the WM and southern NW areas, which resulted in approximately 80 organisations. The survey invitation was aimed at high level management or executive level staff such as such as chief executives, management directors and directors of housing.

Local Authorities:

A similar approach was utilised to develop the contact list for local authorities. Town and Parish Councils were excluded as their authority remit does not cover housing issues. Just over 50 local authorities were identified in the geographical area. Council websites were searched for individuals at management or strategic levels within housing departments or councillors and portfolio holders for housing.

Developers:

The membership list of the Home Builders Federation was screened for developers operating in the relevant geographical regions, which included the national house builders as well as local and regional companies. Sample frame and contact database was then developed utilising primarily companies' websites but also the professional networking site LinkedIn.

5.7.2.3. Survey design

As mentioned above, the aim of the survey was to elucidate the level of importance, or value, that housing stakeholders attach to each of the 'soft' features of sustainable and healthy housing. Values can be defined as 'standards of desirability' (cited in Alwin and Krosnick, 1985) and are commonly measured in surveys by asking respondents to order (or rank) or rate a given set of alternatives (*ibid*). However, both ranking and rating techniques have a number of drawbacks that prevent one becoming preferable over the other (Alwin and Krosnick 1985; Ovadia 2004). Ranking, for instance, can be burdensome for some respondents as it requires greater cognitive effort and is often more time consuming. Rating on the other hand is generally a simpler technique to administer and can be more user-friendly. However the quality of data might be lower because respondents tend to differentiate less between the values (particularly when criteria offered are positive or socially desirable features), and as a result may 'end-pile' their scoring toward the higher end of the scale (McCarty and Shrum, 2000)

To overcome this dilemma, Ovadia (2004) suggests designing surveys that employ both methods. The additional time and financial resources that would normally be required to implement this in a paper-based survey would often be prohibitive for this solution. However, using an online survey largely overcomes these restrictions. Bristol Online Surveys programme was therefore used to develop both rating and ranking questions for exploring the values attached to the 11 'soft' features by different stakeholders.

Rating questions - A 5-point summated rating (Likert) scale was used to create a measure of the level of importance that respondents attached to each of the criteria (where 1 represented '*not at all important'* and 5 - *'extremely important'*). This approach has been employed in previous built environment studies measuring subjective importance (e.g. HCA, 2014b). More complex forms scoring methods have been found to offer no additional advantages (Oppenheim, 1992).

Ranking questions – Respondents were asked how they would prioritise the soft criteria and instructed to rank five most important and five least important features from a dropdown list of the 11 features. Given the greater cognitive effort required for ranking questions (Ovadia, 2004) and to minimise the risk of non-completion, the selection was limited to only five features (as opposed asking to rank all 11 features at once) per 'set' of importance. The software allows for ties, which is important in order to avoid respondents being forced to artificially choose between criteria they may find of equal importance. This section of the questionnaire, allowed respondents to indicate the relative as opposed to the absolute importance of the different features (de Vaus, 2002).

Current provision questions - For the housing-users survey, in addition to the rating and ranking questions, a third set of questions was developed to establish whether their current home and immediate neighbourhood provide for each of the 11 features. Respondents were asked to select one of the following answers: *Yes/ Only partially/ No, but this would be important to me/ No, this is unimportant to me/ Don't know/ Not applicable.*

For the housing providers, the question asked to what extent a particular feature was taken into account by their organisation. The answers were thus adjusted to the following options:

Housing Associations:	Local Authorities:	Developers:
• *Completely taken into account as part of our design brief*	• *Completely taken into account as part of our strategy and/or design brief*	• *Always and completely taken into account*
• *Taken into account, but as good practice, not part of the design brief*	• *Taken into account, but as good practice and not part of the strategy/design brief*	• *Usually taken into account*
• *Partially or occasionally taken into account*	• *Partially or occasionally taken into account*	• *Partially or occasionally taken into account*
• *Not taken into account*	• *Not taken into account*	• *Not taken into account*
• *Don't know*	• *Don't know*	• *Don't know*
• *Not applicable*	• *Not applicable*	• *Not applicable*

Together, the three sets of questions provided a form of triangulation whereby respondents' preferences could be gauged through three different types of query. For the housing providers, this third set of questions was adjusted to investigate the extent to which their organisation provided for these criteria.

It was essential that the core of the survey (rating and ranking questions) was kept identical for all stakeholders. The demographics questions (beyond age and gender) were adjusted accordingly. Thus, the housing-users group was asked about the type of property they live in and their household, while housing providers were asked about their organisation's housing stock as well as their professional role. Questionnaires for all of the stakeholder groups can be found in Appendix II.

5.7.2.4. Survey Piloting

The first survey developed targeted the housing-users. For the pilot survey, an additional page was included at the end of the questionnaire asking respondents to provide feedback on the clarity of aim, questions and response options, as well as the length of time it took them to complete the survey. Participants were also asked to leave any other comments regarding the survey. This pilot was sent to 10 university staff members who were asked to pass it on to their contacts and a total of 13 responses were received. The feedback, comments and associated adjustments made to the final survey are summarised in table 13.

Nº	Question:	Feedback:	Reason for '*no*':	Survey adjustment:
1	Was the purpose of survey clearly explained in the introduction?	Yes: 84.6% No: 15.4%	Not having read the introduction	None
2	Did you find the wording of the questions clear?	Yes: 77.0% No: 23.1%	Ranking questions reported as difficult	Ranking questions were made optional.
3	Did you find explanations of the housing features clear?	Yes: 100% No: 0%	n/a	n/a
4	How long did the survey question take you to complete?	Average: 9 minutes	n/a	n/a

Table 13: Feedback for the questionnaire from the pilot.

Overall, respondents to the pilot found the survey straightforward and easy to complete. In addition to few minor corrections to the wording, the main adjustment was to change the ranking questions into optional as opposed to required questions. While this was not displayed in the questionnaire (in order to encourage responses), participants were able to move to the next question without being forced to rank the criteria.

5.7.2.5. Ethical considerations

Full ethical approval was obtained for carrying out the survey. The respondents were informed of the aim and purpose of the research, and their consent was obtained by informing them that participation is voluntary and they can withdraw from completing the survey at any time. For the housing-users survey, confidentiality and anonymity was ensured as individuals were not asked for their name or full address. Housing providers were asked for the name of the organisation, but this question was marked as optional.

5.7.3. Survey administration and data collection

All stakeholders were invited to fill in the survey via a personalised cover email which contained the URL link for the relevant group survey. For the housing providers, up to three reminder emails were sent (one every four weeks). The survey data was automatically coded by the survey programme, and was imported into IBM SPSS 21 for subsequent analysis. Data collection using the survey took place from August 2013 to February 2014.

5.7.4. Data analysis

The type of statistical methods required to analyse a dataset largely depend on the type of data (i.e. nominal, ordinal, interval or ratio) and on whether the data follow a normal (‘bell-shape’) distribution:

5.7.4.1. Type of data

Data can generally be categorised into four levels: *Nominal* data consist of categories that will have no mathematical relationship between each other (e.g. gender). The categories may be numerically coded, but the extent of statistical manipulation will be limited to basic descriptive statistics. At the next level, *ordinal* data allow categories to be ordered or ranked according to a scale or continuum (e.g. Likert scale). However, with this level of data, one cannot assume that intervals between data points are equal.

At the third level of measurement, *interval* data can be ordered together with a specified level of difference between values (e.g temperature, date). Lastly, *ratio* data, in addition to interval data qualities, will also have a meaningful zero value (e.g. length).

The type of statistical manipulations that can be meaningfully performed will in part depend on these categories. For example, only frequencies can be calculated for nominal data while calculating central tendencies (such as the mean and median) would make no sense. However, while a wider range of statistical tests could be performed on interval and ratio data, obtaining such data would not always be justified given the additional resources, and effort on behalf of the respondents, required for its collection.

The questionnaire administered in this study consisted of nominal and ordinal data. The majority of demographics data was nominal, which meant that analysis was be limited to frequency calculations. However, the core rating and ranking questions yielded ordinal data, and measures of central tendency (mean and median) were used to rank the criteria in terms of importance according to the stakeholders. This implies interpreting the rating scale as having interval qualities. While the controversy of using such techniques on ordinal data is recognised (e.g. discussions by Jamieson, 2004; Knapp, 1990), it is a useful and necessary simplification of rating scores, and an approach that is commonly used in interpreting preference surveys (Tveit, 2009).

5.7.4.2. Assessing normality of data

It is important to determine whether the data follow a normal, i.e. a symmetrical, 'bell-shaped' curve as this will indicate whether parametric or non-parametric tests should be used. The former are generally based on the assumption that data is normally distributed. So if data does not follow normal distribution, non-parametric equivalents should be used, which make no assumptions about the normality of distribution.

Normality can be assessed either through visual or numerical methods. Visual method involves establishing the skewness and kurtosis values of the curve obtained after the data is graphed. Numerical methods, such as the Kolmogorov-Smirnov (K-S) test or Shapiro-Wilk test, measure whether the distribution significantly differs from a normal distribution. These tests compare the sample data with that of a normally distributed set with the same mean and standard deviation. If the test value is found significant at say 5% (p<0.05) then the distribution is considered to be significantly different from a normal distribution. Conversely, if the value is non-significant (p>0.05) then the sample data is not significantly different and can be considered as normally distributed.

The K-S test was carried out for each stakeholder group using SPSS and the summary of the results, shown in table 14, shows the K-S test statistic (D), degrees of freedom (df) and significance. The significance values for all variables is well below 0.05 (*Sig* <0.05), indicating that the distribution of scores in all stakeholder samples significantly deviates from normal distribution. As normal distribution cannot be assumed, non-parametric tests must be used.

	Kolmogorov-Smirnov test[a]											
	Housing-users			Housing Associations			Local Authorities			Developers		
	D	df	Sig.	D	df	Sig.	D	df	Sig.	D	df	Sig.
C1	.338	123	.000	.335	48	.000	.294	34	.000	.389	30	.000
C2	.314	123	.000	.327	48	.000	.277	34	.000	.250	30	.000
C3	.192	123	.000	.246	48	.000	.314	34	.000	.266	30	.000
C4	.176	123	.000	.287	48	.000	.226	34	.000	.220	30	.001
C5	.202	123	.000	.240	48	.000	.235	34	.000	.250	30	.000
C6	.231	123	.000	.276	48	.000	.255	34	.000	.230	30	.000
C7	.251	123	.000	.236	48	.000	.251	34	.000	.303	30	.000
C8	.184	123	.000	.196	48	.000	.239	34	.000	.224	30	.001
C9	.217	123	.000	.261	48	.000	.269	34	.000	.247	30	.000
C10	.199	123	.000	.223	48	.000	.222	34	.000	.235	30	.000
C11	.191	123	.000	.243	48	.000	.293	34	.000	.278	30	.000

Table 14: K-S test for normality. a.Lilliefors Significance Correction.

It is important to note at this stage, that while the K-S test may be a more objective and reliable means of judging normality, caution should be exercised when interpreting results because such tests are very sensitive to sample size (as is the Shapiro-Wilk test) (Field, 2013). In large samples, the test can lead to a significant result even for small deviations from normal distribution, while for small samples the significance test may not have the power to detect large deviations from normality.

5.7.4.3. Non-parametric tests

The need to use non-parametric tests was established through the K-S test, which indicated a non-normal distribution of scores among all stakeholder groups. Such tests are often described as being less statistically powerful (i.e. sensitive) than their parametric equivalents as they overcome the problem of non-normal distribution (as well as any outliers in the date) by ranking scores and thereby losing some of the information. As a result, non-parametric tests may fail to detect differences that do exist (i.e. more prone to Type I error). Nevertheless, they are highly valuable as they allow analysis of data that does not meet the stringent requirements of normal distribution required by the latter. In addition, non-parametric tests are generally more appropriate where data are ordinal, such as in studies using Likert measurement scales (Nanna and Sawilowsky, 1998) – as is the case in this study.

Non-parametric tests such as Mann-Whitney and Kruskal-Wallis (discussed below) work by ranking data while ignoring the group from which the rater came from. This is based on the principle that if there were no difference between groups there would be a similar number of low and high ranks in each group (Field, 2013). Scores are therefore ranked from lowest to highest, the lowest score is then assigned a score of 1, the next higher score a rank of 2, etc. After application of the relevant test, inspection of rank sums will indicate which group gave higher or lower scores.

The choice of non-parametric test was guided by the second research question that the survey sought to answer, namely; *Does the rating of importance differ between the stakeholder groups? (section 5.7.1)*

The non-parametric tests utilised to explore these questions were as follows:

Mann-Whitney *U*- test is used to test for differences between two independent groups, in this case housing-users and housing providers. It is functionally similar to the Wilcoxon rank-sum test and is the non-parametric equivalent to the *t*-test for independent samples. However, whereas independent t-test compares means, Mann-Whitney compares the medians of the two groups.

The strategy behind Mann-Whitney U test is to firstly combine the two samples and rank order the values. The aim is then to determine whether the scores from the two samples are randomly distributed in the rank ordering or if they cluster at the opposite ends. A random distribution indicates no difference between the two groups, while a clustering at the opposite ends indicates that there is a difference (Corder and Foreman, 2009).

Kruskal- Wallis *H*-test is used to compare three or more independent groups, in this case the three housing providers; housing associations, local authorities, and developers. Its parametric equivalent is the ANOVA (one-way analysis of variance), and as with Mann-Whitney, instead of comparing means, it compares medians by ranking the score data. When the test leads to a statistically significant result, it indicates that at least one group is different from the others. However, it does not indicate which group(s) differ and appropriate follow up analysis (post-hoc test) of the significant results is necessary.

A common approach to follow up analysis of the significant results is to carry out a pairwise comparison using the Mann-Whitney U test (Corder and Foreman, 2009; Pallant, 2010). However, carrying out numerous tests on the same data inflates the chance that type I error will be made to above the critical 5%, and the null hypothesis (H_0) may therefore be erroneously rejected when it should not be (Field, 2013). To overcome this, the initial level of significance (α) needs to be adjusted to ensure that the chance of making Type I error remains below 5% - a process known as the Bonferroni procedure (Corder and Foreman, 2009; Pallant, 2010; Field, 2013).

The Bonferroni procedure essentially divides the level of significance (in this case α=0.05) by the number of tests that need to be carried out, and the adjusted, more stringent, α level is used to establish significance in the pairwise comparison. The following formula can be used to calculate the number of comparisons required:

$$= \frac{k(k-1)}{2} \qquad (1)$$

Where k is the number of groups being compared. In this case, the number of comparisons that would need to be made is 3, and therefore the α-level using the Bonferroni adjustment would be 0.05/3 = 0.0167.

5.7.4.4. Measures of reliability

5.7.4.4.1. Internal consistency

When considering the reliability of any questionnaire based study, it is important to take into account the internal consistency of the scale that is used. In other words, it is important to ensure that the scale being used is measuring only the factor or area of interest – in this case level of importance. The most commonly used test to measure internal reliability of a scale, particularly Likert-type questions, is Cronbach's α (Bryman, 2012). This coefficient of reliability is essentially used to measure how consistently the scores vary, i.e. estimating the proportion of systematic or consistent variance in a set of scores.

The *α* values range from 1 (representing perfect internal consistency) and 0 (representing no internal consistency), and as a rule of thumb, a value of 0.7 (and above) is generally regarded as denoting an acceptable level of internal reliability (Nunnally (1978) in Pallant, 2010; Field 2013). However, care should be taken when interpreting Cronbach's *α* because the value is highly dependent on the number of items in a test, and will become artificially inflated as the number of items increases. Therefore, for the 5-point scale used in this questionnaire, the alpha values ranging between .614 and .850 (table 15) are considered to indicate a satisfactory level of internal reliability.

Group:	Cronbach's *α*			N of Items
Housing-users	.659		.664	11
Housing Associations	.694	.717		11
Local Authorities	.614			11
Developers	.850			11

Table 15: Cronbach's α values for the importance scale.

5.7.4.4.2. Inter-rater reliability

Given that the focus of this survey are the ratings of importance awarded to housing features by the different stakeholders, it is also useful to assess the inter-rater reliability (IRR, also known as inter-rater agreement) in order to demonstrate the degree of agreement among the respondents (i.e. raters) (Hallgren, 2012). There are a number of statistical methods used to calculate IRR, the choice of which will be generally determined by the type of data (e.g. nominal, ordinal, interval or ratio), the number of raters and the design of the study.

For ordinal, interval, and ratio data, the intra-class correlation (ICC) is one of the most commonly used statistics for assessing IRR (Hallgren, 2012; Field, 2013). As with Cronbach's α, high ICC values indicate greater IRR - '1' representing perfect agreement and '0' indicating that there is no agreement. Hallgren (2012) outlines a number of important factors that need to be considered when determining which ICC variant is suitable for assessing the IRR in any particular study:

(i) One-way or two-way model, which is based on the way raters are chosen. As this study utilised a fully-crossed design (i.e. within each stakeholder group, all items were rated by multiple but same set of raters), the two-way model for the ICC is applicable.

(ii) It is also necessary to specify whether it is the absolute agreement or consistency of ratings that will indicate good IRR in a particular study. In this questionnaire, because we are interested in the values assigned as the measure of the importance for the 11 features, it is the absolute agreement that is important. In other words, if one respondent provides low ratings of 1, 2 and 3 while another high ratings of 3, 4 and 5, the consistency of these ratings will be high (because the rank order of the features is similar) but the absolute agreement will be low. As we are looking which features are rated low (less important) and which are rated high (important) we need to consider the absolute agreement as good IRR.

(iii)The unit of analysis that ICC applies to can be either average- or single-measures, whereby the former quantifies the reliability of ratings based on the averages of multiple raters while the latter is based on the ratings of individual respondents. In this study, average-measures ICC is appropriate because the study uses the average ratings for hypothesis testing.

The calculated ICC values for each stakeholder group are presented in the survey results (section 7.7 of chapter 7).

5.8. Phase 3: Case study selection and assessment

5.8.1. Research question linked to Phase 3

The research questions linked to this part of the methodology are as follows:

(i) To what extent do new housing developments provide these 'soft' features?

(ii) How do these developments rank when taking into account the level of importance attached to these features by the housing stakeholders?

To address these questions, the last phase of the methodology needs to carry out the following steps:

1. Develop an assessment toolkit that could be used to assess the provision of 'soft' features housing development.
2. Select housing developments to use as case studies

3. Evaluate these housing developments using the assessment toolkit.

4. Apply a multi-criteria analysis method to develop a ranking of 'performance'

5.8.2. Development of a methodological toolkit to assess provision of 'soft' features

In order to evaluate if, and to what extent, a particular housing development provides each of the 'soft' housing design features, an assessment 'toolkit' had to be developed for establishing whether each criterion has been met. It would have been beyond the scope of this study to develop these assessment techniques from 'scratch' (which would also necessitate their validation). Instead, a range of different sources was utilised, such as national and international sustainable housing and other relevant standards. Where necessary, the techniques were simplified to meet the needs of the study. Where no technique was specifically available, the adopted method was informed by the broader literature. For clarity, each of the 11 assessment techniques (table 16) are described in detail in chapter 8 together with the actual assessment and scoring of the housing development.

Soft feature:	**Assessment measure:**	**Source of technique**	**Score**	
			Max	**Min**
C1: Suitable indoor space	Average performance against GLA standard using gross internal area	GLA Space Standard / RIBA	7	1
C2: Private outdoor space	The percentage of dwelling units with private outdoor space meeting or exceeding the minimum specified area	CSH	5	1
C3: Adaptability	Level of compliance with the Lifetime Homes standard	Lifetime Homes Standard	3	1
C4: Compatibility w/ architectural heritage	Points awarded for steps taken to comply with local vernacular	BREEAM Communities	5	1
C5: Features for informal socialising	Number of features within the development	Self-study/ literature	5	0
C6: Accessible public greenspace	>2ha greenspace within the following distance (radius from the middle of the site):	Natural England's ANGSt standard	5	1
C7: Attractive views to the outside	Type of main features in the immediate views (approx. 10m-15m) from the living room window	SBTool	5	0
C8: Opportunities to get involved	Level of support provided to get involved in the management and maintenance of communal facility	BREEAM Communities	5	0
C9: Security features	Level of compliance with the SBD standard:	Secured by Design	7	1
C10: Compact neighbourhood design	Dwellings per hectare	Barton, Grant & Guise, 2010; DCLG, 2006	5	1
C11: Proximity to amenities	Number of amenities within 400m	Multiple: LEED; Barton, Grant and Guise, 2010	5	1

Table 16: Summary of assessment techniques for the 11 'soft' design features.

5.8.3. Selection parameters for housing developments as case studies.

Six housing developments were chosen as case studies to undergo assessment (described in section 8.2). Initially it was anticipated that two developments chosen will have been built by private developer, two by housing associations and two by councils. However, this was not possible due to the very low house building undertaken by local authorities and housing associations in the study area. Instead, the case study selection exhibits an interesting mix of developments built by private house builders and housing associations with affordable housing proportions ranging from zero to 100%.

To ensure developments were as comparable as possible, the selection of case studies was guided by the following parameters:

- *Geography*: In order to minimise the cultural, historical and economic factors that fluctuate between different regions of the country and can influence the nature of a housing development, it was important to ensure that case studies were limited to one locality as much as possible. North Staffordshire was chosen as the area of study as this was where most of the survey respondents from previous section of the study were located.

- *Age*: The developments had to have been built after 2008. The main reason for choosing 2008 was because that year marked the start of the recession which had a severe impact on the house building industry, particularly the private sector. Also, new housing developments are also a good indication of the latest practices and preferences in housing design (Huong and Soebarto, 2003).

- *Price of homes*: This is a factor difficult to keep constant, but the main purpose of this parameter was to avoid 'luxury' private sector developments.

Using the above parameters, an initial list of approximately dozen potentially eligible housing developments was comprised by searching for publically available planning applications. The official website www.planningportal.gov.uk was utilised for this as well as the databases of planning departments of the relevant neighbouring local authorities. This case study candidate list was reviewed and upon closer investigation it became evident that many of the developments in the potential candidates list were phases of larger developments, that is, other parts of the development were either already completed (often prior to 2008) while other parts have not had applications granted yet. Such housing development candidates were dismissed as it was felt that it would be inappropriate to carry out an evaluation of a partially approved housing scheme. In the end, six complete housing developments were chosen (see 8.2 for list and details) as they were in the closest vicinity of each other and have been granted applications with construction either initiated or underway.

5.8.4. Evaluation of housing developments

The evaluation process is outlined in chapter 8. The primary sources of information used for the analysis were the detailed planning application documents submitted by the developer to the relevant local authority, which are publically available. Where necessary, this information was supplemented by the developers' website and/or marketing brochure as well as mapping tools.

5.8.5. Multiple criteria decision analysis

Multiple criteria decision analysis (MCDA) is a broad family of methodological tools used to aid decision making and to address complex decision problems that are typically characterised by the large quantity and complexity of associated information. As the human mind is limited in how much of such information it can handle in a consistent way, the quality of decision making in complex scenarios may be compromised (DCLG 2009). MCDA approach provides a structured mechanism for breaking down a complex problem into constituent parts, thereby presenting a clearer picture of the problem and allowing conflicting elements to be explored simultaneously. Available data and judgements can then be applied to each part before these are reassembled to reveal a more transparent and coherent picture to decision makers (*ibid*).

5.8.5.1. Suitability of MCDA application

MCDA can be applied to any field where a decision problem cannot be solved intuitively due to its size, complexity and/or the existence of multiple or conflicting views and objectives. As such, MCDA is especially suitable for evaluating problems within the sustainable development remit as these tend to involve multiple stakeholders with different values and opinions, and the criteria used to judge such problems tend to be complex, involving non-quantifiable, incommensurate or incomparable attributes (Boggia and Cortina, 2010; De Montis et al 2000; Munda, 2005). While MCDA may not solve the problem to everyone's preference, the approach allows it to be tackled in a systematic and transparent way.

The MCDA approach can be used to rank options, identify one preferred option, short-list a number of options or determine acceptable versus unacceptable options (DCLG, 2009). In this instance, the objective is to assess how different housing developments perform with regards to the provision of the 11 'soft' features while taking into account housing stakeholder assigned weights of importance for these features. As such, MCDA will be utilised to establish a ranking of housing developments according to their provision of such features.

There are many examples where MCDA techniques have been utilised in similar studies within built environment field. These include affordable housing (Mulliner, Smallbone and Maliene, 2013), measuring the sustainability of municipal (e.g. Boggia and Cortina, 2010) and residential areas (e.g. Viteikiene and Zavadskas, 2007) and the exploring the behaviour of property buyers (e.g. Bender *et al*, 2000).

5.8.5.2. Stages in the MCDA process

An MCDA process typically follows a common set of steps, which are illustrated by figure 13 together with how they are adapted in this study.

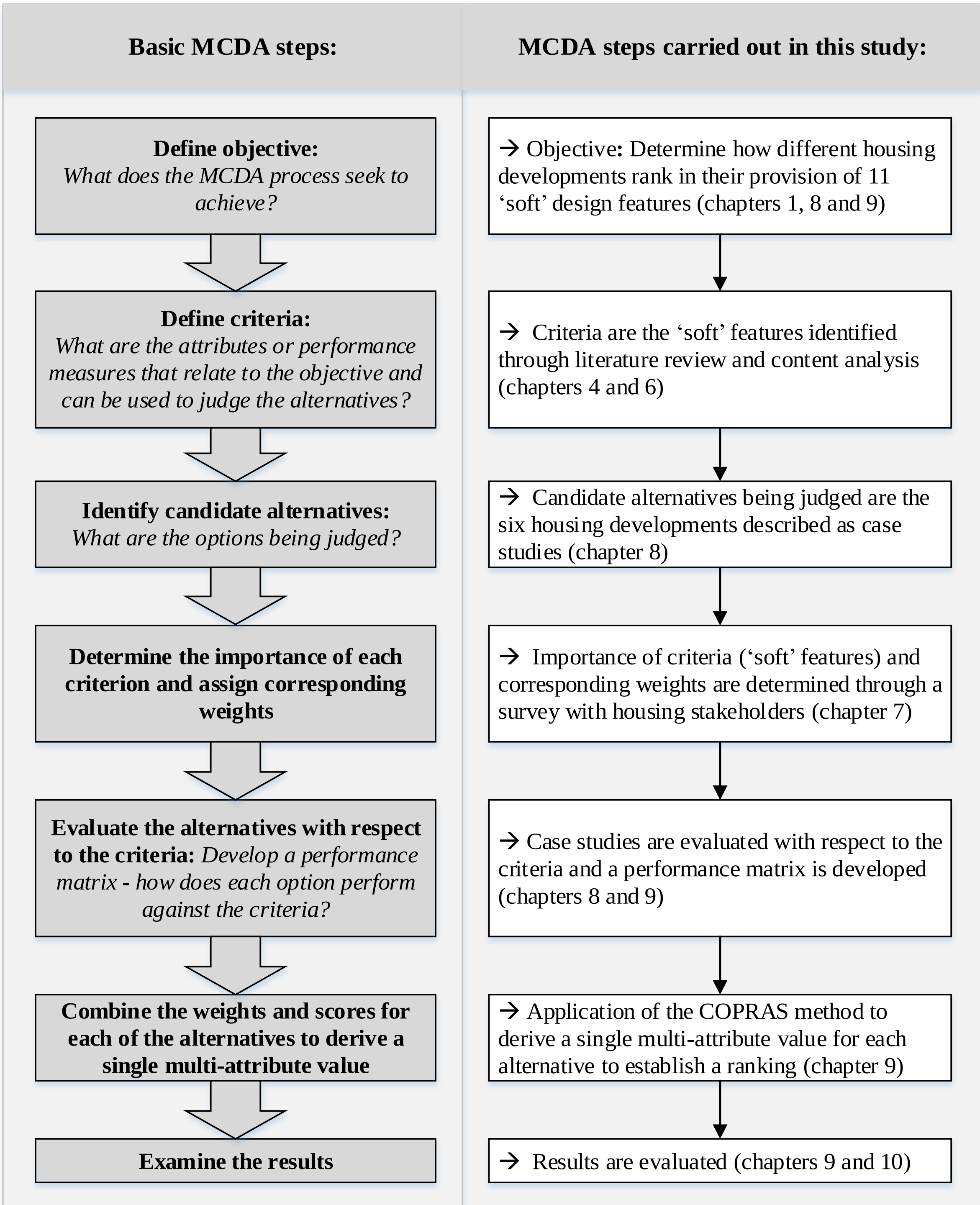

Figure 13: Typical steps in a MCDA process (Sources: Kujawski, 2003; DCLG, 2009; and self-study).

5.8.5.3. Choice of MCDA method

MCDA is an umbrella term for a large number of techniques, which differ in the way they operationalise and assess criteria, compute weights, utilise mathematical algorithms, allow for uncertainty in the data and whether stakeholders are able to participate in the decision process (De Montis *et al.*, 2000). As such, no one technique is suitable for all types of problem (Kujawski, 2003), and choice in any given situation will often depend on the following factors (DCLG, 2009);

- The type of decision (i.e. ranking, single/multiple options)
- Number of alternatives or options being appraised (e.g. finite or infinitely variable options)
- The amount and type of data available for the analysis.
- Decision making circumstances (e.g. available time, skills and resources)

Type of decision: The goal of MCDA application in this study is to rank alternatives (housing developments) in order of performance against the identified criteria ('soft' housing design features) utilising the weights assigned by housing stakeholders. Thus, the chosen method needs to be able to provide a ranking rather than select acceptable versus unacceptable options or a single optimal choice.

Number of alternatives: Different multi-criteria analysis techniques exist for addressing problems that have either a finite or an infinite number of alternatives (De Montis *et al.*, 2000). 'Multi Attribute Decision Making' is used to describe analysis where there is a discrete set of options, as in this case, where the focus is on six housing developments. Alternatively, 'Multi Objective Decision Making' is used when there are infinitely variable outcomes, which are common for instance in design and engineering disciplines (DCLG 2009).

Type of data: 'Multi Attribute Decision Making' techniques may be categorised into compensatory or non-compensatory methods. In the former group, high scoring criteria are allowed to compensate for the poor scores on other criteria, while in the latter such compensation is not allowed.

Decision making circumstances: Given the pragmatic approach adopted, it is desirable that the technique chosen is simple to use so that it can be replicated.

Given the above considerations, the COPRAS (COmplex PRoportional ASsessment) method was chosen for this study, because;

- It enables the ranking of alternatives in order of their performance against the specified criteria.

- It allows the use of qualitative and quantitative criteria in its methodology
- It has been applied in numerous analogous studies: For instance, Viteikiene and Zavadskas (2007) used it to evaluate and rank residential areas in Vilnius, Lithuania, according to their performance against sustainability indicators. Milliner, Smallbone and Maliene (2013) found COPRAS to be a suitable method for ranking assessing the affordability of residential areas in Liverpool.

The end of chapter 8 focuses on the development of the performance matrix and application of the COPRAS method.

5.9. Chapter Summary

- This chapter describes the approach and methods adopted in this research. As this study is embedded within the pragmatic worldview, where the research question is at the centre of importance, the choice of methods was guided by their suitability to address the question.

- In addition to the literature review, the overall methodology consisted of three distinct phases. Phase 1 involved a content analysis of sustainable housing standards to investigate the extent to which each of the 28 features of the framework for sustainable housing with a focus on health and well-being were being addressed. The 11, under-represented ‘soft’ features were used in Phase 2, which consisted of a survey methodology to ascertain the level of importance that housing stakeholders attach to these features. Lastly, the role of Phase 3 was to evaluate the provision of such soft features within new housing developments, which involved the development of an assessment ‘toolkit’ and application of the MCDA approach.

Chapter 6: Content Analysis

6.1. Introduction

This chapter presents the results of the content analysis. It begins with a description of the eight housing standards that were chosen to represent industry's best practice with regard to sustainable housing development. The body of this chapter focuses on identifying whether or not each of the 28 features of the framework for sustainable housing with emphasis on health and well-being identified in chapter 4 is addressed by the standards. As outlined towards the end of the chapter, the content analysis identified 11 features that receive least amount of coverage by the industry best practice. These features, labelled 'soft' features are presented in the results section at the end of the chapter.

6.2. Sustainable housing standards

The criteria for selecting standards are explained in chapter 5 (section 5.6.2).

6.2.1. Code for Sustainable Homes (UK)

The UK's CSH is based on nine categories, each consisting of a number of sub-criteria against which homes are rated between one and six stars with six being exemplar development. The rating represents the building's achievement throughout the nine categories, and while some categories have minimum standards that must the achieved, developers have flexibility as to where and how credits are obtained. However, the relative importance of the criteria is not equal and different weightings are applied for each of the categories. An associated document – the Technical Guidance – is published every six months and provides the details required as evidence to meet the standard, as well as assessment methodologies. The Code document itself does not change without a consultation.

November 2010 Technical guide (DCLG, 2010) was used for the analysis.

6.2.2. BREEAM (UK)

The Building Research Establishment's (BRE) Environmental Assessment Method (BREEAM) aims to reduce the impact of buildings on the environment, enable them to be recognised for their environmental benefits, provide a credible environmental label and encourage demand for sustainable buildings (BRE Global Ltd, 2012a). BREEAM's

EcoHomes scheme, which was designed for domestic new build homes, was replaced by the CSH in 2007 (which is based on the EcoHomes Standard). As BREEAM's 'New Construction' does not cover domestic buildings, the scheme for 'Domestic Refurbishment' was chosen to represent BREEAM's guidance for improving the sustainability of domestic housing. This particular standard was developed to improve the environmental performance of existing buildings in a cost-effective manner. Credits are awarded against criteria in ten categories, which are then used to score a properly as a 'Pass', 'Good', Very Good', 'Excellent' and 'Outstanding'.

BREEAM Refurbishment Domestic Buildings Technical Manual SD5072 - 2012 - 1.0.2 (BRE Global Ltd, 2012a) was used for the analysis.

6.2.3. R-2000 Standard (Canada)

Launched in 1982 by the Government of Canada, the R-2000 is a voluntary standard managed by the Natural Resources Canada's Office of Energy Efficiency. It is based on technical guidance for energy efficiency exceeding building regulations and incorporates training for builders and service providers. Collaborating closely with the home building industry, this partnership between government and industry ensures ongoing review and regular upgrading of the standard.

The standard is designed for residential buildings, whether they are detached, semi-detached or multi-residential. It was chosen because it applies to a large geographical area of North America and while it is labelled as an energy standard it is based on the 'house as a system' concept. The aim of the standard is to encourage the use of cost effective and energy efficient building practices and technologies that would lead to efficient use of energy, improved indoor air quality and better environmental responsibility in the construction and operation of the house (Natural Resources Canada, 2010).

The 2012 version of the standard (Natural Resources Canada, 2012) was used for the analysis.

6.2.4. High Quality Environmental standard (France)

The High Quality Environmental standard (HQE) is the main certification programme for sustainable housing in France which is managed by Paris based Association pour la Haute Qualité Environnementale. The programme is based on multi-criteria system and provides a methodology to assist construction and refurbishment professionals (e.g. developers, project managers and contractors) to choose technologies and solutions to ensure high environmental quality of the housing project (Dalsheimer, 2007).

The programme consists of two components – the environmental management system (EMS) and the environmental quality of the building. The purpose of the EMS is to help the developer to define environmental objectives and provide a method of organising the project to achieve these objectives. While the environmental quality of the building section of the programme seeks to control the impacts on the outer environment (through eco-management and eco-construction) and to create satisfactory internal environment that is healthy and comfortable. The programme is applicable for a variety of buildings, including residential properties, industrial, commercial and tertiary buildings.

The 2012 version of the standard (Qualitel, 2012) was used for the analysis.

6.2.5. Comprehensive Assessment System for Built Environment Efficiency (Japan)

The Comprehensive Assessment System for Built Environment Efficiency (CASBEE) is a Japanese tool for evaluating and ranking the environmental performance of buildings and the built environment. The voluntary standard was introduced in 2001 with the establishment of its management organisation – the Japanese Sustainable Building Consortium by the Ministry of Land, Infrastructure and Transport. It was developed in response to the growing awareness of the wider environmental impact of housing during its lifetime, with the objective to increase the Japanese stock of high quality housing that reduces the environmental load and improves the quality of life (Murakami, 2005).

The scope for evaluation includes the dwelling and its external area as well as occupants' appliances, provision of information by the developers, and actions taken during the production and at the construction site. These factors are deemed as important and taken into consideration by the standard despite the fact that they are often difficult for housing developers to have control over and the standard recognises that environmental performance may not in all cases be evaluated in only quantitative terms.

Each of the categories are broken down into medium-, minor- and detailed items resulting in 54 assessment points. Homes are rated by assigning one to five points to each item, and dedicated software is used to calculate the overall result which ranges from ‘poor’ to ‘excellent’. The weighting coefficients for the criteria were determined by analytic hierarchy process and incorporate views of various stakeholders and specialists such as owners, developers, academics and administrative authorities.

CASBEE for Home (Detached House) Technical Manual 2007 version (Japan Sustainable Building Consortium and Japan GreenBuild Council, 2008) was used for the purpose of content analysis.

6.2.6. SB Tool (International)

The SBTool is a generic framework for developing a rating system to assess the sustainability of buildings, which can be adapted to suit local conditions and a variety of different buildings (housing developments, single buildings, residential, commercial, new and existing dwellings). The Tool consists of criteria ranging from around 6 to over a hundred (120) and covers sustainability in the broad meaning of the term. It has been in development since 1996 and is a software-based output of the Green Building Challenge assessment method that was initially launched by Natural Resources Canada. In 2002 the responsibility has been taken over by the International Initiative for a Sustainable Build Environment (iiSBE).

The key feature of SBTool is that it can be adapted to match regional variations. It provides a common methodology and terms, but given its adaptability, the rating systems developed in different regions can be quite distinctive from one another. This is because the procedure allows third parties to establish the importance to various issues based on regional circumstances – this is seen as an advantageous feature of the system because a version developed based on local culture is expected to be more valuable than more generic systems (Larsson and Macias, 2012). The tool therefore requires ‘regional calibration’ or regionally meaningful benchmarks to be developed into a useful rating method.

The number of active criteria is determined by the scope (‘Developer’ scope, and ‘maximum’, ‘mid-size’ and ‘maximum’ scope) selected by authorised third parties. These default sets of criteria can further be adjusted at the weighing stage to improve the match to local conditions. However a number of criteria are mandatory and cannot be excluded. The assessments to the criteria can be carried out at the pre-design phase as well as design, construction and operations phases.

Interestingly, the system consists of criteria that are data-orientated (e.g. greenhouse gas emissions, energy use) and not data-orientated or 'soft' criteria (e.g. social, cultural and perceptual aspects) that can be dependent on subjective judgements. A scalar scoring system is provided which is linked to text statements that describe performance to these soft criteria. The scoring procedure essentially compares the characteristics of the subject building to the 'minimum', 'good' or 'best practice' scores that have been adapted to regional conditions.

SB Tool 2012 Generic (A) file (iiSBE, 2012) was used for the analysis.

6.2.7. Green Star (Australia)

The Green Star is run by the Green Building Council Australia (GBCA) and is a voluntary environmental rating system for housing. Based on existing systems including BREEAM and LEED (see below), the standard aims to promote and raise awareness, recognise good practice as well as define green building by establishing a common language and standard of measurement. The Green Star tool for multi-unit residential developments can be used for a building with two or more homes. According to the GBCA, the benefits of using these tools include reduction of environmental impacts, health benefits and financial savings for the housing-users.

Green Star – Multi Unit Residential (v1) version (GBCA, 2011) of the standard was used in the analysis.

6.2.8. Leadership in Energy and Environmental Design (US)

The Leadership in Energy and Environmental Design (LEED) system was developed in 1998 by the US Green Building Council for rating the environmental quality of the design, construction and operation of buildings, homes and neighbourhoods. The rating tools are available for new and existing buildings, commercial, retail, healthcare, neighbourhood development and residential homes. The rating system for homes covers 'Single Family' and 'Low-Rise' and midrise multifamily dwellings. The 2008 version of LEED (US Green Building Council, 2008) was used for the content analysis.

6.3. Content analysis

Each standard was systematically reviewed against the 28 sustainable and healthy housing criteria as outlined in chapter 5 (section 5.6.4). A summary of results is shown in tables 17 and 18 towards the end of this chapter, and detailed results can be found in Appendix I.

6.3.1. Thermal comfort

Five of the reviewed housing standards include criteria that specifically refer to ‘thermal comfort’. Green Star, is perhaps most specific, seeking to ‘encourage and recognise buildings that achieve a high level of comfort’ (IEQ-5) and awards credits based on provision of ceiling fans and average heating and cooling loads of less than 30 MJ/m^2. While also specifically addressing thermal comfort, the HQE, considers it only during summer months by evaluating building fabric and orientation factors. The remaining standards focus on thermal comfort as an objective, that is, through provision of thermal insulation and energy efficiency of heating (or cooling) systems. For instance, SBTool states that it aims to achieve thermal comfort by specifying the need for appropriate air temperature and relative humidity in naturally and mechanically ventilated occupancies. Similarly, LEED seeks to achieve improved thermal comfort and energy performance through appropriate distribution of space heating and cooling. CASBEE includes thermal comfort under its ‘QH1 Comfortable, Healthy and Safe Indoor Environment’ where it focuses on evaluating *“the basic thermal performance of the building to ensure the comfort of occupants”* (Q_H1.1.1.1; p38).

6.3.2. Indoor Air Quality

As IAQ is a widely recognised determinant of health, nearly all (seven) of the reviewed standards stipulate criteria for ensuring adequate IAQ with CSH being the notable exception. The remaining criteria seek to ensure healthy IAQ by specifying requirements that would minimise the build-up of pollutants associated with construction and design of a dwelling (particularly VOCs, but also mould and CO_2 concentrations) together with adequate ventilation and air movement.

6.3.3. Noise prevention

Six out of the eight sustainable housing standards reviewed refer to the issue of noise (also listed as sound insulation, acoustics, quietness, or internal noise levels). Most measure this criterion by the presence and type of sound insulation materials and design features and only one of the standards, Green Star, awards credits based on the measurement of sound (dB LA_{eq}).

6.3.4. *Daylight availability*

Six of the reviewed sustainable housing standards include daylight criteria and typically use predicted average daylight factor as a measurement indicator. A number of standards (eg HQE, CASBEE) go further and seek to evaluate structural features that determine amount of indoor daylight including the window opening ratio and direction.

6.3.5. *Toxicity of construction and furnishing materials*

Of the sustainable housing standards investigated, four (BREEAM, HQE, R-2000 and Green Star) specifically address the potential toxicity of materials. These standards specify the use of products (e.g. carpeting, paints and varnishes, adhesives, flooring, cabinets and wood-based products) that are certified to contain low or no formaldehyde and other VOCs. LEED was deemed as not addressing this feature, because while it does stipulate for low-VOC containing materials and the synergy with better IAQ is recognised, the intent of the stipulation is to *"increase demand for environmentally preferable products"* (p79).

6.3.6. *Humidity/damp prevention and control*

Five of the reviewed standards make some form of provision for humidity or dampness prevention and control. Most (BREAAM, R-2000, HQE and SBTool) make these provisions under IAQ and ventilation to ensure occupants are not exposed to high levels of mould spores. LEED however specifically focuses on 'moisture control' (EQ3) for comfort, reduced risk of mould spores and to increase the durability of the dwelling.

6.3.7. *Safety from injury and accidents*

Half (four) of the standards (BREEAM, R-2000, CASBEE and SBTool) reviewed include criteria relating to the safety of occupants and stipulate requirements primarily regarding fire prevention and detection and/or CO detection systems.

6.3.8. *Suitability of indoor space, design and layout*

Of the standards reviewed, only two (CASBEE and SBTool) specifically refer to the suitability of indoor space in terms of layout and functionality.

6.3.9. *Access to high quality open green space*

Three of the housing standards require provision of public open space gathering and recreation, but none specify that this should be a greenspace. LEED includes access to open space as a criterion with the aim of encouraging walking, physical activity and time spent outdoors (LL6). GreenStar, under its ‘Outdoor Communal Facilities criterion (Eco-5) includes options for ‘open landscaped area for active group and /or individual play’; outdoor gym; swimming pool; retained natural habitat/native vegetation; quiet seating options with views of landscaped areas, while SB Tool requires provision of land for ‘public open space’ that can be used for gathering, relaxation and recreation of the housing-users.

6.3.10. Attractive views to the outside

Only one standard, SBTool, includes criteria regarding external views from a dwelling. For residential properties (F3.7 “access to exterior views from interior”) it seeks to assess the quality of exterior views available from the main interior space such as the living room.

6.3.11. Compatibility with local heritage and cultural style

Of the housing standards reviewed, only SB Tool and CASBEE include criteria pertaining to the compatibility of housing developments to local cultural values and the existing streetscape. Both acknowledge and encourage housing design features to be harmonious with the adjacent buildings or surrounding townscape, and seek to evaluate efforts that inherit the housing culture or heritage of the region.

6.3.12. Private outdoor space

Three standards, CSH, GreenStar and SBTool, include criteria for private outdoor space. According to CSH, such space can be in the form of a private or communal garden, large balcony, roof terrace, courtyard, patio or a winter garden if one side can be opened. All standards stipulate minimum space requirements for designated private outdoor area, while CSH also includes access and usability requirements that conform to the inclusive design principles.

6.3.13. Adaptability of dwelling to suit future needs

Of the housing standards reviewed, three (CSH, BREEAM and SBTool) include criteria that specifically refer to the adaptability of dwellings to meet the changing needs of current and future housing-users. The CSH assesses this feature through the

Lifetime Homes Standard, which consists of 16 design features that "*together create a flexible blueprint for accessible and adaptable housing in any setting*" (p. 210). While the SBTool includes the ease with which a tenant is able to modify technical systems (e.g HVAC, lighting, cabling and telecom systems); the potential for extensions; adaptability constraints imposed by structure, floor height, building envelope and technical systems; and, adaptability to future changes in type of energy supply. BREEAM domestic refurbishment standard refers to 'inclusive design' that aims to optimise accessibility and adaptability of the home to meet the changing needs of the household such as old age, frailty or illness.

6.3.14. Features for social interaction

Only two (SBTool and CASBEE) of the reviewed housing standards stipulate provisions for facilities with the specific purpose of communal interactions (others include criteria for open space but for walking and exercise, which is covered by access to open greenspace criterion). SBTool includes criterion (A1.9) for provision of '*public space for gathering, relaxation and recreation of the population within the project and neighbourhood*'. It is acknowledged that this is feasible for larger projects and can include features such as children play areas and facilities for small scale food production. Green Star includes a criterion for 'outdoor communal facilities' to encourage designs that enable housing-users engage in a broad range of outdoor activities: Credits are awarded depending on the size of site that is designated a communal garden (25%), provision of a manual for the communal facilities and the number of facilities provided out of a list of 13.

6.3.15. Design contributes to perception of safety

Three (CSH, BREEAM and CASBEE) of the reviewed housing standards stipulate criteria for security. Both CSH and BREEAM seek to encourage design of developments and projects '*where people feel safe and secure; where crime and disorder, or the fear of crime, does not undermine quality of life or community cohesion'* (Man 4, p.58 CSH summary). CASBEE makes provision for crime prevention; firstly, precautions against crime sub-criterion evaluates openings for measures to prevent intrusions, and secondly, under the 'Safety and Security of the Region' heading, the standard evaluates measures to strengthen disaster and crime prevention for the neighbourhood area – the element pertaining to crime is covered primarily by 'maintenance of good sightline' requirements.

6.3.16. Resident engagement and consultation

Of the sustainable housing standards reviewed, only SBTool makes provision for the involvement of residents in project management. The aim of this criterion is to increase the overall satisfaction and to ensure smoother operation in the long run.

6.3.17. Management and controllability

Virtually all (seven) of the sustainability standards reviewed include criteria relating to the management and control of the building by the user. This is typically assessed through the provision of a user guide, manual or training program (CSH, BREEAM, GreenStar, LEED, HQE). CASBEE considers ‘ease of maintenance’ and regards that provision of a ‘maintenance programme’ to the occupants as a method of promoting longer service life of the dwelling.

6.3.18. Residential density

Only two (SBTool and LEED) of the sustainability standards reviewed address the issue of residential density. SBTool refers to the need to maximise land use efficiency through development density, and measures this through ratio of floor area. LEED awards points for compact developments due to the need to conserve land and promote community liveability, transportation efficiency and walkability.

6.3.19. Proximity to amenities

Three (SBTool, LEED and Green Star) of the reviewed standards include criteria for mixed use developments and proximity of amenities. SBTool seeks to encourage a diversity of major uses within developments in order to reduce the need for commuting and promote an active streetscape, but recognises that this may not be rational or economical for small projects. Both Green Star and LEED focus on the aim to reduce the need for travel, particularly with private car. LEED, under LL5 ‘Community resources/transit’ criterion seeks to encourage homes in development patterns that allow for walking and sustainable transport in order to reduce the reliance on private cars.

6.3.20. Energy Efficiency

All housing standards reviewed stipulate energy efficiency criteria, either as dwelling energy performance or conservation targets.

6.3.21. Water conservation and efficiency

All of the sustainable housing standards include criteria on water use and efficiency. Most of the standards address internal water usage by stipulating minimum water efficiencies of fittings (toilets, taps, showers, etc.) and external water usage through rainwater collection systems. Water Use Calculators are provided by several standards to help calculate the potential water consumption and help meet the stipulated target ranges (eg CSH specifies 80 l/p/d as the maximum water consumption at Levels 5 and 6). Some of the standards go further and include criteria for water meter (e.g. BREEAM, GreenStar), water recycling systems (e.g LEED) and embodied water use of the construction materials (SB Tool).

6.3.22. Sustainable transport

Six of the reviewed standards include some form of provision to encourage sustainable transport. BREEAM and CSH stipulate the need for accessible and adequate cycle storage, while SBTool extends this to include connectivity to off-site cycle routes as well as provision and quality of pedestrian walkways. GreenStar offers the most comprehensive coverage of this criterion and includes recognition where car parking is limited and encourages fuel-efficiency (small cars, car sharing, and mopeds). The standard also considers access to public transport – the type that is available within 1000m, the routes and their frequency. LEED includes criteria to encourage the building of homes in development patterns that promote walking, cycling and use of public transport (in order to reduce reliance on the personal car and its associated environmental impacts), while HQE includes provision of sockets for electric / hybrid cars.

6.3.23. Greenhouse gas emissions

Four of the reviewed standards include sections that specifically refer to reducing CO_2 / GHG emissions in *addition* to criteria for improving energy efficiency of dwellings. CSH, CASBEE and SB Tool take a life cycle approach, and consider emissions arising during construction and operation of the dwelling, while GreenStar focuses on GHG emissions during building operations. Other atmospheric pollutant (SO_2, ethane, ozone depleting CFC-11 equivalents) and those with GWP (insulating materials, refrigerants) are included by CSH, SB Tool and Green star.

6.3.24. Pollution (water run-off, light, NOx)

Specific reference to some form of environmental pollution (non GHG) associated with dwellings is made by six of the housing standards reviewed. Surface water management practices such as sustainable urban drainage systems and permeable surfaces, which reduce pollution of watercourses, are promoted by CSH, BREEAM, CASBEE, GreenStar and LEED. NOx and other air pollutants are covered by CSH, BREEAM, SB Tool and GreenStar. While light pollution and non-toxic pest control is mentioned by Green star and LEED respectively.

6.3.25. Environmental impact of materials and furnishings

All of the reviewed standards include criteria referring to the environmental impact of building materials and the following requirements to a varying degree:

- Reuse of existing materials
- Material efficiency
- Use of reused, recycled materials
- Responsible sourcing
- Local sourcing to minimise transport
- Ease of disassembly and recycling

6.3.26. Environmental impact of construction

Six of the reviewed standards cover environmental impacts of construction. In the UK, the Considerate Constructors Scheme covers environmental factors alongside those of appearance, community, safety and workforce. As such, CSH and BREEAM consider subscription to the Scheme as a key piece of evidence of commitment to managing and reducing the environmental impact of construction. HQE includes an EMS based approach to managing the environmental impacts of construction, while CASBEE, LEED, BREEAM and CSH make specific reference to waste management of the construction site. Prevention of ecological damage, in terms of erosion and soil compaction is referred to by LEED and Greenstar respectively.

6.3.27. Ecology and land use

Almost all (7) of the reviewed standards (except R-2000) include criteria that refer to site-selection and the preservation or enhancement of its ecological value. Regarding the ecological value of the land prior to development, most standards stipulate that priority should be given to land that is of negative or limited ecological value (i.e. brownfield land) in terms of wildlife, biodiversity and natural habitats. If developed on brownfield land, sustainable housing should enhance the ecological value of the site through development of habitats favourable to biodiversity enhancement. Where non-brownfield or developed land has been used, ecological value should be at least maintained.

6.3.28. Promotes and facilitates environmentally sustainable behaviour

Six of the housing standards include one or more features to promote environmentally responsible behaviour. These typically include provision of adequate space for storage and sorting of waste to encourage recycling (e.g. CSH, GreenStar, SB Tool, HQE and CASBEE), clothes drying space and information on energy saving (CSH, BREEAM, CASBEE, HQE), while sustainable transport can be facilitated by provision of adequate space for bicycle storage and a home office (CSH, BREEAM).

6.4. Results of content analysis

An overview of the content analysis results is presented by table 17, showing which criteria feature in which of the eight standards, and by table 18, which presents the tally of how many standards address a particular criterion. Features that scored 6 or more (i.e. were present in standards) were considered to have a relatively high level of coverage by industry best practice, those that scored 4 or 5 – ‘medium’ coverage, and features scoring 3 or below were deemed to have a ‘low’ coverage.

Unsurprisingly, the criteria group with the highest level of coverage were the environmental features, particularly energy efficiency, water conservation and environmental impact of construction materials, which are addressed by all standards reviewed. Ecology and land use also scored high with seven of the standards including this feature, while environmental features such as sustainable transport, pollution, impact of construction and enabling of environmentally friendly behaviour scored comparatively lower with six standards addressing them. Greenhouse gas emissions scored only four, and hence, receive ‘medium’ coverage, which is perhaps expected as many standards would see this issue as addressed through greater energy efficiency of a dwelling.

Criterion:	**CSH**	**BREEAM**	**R-2000**	**HQE**	**CASBEE**	**SBTool**	**Green Star**	**LEED**
1. Thermal comfort	**N**	**N**	**N**	**Y**	**Y**	**Y**	**Y**	**Y**
2. Indoor Air Quality	**N**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
3. Noise prevention	**Y**	**Y**	**N**	**Y**	**Y**	**Y**	**Y**	**N**
4. Daylight availability	**Y**	**Y**	**N**	**Y**	**Y**	**Y**	**Y**	**N**
5. Toxicity of construction and furnishing materials	**N**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**
6. Humidity/dampness prevention and control	**N**	**Y**	**Y**	**Y**	**N**	**Y**	**N**	**Y**
7. Safety from injury and accidents	**N**	**Y**	**Y**	**N**	**Y**	**Y**	**N**	**N**
8. Suitability of indoor space design and layout	**N**	**N**	**N**	**N**	**Y**	**Y**	**N**	**N**
9. Access to high quality open greenspace	**N**	**N**	**N**	**N**	**N**	**Y**	**Y**	**Y**
10. Attractive views to the outside	**N**	**N**	**N**	**N**	**N**	**Y**	**N**	**N**
11. Compatibility with local heritage and cultural style	**N**	**N**	**N**	**N**	**Y**	**Y**	**N**	**N**
12. Private outdoor space	**Y**	**N**	**N**	**N**	**N**	**Y**	**Y**	**N**
13. Adaptability of dwelling to suit future needs	**Y**	**Y**	**N**	**N**	**N**	**Y**	**N**	**N**
14. Features for social interaction	**N**	**N**	**N**	**N**	**N**	**Y**	**Y**	**N**
15. Design contributes to perception of safety	**Y**	**Y**	**N**	**N**	**Y**	**N**	**N**	**N**
16. Engagement and consultation	**N**	**N**	**N**	**N**	**N**	**Y**	**N**	**N**
17. Management and controllability	**Y**	**Y**	**N**	**Y**	**Y**	**Y**	**Y**	**Y**
18. Residential density	**N**	**N**	**N**	**N**	**N**	**Y**	**N**	**Y**
19. Proximity to amenities	**N**	**N**	**N**	**N**	**N**	**Y**	**Y**	**Y**
20. Energy efficiency of dwelling	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
21. Water conservation and efficient use	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
22. Sustainable transport	**Y**	**Y**	**N**	**Y**	**N**	**Y**	**Y**	**Y**
23. Greenhouse gas emissions	**Y**	**N**	**N**	**N**	**Y**	**Y**	**Y**	**N**
24. Pollution (surface water runoff, light, NOx)	**Y**	**Y**	**N**	**N**	**Y**	**Y**	**Y**	**Y**
25. Environmental impact of materials	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
26. Environmental impact of construction	**Y**	**Y**	**N**	**Y**	**Y**	**N**	**Y**	**Y**
27. Ecology and land use	**Y**	**Y**	**N**	**Y**	**Y**	**Y**	**Y**	**Y**
28. Facilitate environmentally sustainable behaviour	**Y**	**Y**	**N**	**Y**	**Y**	**Y**	**Y**	**N**

Table 17: Summary of content analysis results: 'Y' indicates criteria feature is present in the corresponding standard and 'N' indicates it is not present.

Housing features that can have a direct impact on occupant health also received a relatively high level of coverage by the standards – albeit overall not as high as the environmental features. IAQ, noise and daylight all received a 'high' level of coverage, while thermal comfort, toxicity of materials, humidity and safety from accidents received 'medium' level of coverage. One possible reason behind the lower coverage of the latter four criteria may be the expected and assumed synergy with other (environmental) criteria: For instance, the issue of thermal comfort may be assumed to be addressed by better energy efficiency, toxicity of materials by the environmental impact of materials, and humidity by ventilation (under IAQ).

The group of features that received least coverage were the elements of housing and neighbourhood design that can effect well-being and have an indirect, less acute or a 'softer' impact on health. These have been labelled as the 'soft' features of sustainable housing as they are the non-technological factors that are largely subjective and qualitative in nature. The features that received the lowest score of one were 'attractive views' and 'engagement and consultation'. These were followed by suitability of indoor space, compatibility with local heritage, features for social interaction, and residential density – all of which received a score of two, while greenspace, private outdoor space, adaptability, safety, and proximity to amenities received a slightly higher score of three.

Management and controllability was the exception from this group, scoring a seven and receiving a 'high' level of coverage. The reason for this is likely to be linked to the prominence of technologies to enhance the environmental performance of new housing, particularly energy efficiency, as lack of clear guidance on how to use and maintain appliances can severely undermine their efficacy.

Given the diverse nature of these sustainable housing standards, it is interesting to note the relatively consistent results in terms of the environmental aspects scoring high while 'soft' criteria scored low levels of coverage by the industry. However, a closer inspection reveals a high level of variability among the individual standards. No two standards covered all of the same features. Unsurprisingly, SBTool, the international standard (with the purpose of being locally adapted) was the broadest in its scope and included most of the criteria. Nevertheless, it excluded several features that other standards chose to address, demonstrating a high level of variation among the individual standards.

Scope	Type of health impact	No	Sustainable housing feature:	Count	Level of coverage
Health and well-being	**Direct / 'hard'**	1	Thermal comfort	5	Medium
		2	Indoor air quality	7	High
		3	Noise prevention	6	High
		4	Daylight availability	6	High
		5	Toxicity of construction and furnishing materials	4	Medium
		6	Humidity/dampness prevention and control	5	Medium
		7	Safety from injury and accidents	4	Medium
	Indirect / soft/ meaningful	8	Suitability of indoor space design and layout	2	Low
		9	Access to high quality open greenspace	3	Low
		10	Attractive views to the outside	1	Low
		11	Compatibility with local heritage and cultural style	2	Low
Societal & Socio-economic		12	Private outdoor space	3	Low
		13	Adaptability of dwelling to suit future needs	3	Low
		14	Features for social interaction	2	Low
		15	Design contributes to perception of safety	3	Low
		16	Engagement and consultation	1	Low
		17	Management and controllability	7	High
		18	Higher density /compact developments	2	Low
		19	Proximity to amenities	3	Low
Environmental	**'Global'**	20	Energy efficiency of dwelling	8	High
		21	Sustainable transport	8	High
		22	Water conservation and efficient use	6	High
		23	Greenhouse gas emissions	4	Medium
		24	Low pollution (surface water runoff, light, NO_x)	6	High
		25	Low environmental impact of materials & furnishings	8	High
		26	Low environmental impact of construction	6	High
		27	Ecology and land use	7	High
		28	Facilitates environmentally sustainable behaviour	6	High

Table 18: List of sustainable housing features with a focus on health and well-being, showing the level of coverage by housing standards (score of 1-3 is 'low'; 4-5 is 'medium'; and 6-8 is 'high').

6.5. Chapter summary and conclusions

- Content analysis of 8 sustainable housing standards was carried out to determine the level of coverage of the each of the 28 criteria for sustainable housing with an emphasis on health and well-being.

- The results reveal that environmental features have the highest level of coverage, confirming the environmental focus of current sustainable housing (as discussed in chapter 2). Environmental criteria were followed by medium to high coverage of features that can have a direct impact on health.

- The lowest level of coverage was allocated to the 'soft' elements of housing and neighbourhood design. Overall, this group comprises of 12 such 'soft' features, however the feature of 'Management and controllability' (nr 17) was highly covered by industry best practice (i.e. was present in 7 of the 8 standards analysed). However, the remaining majority of 11 such ‘soft’ features have very low coverage (i.e. addressed by only 3 of fewer of the standards). These 11 ‘soft’ features therefore represent an important gap in the current sustainable and healthy housing development agenda, particularly as their importance to health, well-being and social sustainability is supported and demonstrated by empirical research and literature.

Chapter 7: Stakeholder survey analysis

7.1. Introduction

This chapter presents the analysis of the survey data. It begins with an overview of the demographics of each respondent group, including some organisational characteristics of the housing providers. It then presents the rating of the criteria by the stakeholders, and subsequently the weightings of each criterion by the different groups. Findings from the analysis of current provision of features, ranking and other suggestions made by the stakeholder groups are also discussed. Results of non-parametric tests to compare the opinions of different stakeholder groups are analysed. A summary of relative criteria importance and conclusions are presented at the end of the chapter.

7.2. Response rates

In total 123 responses were received for the ‘housing-users’ group and 112 for the housing providers. A breakdown of response rates for the latter group is shown in table 19.

Housing provider	Nº of organisations found to be active in the area	Nº of staff sent invites	Responses	Response rate
Housing associations	80	178	48	27%
Local authorities	51	121	34	28%
Developers	49	131	30	23%
Total	180	430	112	26%

Table 19: Number of organisations operating in the geographical area of study, number of staff members invited to complete the survey and response rates.

7.3. Demographics of survey respondents

7.3.1. Location and dwelling type of ‘housing user’ group respondents

Mapped postcodes of respondents’ home addresses (figure 14) show that the majority of the ‘housing-users’ group were based in the West Midlands region and southern parts of the North West region of the UK. The vast majority (91.1%) of survey respondents lived in a house, either detached, semi-detached, bungalow, or terraced. A small percentage lived in an apartment within either a ‘high-rise’ or ‘low-rise’ building (4.9% and 2.4% respectively).

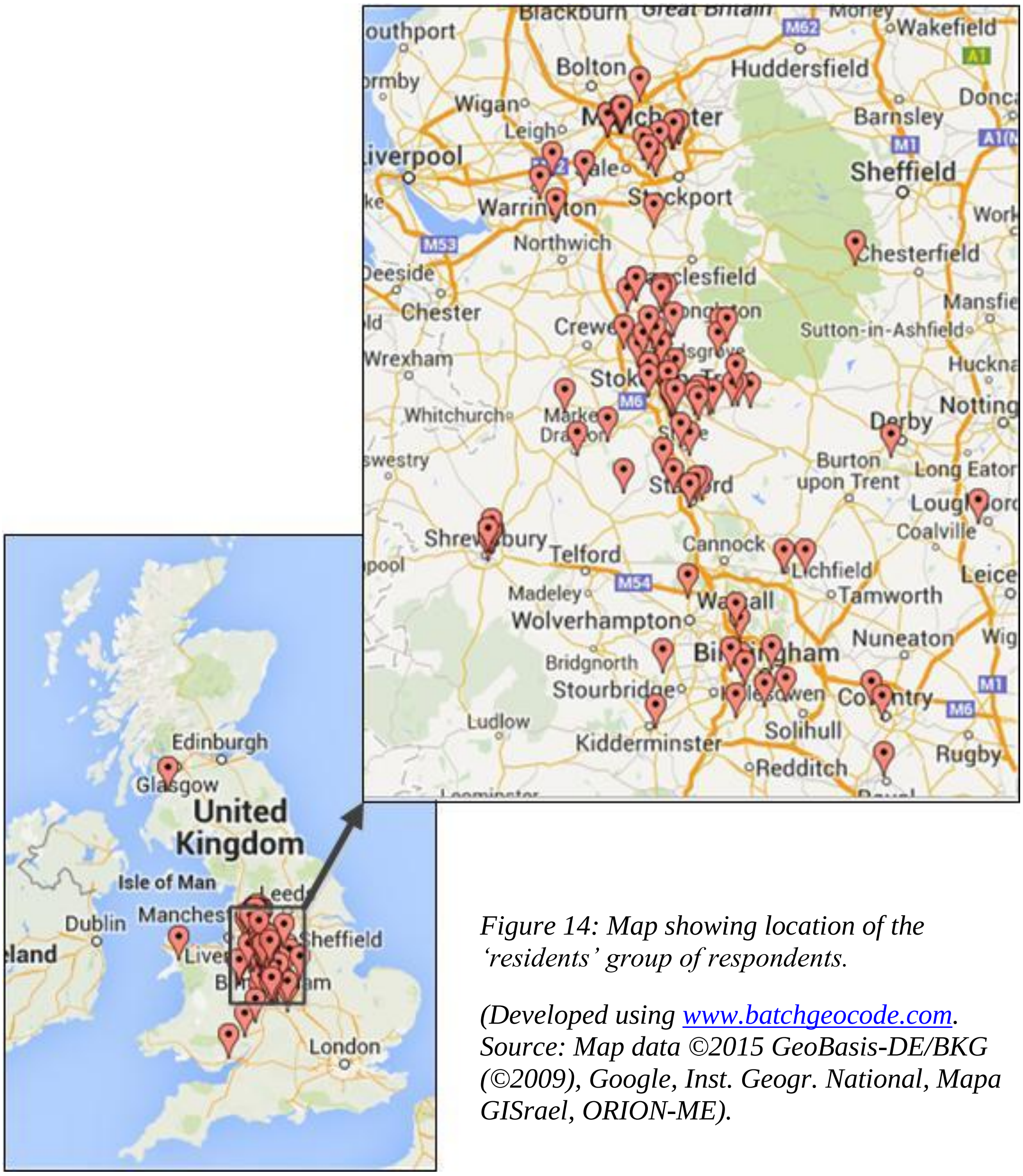

Figure 14: Map showing location of the 'residents' group of respondents.

(Developed using www.batchgeocode.com. Source: Map data ©2015 GeoBasis-DE/BKG (©2009), Google, Inst. Geogr. National, Mapa GISrael, ORION-ME).

7.3.2. Gender and age of respondents

While the 'housing-users' group had a relatively even distribution of males and females (46.3% and 52.8% respectively), there was a considerably higher proportion of males in the housing provider group – with almost four times as many males as there were females (76.8% and 21.4% respectively).

There was also a clear distinction between the two respondent groups in terms of age distribution, which is illustrated by figure 15. The majority of housing providers (53.6%) were aged between 46 and 55 years, which smaller proportions in the younger (ages 36 to 45), and older (ages 56 to 65) bands (17.9% and 18.8% respectively), and even smaller percentages in the remaining age bands. On the other hand, the housing-users' group shows a more even distribution, particularly among three bands that include ages ranging from 36 to 65. As a reference, the median age in England and Wales in 2011 was 39 (ONS, 2012), and just over a fifth of the respondents (22%) fall into the band of this median age (36 – 45), with two thirds (61%) belonging to older age groups.

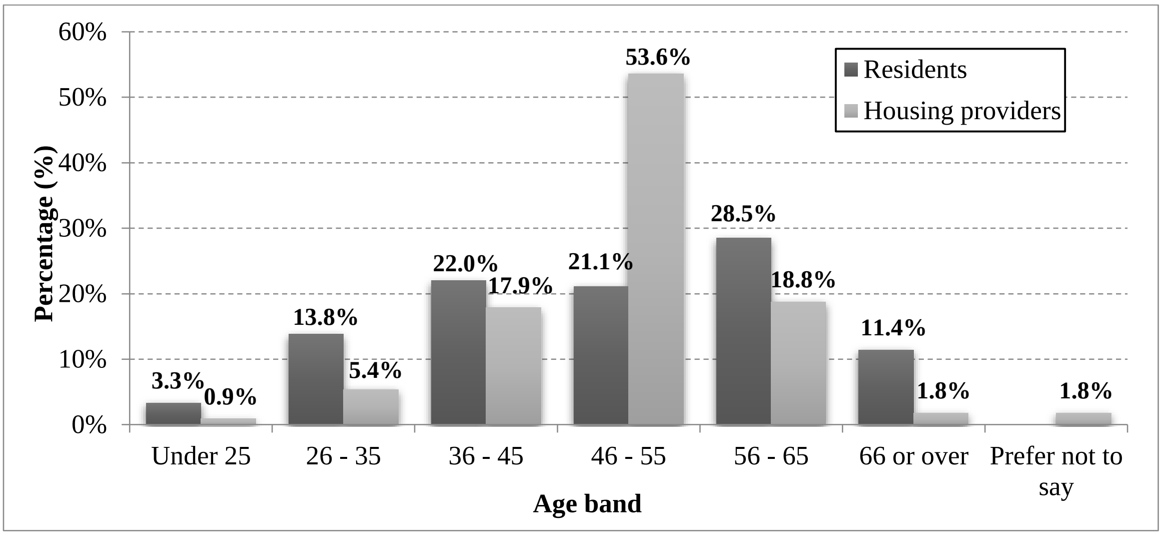

Figure 15: Age distribution of housing-users and housing providers responding to the survey (Source: self-study).

7.3.3. Housing Providers: organisational characteristics

7.3.3.1. Housing associations

Housing portfolio size:

Virtually all (97.9%) of the housing associations (HA) respondents came from organisations with portfolios of more than 1,000 properties. Approximately a third of respondents managed 1001 to 5000, 5001-10,000 and more than 10,000 properties each, with only one responding HA managing under 1000.

Geographical coverage:

HA respondents were asked to select the region where most of their properties are located. The results (figure 16) show that most of the respondent HA properties were located across three regions – the WM Metropolitan County (including Birmingham, Coventry and Wolverhampton) (31.2%), Merseyside (20.8%) and Greater Manchester (10.8%). Unsurprisingly, these are the most urbanised regions within the geographical remit of the study. The remaining HAs managed properties across regions that are more rural, with comparably smaller towns and cities, such as Worcestershire, Cheshire and

Staffordshire. The few respondents marked ‘other’ and specified ‘national’, ‘the midlands or the ‘midlands south and east’.

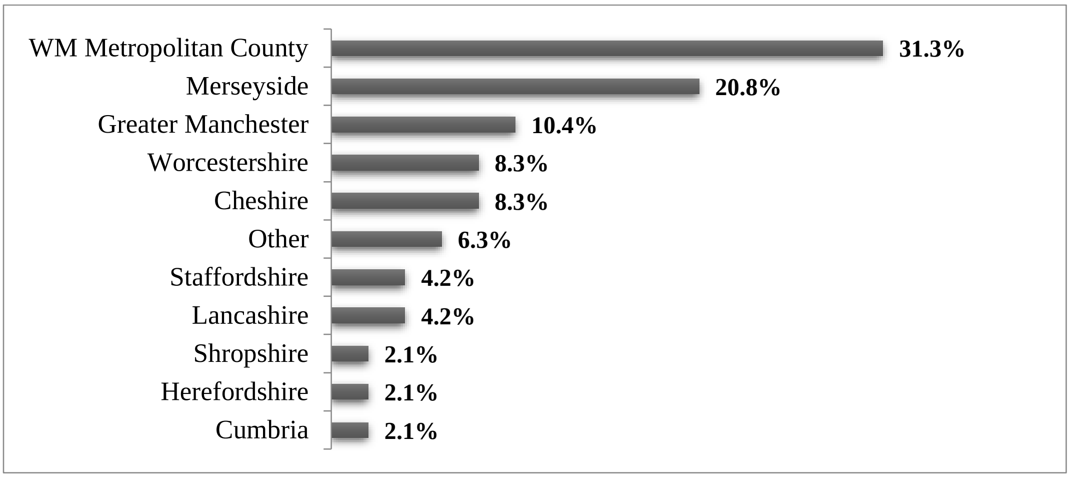

Figure 16: Regions where most of HA properties were located. (Source: self-study).

Type of housing:

As some housing associations specialise in providing housing for certain social groups, the questionnaire sought to ascertain the proportion of those that had such focus and those that provided general needs housing. When respondents were asked whether their organisation specialises in providing housing for people with particular needs, 68.8% answered ‘no, most properties are general needs homes’. The remaining third (31.3%) were asked which special needs groups were targeted, selected the following groups; the elderly (29.2%), disabled (22.9%), families (20.8%), young people (20.8), single people (18.8%) and other (16.7%). Therefore, while about a third of responding companies do provide specialised housing, general needs housing dominated the portfolios of the majority HAs.

7.3.3.2. Local authorities

Housing portfolio size:

Over a third (35.3%) of respondents were from councils that did not own any properties. Only a few (5.8%) councils owned small (under 1000 properties) portfolios, and about a fifth (20.6%) owned between 1001 and 5000. 11.8% owned 5001 to 10,000 and just over a quarter (26.5%) of the sample owned more than 10,000 properties (Figure 17).

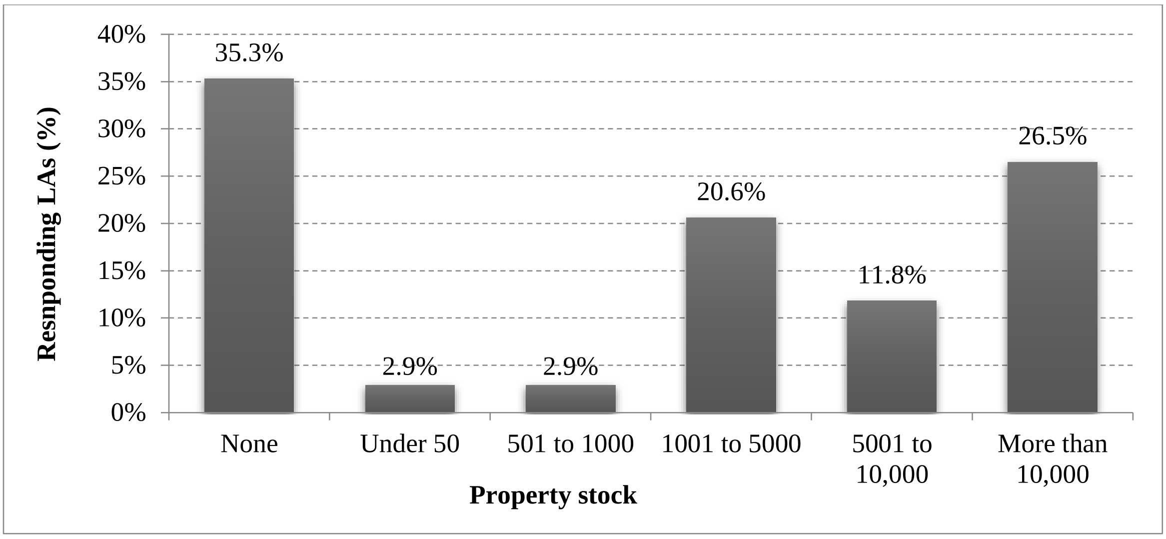

Figure 17: Overview of responding local authority housing portfolio size. (Source: self-study).

Those who owned stock were asked how it was managed. Over half (56.5%) of the councils managed their own housing, 26.1% said that their stock was managed by an arm's length management organisation, while the remainder (17.4%) councils said their housing was managed by other registered providers (e.g. housing associations).

7.3.3.3. Developers

Respondents from the developer group were asked how many people their company employed in the UK and their approximate annual turnover in order to gauge the size of the company. The European Union defines small and medium sized enterprises (SMEs) as those which employ less than 250 staff and have a turnover of approximately £42m (EC, 2003b). A third of the respondents met both of these criteria to be classified as SMEs, while the remainder were large companies employing over 250 and with annual turnover of over £50m.

Geographical coverage:

Respondents were asked to select where their company built most of their residential housing and the results are shown in figure 18. Half of the respondents were from national house builders while the remainder were building homes largely in the North West and West Midland areas.

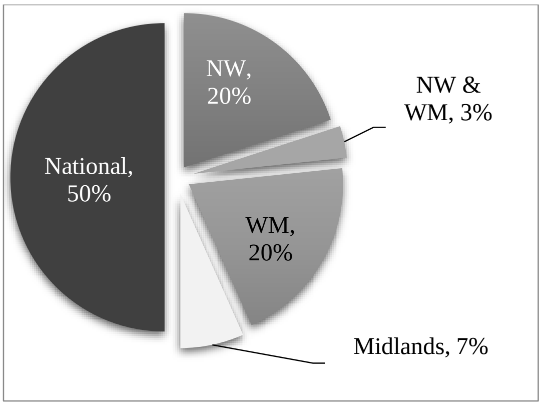

Figure 18: Areas where developer companies built most of their housing. (Source: self-study).

Type of housing:

To gauge the types of homes developers were building, respondents were also asked to indicate the typical price range of their homes as well as the proportion affordable homes they constructed. The minimum price varied widely, ranging from 'below £100,000' to '£200,000', however all respondents selected £275,000 as the top of the range (although higher options in the survey were provided). As desired by the study design, this indicates that none of the builders were building luxury developments. Also, all respondents indicated that their company built affordable homes. Affordable homes made up between 20% and 29% of construction for a majority of the respondents (60%), and between 10% and 19% for a quarter (26.7%) of the participating developers.

Developers were also asked to indicate the typical size of housing developments that their companies built (and were able to select more than one option). The most popular selection was for medium developments (51 - 100 units), which was followed by a 'large', 'very large' and 'small' developments in more or less even proportions (Figure 19). Only few respondents selected the very small (up to 10 units) option, which perhaps reflect the smaller proportion of respondents who were SMEs. None of the developers built individual houses.

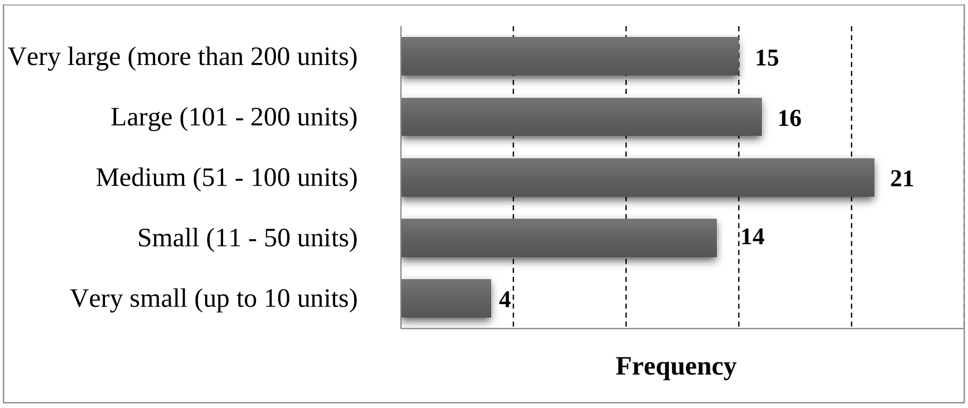

Figure 19: Size of typical housing developments built by the developers (Source: self-study).

7.3.4. Housing Providers – Job roles and length in position

7.3.4.1. Housing associations

Figure 20 shows the job titles of the HA respondents, the majority of which were at the directorship level or higher. The 'other' roles consisted of also high level positions including Assistant Director of Strategy and Regeneration, Head of Asset Management, and Head of Design and Quality.

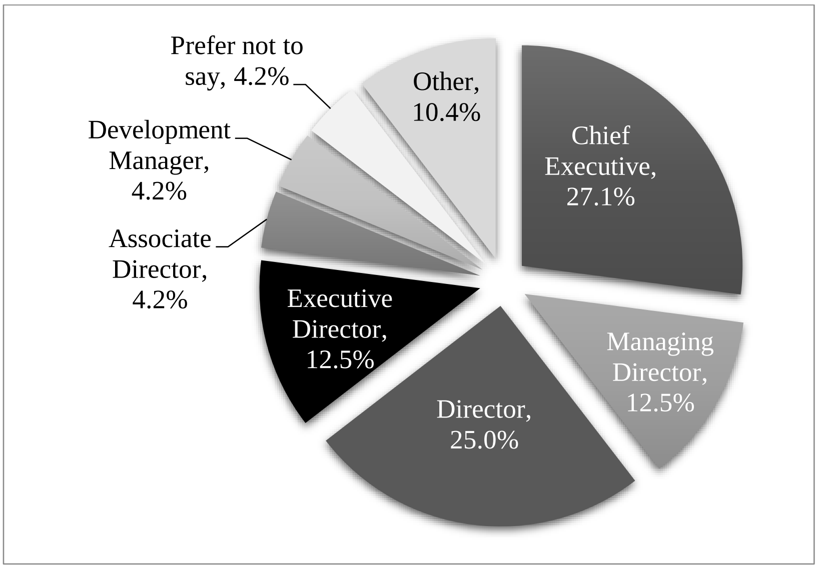

Figure 20: Job roles of housing association respondents (Source: self-study).

All respondents had worked at the organisation for at least over a year. A quarter of the respondents had worked at the organisation for under 5 years, 35.4% between 5 to 10 years and 39.6% had worked at that housing association for more than 10 years.

7.3.4.2. Local Authorities

Around two thirds (61.8%) of the LA respondents' roles were in housing strategy, followed by a fifth (20.6%) who were either a cabinet member or portfolio holder for housing. Small number of respondents worked in planning (8.8%) and housing services (2.9%), while 'other' roles (5.9%) included housing development as well as housing and health roles (figure 21).

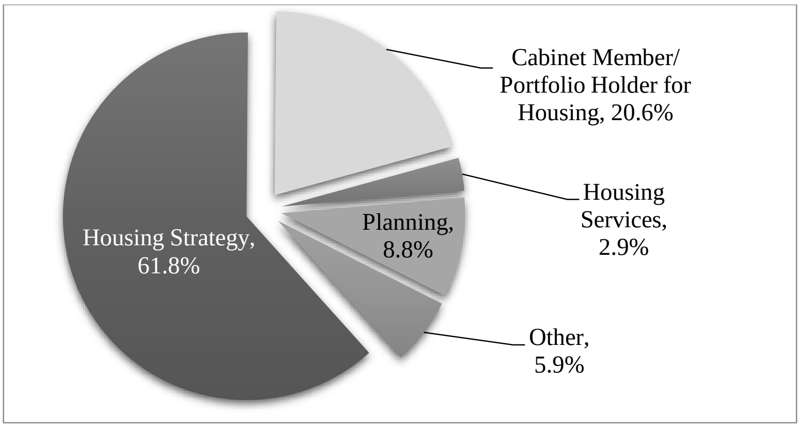

Figure 21: Job roles of local authority respondents (Source: self-study).

Over half (52.9%) of the respondents had worked at the council for more than 10 years, followed by about a quarter (26.5%) who had worked there 5 to 10 years, and about a fifth (17.6%) for 3 to 5 years.

7.3.4.3. Developers

Figure 22 shows the job titles of developer group respondents. About a third (30%) were managing directors and 20% were regional directors, followed by those in chief executive and land director roles (both 13%). In terms of length of employment, just under half (43.3%) of respondents had worked for the organisation for 10 or more years, followed by 23.3% who had worked for 5 – 10 years, 13.3% who had worked for 3-5 years with the remaining 20% working for the company 3 years or less.

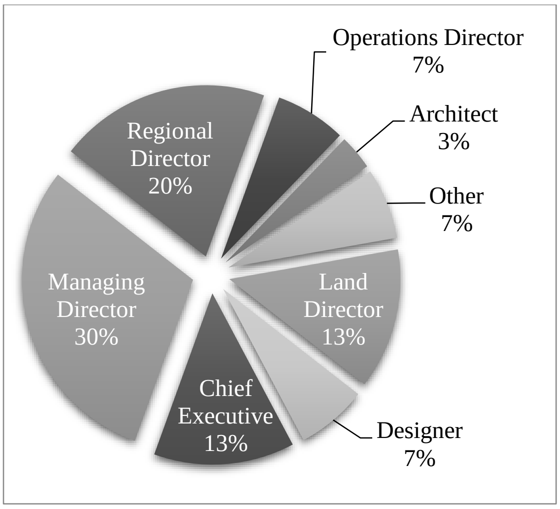

Figure 22: Job roles of private sector respondents (Source: self-study).

7.4. Criteria rating by respondents

Measures of central tendency were used on the rating scores of importance in order to establish the order of importance as indicated by reach group of housing stakeholders.

Standard deviation, which represents the average amount of variability or spread among data scores around the mean, was also calculated. The median (mid-value) is also shown as a useful comparison for the mean, and for clarity, the criteria are rank-ordered from highest to lowest average scores. The results are shown in table 20 followed by a summary.

Ranking:	Criterion:	Mean	SD	Median
HOUSING-USERS				
1st	C1: Suitable indoor space	4.47	0.67	5
2nd	C2: Private outdoor space	4.31	0.91	5
3rd	C6: Accessible and good quality public greenspace	3.80	0.96	4
4th	C7: Attractive views to the outside	3.73	0.84	4
5th	C9: Design features that improve levels of security	3.50	1.07	4
6th	C11:Close to amenities	3.33	1.03	3
7th	C4: Compatibility with local architectural heritage	3.04	1.11	3
8th	C3: Adaptability of the dwelling	2.98	1.12	3
9th	C5: Features for informal socialising	2.89	1.12	3
10th	C8: Opportunities to get involved	2.66	1.09	3
11th	C10: Compact neighbourhood design	2.43	1.09	2
HOUSING ASSOCIATIONS				
1st	C1: Suitable indoor space	4.48	0.58	5
2nd	C9: Security features	4.17	0.69	4
3rd	C11: Close to amenities	3.94	0.73	4
4th	C6: Accessible public greenspace	3.67	0.86	4
5th	C2: Private outdoor space	3.65	0.67	4
6th	C3: Adaptability	3.56	0.85	3.5
7th	C8: Opportunities to get involved	3.48	1.15	4
8th	C4: Compatibility with local architectural heritage	3.21	0.82	3
9th	C5: Features for informal socialising	3.06	0.81	3
10th	C7: Attractive views to the outside	3.06	0.91	3
11th	C10: Compact neighbourhood design	1.94	0.84	2
LOCAL AUTHORITIES				
1st	C1Suitable indoor space	4.15	0.66	4
2nd	C9Security features	3.94	0.69	4
3rd	C3Adaptability	3.88	0.95	4
4th	C11Close to amenities	3.88	0.81	4
5th	C6Accessible public greenspace	3.56	0.86	4
6th	C2Private outdoor space	3.53	0.71	4
7th	C8Opportunities to get involved	3.47	0.83	3.5
8th	C4Compatibility with local architectural heritage	3.24	0.86	3
9th	C7Attractive views to the outside	2.85	0.78	3
10th	C5Features for informal socialising	2.82	0.80	3
11th	C10Compact neighbourhood design	2.32	0.95	2

DEVELOPERS				
1st	C1: Suitable indoor space	4.60	0.50	5
2nd	C2: Private outdoor space	3.90	0.80	4
3rd	C11: Close to amenities	3.73	0.94	4
4th	C6: Accessible public greenspace	3.63	1.03	3.5
5th	C9: Security features	3.60	0.86	4
6th	C4: Compatibility with local architectural heritage	3.57	0.97	3.5
7th	C7: Attractive views to the outside	3.57	0.90	3
8th	C5: Features for informal socialising	3.23	1.10	3
9th	C3: Adaptability	2.83	0.99	3
10th	C8: Opportunities to get involved	2.27	0.91	2
11th	C10: Compact neighbourhood design	1.93	0.83	2

Table 20: Rating scores provided by the four stakeholder groups.

A schematic representation of ratings by the four stakeholder groups is presented by figure 23.

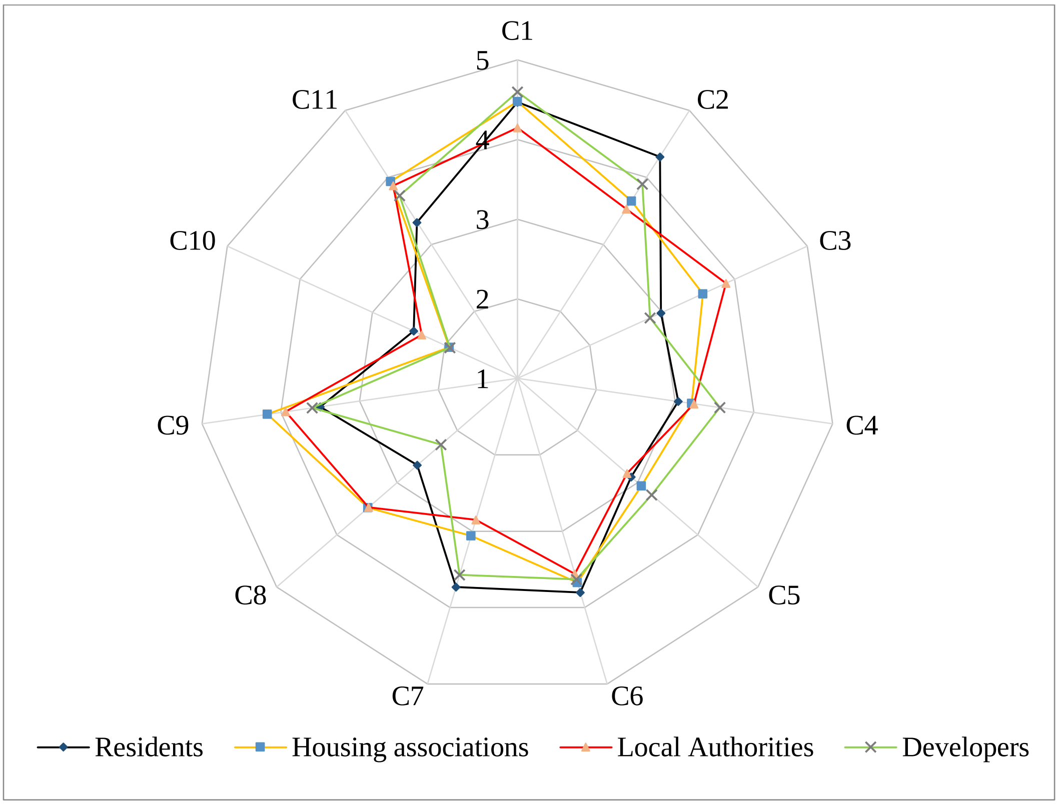

Figure 23: Summary schematic showing the importance ratings for the 11 soft features given by the four stakeholder groups. (Source: self-study).

Respondents in the developer group used the widest part of the rating scale (M = 4.6 to M = 1.93), followed by housing associations (M = 4.48 to M = 1.94), housing-users (M = 4.47 to M = 2.04), and lastly local authority respondents who used the smallest part of the scale (M = 4.15 to M = 2.32). This suggests that the latter found the criteria more similar in importance than did the other stakeholder groups, particularly developers, whose wider use of the rating scale suggests a broader range of opinion.

All groups rated C1 (indoor space) as the most important feature. Standard deviation was also relatively low among all stakeholders indicating low variation, and therefore high agreement, in the scoring (it was lowest for developers, SD = 0.50 and highest for housing-users SD = 0.67). Of the four groups, developers gave C1 the highest average score (M = 4.60) followed by housing associations (M = 4.48), housing-users (M = 4.47), and lastly local authorities (M = 4.15).

C2 (outdoor space) was rated second in importance by both the housing-users and developers, although housing-users gave this feature a higher average score (M = 4.31, SD = 0.91) than did the developers (M = 3.90, SD = 0.80). On the other hand, this criterion was marked only as fifth in importance for housing associations (M = 3.65, SD = 0.67) and sixth by local authorities (M = 3.53, SD = 0.71). Both social housing providers rated C9 (security features) in second place of importance, while this criterion came fifth in importance for both housing-users (M = 3.50, SD = 1.07) and developers (M = 3.60, SD = 0.86).

The third place in terms of importance was allocated by the housing-users group to C6 (greenspace) (M = 3.80, SD = 0.96). Which was rated similarly - fourth in importance - by both housing associations (M = 3.67, SD = 0.86) and developers (M = 3.63, SD = 1.03), and a little lower in importance – fifth – by local authorities (M = 3.56, SD =0.86).

Interestingly, housing-users rated C7 (attractive views) as fourth in importance (M = 3.73, SD = 0.84) while all housing providers, but particularly social housing providers marked this much lower in importance; with housing associations scoring it 10th (M = 3.06, SD = 0.91), local authorities scoring it 9th (M = 2.82, SD = 0.78) and developers scoring it 7th (M = 3.57, SD = 0.90). From the mean scores however it can be seen that out of the three housing provider groups, developers gave this feature the highest rating and local authorities the lowest.

Another interesting point to note is the difference in level of importance allocated to C11 (amenities). Housing-users placed this feature in the middle place, sixth, with a mean score of 3.33 (SD = 1.03). However all of the housing providers allocated a higher level of importance to this feature – both housing associations and developers placed it in third place (M = 3.94, SD =0.73 and M = 3.73, SD =0.94 respectively) and local authorities in fourth place (M = 3.88, SD = 0.81). In terms of mean scores, housing associations gave it the highest score, followed by local authorities and developers – all scoring it higher than housing-users.

Local authorities differed from all the other stakeholder groups in the relatively high level of importance they allocated to C3 (adaptability). This group marked C3 as third in importance with the mean score of 3.88 (SD = 0.95). Housing-users allocated this feature to 8th place with a relatively low score of 2.98 (SD =1.12). Similarly, developers placed it 9th with the mean score of 2.83 (SD =0.99), while housing associations have it slightly higher rating of 3.56 (SD =0.85) placing it 6th.

No major differences can be seen in the ratings given to C4 (compatibility). Both social housing providers placed this feature in 8th position with housing associations scoring it an average of 3.21 (SD =0.82) and local authorities, 3.24 (SD =0.86). Housing-users scored this lower at 3.04 (SD =1.11), ranking it in 7th place. Among the four groups, developers gave it the highest scoring of 3.56 (SD =0.97), placing it in 6th position of relative importance.

C5 (features for informal socialising) and C8 (involvement) were scored low by all groups. C5 received the average score of 2.89 (SD = 1.12) by the housing-users, placing it in the 9th position, while housing associations placed it in the same position with the average score of 3.06 (SD = 0.81). Local authorities C5 in the 10th position of relative importance with scores of 2.82 (SD = 0.80), while developers marked it slightly higher with 3.23 (SD = 1.10) placing it in 8th position.

For C8 (involvement), both of the social housing providers placed this in the 7th position with housing associations scoring it 3.48 (SD =1.15) and local authorities scoring it similarly with 3.47 (SD =0.83). Housing-users and developers both placed C8 in the lower 10th position, with the former giving this feature a slightly higher average score of 2.66 (SD =1.09) than the latter group who scored it as 2.27 (SD =0.91).

Lastly, all groups placed C10 (compactness) as the last in the list of relative importance. In terms of the mean scores, housing-users scored this as highest of the four groups at 2.43 (SD = 1.09), followed by local authorities at 2.32 (SD =0.95), with housing association and developers giving it very similar scores of 1.94 (SD =0.84) and 1.93 (SD = 0.83) respectively.

7.4.1. *Criteria weights*

In order to establish how important the criteria are relative to each other, i.e. weight of the criteria, the weighted mean was calculated. This was done by dividing each mean by the sum of the 11 means and the resulting values are shown in table 21.

C#	Criterion description	Housing-users		Housing associations		Local Authorities		Developers	
		Mean	Weight	Mean	Weight	Mean	Weight	Mean	Weight
C1	Suitable indoor space	4.47	0.12	4.48	0.12	4.15	0.11	4.6	0.12
C2	Private outdoor space	4.31	0.12	3.65	0.10	3.53	0.09	3.9	0.11
C3	Adaptability of the dwelling for future needs of the household	2.98	0.08	3.56	0.09	3.88	0.10	2.83	0.08
C4	Compatibility with local architectural heritage and cultural styles	3.04	0.08	3.21	0.08	3.24	0.09	3.57	0.10
C5	Features in the neighbourhood for informal socialising	2.89	0.08	3.06	0.08	2.82	0.07	3.23	0.09
C6	Accessible and good quality public greenspace	3.8	0.10	3.67	0.10	3.56	0.09	3.63	0.10
C7	Attractive views to the outside	3.73	0.10	3.06	0.08	2.85	0.08	3.57	0.10
C8	Opportunities to get involved	2.66	0.07	3.48	0.09	3.47	0.09	2.27	0.06
C9	House and neighbourhood design features that improve levels of security	3.5	0.09	4.17	0.11	3.94	0.10	3.6	0.10
C10	A more compact (higher density) neighbourhood design	2.43	0.07	1.94	0.05	2.32	0.06	1.93	0.05
C11	Close to amenities	3.33	0.09	3.94	0.10	3.88	0.10	3.73	0.10
	Sum(Σ=)	**37.14**	**1**	**38.22**	**1**	**37.64**	**1**	**36.86**	**1**

Table 21: Importance weights of criteria according to the four stakeholder groups.

7.5. Current provision of features

Respondents were asked about the current provision of the soft design features. For the housing-users' group this was phrased with respect to their *current housing*, while for the housing provider groups, the question was phrased as the "*extent to which their organisations integrated these features in the design and development of new housing*".

7.5.1. *Does the current home and neighbourhood of the housing-users provide the features?*

Respondents were asked to indicate whether their current homes and neighbourhoods provided for the 11 soft criteria, and if they did not, whether or not this was an important issue to them. This section was left incomplete by 6 of the respondents - these responses were removed from analysis. Respondents' answers are shown in figure 24.

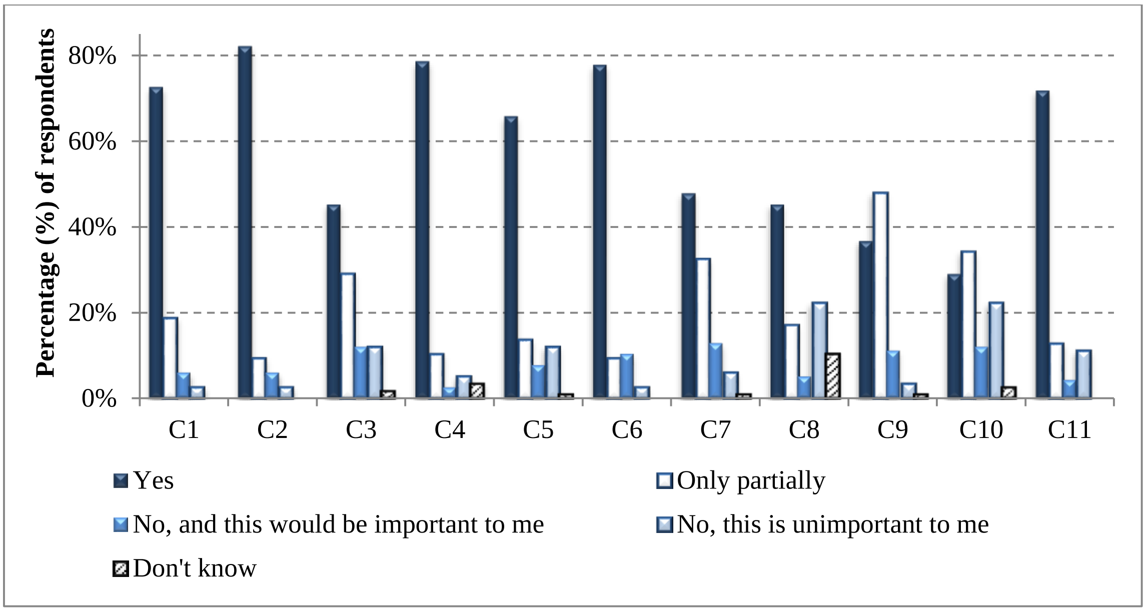

Figure 24: Provision of features in current homes and neighbourhoods of resident-group respondents (Source: self-study).

With the exception of two criteria, C9 (secure design) and C10 (compact), majority of respondents thought that these design features were largely provided by their homes and neighbourhoods. For both C9 and C10, the largest of proportion of respondents thought that these features existed only partially (47.9% and 34.2% respectively). However, a more telling distinction between these two criteria is a much larger proportion (22.2%) of respondents who answered that C10 (compact) would be unimportant to them, compared to the few (3.4%) who answered that C9 (secure design). This seems to indicate, as with previous answers and comments, the low popularity of compact neighbourhoods.

7.5.2. Provision of features by housing associations

Housing association respondents were asked to what extent they thought that the different features were being taken into account by their organisation in the design and delivery of general needs housing developments. A summary of results is shown in figure 25.

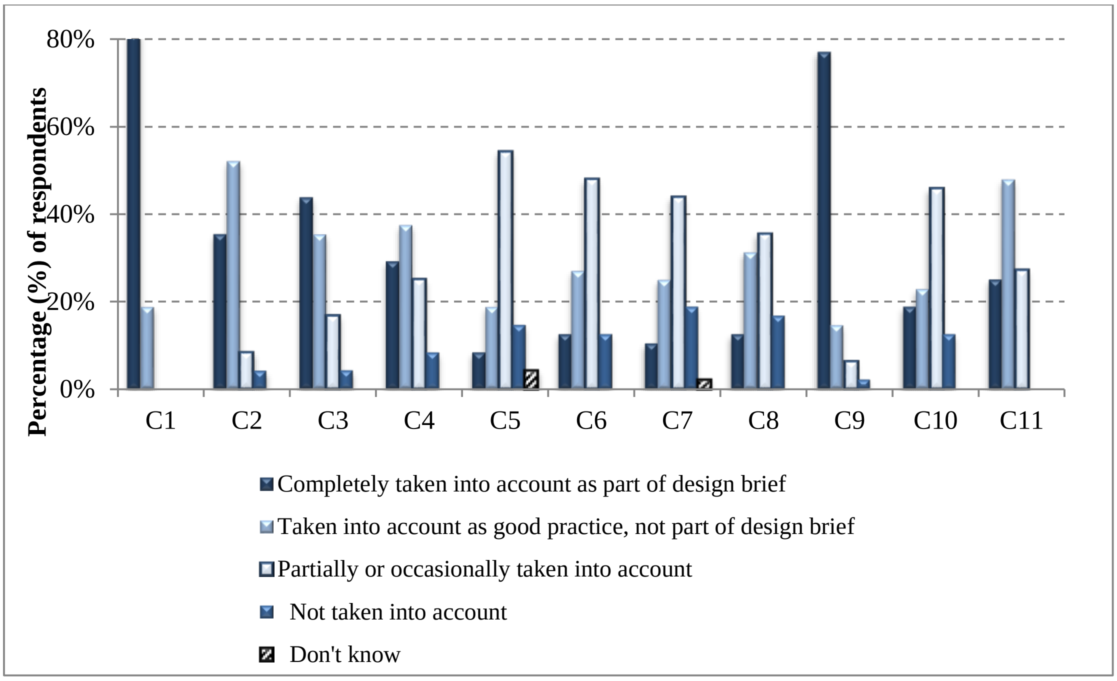

Figure 25: Provision of features by housing associations for general needs housing. (Source: self-study).

C1 (Indoor space), C3 (Adaptability) and C9 (Security) were the three features that the majority of respondents stated were completely taken into account as part of the design brief (81.3%, 43.8% and 77.1% respectively). C2 (outdoor space), C4 (compatibility), and C11 (access to amenities), were taken into account more as good practice and were not part of the design brief. The remaining criteria - C5 (features for social interaction), C6 (greenspace), C7 (Attractive views), C10 (Compact) and C8 (engagement) – were only partially or occasionally taken into account by the respondents' organisations.

7.5.3. Provision of features by local authorities

Local authority respondents were asked to what extent they thought that the different features were being taken into account by their council in the design and delivery of housing. While all respondents answered these questions, about a third (29.4%) marked this question 'not applicable', presumably because their council is not building housing. These answers were taken out of the summary of results (figure 26) for clarity.

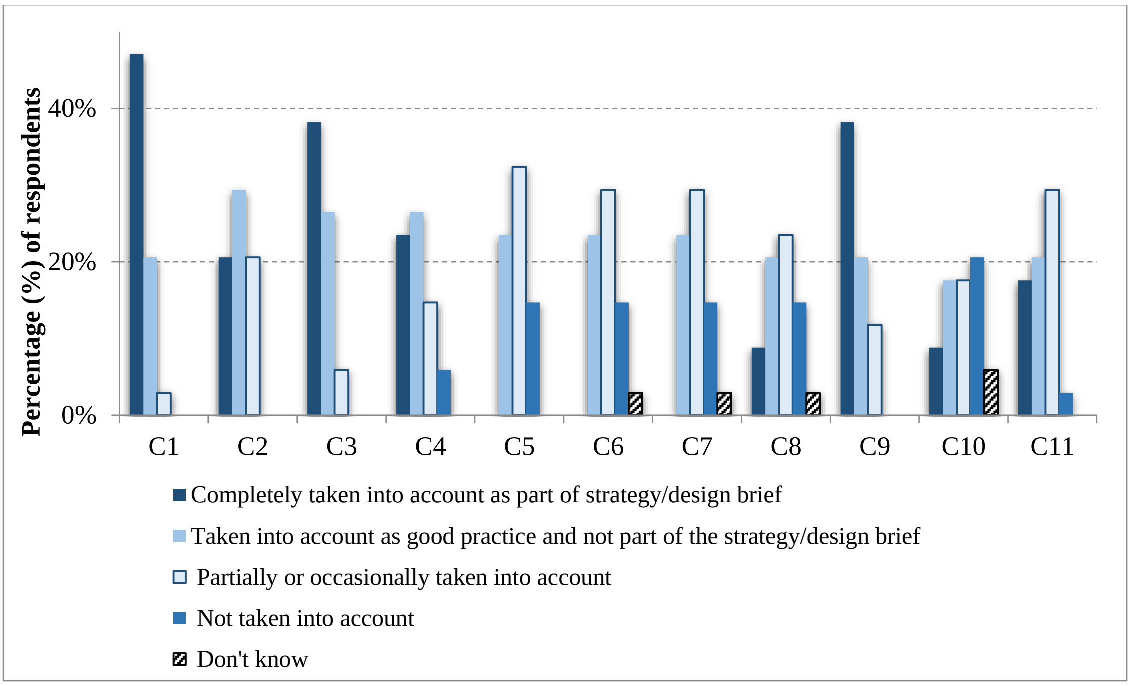

Figure 26: Provision of features by local authorities for council housing. (Source: self-study).

Three features – C1 (indoor space), C3 (adaptability) and C9 (security) - were marked by most local authority respondents as being completely taken into account as they are part of the council's strategy/design brief. C2 (outdoor space) and C4 (compatibility) were more likely to be taken into account as good practice but were not part of the housing strategy or design brief. While C5 (features for social interaction), C6 (greenspace), C7 (attractive views), C8 (engagement) and C11 (amenities) were largely taken into account only partially or occasionally. Interestingly, for C10 (compactness) most respondents (20.5%) indicated that this was not taken into account, although only a slightly smaller proportion of respondents said this was only occasionally taken into account or taken into account as good practice and not part of their strategy or design brief (17.6% each)

7.5.4. Provision of features by developers

Respondents from private house building companies were asked to what extent they thought the features were taken into account in the typical housing developments built by their company. Figure 27 shows a summary of their responses.

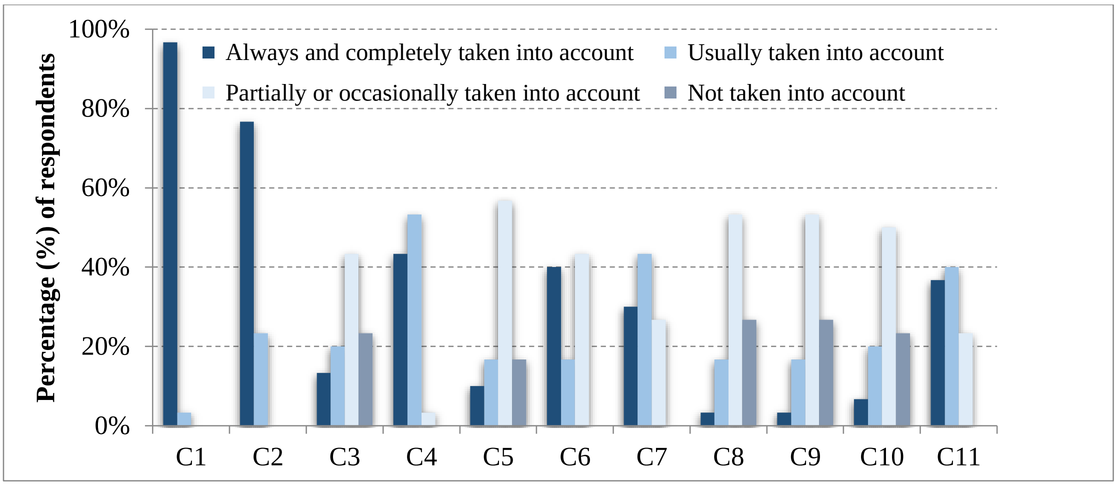

Figure 27: Provision of features by developers in typical housing developments. (Source: self-study).

C1 (indoor space) and C2 (outdoor space) were marked as the two main factors that were always and completely taken into account (96.7% and 76.7% respectively) by the developer companies. C4 (compatibility), C7 (attractive views) and C11 (amenities) were usually taken onto account (53.3%, 43.3% and 40.0% respectively), although a large proportion of respondents also stated that these criteria were always taken into account (43.3%, 30.0% and 36.7% respectively). The remaining criteria C3 (adaptability), C5 (social interaction), C6 (greenspace), C8 (engagement), C9 (security) and C10 (compactness) were only partially or occasionally taken into account according to the majority of respondents (43.3%, 56.7%, 43.3%, 53.3%, 53.3% and 50.0% respectively) with the exception of C6 (greenspace) where a large proportion of respondents also said this was always and completely taken into account (40.0%).

7.5.5. Summary of provision

With the exception of C9 (security) and C10 (compactness), the housing-users group thought that all of the features were provided in their current housing or neighbourhood. More interesting comparisons can be noted among the three housing provider groups, a summary of which is illustrated by figure 28.

<table>
<tr><th></th><th>Local Authorities</th><th>Housing Associations</th><th>Developers</th></tr>
<tr><td rowspan="3">Always taken into account (as part of strategy/design brief)</td><td colspan="3">C1 (indoor space)</td></tr>
<tr><td colspan="2">C3 (adaptability)</td><td rowspan="2">C2 (outdoor space)</td></tr>
<tr><td colspan="2">C9 (Secure)</td></tr>
<tr><td rowspan="2">Usually taken into account as good practice</td><td colspan="3">C4 (compatibility)</td></tr>
<tr><td colspan="2">C2 (outdoor space)</td><td>C7 (attractive views)</td></tr>
</table>

		C11 (amenities)	
Partially/occasionally taken into account	C5 (social interaction)		
	C6 (greenspace)		
	C8 (engagement)		
	C7 (attractive views)		C3 (adaptability)
	C11 (amenities)	C10 (compactness)	
			C9 (Secure)
Not taken into account	C10 (compactness)		

Figure 28: The extent to which the soft features are taken into account by the housing providers' organisations. (Source: self-study).

All housing providers stated that C1 (indoor space) was always taken into account. Unsurprisingly, both of the social housing providers agreed that C3 (adaptability) and C9 (security) were also always taken into account, while developers marked C2 (outdoor space) (not C3 and C9) as the other feature always taken into account.

All housing providers saw C4 (compatibility) as a feature that was usually into account (in the case of developers) or taken into account as good practice rather than as part of design brief (social housing providers). Both social housing providers regarded C2 (outdoor space) as a feature that was taken into account as best practice rather than design brief. Developers also usually took C7 (attractive views) and C11 (access to amenities) into account. The latter was also taken into account as best practice (but not design brief) by housing associations but not local authorities.

The remaining criteria were largely considered to be taken into account only partially or occasionally. All housing providers placed C5 (social interaction), C6 (greenspace) and C8 (engagement) into this category. Interestingly, both social housing providers placed C7 (attractive views) as a feature that was only partially or occasionally taken into account while developers saw this as something usually taken into account. For local authorities, C11 (access to amenities) was a feature taken into account less often than by housing associations or developers.

The largest difference in terms of provision among the different housing providers were C3 (adaptability) and C9 (security). While both social housing providers considered these to be always and completely taken into account by their organisations as part of the design brief, for developers these two features were only partially or occasionally taken into account.

Lastly C10 (compactness) was elected as a feature taken into account only partially or occasionally by both developers and housing associations. Whereas a comparatively large proportion of local authority respondents stated that C10 (compactness) was not taken into account.

7.6. Other features of importance suggested by respondents

The respondents were also given the opportunity to suggest any other housing and/or immediate neighbourhood features that they felt were important to housing-users' well-being and satisfaction with their home. These comments were content analysed and coded into categories.

7.6.1. Suggestions by the housing-users group

A third of the resident group respondents (33%, 41) chose to leave a suggestion. Categories suggested two or more times are shown in figure 29.

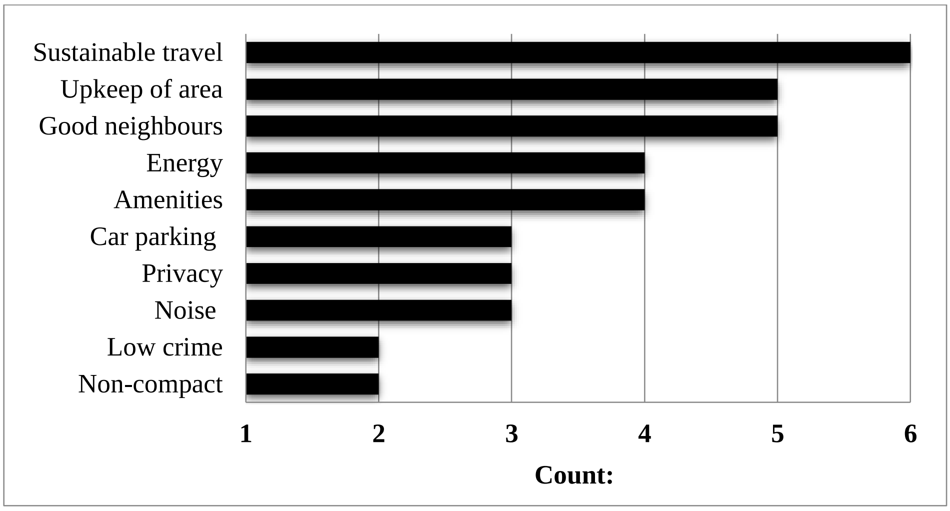

Figure 29: Suggestions of other 'soft' features by housing users (Source: self-study).

The most frequently mentioned feature by the respondents was coded as **'sustainable travel'**. None of the respondents used this phrase specifically, but articulated the importance of safely walking, cycling or accessing some form of public transport links was mentioned frequently in the comments. This was followed by the desire to see good **'upkeeping of the area'** in terms of clean and litter-free streets, mowed grass and lighting. The same frequency of suggestions was coded under **'good neighbours'** – "demographics of neighbours" and "no anti-social neighbours" are examples of the terminology used. **'Energy'** included the preference for energy efficient housing and/or some form of renewable energy. Equal number of comments were made regarding availability of private **'parking'**, **'privacy'** and being away from sources of **'noise'**. Lastly, a number of people stressed their dislike of compact neighbourhood design.

Two of the suggested categories can be subsumed by the list of 'soft' criteria already presented. A number of respondents mentioned access to amenities, particularly schools, in the area, but as education was included under the C11 'Close to amenities' criterion – these suggestions were regarded as repetition. Similarly, mentions of 'low-crime' were considered as falling under the C9 'Secure design' criterion.

7.6.2. Suggestions by housing association respondents

Almost half (47.9%, 23) of the housing association respondents chose to leave a suggestion for other features. **Energy efficiency** was the most frequently mentioned feature, and which was also articulated as affordable warmth and renewable or green energy. This was followed by access to **transport links**. Other suggestions included fast broadband, safety and age-friendly neighbourhood design. Good quality kitchens, bathrooms and attractive design suggestions were all grouped under the **'high quality design'** category. Few respondents mentioned the importance of **'parking'** and **'employment opportunities'**. Some of the suggestions were already included in the set of soft criteria and these were different types of **'amenities'** (schools, shops, healthcare etc.) as well as the need for **'consultation and involvement'**.

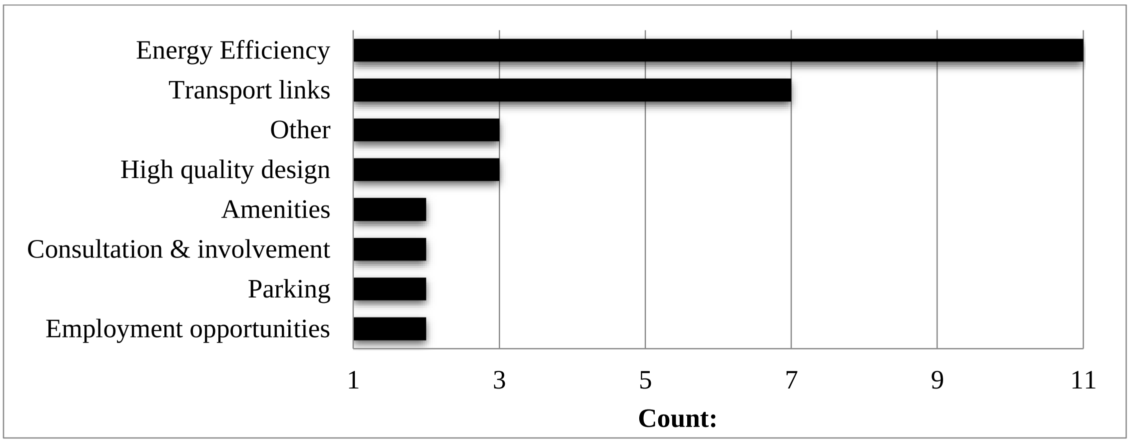

Figure 30: Suggestions of other 'soft' features by housing associations (Source: self-study).

7.6.3. Suggestions by local authority respondents

A third (32.4%, 11) of the local authority respondents chose to leave a comment. The most frequently mentioned issue (6 counts) was that of **'energy efficiency'**, and as with housing association respondents, this was often mentioned in terms of cost of heating and fuel poverty. Other suggestions mentioned included suitability of dwelling for the elderly and ethnic minority groups, indoor space, access to amenities, public transport and parking.

7.6.4. Suggestions by developer group

40% (12) of the developers left a suggestion for other features. The most frequently mentioned factor was **'external design'** (5 counts), followed by internal design aspects such as layout and design and build quality. Other features mentioned (with equally low frequency) included access to public transport, good footpath links, design of the development, energy efficiency and parking.

7.6.5. Summary of suggested features

Only very tentative comparisons can be made in this section as the number of people choosing to make a suggestion was low. However, given that a respondent would choose to make a suggestion, indicates that she or he felt it was of particular importance.

The most frequently suggested additional feature by the housing-users was some form of 'sustainable travel'. This was most closely matched by the housing association respondents, where it came second in terms of the most frequently mentioned feature. Upkeep and attractiveness of the area was also often mentioned by the housing-users, and this matched most closely to developers' suggestion that attractive external design was of importance. That energy efficiency came highest for both local authority and housing association respondents is perhaps not surprising given the prominence of fuel poverty as a major policy issue. This was also of importance to the housing-users group, but it came fourth in terms of frequency of mention, the same as access to 'amenities', but less than 'sustainable travel', 'upkeep of the area', and 'good neighbours'.

7.7. Level of agreement within each stakeholder group (Intra-Class Correlation)

Before statistical tests are performed to compare the opinions of different stakeholder groups, it is first worth establishing the IRR or the degree of agreement among the respondents within each group. ICC (see section 5.7.4.4.2) was utilised to illustrate this level of agreement. ICC value can range from 0 (no agreement) to 1 (complete agreement) and commonly used cut-offs are follows; the IRR is considered poor for ICC values less than .40, 'fair' for values between .40 and .59 good for values between .60 and .74 and excellent for values between .75 and 1.0 (cited in Hallgren, 2012).

Table 22 shows average-measures ICC values for the four stakeholder groups. The IRR is considered to be excellent for all groups as the ICC values are above 0.9. While we are more interested in the 'absolute agreement' values (see explanation in section 5.7.4.4.2), the high consistency values indicate that there is high level of agreement in terms of the rank order of the 11 features as well as the absolute values of 'importance' assigned to them by the respondents.

Stakeholder group	Average measures ICC	
	Consistency	Absolute agreement
Housing-users	0.984	0.981
Housing associations	0.974	0.969
Local Authorities	0.947	0.939
Developers	0.968	0.953

Table 22: Average-measures ICC values for each stakeholder group.

7.8. Comparison of stakeholder opinions using non-parametric tests

Non-parametric tests were employed to investigate whether there were any statistically significant differences in the ratings of importance given by the different stakeholder groups (these tests are schematically illustrated by figure 31). This section begins by investigating any initial differences between the two main groups – housing-users and housing providers, before delving into the differences in opinion among the four groups. Separate tests are then carried out between the three different providers as well as between age and gender subgroups of housing-users and housing providers.

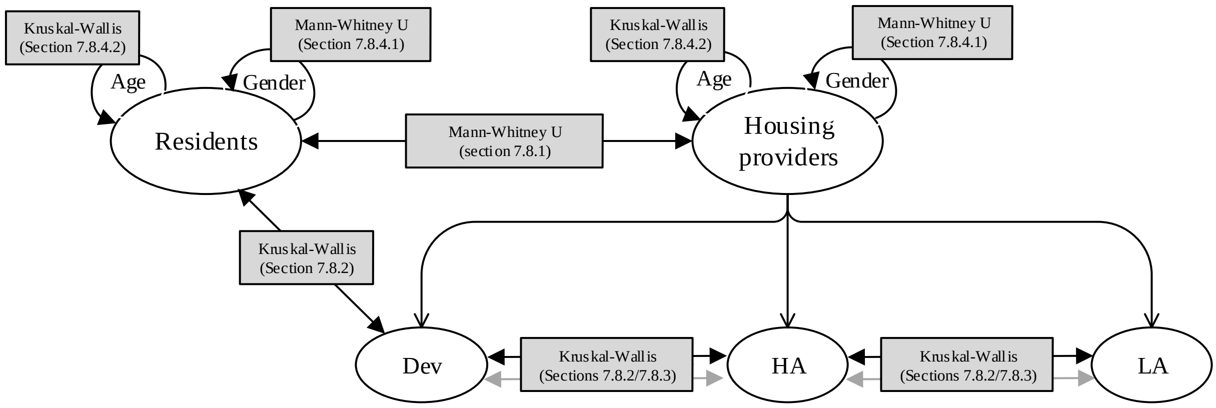

Figure 31: An illustrative summary of the non-parametric tests used to explore differences in opinion among the different stakeholder groups. (Source: self-study).

7.8.1. Comparing the opinions of housing-users' and housing providers' groups (Mann-Whitney U test)

Using SPSS, Mann-Whitney U test was carried out for each criterion in order to determine whether there is a statistically significant difference between the levels of importance provided by the housing-users group (n=123) and the housing providers (n=112, i.e. developers, housing associations and local authorities). Using significance (α) level of 0.05, the null hypothesis (H_0) for each criterion is as follows:

> *H_0: There is no tendency for the ranking by housing-users to be significantly higher or lower than for the housing providers.*

To provide a measure of the size of the difference, the effect size (*r*) for each criterion was also calculated using the equation (where *z* is the corresponding *z* value and *N*=235):

$$r = \frac{z}{\sqrt{N}} \qquad (2)$$

The results, including the test statistic (*U* value), effect size (r), *z*-value, *p*-value and the resulting decision regarding H_0 are shown in table 23.

Criterion	Stakeholder Group	Mean Rank	Mdn	*U*-value	Effect size (*r*)	*z*-value	*p*-value	Decision
C1: Suitable indoor space	Housing provider	113.55	4	6,390	-0.07	-1.077	0.281	Retain H_0
	Resident	122.05	5					
C2: Private outdoor space	Housing provider	90.50	4	3,808	-0.41	-6.276	0.000	Reject H_0
	Resident	143.04	5					
C3: Adaptability	Housing provider	132.34	3	5,282	-0.21	-3.206	0.001	Reject H_0
	Resident	104.94	3					
C4: Compatibility architectural heritage	Housing provider	126.08	3	5,984	-0.12	-1.821	0.069	Retain H_0
	Resident	110.65	3					
C5: Features for informal socialising	Housing provider	122.82	3	6,349	-0.07	-1.091	0.275	Retain H_0
	Resident	113.61	3					
C6: Accessible public greenspace	Housing provider	110.76	4	6,078	-0.11	-1.638	0.101	Retain H_0
	Resident	124.59	4					
C7: Attractive views to outside	Housing provider	95.64	3	4,384	-0.33	-5.069	0.000	Reject H_0
	Resident	138.36	4					
C8: Opportunities to get involved	Housing provider	133.27	3	5,178	-0.22	-3.401	0.001	Reject H_0
	Resident	104.09	3					
C9: Security features	Housing provider	132.07	4	5,313	-0.21	-3.190	0.001	Reject H_0
	Resident	105.19	4					
C10: Compact neighbourhood design	Housing provider	106.46	2	5,595	-0.17	-2.594	0.009	Reject H_0
	Resident	128.51	2					
C11: Proximity to amenities	Housing provider	136.36	4	4,832	-0.27	-4.162	0.000	Reject H_0
	Resident	101.28	3					

Table 23: Results of Mann-Whitney U test showing the statistically significant differences between the levels of importance according to the housing-users group and the housing providers.

The *p*-values for four of the criteria (C1, C4, C5 and C6) were greater than 0.05. The H_0 for these criteria therefore cannot be rejected, indicating that there is no statistical difference in the rating of these features by housing-users and housing providers.

For the remaining seven criteria, the p-value is much less than 0.05 and the H_0 can therefore be rejected indicating that there is a statistically significant difference between the two groups. Indeed, for C2, C7 and C11, *p* is below 0.001 indicating a very high statistical significance. Housing-users gave higher scores (indicated by the higher mean ranks) to C2 (private outdoor space), C7 (attractive views) and C10 (compact neighbourhood design). Conversely, housing providers gave higher scores to C3 (adaptability), C8 (opportunities to get involved), C9 (security features) and C11 (proximity to amenities).

The effect sizes (*r* values) for all seven of the criteria are in the small to medium range of effect[3]. C2 (private outdoor space) has the highest effect size at magnitude of 0.41, followed by C7 (attractive views), C11 (proximity to amenities), C8 (opportunities to get involved), C3 (adaptability) and C9 (security) being equivalent in effect size, and C10 (compactness) coming last and thus representing the smallest effect size.

7.8.2. Comparing the opinions between all four stakeholder groups (Kruskal-Wallis test)

The Kruskal-Wallis test was utilised to explore whether there are any differences in opinion among all four housing stakeholder groups, that is the housing-users and the three different housing providers.

As before, using significance (α) level of 0.05, the null hypothesis (H_0) for each criterion is as follows:

> *H_0: There is no tendency for the ranking to be significantly higher or lower among the four groups of housing stakeholders.*

The results, including the test statistic (H value), degrees of freedom (df), p-value and the resulting decision regarding H_0 are shown in table 24

Criterion	***H*-value**	**df**	***p*-value**	**Decision**
C1: Suitable indoor space	9.777	3	0.021	Reject H_0
C2: Private outdoor space	42.667	3	0.000	Reject H_0
C3: Adaptability	29.344	3	0.000	Reject H_0
C4: Compatibility architectural heritage	5.620	3	0.132	Retain H_0
C5: Features for informal socialising	3.733	3	0.292	Retain H_0
C6: Accessible public greenspace	2.984	3	0.394	Retain H_0

[3] Following Cohen's (1988) criteria of 0.1=small effect, 0.3=medium effect and 0.5=large effect.

C7: Attractive views outside	34.358	3	0.000	Reject H_0
C8: Opportunities to get involved	37.003	3	0.000	Reject H_0
C9: Security features	17.300	3	0.001	Reject H_0
C10: Compact neighbourhood design	10.351	3	0.016	Reject H_0
C11: Proximity to amenities	17.967	3	0.000	Reject H_0

Table 24: Results of the Kruskal-Wallis test showing statistically significant differences in opinion among the four housing stakeholder groups.

Only three criteria (C4, C5 and C6) had a p-value over 0.05 and so for these features the H_0 cannot be rejected, as there is no statistical difference in the rating of these features among the four housing stakeholders. However, the p-values for the remaining criteria were much lower than 0.05 making it necessary to reject the null hypothesis as the rating of at least one group is statistically significant from the others. To determine which group(s) differed, a follow-up Mann-Whitney U test was carried out) using the adjusted α level of **0.0125** (=0.05/4) (Bonferroni adjustment, see section 5.7.4.3)).

The null hypothesis for each comparison is as follows:

> *H_0 = there is no difference in the distribution of score rankings between these two groups.*

Full SPSS outputs of all pairwise comparisons can be found in Appendix III - table 25 below only shows the groups with statistically significant differences (i.e. where p< 0.0125). The results for each group pair comparison, including the test statistic (difference between mean ranks), the adjusted *p*-values, effect size (*r*) and subsequent decision regarding H_0 are as follows:

Criterion	**Pairwise comparison of:**	**Test Statistic**	**Adj sig (p-value)**	**Effect size calculation:**			**Decision**
				z	**N**	**= r**	
C2: Private outdoor space	LA vs Res	-63.427	0.000	-5.107	157	-0.41	Reject H_0
	HA vs Res	-55.649	0.000	-5.101	171	-0.39	Reject H_0
C3: Adaptability	Dev vs HA	-47.348	0.011	-3.108	78	-0.35	Reject H_0
	LA vs Dev	-70.390	0.000	-4.293	64	-0.54	Reject H_0
	LA vs Res	56.135	0.000	4.426	157	0.35	Reject H_0
C7: Attractive views outside	LA vs Res	-61.215	0.000	-4.895	157	-0.39	Reject H_0
	HA vs Res	-47.133	0.000	-4.291	171	-0.33	Reject H_0
C8: Opportunities to get involved	Dev vs HA	-69.894	0.000	-4.572	78	-0.52	Reject H_0
	Dev vs LA	-71.761	0.000	-4.361	64	-0.55	Reject H_0
	HA vs Res	47.334	0.000	4.234	78	0.48	Reject H_0
	LA vs Res	49.201	0.001	3.866	157	0.31	Reject H_0
C9: Security features	HA vs Res	42.809	0.001	3.900	171	0.30	Reject H_0
C11: Proximity to amenities	HA vs Res	38.861	0.002	3.539	171	0.27	Reject H_0

Table 25: Results of post hoc pairwise comparisons (significant values only) for the Kruskal Wallis test to investigate difference in opinion between the four stakeholder groups.

Follow up tests revealed no statistically significant ($p > 0.0125$) difference among pairwise comparisons for C1 and C10 (see Appendix III). A number of groups did differ in their opinions for the remaining six criteria:

Most of the differences in opinion were found for the C8 (opportunities to get involved) criterion with all four of the pairwise group comparisons (out of 6) showing statistically significant differences in their rating of importance. These differences are illustrated by figure 32 below, with the rank sum value shown below each of the stakeholder nodes and grey lines illustrating the statistically significant differences.

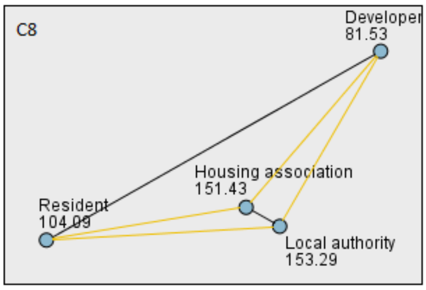

Figure 32: Pairwise comparisons of stakeholder opinions for C8 (Source: SPSS output).

Both developers and housing-users rated C8 lower in importance compared to housing associations and local authorities, with the latter giving the highest rates among all four stakeholder groups, while developers gave the lowest.

For C3 (adaptability), three of the six pairwise comparisons showed statistically significant differences, and these are illustrated (yellow lines) together with rank sum for each group by figure 33. Both developers and housing-users rated C3 lower than did housing associations and local authorities, the latter rating it highest among the four stakeholder groups.

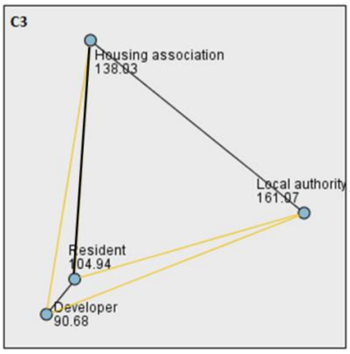

Figure 33: Pairwise comparisons of stakeholder opinions for C3 (Source: SPSS output).

Post-hoc tests revealed statistically significant differences for two pairwise comparisons for both C2 (outdoor space) and C7 (attractive views). The groups that differed as well as the corresponding rank sums are illustrated by figures 34. For both C2 and C7, local authorities gave lowest ratings followed by housing associations, while housing-users rated these features highest.

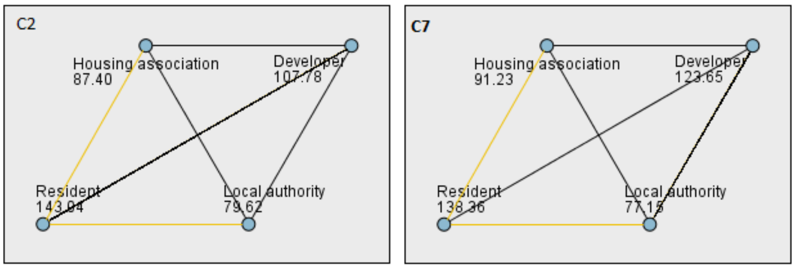

Figure 34: Pairwise comparisons of stakeholder opinions for C2 and C7 (Source: SPSS output).

Least difference was observed for C9 (security) and C11 (amenities) where only one pairwise comparison showed statistically significant difference; for both criteria a statistically significant difference in opinion was found between the housing-users and housing associations. Housing associations rated C9 and C11 higher (rank sum 148.00 and 140.15 respectively) than did the housing-users group (rank sum 105.19 and 101.28 respectively).

All of the effect sizes were either medium or large, ranging from the lowest, r=0.27 for the HA vs housing-users for C11 to the highest, r=0.55 for developers vs local authorities under C8.

7.8.3. Comparing opinions of the 3 housing provider groups (Kruskal Wallis test)

The Kruskal-Wallis test was utilised to explore whether there are any differences in opinion (regarding the importance of the criteria) among the three housing provider groups; housing associations (n=48), local authorities (n=34) and developers (n=30).

Using significance (α) level of 0.05, the null hypothesis (H_0) for each criterion is as follows:

> *H_0: There is no tendency for the ranking to be significantly higher or lower among the three groups of housing providers.*

The results, including the test statistic (H value), degrees of freedom (df), p-value and the resulting decision regarding H_0 are shown in table 26.

Criterion	*H*-value	df	*p*-value	Decision
C1: Suitable indoor space	8.894	2	0.012	Reject H_0
C2: Private outdoor space	4.036	2	0.133	Retain H_0
C3: Adaptability	20.431	2	0.000	Reject H_0
C4: Compatibility with architectural heritage	2.793	2	0.247	Retain H_0
C5: Features for informal socialising	3.023	2	0.221	Retain H_0
C6: Accessible public greenspace	0.316	2	0.854	Retain H_0
C7: Attractive views to the outside	9.022	2	0.011	Reject H_0
C8: Opportunities to get involved	25.303	2	0.000	Reject H_0
C9: Security features	8.775	2	0.012	Reject H_0
C10: Compact neighbourhood design	3.999	2	0.135	Retain H_0
C11: Proximity to amenities	0.558	2	0.757	Retain H_0

Table 26: Results of the Kruskal-Wallis test showing statistically significant differences in opinion among the three housing provider groups.

The *p*-values for six of the criteria (C2, C4, C5, C6, C10 and C11) were greater than 0.05. The H_0 therefore cannot be rejected, indicating that there is no statistical difference in the rating of these features among the three housing providers. For five of the criteria (C1, C3, C7, C8 and C9) the *p*-values were much lower than 0.05. H_0 can therefore be rejected, indicating that the rating of at least one group is statistically significant from the others.

For the latter five criteria, pairwise comparisons were carried out in SPSS using the Bonferroni adjusted α level of **0.017** (=0.05/3) as in the previous section. The null hypothesis for each comparison is as follows:

> *H_0 = there is no difference in the distribution of score rankings between these two groups.*

The results for each group pair comparison, including the test statistic (difference between mean ranks), the adjusted *p*-values, effect size (*r*) and subsequent decision regarding H_0 are shown in table 27:

Criterion	Pairwise comparison of:	Test Statistic	Adj sig (p-value)	Effect size calculation:			Decision
				z	N	= r	
C1: Suitable indoor space	LA vs HA	15.012	0.062	2.315	82	0.26	Retain H_0
	LA vs Dev	20.397	0.015	2.814	64	0.35	Reject H_0
	HA vs Dev	5.385	1.000	0.800	78	0.09	Retain H_0
C3: Adaptability	HA vs LA	-11.972	0.258	-1.717	82	-0.19	Retain H_0
	Dev vs LA	-43.758	0.000	-4.461	64	-0.56	Reject H_0
	Dev vs HA	-22.785	0.005	-3.148	78	-0.36	Reject H_0
C7: Attractive views to the outside	LA vs HA	6.479	1.000	0.950	82	0.10	Retain H_0
	LA vs Dev	22.300	0.010	2.925	64	0.37	Reject H_0
	HA vs Dev	15.821	0.077	2.333	78	0.26	Retain H_0
C8: Opportunities to get involved	HA vs LA	0.398	1.000	0.057	82	0.01	Retain H_0
	Dev vs LA	-33.413	0.000	-4.255	64	-0.53	Reject H_0
	Dev vs HA	-33.810	0.000	-4.634	78	-0.52	Reject H_0
C9: Security features	HA vs LA	9.245	0.508	1.375	82	0.15	Retain H_0
	Dev vs LA	-11.388	0.389	-1.515	64	-0.19	Retain H_0
	Dev vs HA	-20.633	0.009	-2.955	78	-0.33	Reject H_0

Table 27: Results of post hoc pairwise comparisons for the Kruskal Wallis test showing differences in opinion between the three housing provider groups.

For C1 (indoor space), statistically significant difference was found between local authorities and developers (*p*=0.015), with the latter giving higher scores (mean rank 65.0) than local authorities (mean rank 44.6). The observed effect size is in the medium range.

For C3 (adaptability), statistically significant difference was found between developers and local authority respondents (*p*=.000) as well as between developers and housing associations (p=.005). In both comparisons, respondents in housing associations (mean rank 58.97) and local authorities (mean rank 70.94) gave higher scores than those in the developer group (mean rank 35.18). The observed effect size was medium for the developer vs housing association comparison, and large for the developer vs local authority comparison.

For C7 (attractive views), statistically significant difference was found between local authority and developer groups (p=.010), with developers giving higher scores (mean rank 70.05) than local authorities (mean rank 47.75). Medium effect size was observed for this comparison.

For C8 (opportunities to get involved), statistically significant difference was found between developers and local authorities (p=.000) as well as developers and housing associations (p=.000). In both comparisons, housing association (mean rank 65.68) and local authority (mean rank 65.28) respondents scored higher than developers (mean rank 31.87). The effect size for both comparisons was large.

For C9 (security), statistically significant difference was found between developer and housing association groups (p=.009), with the latter giving higher scores (mean rank 64.84) than developers (mean rank 44.20). Medium effect size was observed for this comparison.

7.8.4. Investigating whether stakeholder opinions were influenced by gender or age.

The uneven distribution in the gender and age demographics between the two main stakeholder categories was highlighted in section 7.3.2. There was a much higher proportion of males in the housing provider group than there were females (76.8% vs 21.4% respectively), while within the housing-users group, the proportion was more even but with slightly fewer males than females (46.3% vs 52.8% respectively). In terms of respondents' age, over half of the housing providers were between ages of 46 to 55, while the age groupings of the housing-users were more evenly distributed.

Due to these demographic inequalities between the two stakeholder groups, it was deemed important to investigate whether any significant differences existed between different gender and age groups.

7.8.4.1. Gender

As gender is a categorical variable with two independent groups (male/female), Mann-Whitney U test is the most suitable test to measure any differences in the scoring of men and women. The data was first prepared by removing the few cases were the respondents chose not to disclose their gender (only one case in the housing-user groups and two in provider group). The housing-users group was then separated into males (n=57) and females (n= 65) as was the housing provider group (males n= 86 and females n= 24). As in section 7.8.1, α level of 0.05 was used, with the H_0 for each criterion as follows:

> *H_0: There is no tendency for the ranking by males to be significantly higher or lower than by the females.*

The results of the Mann-Whitney U Test for the housing-users group are shown in table 28 together with the test statistic (*U* value), effect size (r), *z*-value, *p*-value and the resulting decision regarding H_0. The effect size (*r*) was calculated as in section 7.8.1 using formula 2, except that in this case N=122.

Criterion	Resident gender	Mean Rank	Mdn	*U*-value	Effect size (*r*)	*z*-value	*p*-value	Decision
C1: Suitable indoor space	Male	59.17	5	1,719	-0.07	-0.776	0.438	Retain H_0
	Female	63.55	5					
C2: Private outdoor space	Male	59.46	5	1,736	-0.06	-0.660	0.509	Retain H_0
	Female	63.28	5					
C3: Adaptability	Male	57.33	3	1,615	-0.11	-1.264	0.206	Retain H_0
	Female	65.15	3					
C4: Compatibility with architectural heritage	Male	57.99	3	1,652	-0.10	-1.064	0.288	Retain H_0
	Female	64.58	3					
C5: Features for informal socialising	Male	62.43	3	1,905	0.03	0.284	0.777	Retain H_0
	Female	60.68	3					
C6: Accessible public greenspace	Male	60.98	4	1,823	-0.01	-0.159	0.874	Retain H_0
	Female	61.95	4					
C7: Attractive views to the outside	Male	61.78	4	1,868	0.01	0.088	0.930	Retain H_0
	Female	61.25	4					
C8: Opportunities to get involved	Male	63.59	3	1,971	0.06	0.635	0.525	Retain H_0
	Female	59.67	3					
C9: Security features	Male	55.19	4	1,493	-0.17	-1.917	0.055	Retain H_0
	Female	67.03	3					
C10: Compact neighbourhood design	Male	56.57	3	1,571	-0.14	-1.496	0.135	Retain H_0
	Female	65.82	2					
C11: Proximity to amenities	Male	62.18	3	1,891	0.02	0.209	0.834	Retain H_0
	Female	60.91	3					

Table 28: Results of Mann-Whitney U test for differences in opinion between males and females in the housing users group.

The *p*-values for all of the criteria are greater than 0.05. This indicates that the H_0 cannot be rejected, that is, no statistical difference can be observed in the ratings by males and females in the resident group.

The equivalent test procedure was run for the provider group and the results are shown in table 29:

Criterion	Provider gender	Mean Rank	Mdn	*U*-value	Effect size (*r*)	*z*-value	*p*-value	Decision
C1: Suitable indoor space	Male	57.66	5	1218	0.14	1.51	0.131	Retain H_0
	Female	47.75	4					
C2: Private outdoor space	Male	56.90	4	1152	0.09	0.962	0.336	Retain H_0
	Female	50.48	4					
C3: Adaptability	Male	51.08	3	652	-0.27	-2.869	0.004	Reject H_0
	Female	71.33	4					
C4: Compatibility with architectural heritage	Male	54.67	3	961	-0.05	-0.548	0.584	Retain H_0
	Female	58.46	3					
C5: Features for informal socialising	Male	55.78	3	1056	0.02	0.186	0.853	Retain H_0
	Female	54.50	3					
C6: Accessible public greenspace	Male	54.22	4	922	-0.08	-0.840	0.401	Retain H_0
	Female	60.08	4					
C7: Attractive views to the outside	Male	56.82	3	1146	0.08	0.874	0.382	Retain H_0
	Female	50.77	3					
C8: Opportunities to get involved	Male	49.60	4	525	-0.36	-3.798	0.000	Reject H_0
	Female	76.62	3					
C9: Security features	Male	52.73	4	794	-0.18	-1.874	0.061	Retain H_0
	Female	65.44	4					
C10: Compact neighbourhood design	Male	56.52	2	1120	0.06	0.672	0.502	Retain H_0
	Female	51.83	2					
C11: Proximity to amenities	Male	52.54	4	778	-0.19	-1.995	0.046	Reject H_0
	Female	66.10	4					

Table 29: Results of Mann-Whitney U test for differences in opinion between males and females in the housing provider group.

The p-values for three criteria (C3 'adaptability', C8 'opportunities to get involved' and C11 'amenities') are under 0.05 meaning that the H_0 can be rejected and that there was a difference in importance ratings given by males and females. Females gave higher scores for all three of the criteria. For C3 and C8, the p-values were very low (under 0.001 for C8) indicating a particularly high statistical significance, with the effect size (*r*) either approaching (for C3) or above (for C8) the indicative value of 0.3 for medium effect. The effect size for C11 was smaller with r=0.19.

7.8.4.2. Age

To elucidate any differences in opinion due to age, the six age bands were recoded into three bands ('≤ 35', '36-55'and '≥56'). The number of housing user respondents in each age band were; n= 21 for '≤ 35', n=53 for '36-55'and n=49 for '≥56', and for providers; n= 7 for '≤ 35', n=80 for '36-55'and n=23 for '≥56' (two cases of 'prefer not to say' were removed). As this yields three independent groups (for each type of stakeholder) for comparison, Kruskal-Wallis is the most appropriate test in this instance. As in sections 7.8.2 and 7.8.3, using α level of 0.05, the null hypothesis (H_0) for each criterion (and for both housing-users and housing provider groups) can be stated as follows:

H_0: There is no tendency for the ranking to be significantly higher or lower among the three age groups.

The results for the housing-users group, including the test statistic (*H* value), degrees of freedom (*df*), *p*-value and the resulting decision regarding H_0 are shown in table 30:

Criterion	*H*-value	df	*p*-value	Decision
C1: Suitable indoor space	10.060	2	0.007	Reject H_0
C2: Private outdoor space	3.152	2	0.207	Retain H_0
C3: Adaptability	2.651	2	0.266	Retain H_0
C4: Compatibility with architectural heritage	0.033	2	0.983	Retain H_0
C5: Features for informal socialising	1.202	2	0.548	Retain H_0
C6: Accessible public greenspace	0.146	2	0.929	Retain H_0
C7: Attractive views to the outside	0.509	2	0.775	Retain H_0
C8: Opportunities to get involved	1.642	2	0.440	Retain H_0
C9: Security features	2.305	2	0.316	Retain H_0
C10: Compact neighbourhood design	5.312	2	0.070	Retain H_0
C11: Proximity to amenities	3.577	2	0.167	Retain H_0

Table 30: Results of Mann-Whitney U test for differences in opinion among different age groups of the housing users group.

The *p*-value of only criterion (C1; indoor space) was smaller than the alpha value of 0.05, indicating that the H_0 can be rejected and that there is a difference in opinion among the three different age groups. A follow up Mann-Whitney U test was carried out to determine which groups differed in their opinion using the stricter alpha value of **0.017** (following the Bonferroni adjustment), the results of which are shown in table 31:

Criterion	Pairwise comparison of:	Test Statistic	Adj sig (p-value)	Effect size calculation:			Decision
				z	N	= r	
C1: Suitable indoor space	'≥56' vs '≤ 35'	18.102	0.081	2.211	70	0.26	Retain H_0
	'≥56' vs '36-55'	18.427	0.009	2.962	102	0.29	Reject H_0
	'≤ 35' vs '36-55'	-0.325	1.000	0.968	74	.011	Retain H_0

Table 31: Results of post hoc pairwise comparisons for the Kruskal Wallis test showing differences in opinion between different age groups (housing user group).

The follow up test revealed a statistically significant difference ($p<0.017$) between the scoring of housing-users that were aged 56 and over and between ages 36 and 55. The effect size of this was medium ($r=0.29$). The mean rank of the latter group was 69.40 and for the former 50.97, revealing that overall the older respondents gave this criterion lower scores than the younger respondents. It is conceivable that this difference may be due to the younger group more likely to have children living the household.

The results for the provider group, including the test statistic (*H* value), degrees of freedom (*df*), *p*-value and the resulting decision regarding H_0 are shown in table 32.

Criterion	H-value	df	p-value	Decision
C1: Suitable indoor space	5.397	2	0.067	Retain H_0
C2: Private outdoor space	1.159	2	0.560	Retain H_0
C3: Adaptability	0.586	2	0.746	Retain H_0
C4: Compatibility with architectural heritage	5.412	2	0.067	Retain H_0
C5: Features for informal socialising	0.821	2	0.663	Retain H_0
C6: Accessible public greenspace	5.910	2	0.052	Retain H_0
C7: Attractive views to the outside	1.738	2	0.419	Retain H_0
C8: Opportunities to get involved	1.368	2	0.504	Retain H_0
C9: Security features	8.395	2	0.015	Reject H_0
C10: Compact neighbourhood design	2.467	2	0.291	Retain H_0
C11: Proximity to amenities	0.488	2	0.783	Retain H_0

Table 32: Results of Mann-Whitney U test for differences in opinion among different age groups of within the housing provider group.

The p-value was below the alpha level of 0.05 for only one criterion – C9 (security), which indicated that as H_0 can be rejected as there was a difference between the three age groups. However, results of the follow up Mann Whitney test (table 33) revealed no statistically significant difference as the *p* values all three pairwise comparisons were above the adjusted alpha level of 0.017.

Criterion	Pairwise comparison of:	Test Statistic	Adj sig (p-value)	Effect size calculation:			Decision
				z	N	= r	
C9: Security features	'≥56' vs '≤ 35'	-21.885	0.253	-1.725	30	-0.31	Retain H_0
	'≥56' vs '36-55'	-31.422	0.020	-2.713	103	-0.27	Retain H_0
	'≤ 35' vs '36-55'	9.537	0.510	1.372	87	0.15	Retain H_0

Table 33: Results of post hoc pairwise comparisons for the Kruskal Wallis test showing no differences in opinion between different age groups (housing providers).

7.9. Criteria ranking by respondents

As explained in section 5.7.2.3, respondents were also asked to rank the 11 criteria according to the 5 features they perceived as most important and 5 least important. These two questions were made optional following feedback from the pilot, and as a likely consequence of this, not all respondents fully answered this question. To avoid missing values introducing bias, cases with partially answered or missing answers were excluded from analysis (de Vaus, 2002)[4].

Ranking data was recoded in excel to give each criterion a score depending on the rank it received as illustrated by table 34.

[4] 5 local authority and 10 resident cases were removed

Rank received in the survey		Score allocated
"Which are the 5 MOST important?"	1st [Most important]	1
	2^{nd}	2
	3^{rd}	3
	4^{th}	4
	5^{th}	5
"Which are the 5 LEAST important?"	1st [Least important]	11
	2^{nd}	10
	3^{rd}	9
	4^{th}	8
	5^{th}	7
Unassigned		6

Table 34: Recoding matrix for the ranking scores.

The scores allocated were '1' for the most important criterion to '11' for the least important. A score of '6' was assigned to the 11^{th} criterion that was not selected either with the important or unimportant groups and thus can be presumed to be ranked in the 'middle'. The sums of the ranking scores thus indicate the relative importance of the criteria in an inversely proportional relationship – low sums representing high importance and high scores representing low importance.

7.10. Comparing the opinions between all four stakeholder groups using ranking data (Kruskal-Wallis Test)

It would be logical to assume that the relative importance attached by each group to each feature would be the same when rating and ranking the 11 criteria. In order to check this reliability of the four stakeholders' opinions from the rating data, Kruskal-Wallis test was performed on the ranking data.

As in section 7.8.2, using significance (α) level of 0.05, the null hypothesis (H_0) for each criterion is as follows:

> *H_0: There is no tendency for the ranking to be significantly higher or lower among the four groups of housing stakeholders.*

The results, including the test statistic (H value), degrees of freedom (df), p-value and the resulting decision regarding H_0 are shown in table 35.

Criterion	*H*-value	df	*p*-value	Decision
C1: Suitable indoor space	3.975	3	0.264	Retain H_0
C2: Private outdoor space	74.138	3	0.000	Reject H_0
C3: Adaptability	33.730	3	0.000	Reject H_0
C4: Compatibility with local architectural heritage	0.489	3	0.921	Retain H_0
C5: Features for informal socialising	3.065	3	0.382	Retain H_0
C6: Accessible public greenspace	10.004	3	0.019	Reject H_0
C7: Attractive views to the outside	61.360	3	0.000	Reject H_0
C8: Opportunities to get involved	11.158	3	0.011	Reject H_0
C9: Security features	33.035	3	0.000	Reject H_0
C10: Compact neighbourhood design	2.685	3	0.443	Retain H_0
C11: Proximity to amenities	23.950	3	0.000	Reject H_0

Table 35: Results of Kruskal-Wallis test on the ranking data comparing opinions of all four stakeholder groups.

The *p* value was above 0.05 for four of the criteria – C1, C4, C5 and C10 – indicating that the H_0 must be retained and that there is no difference in opinion between the four groups for these features. This differs slightly from the rating results (see table 24 in 7.8.2 and figure 36 below) where H_0 was rejected for C1 and C10, but retained for C6. However, to determine which group(s) differed in their ranking opinion over the features where H_0 was rejected (i.e. C2, C3, C6-C9 and C11), a follow-up Mann-Whitney U test was carried out using the Bonferroni adjusted α level of 0.0125 (=0.05/4). The null hypothesis for each comparison is as follows:

> *H_0 = there is no difference in the distribution of score rankings between these two groups.*

The results for each group pair comparison with statistically significant differences (i.e. where $p < 0.0125$), including the test statistic (difference between mean ranks), the adjusted *p*-values, effect size (*r*) and subsequent decision regarding H_0 are shown in table 36. Full SPSS outputs of all pairwise comparisons can be found in Appendix IV.

Criterion	Pairwise comparison of:	Test Statistic	Adj sig (p-value)	Effect size calculation:			Decision
				z	N	= r	
C2: Private outdoor space	LA vs Res	80.392	0.000	6.225	139	0.53	Reject H_0
	HA vs Res	70.365	0.000	6.583	158	0.52	Reject H_0
	Dev vs Res	65.073	0.000	5.107	140	0.43	Reject H_0
C3: Adaptability	HA vs Res	-35.599	0.007	-3.261	158	-0.26	Reject H_0
	LA vs Dev	59.873	0.002	3.628	59	0.47	Reject H_0
	LA vs Res	-71.455	0.000	-5.417	139	-0.46	Reject H_0
C7: Attractive views to the outside	LA vs Res	73.585	0.000	5.587	139	0.47	Reject H_0
	HA vs Res	67.212	0.000	6.166	158	0.49	Reject H_0
	Dev vs Res	58.008	0.000	4.464	140	0.38	Reject H_0
C9: Security features	HA vs Res	-58.532	0.000	-5.384	158	-0.43	Reject H_0
	LA vs Res	-41.014	0.011	-3.123	129	-0.27	Reject H_0

C11: Proximity to amenities	Dev vs Res	-49.291	0.001	-3.809	140	-0.32	Reject H_0
	HA vs Res	-42.429	0.001	-3.908	158	-0.31	Reject H_0

Table 36: Results of the post hoc pairwise comparisons (significant values only) for the Kruskal Wallis test to investigate difference in opinion between the four stakeholder groups using ranking data.

Follow up tests revealed no statistically significant difference among pairwise comparisons for C6 and C8 as the resulting *p* values were above the adjusted alpha level of 0.0125 (see Appendix IV). The groups that differed in their opinion for the remaining five criteria are as follows (illustrated by figure 35):

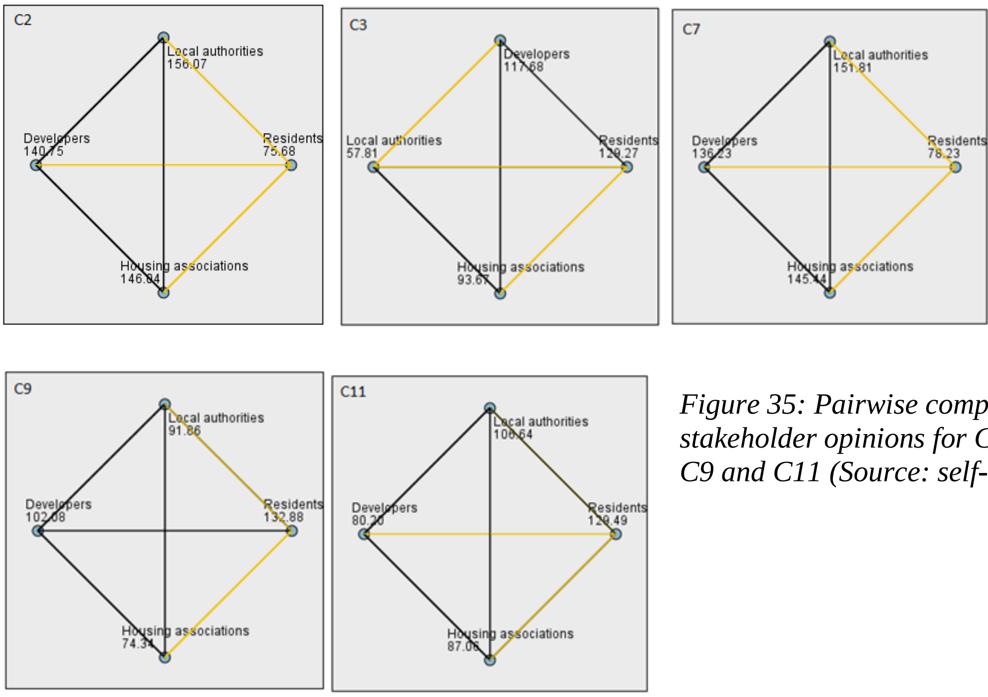

Figure 35: Pairwise comparisons of stakeholder opinions for C2, C3, C7, C9 and C11 (Source: self-study).

For C2, follow-up pairwise comparison tests revealed statistically significant differences between housing-users and all three housing provider groups. Unlike the rating data, the ranking data results also included a significant difference between housing-users and developers. As illustrated by the grey lines in figure 35, which also shows corresponding groups' rank sums, housing-users ranked this feature as more important more frequently than did housing providers[5].

For C3, two of the significant pairwise comparisons are the same as indicated with rating data – local authorities rated and ranked adaptability as more important than did housing-users and developers. However, while rating data yielded statistically

[5] Unlike the rating data where higher rank sum signified greater ratings of importance, for ranked data the inverse is true – that is, a low rank sum indicates higher ranking in terms of importance. This is because of the way the ranked data was coded, which is explained in section 7.9.

significant difference between housing associations and developers, rankings were different between housing associations and housing-users instead, with the latter ranking adaptability as lower in importance.

Housing-users ranked C7 higher than any of the three housing providers. This was similar to the results of the rating data with the exception that the difference was found significant only between housing-users and the two social housing providers, and not with developers.

Both housing authorities and local authorities ranked C9 higher in importance than housing-users. Rating data however only yielded significant difference between housing associations and housing-users, with no significant difference found between the latter and local authorities.

Lastly, a statistically significant difference was found in the rankings of C11 between housing-users and developers and housing associations – with housing-users ranking this feature lower in importance than either of these two housing providers (figure 35). Ranked data did not show significant differences for C8 (opportunities to get involved), whereas for the rating data significant differences were found for four of the six pairwise comparisons.

All of the effect sizes were generally in the medium to large. The largest effect size was observed for C2 comparing the rankings between local authorities and housing-users ($r=0.53$) and the lowest for housing associations and housing-users for C3 ($r= -0.26$)

7.11. Comparing importance attached to soft features through rating versus ranking scores

Figure 36 illustrates the statistically significant differences in importance revealed by Kruskal Wallis and post hoc tests of rating and ranking scores. Overall, it can be concluded that there is little difference between these two forms of scoring, thus showing a good degree of consistency in the stakeholder opinion regarding these housing design features. The greatest difference between the two types of scores can be observed for C8 (opportunities to get involved) where, unlike the rating scores, the ranking scores showed no statistically significant difference between the four housing stakeholder groups.

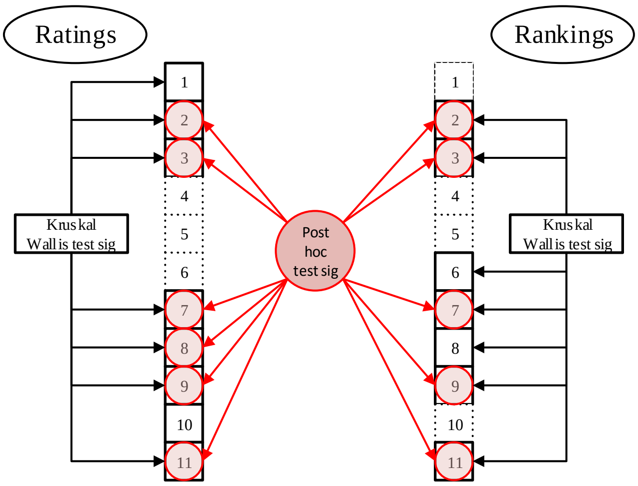

Figure 36: Comparison of Kruskal Wallis and post hoc tests' differences between the rating and ranking scores *(Source: self-study).*

7.12. Chapter summary and conclusions

A summary overview is provided for each of the 11 features followed by concluding statements.

7.12.1. Criteria summary

C1 Suitable indoor space: All stakeholder groups marked 'suitable indoor space' as first in importance both in the rating and ranking sections of the questionnaire. The importance of this feature is further demonstrated by all housing providers stating that this feature is fully taken into account by their organisations as part of their design brief.

Mann-Whitney U test found no statistically significant difference in the ratings of importance between the housing-users and the housing provider groups. However, closer investigation of ratings given by the three housing provider groups, found a statistically significant difference between local authorities and developers, with the latter giving higher rating to this feature than local authorities.

C2 Private outdoor space: Both resident and developer groups marked private outdoor space as second in importance. However, the ratings given by housing associations and local authorities placed this feature much lower, 5th and 6th respectively, in relative importance to other criteria. Indication that this feature was of importance to developers was also reflected by this group marking private outdoor space as something that was always and completely taken into account, while a larger proportion of housing association and local authority respondents indicated that this was taken into account as best practice rather than part of design brief.

Unsurprisingly given the ratings, a statistically significant difference was found between housing-users and housing provider groups by the Mann-Whitey U test, with housing-users giving it higher ratings. It is also worth pointing out that this difference in importance accorded to C2 was also marked by the highest effect size – other statistically significant differences were of lower effect size. Despite developers' ratings placing C2 relatively high (2^{nd}) in relative importance – Kruskal-Wallis H test revealed no statistically significant differences among the three housing provider groups.

C3 Adaptability: Only local authority respondents rated this feature relatively highly at 3^{rd} place, while the remaining groups placed adaptability much lower – 8^{th} by housing-users, 6^{th} by housing associations and 9^{th} by developers. However, most of respondents from local authority and housing association groups considered adaptability to be always and completely taken into account by their organisations as part of the design brief. For most of the developers this feature was only partially or occasionally taken into account.

Statistically significant differences in opinion were found between housing-users and housing providers as well as among the three housing provider groups. Overall, housing providers rated this feature as higher in importance than housing-users. However among the providers, statistically significant difference was found between developers and local authority respondents as well as between developers and housing associations. In both comparisons, respondents in housing associations and local authorities gave higher scores than those in the developer group. The observed effect size was medium for the developer vs housing association comparison, and large for the developer vs local authority comparison.

C4 Compatibility with local architectural heritage: Very little variation in opinion regarding this feature's importance could be found among the stakeholder groups. Developers gave it slightly higher ratings than the other groups, placing it in 6^{th} position as opposed to 7^{th} by housing-users and 8^{th} by both housing associations and local authorities. The majority respondents in all housing provider groups regarded compatibility as a feature that was usually into account (in the case of developers) or taken into account as good practice rather than as part of design brief (social housing providers).

In terms of importance ratings, no statistically significant difference was found for this criterion either between housing-users and housing providers, or among the three provider groups.

C5 Features for informal socialising: As with the compatibility criterion, there is little variation in opinion regarding the importance of features for informal socialising among the stakeholder groups. Overall, it was regarded less important than C4, as housing-users rated it 9th in terms of relative importance, as did the housing associations, while developers placed it slightly higher in 8th position, and local authorities lower (10th). All housing providers considered this feature taken into account only partially or occasionally by their organisations.

As with C4, no statistically significant difference was found for this criterion either between housing-users and housing providers, or among the three provider groups.

C6 Accessible public greenspace: Ratings by the respondent group placed this feature in 4th position – similar to housing providers who rated it in 4th (housing associations and developers) and 5th (local authorities) position of importance. The non-parametric tests also indicated no statistically significant difference between housing-users and housing providers, nor among the three provider groups.

All housing providers considered this feature taken into account only partially or occasionally by their organisations.

C7 Attractive views to the outside: A relatively large difference can be discerned in the ratings of importance by housing-users and housing providers. While the former placed it 4th in importance, all of the housing providers gave it much lower ratings – developers placing it 7th, local authorities, 9th and housing associations, 10th in the list of relative importance. Reflecting these rankings among housing providers, developers stated this feature was usually taken into account, housing associations as taken into account as best practice (but not design brief), while local authorities thought it was only occasionally or partially taken into account.

Unsurprisingly, Mann-Whitney U test found a statistically significant difference in opinion ratings between housing-users and housing providers, with the former giving higher scores than the latter. A significant difference was also revealed by Kruskal-

Wallis H among the housing provider groups. Closer investigation revealed that developers gave higher scores than local authority respondents.

C8 Opportunities to get involved: This feature was rated low, 10^{th} in relative importance by both housing-users and developers, and a little higher, in 7^{th} position by both of the social housing provider groups. Reflecting this rating, all housing providers thought their organisations took this feature only partially or occasionally into account.

These ratings were also reflective of the differences highlighted by the nonparametric tests. A statistically significant difference was found between the housing-users and provider groups, with the latter giving overall all higher ratings to C8 criterion. Investigation of differences among the three housing provider groups revealed significant differences in pairwise comparisons between developers and local authorities and between developers and housing associations. In both cases, the social housing providers gave higher ratings than developers.

C9 Security features: Both social housing provider groups rated this feature highly placing it in second position in the list of relative importance. Housing-users and developers gave security comparatively lower ratings, ranking it in 5^{th} position. Unsurprisingly, both social housing providers considered security to be always and completely taken into account by their organisations as part of the design brief, while according to most developer respondents this feature was only partially or occasionally taken into account.

The nonparametric tests revealed a statistically significant difference between the housing-users and provider groups, with the latter giving overall all higher ratings to this criterion. Investigation of differences among the three housing provider groups revealed a significant difference only in the pairwise comparison between developers and housing associations, with the latter giving higher scores than developers.

C10: Compact neighbourhood design: C10 was unanimously rated last in importance by all stakeholder groups. This feature was also taken into account only partially or occasionally by both developers and housing associations, while a comparatively large proportion of local authority respondents stated C10 was not taken into account.

Mann-Whitney U test found a statistically significant different between the provider and housing-user groups, with the latter giving higher ratings, however the effect size for this comparison was smallest among all comparisons in the test. Kruskal-Wallis H test found no significant differences among the housing provider groups.

C11: Proximity to amenities: The housing-users group scored this criterion as 6th in importance, while all of the housing providers rated it slightly higher; housing associations and developers both placing it in 3rd position and local authorities in 4th position of relative importance. The latter housing provider group also marked that C11 was taken into account less often than did housing associations or developers.

Mann-Whitney U test also found a significant difference in opinion between housing providers and housing-users, with the latter giving lower ratings. No statistically significant differences could be found among the housing provider groups with the Kruskal Wallis H test.

7.12.2. Conclusions

- C1 (indoor space) was rated highest in importance by all groups. There was also widespread agreement in the ratings as demonstrated by the non-parametric tests (only exception was developers scoring it more highly than local authorities in the pairwise comparison).

- C10 (compactness) unanimously received the lowest ratings as no statistically significant differences in opinion could be established among the four stakeholder groups.

- According to the Mann-Whitney U test, the level of importance accorded to 7 of the criteria differed between housing-users and housing providers. These were to C2 (private outdoor space), C3 (adaptability), C7 (attractive views), C8 (opportunities to get involved), C9 (security features), C10 (compact neighbourhood design) and C11 (proximity to amenities).

- The most notable of these (highest effect size) was the greater level of importance attached by the housing-users group to C2 (outdoor space) and C7 (attractive views) and a lower rating of importance assigned to C11 (amenities) than any of the housing providers.

- Of the three housing provider groups, developers' opinions regarding the relative order of criteria importance were the best matched to those of the housing-users.

The order of importance assigned by the housing-users differed most to that of local authority respondents.

- Kruskal Wallis H test found statistically significant difference in opinion among the housing provider groups for 5 of the criteria. These were C1 (indoor space), C3 (adaptability), C7 (attractive views), C8 (opportunities to get involved) and, C9 (security features).

- Largest differences in the pairwise comparisons (highest effect size) could be observed for C3 (adaptability) where local authorities gave significantly higher scores than developers. Similarly for C8 (opportunities to get involved), both housing associations and local authorities gave higher scores than developers.

Chapter 8: Assessment of housing developments

8.1. Introduction

The aim of this chapter is to assess six housing developments against the 11 'soft' housing features identified in chapter 6. It begins by explaining the case study selection process and describes the six developments that were selected for analysis. The first and main section on the chapter is focused on the assessment of case studies against each of the features, and for ease and clarity, the method of evaluation is explained immediately prior to the assessment of the case studies. The second section presents the calculations and results of COPRAS method application to assess the performance of six housing developments against the 'soft' criteria using the weights assigned by housing stakeholders. The aim of this exercise is to rank these housing developments according to best through to worst level of 'soft' features provision. The chapter concludes with a summary of the findings.

8.2. Selected housing developments as case studies

The criteria for selecting housing developments as case studies are described in section 5.8.3. The main characteristics of the six developments chosen as case studies are shown in table 37, while their location is illustrated in figure 37 and a brief description of each development is provided below.

Case study	Developer(s)	Name of development	Application date	Location	Units	Affordable homes	Price range (approx)
A	Taylor Wimpey	Bluebell Croft	April 2011	Kidsgrove, ST7 1TW	87	19.5%	184,995 232,500
B	Barratt Homes & Aspire Housing	Gloster Gate	September 2011	Newcastle under Lyme, ST5 9HJ	117	24.8%	£137,000 - £156,000
C	Seddon Homes Ltd	Ivy House Mills	January 2013	Stoke-on-Trent, ST1 3RN	62	0%	£113,500 - £132,450
D	Midland Heart Housing Group	All Saints Road	September 2012	Stoke-on-Trent, ST4 4BL	23	100%	n/a
E	Trent and Dove	Dallow Bridge	December 2011	Burton-on-Trent, DE14 2PH	40	100%	n/a
F	Bellway	Hydro	November 2012	Burton-on-Trent, DE14 2BB	81	9.9%	From £163,995

Table 37: Six housing developments selected as case studies.

Case study A - 'Bluebell Croft':

Bluebell Croft is an 87-unit development in Kidsgrove, Staffordshire (within the remit of Newcastle-under-Lyme Borough Council), built by Taylor Wimpey, one of the largest, national housebuilding companies in the country. The development is mostly comprised of three- and four-bedroom housing (26 and 39 respectively) and about a quarter of the properties (22) are two-bedroom dwellings (12 of which are low-rise flats) (see sitemap, figure 38). While 17 of the two- and three-bedroom homes are demarcated as affordable housing (through shared ownership or rent), these are indistinguishable from the other dwellings. The development is built on a site of old industrial buildings and is surrounded primarily by other residential dwellings.

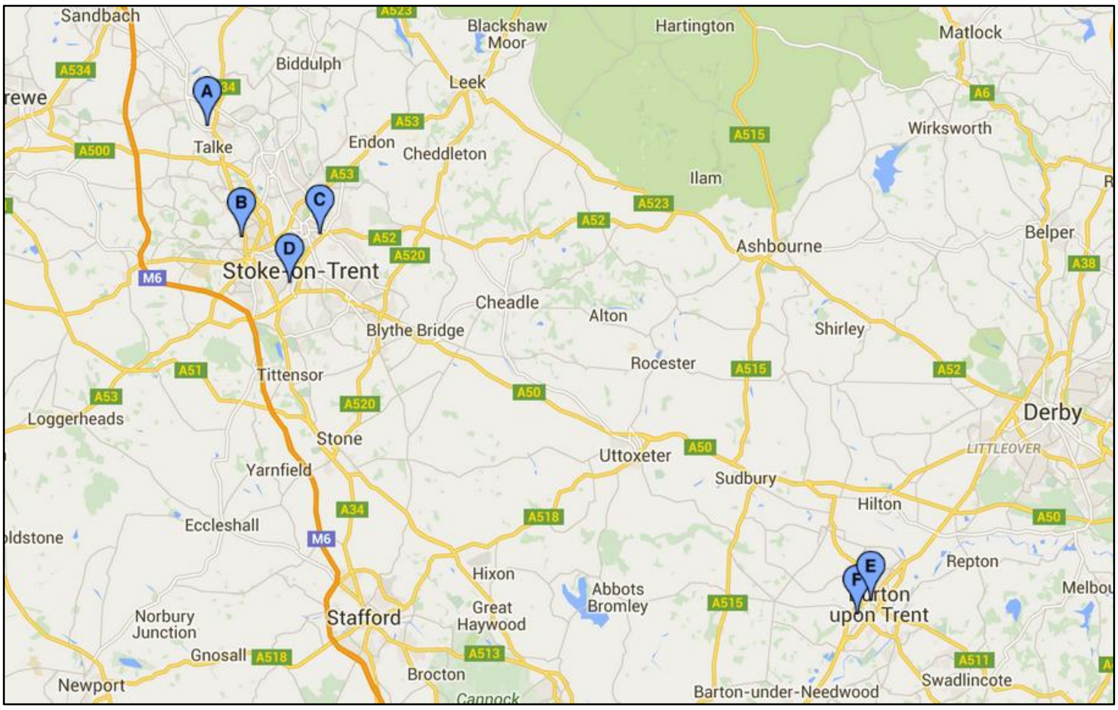

Figure 37: Locations of the six case studies (Developed using www.batchgeocode.com. Source: Map data ©2015 Google).

Figure 38: Site plan of case study A (Bluebell Croft) in Kidsgrove (Source: Taylor Wimpey, 2010).

Case study B - 'Gloster Gate':

With 117 units, Gloster Gate is the largest of the case study developments and built in partnership between Aspire Housing (a local housing association) and Barratt Mercia (regional branch of Barratt Homes, a large, national house builder). Located in Newcastle-under-Lyme in Staffordshire, the development consists of two-, three- and four-bedroom housing (29, 47, and 12 respectively) and 29 affordable two- and four-bedroom units (see sitemap, figure 39) (no flats). The site is surrounded by largely residential dwellings and formerly consisted of terraced housing and apartment blocks that were demolished a few years prior to the application.

Figure 39: Site plan of case study B (Gloster Gate) in Newcastle-under-Lyme (Source: Aspire Housing and Barratt Homes, 2012).

Case study C - 'Ivy House Mills'

Ivy House Mills is a 62-unit development in Stoke-on-Trent, Staffordshire developed by Seddon Homes Ltd, a house building company that operates primarily in the Northwest, Midlands and Yorkshire regions. The development consists of two-, three- and four-bedroom dwellings (17, 37, and 8 respectively) and no flats (see sitemap, figure 40). There is no affordable housing provision in the development as the developer obtained an exception to this requirement by providing a financial viability appraisal illustrating that the scheme would not be viable with affordable housing provision. On its south side, the site is flanked by a canal and on its east side by existing residential dwellings, while the land on the remaining two sides is currently empty but designated for residential development in the future. The site was previously used for industrial purposes, namely paper manufacture.

Figure 40: Site plan of case study C (Ivy House Mills) in Stoke-on-Trent (Source: DLG Associates Ltd, 2013).

Case study D - 'All Saints Road'

The development off All Saints Road in Stoke-on-Trent is the smallest of the case studies with 23 units commissioned by the regional housing association, Midland Heart Housing Group. The site comprises of two-, three- and four-bedroom dwellings (6, 15, and 2 respectively) (no flats) – all of which are for social rent (see sitemap, figure 41). A primary school was formerly located on the site but the buildings were demolished prior to the application. Currently, the area is surrounded primarily by residential dwellings (including a new housing development opposite) with some commercial and community buildings.

Case study E - 'Dallow Bridge'

Dallow Bridge is a 40-unit development in Burton-upon-Trent (remit of East Staffordshire Borough Council), Staffordshire, commissioned by Trent and Dove Housing Association. The development consists of two-, three- and four-bedroom dwellings (10, 8, and 2 respectively) and 20 low-rise flats (see sitemap, figure 42). All units are designated as affordable housing with 22.5% intended for shared ownership and 77.5% rental. As with case studies C and F, the development is flanked on one side by the Trent and Mersey Canal, and residential dwellings and allotments on the other sides. The site was previously used as a builder's yard with a number of associated buildings, which have since been demolished to make space for the new housing.

Figure 41: Site plan of case study D (All Saints Road) in Stoke-on-Trent (Source: Sutton & Wilkinson, 2012).

Case study F - 'Hydro'

Hydro is an 81-unit development in Burton-upon-Trent developed by Bellway, a large national house builder. The development consists of two-, three- and four-bedroom dwellings (1, 19, and 53 respectively) (no flats) – and 8 homes designated as affordable housing (see sitemap, figure 43). As with case studies C and E, the development is flanked on its eastern side by the Trent and Mersey Canal and by a leisure centre and its sporting facilities on the northern and western sides. The site is on the edge of a large residential area, and the land was previously used for commercial purposes but the buildings have since been demolished.

Figure 42: Site plan of case study E (Dallow Bridge) in Burton-upon-Trent (Source: Baily Garner LLP, 2011).

As described above, the developments range in size from 23 units (case study D) to 117 units (case study B). Ideally, larger developments might have been preferable as some of the criteria (e.g. opportunities to get involved in management and maintenance) may not be feasible in very small developments. However, the choice of case studies was restricted to developments of this size due to a number of factors; firstly, the desire to select developments within a restricted geographical area; secondly, the limitation placed by the public availability of application documents; thirdly, many of the large developments (200+ units) in the area were being built in phases, whereby some parts were older than 2008 and others not finalised yet. Lastly, it was important to include developments built by social housing providers, and as these had only built relatively small developments, it was decided to try and keep all case studies within a smaller range to allow for a more fair comparison. Where the size of a development had a potential implication on the provision of a particular soft feature, these are discussed in the method assessment section of the particular feature.

Figure 43: Site plan of case study B (Hydro) in Burton-upon-Trent (Source: Bellway, 2012).

8.3. Assessment of case study housing developments

For clarity, the assessment technique for each 'soft' feature is presented below together with the assessment and scoring of the housing developments.

8.3.1. Indoor space provision (C1)

8.3.1.1. Method of assessment

How much space is deemed adequate and suitable for a household will depend on its size, life-style factors and personal preferences. Due to the high level of subjectivity involved, some researchers (e.g. Drury, Welch and Allen 2009) use resident questionnaires with Likert-style scoring to assess the level of satisfaction with space in various parts of a house including the ability to carry out certain functions (e.g. entertain visitors, prepare meals, store belongings). However, while valuable in the level of detailed information it provides, this method can only be used in post-occupancy assessments and for the purpose of this study, a method that allows assessment to be made in the design stage would be more desirable.

The two sustainable housing standards (reviewed in Chapter 6) that address this feature, CASBEE and SB Tool, focus on evaluating the dwelling based on the expected space needs of the household. Thus, CASBEE awards points according to the ratio of floor area to inhabitants, and similarly, SB Tool considers the functionality and appropriateness of interior space and floor area.

In line with the approach used by these buildings standards, the method of assessment chosen will focus on the dwelling as opposed to the survey-based housing-users' evaluation of adequate space. According to the Royal Institute of British Architects (RIBA) (2011), the best available benchmark for assessing whether a house has adequate space is the London Space Standard (LSS). This minimum space standard was based on research commissioned by Greater London Authority (GLA) that reviewed current trends, literature and interviewed stakeholders, and attempted to establish a standard based on current needs of a typical household. The GLA introduced these standards for both public and privately funded homes in 2011 (GLA, 2011) and the recommended minimum space in m^2 for different residential dwellings are outlined in table 38 below. The gross internal area (GIA) is the internal area of the dwelling measured to the internal face of the perimeter walls. For dwellings designed for more than 6 persons, $10m^2$ should be added for each additional person.

<table>
<tr><th colspan="2">Dwelling type (bedroom (b) /persons-bed spaces (p))</th><th>Essential GIA (m²)</th><th colspan="2">Dwelling type (bedroom (b) /persons-bed spaces (p))</th><th>Essential GIA (m²)</th></tr>
<tr><td rowspan="8">Flats</td><td>1b2p</td><td>50</td><td rowspan="5">Two storey house</td><td>2b4p</td><td>83</td></tr>
<tr><td>2b3p</td><td>61</td><td>3b4p</td><td>87</td></tr>
<tr><td>2b4p</td><td>70</td><td>3b5p</td><td>96</td></tr>
<tr><td>3b4p</td><td>74</td><td>4b5p</td><td>100</td></tr>
<tr><td>3b5p</td><td>86</td><td>4b6p</td><td>107</td></tr>
<tr><td>3b6p</td><td>95</td><td rowspan="3">Three storey house</td><td>3b5p</td><td>102</td></tr>
<tr><td>4b5p</td><td>90</td><td>4b5p</td><td>106</td></tr>
<tr><td>4b6p</td><td>99</td><td>4b6p</td><td>113</td></tr>
</table>

Table 38: The London Space Standard (RIBA, 2011).

The methodology used to assess this criterion in this study is similar to that developed by RIBA for their 2011 report (*The Case for Space: the size of England's new homes*) which evaluated new homes built by the top eight house builders across England. However, the calculations were slightly adjusted to reflect compliance of dwellings in a particular housing development rather than across multiple developments. The following formula will be used to calculate the extent of compliance with the standard:

$$= \frac{Total\ actual\ GIA}{Total\ 'ideal'\ GIA\ based\ on\ GLA\ standard} \times 100\% \qquad (3)$$

The following scoring system will be used to score performance against C1 (indoor space) criterion:

Average performance against GLA standard	Indoor space provision	Score
Above 100%	Excellent	7
91% - 100%	Good	5
81% - 90%	Fair	3
80% and lower	Poor	1

8.3.1.2. Level of indoor space provision in case study housing developments

Table 39 shows how the dwellings in each of the six housing developments compared to the LSS (detailed calculations are shown in Appendix V).

Case study	Average performance against GLA standard	Indoor space provision	Score
A	94%	Good	5
B	86%	Fair	3
C	85%	Fair	3
D	89%	Fair	3
E	101%	Excellent	7
F	112%	Excellent	7

Table 39: Level of indoor space provision in case study housing developments.

Only two of the developments, E and F, consisted of dwellings with average indoor space above the LSS. Development E, which was similar to LSS was built by a housing association, while development F, built by a large private sector developer consisted of homes 12% larger than LSS specifications. The remaining four developments were below the standard's recommendations – with case study C, built by a regional private sector developer, consisting of the smallest dwellings with on average measuring only 85% of the recommended GIA.

8.3.2. Private outdoor space (C2)

8.3.2.1. Method of assessment

According to CSH, three conditions need to be met to satisfy the 'Private space' criterion. An outdoor space (whether private or semi-private) must:

i) Be of the designated minimum size in order for all occupants to use the space:

   a. If private; 1.5m^2 per bedroom

   b. If shared space; 1m^2 per bedroom

ii) Have inclusive access and usability

iii) Be accessible only to housing-users in designated dwellings. The designation should be made clear through the use of buildings themselves or other type of boundary markings such as fences, plantings or other barriers (DCLG, 2008).

As a comparison, the international standard for sustainable buildings, SB Tool, specifies a minimum size and awards points to a development depending on the percentage of units that meet or exceed this minimum area. The Australian Green Star also specifies minimum outdoor space, but only awards points if such space is provided by at least 90% of unit in a development.

The assessment methodology for this criterion will use the minimum outdoor space area specified by the CSH (as it will be most appropriate for the geographical area of study) designated as 1.5m^2/bedroom for private space and 1m^2/bedroom for shared space (i.e. for apartments). However, the assessment will also include the practice used by SB Tool and Green Star of penalising developments if less than 90% of dwellings meet the minimum space requirements.

This means that minimum garden area for each dwelling needs to be:

	For houses (private space garden):	For apartments (shared space):
2 bedroom:	= 3m^2	= 2m^2
3 bedroom:	= 4.5m^2	= 3m^2
4 bedroom:	= 6m^2	= 4m^2

Housing developments will be scored depending on the percentage of units in a development that meet or exceed this minimum, as follows:

The percentage of dwelling units with private outdoor space meeting or exceeding the minimum specified area:	**Provision of private outdoor space :**	**Score:**
100 %	High	5
91% - 99%	Medium	3
Below 90%	Low	1

8.3.2.2. Level of private outdoor space provision in case study housing developments

Table 40 describes the level of private outdoor space provision in each of the six housing developments.

Case study	Outdoor Space provision	Source	Score
A	*High:* All houses have useable, secure, private rear gardens that slightly exceed 10.7m in length and $65m^2$ in area Private amenity space or communal open space is provided for the housing-users of the apartments only. All 12 apartments are 2 bed (minimum total outdoor area should therefore be $24m^2$), and the shared communal area exceeds $46m^2$ (estimated from planning layout)	Design and Access Statement (DAS); Site layout	5
B	*High:* All houses have private gardens larger than the minimum specified by CSH.	Site layout (estimated)	5
C	*High:* All dwellings have a secure and private rear garden space, the smallest of which appears to belong to plot 9 ('Brierfield') and is estimated to be at least $14m^2$	Site layout (estimated)	5
D	*High:* All houses have private gardens larger than the minimum specified by CSH.	Site layout (estimated)	5
E	*Low*: All houses have private gardens larger than the minimum specified by CSH. Plot 16-26 apartments have a garden secured by a fence which is at least 115 m^2. This area exceeds the minimum specified by the CSH. Plot 1-9 apartments are surrounded by a narrow area of shrubbery, and while it is enclosed by a 1.2, high looped top fence, it does not appear to be a private garden space. This implies that only 31 dwellings (77.5% of the development) have private outdoor space meeting or exceeding the minimum specified area.	Site layout (estimated)	1
F	*High:* All dwellings have a secure and private rear garden space, the smallest of which appears to belong to plot 79 ('Somerby') and is estimated to be approximately $30m^2$	Site layout (estimated)	5

Table 40: Level of private outdoor space provision in case study housing developments.

Only one development, E, which was built by a housing association, failed to score full marks for the C2 criterion due to large number of apartments that did not appear to have designated outdoor garden space that would be accessible only to housing-users in the designated dwellings. The remaining five developments scored full marks.

8.3.3. Adaptability of the dwelling (C3)

8.3.3.1. Method of assessment

Adaptability of a dwelling design can be assessed by its compliance with the Lifetime Homes standard. The standard, developed in the early 1990s by Habinteg Housing Association and Joseph Rowntree Foundation, consists of 16 design criteria that can be applied to new dwellings. The design features are low cost measures that contribute to the comfort and convenience as well as provide the flexibility and potential for adaptability to meet the changing needs of the occupants at different stages of life, for instance, such as growing families, illness and reduced mobility (Lifetime Homes, 2013). While half of the 16 design criteria are partially covered by building regulations Approved Document M, 2004 (which primarily deals with accessibility), the standard includes 8 criteria that are additional to the regulations.

The following assessment scale was devised based on the level of compliance with the standard:

Level of compliance with the Lifetime Homes standard	**Potential for adaptability**	**Score**
Full: Schedule of compliance with Lifetime Homes standard	High	3
Minimal: Meets Part M of building regulations only	Low	1

8.3.3.2. Level of dwelling adaptability in case study housing developments

Table 41 summarises level of compliance of dwellings to the Lifetime Homes standard:

Case study	**Compliance with Lifetime Homes standard:**	**Level of adaptability**	**Score**
A	Minimal	Low	1
B	Minimal	Low	1
C	Minimal	Low	1
D	Full	High	3
E	Full	High	3
F	Minimal	Low	1

Table 41: Level of dwelling adaptability in case study housing developments

Only two of the case studies met the Lifetime Homes Standard, therefore offering adaptable homes - unsurprisingly these were the two developments built by housing associations with 100% affordable housing. The remaining four case studies offered only a limited level of adaptability as specified by the building regulations.

8.3.4. Compatibility with the local architectural heritage (C4)

8.3.4.1. Method of assessment

The two assessed standards that include this feature (SBTool and CASBEE) acknowledge that the assessment of housing compatibility with local heritage and cultural style will be subjective. CASBEE attempts to evaluate the efforts that have gone in to inherit the regional housing culture and use of local materials and building styles. Similarly, SB Tool’s assessment focuses on the compatibility of architectural features with the existing cultural values relating to urban design, and recommends an experienced third party design professional to carry out the assessment. Scores are attributed depending on the extent of compatibility with existing cultural values of urban design and architecture.

A slightly different approach is utilised to assess the 'SE 14 – Local vernacular' criterion by the BREEAM Communities standard (BRE Global Ltd, 2012b). BREEAM requires the design process of a development to follow the following steps:

1. Review of local area to establish key aspects of the local character
2. Consultation carried out with local stakeholders (local authority, community representatives, etc.).
3. Analysis of consultation results and inclusion in the design of the key elements that support the local vernacular.
4. A number of additional elements are included that may help to reinforce the local identity. Examples of these include - use of local materials; use of local building forms, heights and architectural features; inclusion or retention of historic features/associations (e.g. retaining archaeological foundations, etc.); and use of local or regional plant species throughout the development.

As with other standards addressing this feature (e.g. SB Tool and CASBEE), the BREEAM approach is essentially evaluating the effort that a developer has made to ensure the new development is sensitive to local architectural heritage. Therefore, based on the best practice steps outlined by BREEAM, the following rating system has been adapted for the assessment of this criterion:

One point to be allocated for each of the following elements implemented;

- Detailed review of local area to establish key aspects of the local character.
- Consultation with stakeholders.
- Inclusion in the design of the key elements that support the local vernacular.
- Use of local building forms, heights and architectural features.
- Use of local materials and/or local or regional plant species.

Depending on the number of points achieved, the following scoring system will be used:

Total number of points achieved	Level of effort to comply with local vernacular	Score
4-5	High	5
2-3	Average	3
1 or less	Low	1

8.3.4.2. Level of compatibility with the local vernacular in case study housing developments

Detailed review of the design and access statements (DAS) was carried out to ascertain the level of effort made to comply with the local vernacular and the results are presented in table 42.

Case Study:	A	B	C	D	E	F
Detailed review of local area to establish key aspects of the local character		✓		✓		
Consultation with stakeholders.		✓	✓		✓	✓
Inclusion in the design of the key elements that support the local vernacular					✓	✓
Use of local building forms, heights and architectural features	✓	✓	✓	✓	✓	✓
Use of local materials and/or local or regional plant species						
Total number of points achieved:	1	3	2	2	3	3

Table 42: Level of effort made to comply with the local vernacular by the housing developments.

Table 43 below shows the number of points and the subsequent scoring achieved by each of the six case study housing developments.

Case study	Total number of points achieved:	Level of effort to comply with local vernacular:	Score
A	1	Low	1
B	3	Average	3
C	2	Average	3
D	2	Average	3
E	3	Average	3
F	3	Average	3

Table 43: Level of compatibility with the local vernacular in case study housing developments

Five of the case studies, B to F, scored average in terms of the level of effort made to comply with the local vernacular. Case study A, built by a large private sector developer, scored lowest as only one element (out of five) was specified in its DAS.

8.3.5. Features for informal socialising (C5)

8.3.5.1. Method of assessment

Any feature that facilitates informal social interaction needs to be easily accessible and of good quality to ensure that members of the community from different societal groups are not discouraged from using it. Typical features that could be integrated into a housing development are as follows;

- Allotments / communal gardens
- Children play areas
- Seating
- Landscaped area for active recreation (e.g. team sports, outdoor gym)
- Outdoor dining (picnic, barbeque stands)

The following rating system will be used depending on the number of such features present in the development:

No of features within the development:	Provision of features for social interaction:	Score:
4 or more	High	5
2-3	Medium	3
1	Low	1
0	None	0

8.3.5.2. Level of provision of features for informal socialising in case study housing developments

Developments were analysed whether they had any of the features listed in section 8.3.5.1 that could be used for informal socialising. Table 44 below summarises the results. Half of the developments scored zero on this criterion as they had no features for informal interaction. These were case studies B, C and D – three developments built by three different types of builders (private developer-housing association partnership, regional developer and a housing association respectively) that include the largest (case study B) and smallest (case study D) of the case studies. Developments A and E both contained green areas that housing-users could potentially use as an informal meeting area, while case study F also includes a toddler play area in addition to a green space, thus scoring highest of the six developments.

Case study	Number of features within development	Source	Score
A	1 (Low): An informal area of public open space (approx. 0.165ha)	Planning documents/ Layout map	1
B	None	Planning documents/ Layout map	0
C	None	Planning documents/ Layout map	0
D	None	Planning documents/ Layout map	0
E	1 (Low): Centralised area of designated amenity space	Planning documents/ Layout map	1
F	2 (Medium): Toddler play area and public amenity area	Planning documents/ Layout map	3

Table 44: Level of provision of features for informal socialising in case study housing developments

8.3.6. Accessible and good quality greenspace (C6)

8.3.6.1. Method of assessment

This criterion can be assessed by looking at the size of the greenspace and its distance from the housing development. The assessment used in this study is based on a standard developed by Natural England known as ANGSt (Accessible Natural Greenspace Standard) (Natural England, 2010). The standard was originally developed in the early 1990s and based on studies into the minimum distance that people would travel to get to a greenspace (*ibid*). Following a review of the standard in 2008, Natural England concluded that the recommendations are still valid.

According to ANGSt, accessible greenspace should be;

- of at least 2 hectares (ha) in size, no more than 300m (5-minute walk) from home;
- at least one accessible 20ha site within 2km of home;
- one accessible 100ha site within 5km of home; and
- one accessible 500ha site within 10km of home; plus
- a minimum of 1ha of statutory Local Nature Reserves per thousand population.

A ‘greenspace’ can be a park, village green or woodland that is accessible to the public. In order to be accessible, and utilised frequently, the greenspace must be free and within a short, preferably walking, distance. It is acknowledged however that including public greenspace in smaller developments would not be feasible. In these cases, it is important that there is accessible greenspace outside the development.

Taking these factors into consideration the following assessment scale will be used:

>2ha greenspace within the following distance (radius from the middle of the site):	Access to good quality public greenspace:	Score:
300m or less	High	5
Between 300m – 600m	Medium	3
Over 600m	Low	1

8.3.6.2. Level of access to good quality greenspace in case study housing developments

Availability of greenspace that is at least 2ha within 300m radius was assessed using Google Maps based mapping tools[6], and the results are shown in the table 45 below.

Case study	Access to public greenspace:	Source	Score
A	High: Public greenspace of 2.743ha within 300m.	Map	5
B	High: Public greenspace of 2.341ha within 300m.	Map	5
C	Medium: Two public greenspace areas larger than 2ha are within a 300-600m radius.	Map	3
D	Low: Public greenspace larger than 2ha (8.659ha) is more than 600m away	Map	1
E	Low: Public greenspace larger than 2ha is more than 600m away	Map	1
F	Medium: A public greenspace area larger than 2ha (Oaks Wood approx. 5.429 Ha) is within a 300-600m radius. Note that while the Shobnall Leisure Complex is within 300m, it is not considered as an public open space as many facilities require a fee and/or have restrictions (such as no dog walking)	Map	3

Table 45: Level of access to good quality greenspace in case study housing developments

Two of the developments (A and B) scored high as they were close (less than 300m) to a large public greenspace, while two case studies (C and F) scored medium as distance to green space was between 300m – 600m. The two case studies (D and E) built by housing associations scored low as greenspace of sufficient size were over 600m away. The latter might be a reflection of these housing associations' mandate to build social housing in more densely built up, inner-city areas.

8.3.7. Attractive views to the outside (C7)

8.3.7.1. Method of assessment

The 'attractiveness' of a view is a subjective matter, however an approximation can be made by evaluating the proximity and the type of features present in the views from the main living areas. This approach is utilised by the SB Tool, which evaluates this criterion by taking into consideration two factors – the quality of the features and the distance from the living area (main living room or lounge), and provides the following scores (shown in brackets):

Exterior objects seen from the living area are:

- less than 10m. from the living area window, or views are unacceptably ugly (score: -1)
- at least 15 m., and views are visually acceptable (score: 0)

[6] www.freemaptools.com

- at least 20 m., and views include features of interest or natural features (score: 3)
- more than 20 m. distant, and views include features of considerable interest or natural features that are visually attractive (score: 5)

Based on the principles used by SB Tool, the following indicators were developed to guide the scoring of the views from the main living room:

Main features in the immediate views (approx. 10m-15m) from the living room window are:	**Examples:**	**Attractiveness of outside views:**	**Score**
Of considerable interest or natural features that are visually attractive	Greenspace with mature vegetation, water features	Excellent	5
Of interest or natural features	Garden lawn	Good	3
Visually acceptable	Paths, houses, small roads	Fair	1
Unsightly	Busy roads, industry, refuse storage	Poor	0

8.3.7.2. Level of provision of attractive views from dwellings in the case study housing developments

Using the layout maps of the housing developments, the orientation of living rooms in each dwelling was identified together with the type of features within approximately 10 – 15 meters of the window(s). These were then allocated points as specified in section 8.3.7.1 and the average points (mode) are shown in table 46 (full results are shown in Appendix VI).

Case study	**Attractiveness of outside view**	**Source**	**Score (Mode)**
A	Good	Layout map/Housetype specification	3
B	Fair	Layout map/Housetype specification	1
C	Fair	Layout map/Housetype specification	1
D	Good	Layout map/Housetype specification	3
E	Good	Layout map/Housetype specification	3
F	Fair	Layout map/Housetype specification	1

Table 46: Level of provision of attractive views from dwellings in the case study housing developments

All developments scored either ‘good’ or ‘fair’ in terms of attractiveness to outside views. Case studies A, D and E (built by a private sector developer and two housing associations respectively) scored slightly higher than developments B, C and F.

8.3.8. Opportunities to get involved in management and maintenance (C8)

8.3.8.1. Method of assessment

The purpose of this criterion assessment is to evaluate the extent to which the developer has made provisions to give housing-users the opportunity to get involved in management and maintenance issues of the housing development. As the type and extent of engagement and consultation activities that would be appropriate depend on the housing development, BREAAM Communities standard recommends that the focus should be on the consultation plan developed by the design team that would reflect the appropriate needs of the project. SB Tool uses a similar approach to assess this criterion based on the quality of participation plans or survey of housing-users.

The assessment method will be based on the approach used by BREEAM Communities 'GO 04 – Community management of facilities' criterion. The aim of this criterion is to "*support communities in active involvement in developing, managing and/or owning selected facilities" (GO 04)*. The standard defines community facilities and support as follows:

'Community facility': Any service, facility or amenity that the community expresses a desire in managing. This could include community buildings, allotments, meeting places, areas of public access, or any other facility agreed by the community.

'Significant support': Support could be through financial, technical and/or operational measures. The developer should work in partnership with the community on this issue.

Using the above definitions, this criterion can be assessed and scored as follows:

Level of support provided:	**Opportunity for community to get involved:**	**Score**
Significant support has been provided by the developer to a community group to manage one or more community facility	Excellent	5
All community facilities have been developed and managed with the intention and procedures in place to allow handover to community group(s) at project completion.	Good	3
Housing-users have been engaged and consulted regarding facility management and maintenance.	Fair	1
None of the above	Negligible	0

8.3.8.2. Provision of opportunities to get involved in management and maintenance in case study housing developments

Considering the types of features under the definition of 'community facility' that are feasible for a community of housing-users to manage, only three of the case studies, A, E and F, would be eligible for assessment under this criterion (as these have areas of public open space). Case studies B, D and E have no potential facility that the community could potentially manage and maintain. This may be due to the fact that all of the case studies are relatively small, although compared in relation to one another, size did not appear to have an influence on the existence of such community features (see section 8.3.5). It was therefore decided to exclude criterion C8 from the overall assessment, because scoring only half of the developments would lead to a bias in the overall scores of the developments.

This decision has also been made by previous researchers. For example, Williams and Dair (2007) in their analysis of housing developments against sustainability objectives of their analytic framework acknowledge that not all objectives will be relevant to all schemes. In such cases, the authors recorded the objectives as 'not applicable'.

8.3.9. Features that enhance sense of security (C9)

8.3.9.1. Method of assessment

Provision of this feature can be assessed by the extent that the housing development complies with 'Secured by Design – New Homes' guidance[7]. Secured by Design (SBD) guidance is a UK police initiative that seeks to encourage the homebuilding industry to adopt design elements that reduce opportunities for crime. According to the 2010 version of the guide, SBD housing developments experience 50% fewer burglaries, 25% fewer vehicles crimes and 25% less criminal damage than those compared to non-SBD developments.

SBD for new homes consists of two sections:

1. Section 1: Development layout and design (planning issues)

2. Section 2: Building control and code for sustainable homes issues (physical security)

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[7] http://www.securedbydesign.com/

The CSH (Man4 – Security) focuses on compliance with section 2 only and requires an Architectural Liaison Officer (ALO) or Crime Prevention Design Advisor (CPDA) from the local police to be consulted at the design stage if full credits are to be achieved. In line with the CSH approach, the following assessment method will be used for this criterion:

Level of compliance with the SBD standard:	Security of design:	Score:
Full compliance with the standard	Excellent	7
Partial compliance with SBD and/or consultation with local ALO or CPDA at the design stage.	Good	5
Some elements of SBD incorporated in the design	Fair	3
No elements of SBD incorporated in the design and no consultation with ALO or CPDA.	Minimal	1

8.3.9.2. Level of provision of security design features in case study housing developments

Planning documents were investigated to ascertain the level of SBD guidance incorporated into the case study design and development, and the results, together with the scoring are presented in table 47 below.

Case study	Security considerations	SDS compliance level:	Source of information	Score
A	A number of security measures have been considered and incorporated into the design, but ALO has not been consulted prior.	Fair	DAS; Review of application from ALO in response to e-consultation notification	3
B	Guided by the Secure by Design strategy and ALO visit to the site	Good	DAS; Review of application from ALO in response to e-consultation notification	5
C	A number of security measures have been considered and incorporated however ALO has not been consulted prior	Fair	DAS; Review of application from ALO in response to e-consultation notification	3
D	A number of security measures have been considered and incorporated however ALO has not been consulted prior	Fair	Review of application from ALO in response to e-consultation notification	3
E	Includes measures to reduce the likelihood of crime, such as design of areas to benefit from high levels of natural surveillance.	Fair	DAS	3
F	Indicative layout incorporates a range of measures that deter criminal activity, including overlooking of open space areas and the 'public realm'.	Fair	DAS	3

Table 47: Level of provision of security design features in case study housing developments

Most of the developments, A and C to F, scored as 'fair' in terms of the level of compliance with the SBD, that is only some elements of SBD are incorporated into the design. Case study B (built by private sector developer and a housing association) scored slightly higher as an ALO had visited the site and the design has been guided by SBD.

8.3.10. Higher level of dwelling density (C10)

8.3.10.1. Method of assessment

Residential housing density is typically measured as dwellings per hectare (dph). The Planning Policy Statement 3 (DCLG 2006c), which was superseded by NPPF, specified 30dph as a national indicative minimum to guide Local Authorities. The current NPPF does not specify a value, but states that LAs should develop "*their own approach to housing density to reflect local circumstances*" (DCLG, 2012; p13). It has also been suggested that a minimum density of 30 dph is necessary for the creation of character or a sense of place (Falk and Carley 2012).

While very low residential densities are widely regarded as undesirable, land saving benefits beyond 70dph reduce as more land becomes required for more amenities to support the proportionally higher population (except in town/city centres where higher densities may be justified and achieved) (Barton, Grant and Guise, 2010). As this study is focusing on typical housing developments outside large city and town centres, the recommended value by Barton, Grant and Guise, (2010) of 50dph will be used as a fair average. This figure is higher than the minimum 30dph as well as the 42dph average densities currently being built (DCLG, 2013c), but according to Barton, Grant and Guise (2010) can still be achieved with provision of gardens and normal parking.

Using the recommendations and arguments above, the following scoring method was devised:

Average dph	**Development density**	**Score:**
50dph – 60dph	High	5
Between 30dph – 50dph	Medium	3
< 30dph or >60dph	Too low / too high	1

8.3.10.2. Level of housing density in case study housing developments

Housing density was obtained either directly from the planning documentation or calculated from layout maps provided. Table 48 shows the dph values and the associated scores.

Case study	Density (dph)	Source:	Score
A	40 dph (medium)	Layout map	3
B	42 dph (medium)	Design and Access Statement	3
C	40 dph (medium)	Design and Access Statement	3
D	61 dph (too high)	Design and Access Statement	1
E	38 dph (medium)	Design and Access Statement	3
F	28 dph (too low)	Design and Access Statement	1

Table 48: Gross residential housing density in case study housing developments.

Most of the case studies scored medium in terms of the 'appropriateness' of the housing density, however they reflect the typical national average (DCLG, 2013c). Case studies D and F scored low as the former (built by a housing association) had a very high housing density, while that of the latter (built by private sector developer) was deemed too low.

8.3.11. Access to amenities (C11)

8.3.11.1. Method of assessment

The number and type of amenities feasible in any given area are dependent on the neighbourhood density, and while some people may choose not to use local facilities it is important to offer the choice (Barton, Grant and Guise, 2010). Both LEED and SBTool assess mixed use or proximity to amenities by calculating the number of amenities within a certain walking distance (400m in case of the two standards). LEED's LL5 'Community resources / transit' criterion awards points to sites that are located within a certain distance to basic community amenities. The standard uses 400m as the minimum distance, with 4 basic amenities receiving 1 point, 7 amenities 2 points and 11 amenities 3 points. Following the approach used by LEED, the following assessment method has been devised for this criterion:

Number of amenities within 400m:	Proximity to amenities:	Score:
10 or more	High	5
5-9	Medium	3
4 or less	Low	1

8.3.11.2. Level of access to amenities in case study housing developments

Google mapping tools were used to analyse the type of amenities within the 400m radius of the development (measuring from the centre of the site). List of amenities accessible from each site is presented in Appendix VII, and table 49 presents the results and scoring.

Case study	Number of amenities within 400m:	Proximity to amenities:	Score
A	12	High	5
B	7	Medium	3
C	7	Medium	3
D	10	High	5
E	9	Medium	3
F	4	Low	1

Table 49: Level of access to amenities in case study housing developments.

Case studies A and D scored highest in terms of access to amenities, followed by B, C and E, which scored medium. Case study F scored the lowest with fewest amenities accessible to its housing-users.

8.4. Scoring results

Table 50 below summarises the scores received by each housing development case study. Because the scoring system produces a minimum score of 8 rather than zero (i.e. all case studies receive a total of 8 points by default), the scoring was adjusted (by subtracting 8 from all sums) in order to reveal a more accurate reflection of case study achievements. Performance ratio against each feature is calculated based on the rationale that 100% would represent perfect scoring (i.e. maximum points achieved) by all six case studies against that particular feature.

Soft feature:	Possible score		Development						Performance ratio
	Max	Min	A	B	C	D	E	F	
C1: Suitable indoor space	7	1	5	3	3	3	7	7	➞ 67%
C2: Private outdoor space	5	1	5	5	5	5	1	5	➞ 87%
C3: Adaptability	3	1	1	1	1	3	3	1	➞ 56%
C4: Compatibility architectural heritage	5	1	1	3	3	3	3	3	➞ 53%
C5: Features for informal socialising	5	0	1	0	0	0	1	3	➞ 17%
C6: Accessible public greenspace	5	1	5	5	3	1	1	3	➞ 60%
C7: Attractive views outside	5	0	3	1	1	3	3	1	➞ 40%
C8: Opportunities to get involved	*(5)**	*(0)**	n/a	n/a	n/a	n/a	n/a	n/a	n/a
C9: Security features	7	1	3	5	3	3	3	3	➞ 48%
C10: Compact neighbourhood design	5	1	3	3	3	1	3	1	➞ 47%
C11: Proximity to amenities	5	1	5	3	3	5	3	1	➞ 67%
Total score:	52	8	32	29	25	27	28	28	
Adjusted scores:	*44*	*0*	24	21	17	19	20	20	
Adjusted percentage (%):	*100%*	*0%*	55%	48%	39%	43%	45%	45%	

*Table 50: Summary of housing development scores (*excluded from 'total score' sum)*

A schematic representation of performance against each feature is presented by Figure 44, where the scoring of each development is shown together with the overall performance ratio.

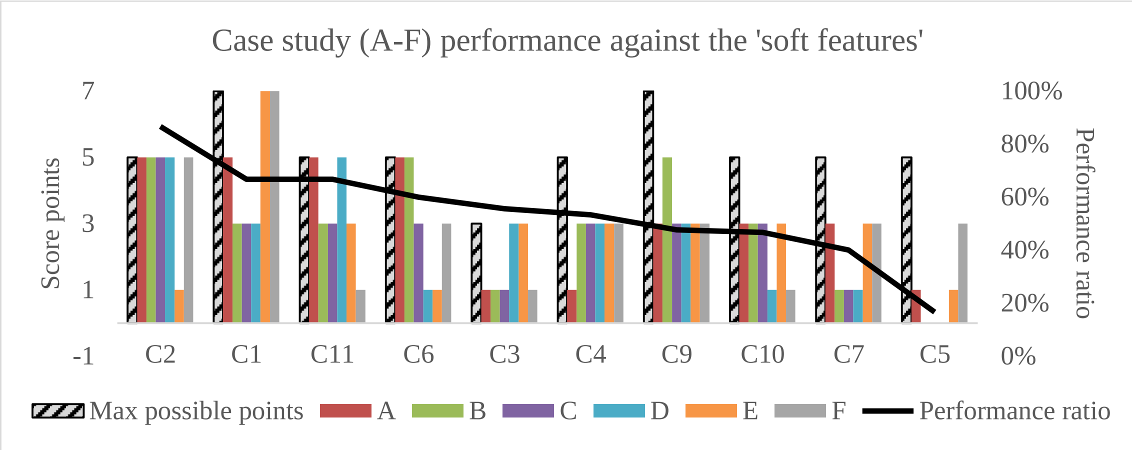

Figure 44: Performance of each case study (A-B) against 'soft' features (C1- C11, excluding C8). Performance is ordered from high (for C2) to low (for C5). (Source: self-study).

Overall, all six case study developments scored relatively low in terms of provision of the 'soft' features. The scores were not widely distributed raging between 39% and 55%. The similar scores are perhaps not surprising given that the case studies were in close geographical proximity (north Staffordshire) and therefore under the influence of similar cultural and socioeconomic factors.

The highest scoring (55%) development A was built by a large national housebuilder (Taylor Wimpey). Scoring in the middle of the range were developments B, E and F; development B (48%) was built jointly by a large private housebuilder and a housing association (Barratt Homes & Aspire Housing), while developments E and F that scored equally 45% were built by a housing association (Trent and Dove) and a large national housebuilder (Bellway) respectively. Scoring at the lower end of the range was development D built by a regional housing association (Midland Heart Housing Group) with 43%, and lastly development C built by a smaller, regional developer scoring last (39%, Seddon Homes Ltd).

Generally speaking, provision of the following four features was the highest; private outdoor space (C2), suitable indoor space (C1), proximity to amenities (C11) and proximity to public greenspace (F6) with performance ratios of 87%, 67%, 67% and 60% respectively across the six developments. Provision of 'attractive views to the outside' (C7) and 'features for informal socialising' (C5) was lowest with performance ratios of 40% and 17% respectively.

In terms of provision of the soft features, the performance of the six housing developments was as follows:

- Only two of the housing developments (E and F) provided dwellings that exceeded the minimum **indoor space** specified by the GLA standard, while three (B, C and D) developments provided indoor space only within 80% - 90% range of the standard's recommended GIA minimum.
- All except one of the case studies scored high in the provision of **private outdoor space**. The development (E) that failed to reach full marks for this feature did so because of unclear provision of private garden space for affordable housing apartments.
- Unsurprisingly, only the two affordable housing developments (D and E) built by housing associations scored the maximum points for **adaptability**.
- Most of the housing developments (B to F) scored a satisfactory, albeit not the maximum number of points for their **compatibility with local architectural heritage**.
- Half of the developments (B, C and D) provided no **features for informal socialising**. Developments A and E provided one and F provided two such features - all in the form of internal greenspace areas.
- In terms of **access to greenspace**, two of the developments (A and B) scored high, while two (C and F) scored adequately, and two (D and E) scored low.
- None of the developments scored the maximum number of points for providing dwellings with **attractive views to the outside**. Three of the developments, A, D and E scored higher than the remaining three.
- As above, none of the developments scored the maximum number of points available for providing more design **features to enhance the sense of security.** All scored relatively low, with only one case study, scoring a slightly higher score of 5.
- None of the developments scored maximum number of points under the **appropriate level of housing density** criterion, with most (A, B, C, and E)

scoring in the middle and two (E and F) scoring low for providing housing density that was deemed to be either too high or too low.

- Overall, **access to amenities** was good with two developments (A and D) scoring maximum points, three (B, C and E) scoring medium, and only one (F) scoring low points.

8.5. Application of COPRAS to evaluate the provision of 'soft' features by the six housing developments

The basic information and data required for the COPRAS calculations are the criteria (i.e. the 'soft' design features), their weights, the alternatives (i.e. six housing developments) and their performance against the criteria (i.e. provision of the 'soft' features). This information has been acquired in previous chapters and it summarised by the performance matrix (table 51):

Criteria, *i*	**Weight, *q***				**Performance of the alternatives, *j***					
	Users	**HA**	**LA**	**Dev**	A_1 (A)	A_2 (B)	A_3 (C)	A_4 (D)	A_5 (E)	A_6 (F)
C1: Suitable indoor space	0.13	0.13	0.12	0.13	5	3	3	3	7	7
C2: Private outdoor space	0.13	0.11	0.10	0.11	5	5	5	5	1	5
C3: Adaptability	0.09	0.10	0.11	0.08	1	1	1	3	3	1
C4: Compatibility with architectural heritage	0.09	0.09	0.09	0.10	1	3	3	3	3	3
C5: Features for informal socialising	0.08	0.09	0.08	0.09	1	0	0	0	1	3
C6: Accessible public greenspace	0.11	0.11	0.10	0.10	5	5	3	1	1	3
C7: Attractive views to the outside	0.11	0.09	0.08	0.10	3	1	1	3	3	1
C8: Opportunities to get involved	-	-	-	-	-	-	-	-	-	-
C9: Security features	0.10	0.12	0.12	0.10	3	5	3	3	3	3
C10: Compact neighbourhood design	0.07	0.06	0.07	0.06	3	3	3	1	3	1
C11: Proximity to amenities	0.10	0.11	0.11	0.11	5	3	3	5	3	1

Table 51: The performance matrix.

(Given that not all housing developments had the conditions necessary for C8 (lack of public open spaces for housing-users to get involved in managing, see discussion in section 8.3.8), it was decided to disregard this criterion in the multicriteria calculations. As such, the weights for the remaining criteria were recalculated accordingly.)

As highlighted in chapter 5, numerous studies using COPRAS to evaluate housing areas have been published and the calculations presented here follow those detailed in Viteikiene and Zavadskas (2007), Zavadskas and Antucheviciene (2007), Maliene (2011) and Mulliner, Smallbone and Maliene (2013).

Stage 1: The first step of the COPRAS method requires the development of the weighted normalised decision matrix *D*. Normalisation converts different units used to measure criteria (e.g. counts, quantities, percentages) into weighted dimentionless values, which enables the direct comparison of all the criteria. To achieve this, the following formula is used:

$$d_{ij} = \frac{x_{ij} \cdot q_i}{\sum_{j=1}^{n} x_{ij}} \qquad (4)$$

where x_{ij} is the value of the *i*-th criterion of the *i*-th alternative and q_i is the weight of the *i*-th criterion. For instance, the dimentionless (i.e. normalised weighted) value (d_{ij}) calculation for C_1 of A_1 would be as follows:

$$d_{11} = \frac{x_{11} \cdot q_1}{x_{11}+x_{12}+x_{13}+x_{14}+x_{15}+x_{16}} = \frac{5 \cdot 0.13}{\mathbf{5+3+3+3+7+7}} = 0.023$$

The full normalised decision matrix, *D*, using *housing user* weightings is presented in table 52 (normalised decision matrices for housing providers are shown in Appendix VIII). Application of this formula means that the sum of dimentionless values (d_{ij}) of each criterion will equal the weight (q_i) of that criterion:

$$q_i = \sum_{j=1}^{n} d_{ij} \qquad (5)$$

Criteria, *i*	***d_{ij}***						***Housing users q_i***
	A_1	**A_2**	**A_3**	**A_4**	**A_5**	**A_6**	
C1: Suitable indoor space	0.023	0.014	0.014	0.014	0.032	0.032	0.13
C2: Private outdoor space	0.024	0.024	0.024	0.024	0.005	0.024	0.13
C3: Adaptability	0.009	0.009	0.009	0.026	0.026	0.009	0.09
C4: Compatibility with architectural heritage	0.006	0.017	0.017	0.017	0.017	0.017	0.09
C5: Features for informal socialising	0.017	0.000	0.000	0.000	0.017	0.050	0.08
C6: Accessible public greenspace	0.031	0.031	0.018	0.006	0.006	0.018	0.11
C7: Attractive views to the outside	0.027	0.009	0.009	0.027	0.027	0.009	0.11
C8: Opportunities to get involved	-	-	-	-	-	-	-
C9: Security features	0.015	0.025	0.015	0.015	0.015	0.015	0.10
C10: Compact neighbourhood design	0.015	0.015	0.015	0.005	0.015	0.005	0.07
C11: Proximity to amenities	0.024	0.014	0.014	0.024	0.014	0.005	0.10

Table 52: The normalised decision matrix, D, (using weights determined by housing users) showing that the sums of dimentionless values (dij) of each criterion equal the weight (qi) of that criterion.

Stage 2: The second stage requires the calculation of the sums of weighted normalised criteria for each alternative (*j*). COPRAS method allows the use of maximising (i.e. positive) criteria, S_{+j} and minimising (i.e. negative criteria), S_{-j}, to describe the performance of the alternatives whereby higher values for the former and lower values for the latter are better;

$$S_{+j} = \sum_{i=1}^{m} d_{+ij} \quad \text{and} \quad S_{-j} = \sum_{i=1}^{m} d_{-ij} \qquad (6) \text{ and } (7)$$

Because in this study only maximising criteria, S_{+j}, are used, S_{-j} values are zero.

Stage 3: The COPRAS method uses S_{+j}, and S_{-j} to calculate the relative significance, Q_j (i.e. provision of 'soft' features) of each alternative housing development according to the following formula:

$$Q_j = S_j^+ + \frac{S_{min}^- \sum_{j=1}^{n} S_j^-}{S_j^- \sum_{j=1}^{n} \frac{S_{min}^-}{S_j^-}} = S_j^+ + \frac{\sum_{j=1}^{n} S_j^-}{S_j^- \sum_{j=1}^{n} \frac{1}{S_j^-}} \qquad (8)$$

However, if only maximising criteria are used, then $Q_i = S_{+j} = S_j$ (Podvezko, 2011)

Stage 4: This stage enables the ranking of the alternative housing developments in terms of their performance against the 'soft' features. The priority of each alternative is determined by the Q_i value – the higher it is, the better the performance. From table 53, it can be seen that the rank order of the six housing developments according to the provision of soft features is as follows:

Housing Users: $A_1 > A_6 > A_5 > (A_2 \,\&\, A_4) > A_3$

Housing Associations: $A_1 > A_6 > A_5 > A_4 > A_2 > A_3$

Local Authorities: $A_1 > A_6 > A_5 > A_4 > A_2 > A_3$

Developers: $A_6 > A_1 > A_5 > A_4 > A_2 > A_3$

Stage 5: Having established the ranking of the alternatives, this last stage calculates the degree of utility, N_j, or the relative level of performance of each development against the top performing one (i.e. A_1). This is done using the following formula:

$$N_j = \frac{Q_j}{Q_{max}} 100\% \qquad (9)$$

As A_1 is the development that best satisfies the soft criteria, it is the alternative with the highest degree of utility which can be represented as 100%. The performance (degree of utility) of the remaining alternatives, can be measured on a range of 0% to 100%.

	S_{+j} / Q_i				S_{-j}	***Rank***				N_j			
	Users	HA	LA	Dev	all	***Users***	***HA***	***LA***	***Dev***	Users	HA	LA	Dev
***A_1* (A)**	0.19	0.187	0.185	0.188	0	***1***	***1***	***1***	***2***	100%	100%	100%	99%
***A_2* (B)**	0.158	0.157	0.158	0.155	0	***4***	***5***	***5***	***5***	83%	84%	85%	82%
***A_3* (C)**	0.135	0.134	0.135	0.133	0	***5***	***6***	***6***	***6***	71%	72%	73%	70%
***A_4* (D)**	0.158	0.16	0.162	0.158	0	***4***	***4***	***4***	***4***	83%	86%	87%	83%
***A_5* (E)**	0.174	0.177	0.178	0.176	0	***3***	***3***	***3***	***3***	92%	95%	96%	93%
***A_6* (F)**	0.184	0.185	0.181	0.19	0	***2***	***2***	***2***	***1***	97%	99%	98%	100%

Table 53: COPRAS method calculations and results.

8.6. Chapter summary and conclusions

- The aim of this chapter was to evaluate the extent to which six housing developments provided for the 11 ‘soft’ features. For each feature, an evaluation methodology was developed based on existing methods, and publically available planning documents were used to carry out the assessments.

- None of the case studies scored the maximum possible number of points that would represent full provision of all soft features. The highest score achieved was by a housing development of 87 units in Newcastle-upon-Lyme built by one of the largest homebuilders in the country. The lowest ranking development was also built by a private developer and located in Stoke-on-Trent.

- Generally, developments scored well in the provision of private outdoor space, indoor space, proximity to amenities and to public greenspace. However, provision of indoor space could be further improved by most of the case study developments due to the importance of this feature to housing-users as well as the fact that the assessment methodology is based on the recommended *minimum* GIA standard.

- Two soft features whose provision could be improved across all case study developments were attractive views to the outside and features for informal socialising as performance with regard to their provision was low, particularly for the latter feature.

- The MCDA method COPRAS was employed to assess the performance of the six housing developments against the ‘soft’ design criteria by utilising the weights of importance determined by the stakeholder groups in chapter 7.

- The results revealed that development A ranked first and was closely followed by Development ‘F’, indicating that these developments offered the best provision of ‘soft’ features according to stakeholder priorities. Conversely, development ‘C’ was ranked last by all stakeholders, indicating that this development performed least well in terms of ‘soft’ feature provision out of the six housing development case studies.

Chapter 9: Discussion and conclusions

9.1. Introduction

This final chapter collates and distils the findings from each section of the study to reveal the overall conclusions of this thesis that address the research questions and aims set out in the introduction. The chapter begins with a brief overview of the literature based chapters that were used to establish the context and build the foundations for the study. It then moves on to highlight the findings of the content analysis and explain their significance to the research framework. A substantial part of this chapter is devoted to a discussion of the stakeholder survey results, particularly the differences in opinion between housing users and housing providers, and where relevant, how these findings link to current policy and previous research. Lastly, the chapter focuses on the housing development case studies and their performance in terms of provision of 'soft' features. After pointing out some of the research limitations encountered during the study, the chapter concludes with a final summary that addresses the initial research questions and aim, and highlights the contribution to knowledge made by this research.

9.2. Key findings from the literature review

The literature review was carried out in three stages: Firstly, a review was carried out to gain an understanding of sustainable housing in its holistic sense and establish the current situation with regards to its implementation in the UK. Secondly, literature on housing and health was explored for a deeper understanding of how housing impacts health and well-being. Lastly, using the understanding gained in the first two stages, a framework was developed for sustainable housing with a particular focus on health and well-being. The key findings of these stages are briefly outlined next:

9.2.1. Sustainable housing

The difficulties in establishing a clear definition for sustainable housing that could be widely agreed upon, and useful in practice, can be traced back to the difficulties associated with defining sustainable development. As a consequence, the concept of 'sustainable housing' tends to be understood in narrow environmental terms and is commonly used to refer to dwellings with enhanced environmental performance (Turcotte and Geiser, 2010; UN-Habitat, 2012). However, given that quality of human life is at the core of the sustainable development concept, the focus of sustainable housing should be on enhancing the quality of life of current and future housing-users within the broader social, environmental and economic contexts (Brown and Bhatti, 2003; Chiu, 2003; Mateus and Bragança, 2011; Priemus, 2005). Sustainable housing can therefore be defined as *housing that ensures a better quality of life for current and future residents within the wider social, environmental and economic contexts*. However given the complexity of the subject, it is acknowledged that a framework based approach is a more serviceable method for defining sustainable housing.

Within the UK's sustainable development strategy, while there is no explicit mention of sustainable housing or its direct effect on the quality of life, the importance of housing is viewed primarily in terms of energy efficiency and sustainable communities. The latter is particularly pertinent as the concept of a sustainable community is closely tied to that of sustainable housing – housing and neighbourhood design that follows the holistic principles of sustainability is essential in helping to achieve the eight principles of sustainable communities. In terms of sustainable housing aspirations within the house building industry, interesting observations can also be made with regards to the sustainable construction strategy where, unlike its 2005 predecessor, the focus of the 2008 version is very much on economic and environmental sustainability, with no mention of quality of life and well-being.

Key drivers for sustainable housing at policy level are the national housing strategy and the NPPF, both of which recognise the holistic nature of such housing and stress its importance to the quality of life. However in practice, it is largely the planning policy, Building Regulations and building standards such as the CSH that drive the development of sustainable housing in the UK (DCLG, 2012b; Pickvance, 2009a). As such, it could be argued that this results in an inadequate stimulus for the implementation of sustainable housing (in its holistic sense) as each of these drivers suffer from inadequacies in this regard:

Firstly, while NPPF does place a strong stress on holistic sustainability, the onus is placed very much on local authorities to implement it in practice. Secondly, the Building Regulations focus primarily on building safety, accessibility, performance efficiency (especially energy and water) and environmental protection rather than direct acknowledgement of impacts on quality of life. Lastly, the building standards such as CSH, BfL12, Lifetime Homes and HCA's Housing Quality Indicators do focus on holistic sustainability and quality of life (to varying degree and according to remit), however to date, these have been largely voluntary for the private sector, and following the Housing Standards Review, their application within the social housing sector will be reduced. In addition to these arguably weak drivers for holistically sustainable housing that enhances quality of life, a broad range of barriers have also been identified and include informational/conceptual, institutional, financial, regulatory, market demand and social/psychological factors.

With regard to the current levels of sustainable housebuilding in the UK, the literature review revealed very little in-depth and peer-reviewed analysis of sustainable housing provision with the notable exceptions of Barton (2000) and Williams and Lindsay (2007). It is presumed that the reason for the lack of more recent assessments is partly due to dwellings built to the CSH specifications regarded as *de facto* sustainable housing, and the data for which is made publically available by the DCLG. However, even if one is to use the CSH figures as an indication of the levels of sustainable house building in the UK, the situation does not look particularly good: Not only the Code is largely focused on environmental sustainability, it is only mandatory where it is specified as a requirement by local authority planning policy or the housing is funded by the HCA. Audits using other indicators such as BfL12 are also not particularly encouraging, with only 18% of the assessed samples of private and social housing developments rated as ‘good’ or ‘very good’ (CABE, 2011).

The literature review also looked at the role of stakeholders given that the complex nature of sustainable housing means that no single organisation has the expertise or ability to deliver it singlehandedly (Miller and Buys, 2012). While there are a number of different housing stakeholders, four groups were identified as of particular interest to this study. These were local authorities, housing associations, private sector house builders (i.e. the main housing providers) and housing end-users. In terms of the housing providers, the characteristics of and pressures acting on each group influence their ability and willingness to provide sustainable housing. While regarding housing end-users, their behaviour and preferences have implications on the development of sustainable housing.

9.2.2. The relationship between housing and health and well-being

Similarly to the ‘sustainable housing’ concept, there is no widely agreed upon definition for ‘healthy housing’ (Bonnefoy, 2007). However using the broad definitions of housing and health as well as the evidence that housing is an important social determinant of health and well-being, the following definition was adopted; *healthy housing is housing that is designed and built in a way that not only avoids the negative health impacts, but also contributes positively towards healthy life-styles within the physical, mental and social well-being domains of health*.

The importance of housing on health and well-being can be illustrated by two conceptual frameworks. The first is Maslow's Hierarchy of Needs (Maslow, 1943) (figure 3) where housing can contribute to or facilitate three of the five levels of needs – safety, love and relationship and self-esteem needs. The second framework is the 'Settlement Health Map' (Barton and Grant, 2006; Dahlgren and Whitehead, 1991) (figure 4) where housing (within the built environment layer) can affect health and well-being either directly or indirectly by influencing the lifestyle, community, activities and local economy as well as the natural environment and global ecosystem layers.

Study of the housing and health relationship has a long history, with some of the earliest detailed accounts linking poor housing to poor health and disease made by Friedrich Engels and Edwin Chadwick in the 19th century. While communicable diseases associated with poor housing have been largely eradicated (at least in developed countries) through targeted public health initiatives, some of them have also inadvertently laid the foundations for a number of today's unsustainable and health-adverse housing designs (Perdue, Stone and Gostin, 2003; Stevenson and Williams, 2000). In addition, the success of some of these early initiatives in combating disease has led to the decoupling of public health from housing design and policy giving rise to a situation where housing and planning issues are largely excluded from the remit of health ministries and covered solely by housing/construction or environment ministries (Bonnefoy, 2007) and led by professions for whom health is not necessarily the primary focus (Bird and Grant, 2011).

Yet the importance of housing to health and well-being is again gaining increasing recognition as demonstrated by the acknowledgement of its importance by the New Public Health agenda. Housing is recognised as a key ingredient required in the development of supportive environments, community involvement in decision making and planning strategies, and the development of personal skills to enable people to learn about health conductive choices (WHO 1986). In the UK, the importance of housing on health and well-being has been reverberated in the 2010 Government's white paper *Healthy Lives, Healthy People* (HM Government, 2010), which recognises that housing design can support well-being, resilience as well as mental and physical health throughout different stages of life. Obesity, mental health and health inequalities are seen today as the main issues that are effected by urban planning and design (Barton, Grant and Guise, 2010; Marmot, 2010; SDC, 2008).

The long history of research into the health impacts of housing, particularly poor housing, has produced a substantial body of literature exploring this relationship. Much of this literature can be categorised into research looking into chemical, biological and physical exposures; dwelling and wider design characteristics; social, economic and affordability issues; and the impacts on vulnerable social groups (Fuller-Thomson, Hulchanski and Hwang, 2000; Turkington, Leng and Wright, 2010). However the complex, multi-dimensional nature of the subject, the ethical issues associated with it as well as the shortcomings of the literature itself have prevented the establishment of definitive causal relationships within the housing and health research field (Shaw, 2004; Turkington, Leng and Wright, 2010). Nevertheless, it has been argued that sufficient knowledge and evidence for the creation of healthy homes is now available, but that the implementation of this knowledge is still weak and the real current challenge is the transfer of this knowledge into practice (Braubach 2011; Jackson, Dannenberg and Frumkin, 2013).

A full review of the housing and health relationship was beyond the scope of this study given the complex and multi-dimensional nature of the subject. However, having reviewed how conceptual models are used to illustrate and describe the relationship schematically, a *'map'* of housing factors that influence health and well-being was developed (figure 8). The map focuses on the housing and neighbourhood design characteristics that can be influenced by housing providers, showing where these can cause negative or positive impacts on health and well-being. This conceptual map was then utilised as a 'skeleton' upon which the framework for sustainable housing with an emphasis on health and well-being was built.

9.2.3. Framework for sustainable housing with an emphasis on health and well-being

From chapter 2 it became apparent that a framework is a more suitable approach for defining sustainable housing, and a similar conclusion was drawn from chapter 3 for the housing and health relationship. In line with these findings, a framework was developed for conceptualising and defining sustainable housing that placed an emphasis on health and well-being. It consisted of 28 design features identified as necessary components whereby each had an impact on health and well-being in either direct/ ‘hard’, indirect/ ‘soft’/meaningful or global ways – a form of categorisation used by other researchers (e.g. Shaw, 2004). Literature based justification for the inclusion of these components was outlined for each component.

9.3. Key findings from the content analysis (Phase 1)

In order to ascertain the extent to which each feature in the sustainable and healthy housing framework was acknowledged by the construction industry’s best practice, a content analysis was carried out using eight sustainable housing standards from the UK and abroad. Unsurprisingly, the analysis revealed that environmental features received the highest level of coverage, particularly energy efficiency, water conservation and environmental impact of construction materials, which were addressed by all standards reviewed. Similarly, features with direct or ‘hard’ impacts on health received either high or medium coverage – albeit as a group, these were not as prominent as the environmental features.

Features that received least overall coverage were those aspects of design that have ‘soft’ or indirect/meaningful impacts on health and well-being. These 11 components of the framework were labelled as the ‘soft’ features of sustainable housing because they are all non-technological elements of housing and neighbourhood design that can have an indirect, but nevertheless important impact on the health and well-being of housing-users and the satisfaction with their homes.

9.4. Key findings from survey analysis of stakeholder preferences (Phase 2)

The aim of this stage was to gauge the level of relative importance that housing users attach to the 11 ‘soft’ features of housing and neighbourhood design and to compare how opinions differ between housing users and housing providers. This was achieved through the development and administration of an online questionnaire to a group of housing users and housing providers (namely local authorities, housing associations and private sector house builders) within the north WM and southern parts of NW regions of the UK. Figure 45 provides a summary of the relative importance of the 11 features as indicated by the mean ratings by different stakeholder groups, while non-parametric statistical analyses were carried to identify any significant differences in opinion. While some features appeared to be generally more important than others, a number of interesting differences can be discerned in the opinions of the four housing stakeholders.

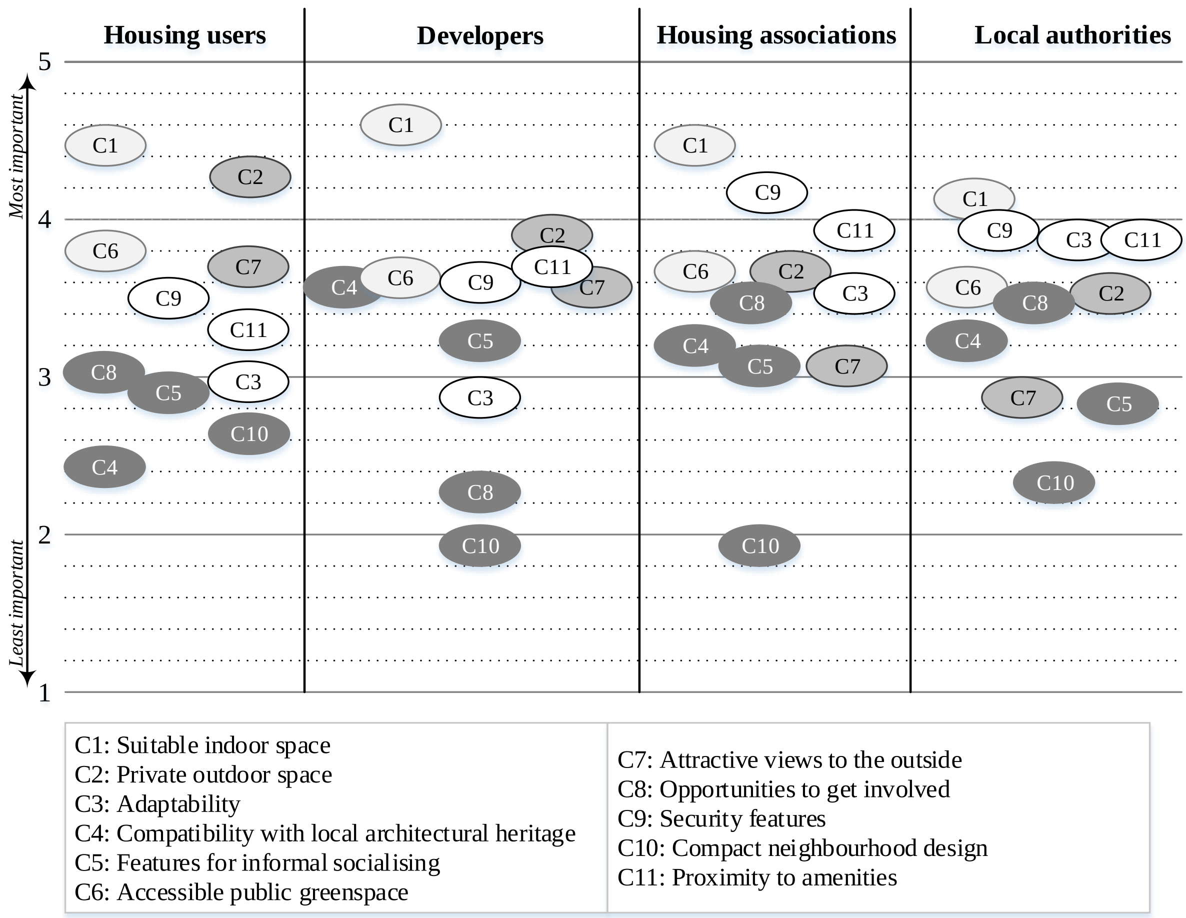

Figure 45: Mean scores of importance for the 11 'soft' features (C1 – C11) as rated by the four housing stakeholder groups (from 1 = 'not at all important' to 5 = 'extremely important'). (The shading of the features is only to aid the reading of the diagram). (Source: self-study).

Indoor space was rated highest in relative importance by all stakeholder groups and no statistically significant difference was observed between the scores of housing users and the housing provider groups. This importance of indoor space to occupants is in line with other consumer preference surveys, such as the research carried out by CABE and RIBA (e.g. CABE, HATC and Ipsos MORI, 2009; Ipsos MORI and RIBA, 2012; 2013; RIBA, 2011). For instance, 80% of respondents in a 2013 RIBA survey stated that they would be more likely to choose a home that met minimum space standards over standards relating to energy, security and access (Ipsos Mori and RIBA, 2013).

This finding is particularly pertinent given the relatively small average indoor area of new housing in the UK. In 2011, a RIBA study found that an average three-bedroom home in England was 88sqm – 92% of the minimum Greater London Authority space standards, which the study was using as a benchmark. The average size appeared to be slightly better in the 2012 English Housing Survey (DCLG, 2014b), which calculated the average total floor area of new homes (built since 2002) to be 96m². However, the survey authors cautioned that this higher average size of new homes was boosted by some very large dwellings. Perhaps a more revealing statistic from the Housing Survey was that a higher proportion (44%) of new builds had a useable floor space under $69m^2$, compared with 35% of older dwellings.

Concern over the decrease of internal space of new homes has been voiced ever since the ending of the Parker Morris standards in 1980, which had stipulated minimum house sizes for publically funded homes (Carmona, Gallent and Sarkar, 2010). In an attempt to remedy this, the UK Government announced in 2014 the introduction of new national minimum space standard for new homes in England following its Housing Standards Review (DCLG 2014a). However, adoption of this national space standard will be voluntary as an optional planning condition whereby local authorities will be required to justify the local viability of the standard before it is adopted. In light of the space standard's reliance on local authorities for implementation, it is interesting that this survey found a statistically significant difference between the importance scores for internal space of local authorities and private sector developers, with the latter giving higher rating to this feature than local authorities.

For housing users and private sector developers, ***private outdoor space*** came second in importance after indoor space – much higher in ranking than allocated by the two social housing providers. However statistical tests of the importance scores revealed that this was a feature over which housing users and housing providers differed most – with the former giving higher ratings than the latter. Despite the relatively high ratings given by the developers than by social housing providers to outdoor space, statistical tests revealed no statistically significant differences among the three housing provider groups.

The importance of private outdoor space to housing consumers supports findings of previous research (CABE, 2005; Leishman *et al*, 2004; Ipsos MORI and RIBA, 2012). However, the apparent discrepancy with the opinions of housing providers in this survey is interesting. Housing providers are under increasing pressure to build to higher densities, effectively limiting the provision of adequately sized private gardens – it would be interesting to ascertain through further research whether there is an element of downplaying the relative importance of private outdoor space by the housing providers, particularly among housing associations and local authorities.

Also, an interesting comparison can be made here with the importance attached to the availability of good quality and accessible ***public greenspace***. In this study, housing providers rated public greenspace and private outdoor space similarly in terms of importance, while housing users scored the former as slightly less important than the latter. Greenspace can afford similar benefits as an outdoor private space, such as access to nature and active recreation, and as such may be treated by housing providers as a substitute for larger gardens (Coolen and Meesters, 2012). However a public greenspace cannot fully substitute a garden, as the privacy of the latter enables many to view and treat it as an important extension of the main living and social areas of their home (Ipsos MORI and RIBA, 2012).

Another feature that appeared to be much more important to housing users than to housing providers was ***attractive views*** from the dwelling. It is difficult to link this to findings in other housing consumer surveys in the UK context as these tend to focus on window design more from light availability or security aspects rather than orientation for views. For instance, RIBA's research found that in dense developments, windows overlooking other homes can intrude on people's sense of privacy (Ipsos MORI and RIBA 2012). The type of view from a dwelling appears to be an important feature to occupants that warrants greater attention in housing consumer surveys, particularly, as mentioned earlier, the WHO LARES study found that bad views from the dwelling was one of the four key housing problems that were linked to increased prevalence of mental health symptoms (Bonnefoy 2007).

Three features were perceived more important by housing providers than by housing users: 'House and neighbourhood ***design that contributes to safety from crime***' was ranked higher by social housing providers than by housing users (and private sector developers). The relatively low ranking awarded by housing users has also been found in other surveys where it has been suggested that this may be due to participants regarding security as their own responsibility rather than that of those designing or developing homes (Ipsos MORI and RIBA, 2012).

A similar situation was observed for ***dwelling adaptability***. There has been much discourse over the values and benefits of adaptable homes (e.g. Carmona, Gallent and Sarkar, 2010), so much so that from 2010, 'Lifetime homes' has become the only mandatory element under the 'Health and Well-being' category of the Code for Sustainable Homes (at level 4) (DCLG, 2010). Interestingly, the importance of adaptability was generally scored much lower by housing users than by housing providers, particularly local authorities and housing associations. More research would be necessary to explain the reasons for the low importance awarded by housing users, but perhaps there is a lack of awareness of the benefits: as few properties are amenable to easy and cost effective adaptation, people are more used to moving home as their circumstances change. The low scoring by private sector developers however is unsurprising as demand for new and greater range of homes is favourable to business profitability.

Proximity to amenities was the third feature that housing providers ranked higher in importance that did the housing users group. This relatively low rating of importance has also been found by earlier surveys. For instance, earlier CABE research found that more people were willing for forgo amenities for the right home than vice versa (CABE, 2005b). However as CABE authors pointed out, this preference tends to be linked to particular life stages and styles, with younger and older respondents placing greater value on proximity to amenities than those with families, who are more likely to compromise in favour of larger properties with private outside space.

The four features that were ranked lowest in importance by all stakeholders, and with little variation in opinion among the groups, were; features for ***informal socialising***, ***compatibility with local architectural heritage***, ***opportunities to get involved***, and lastly, a more compact (***higher density***) neighbourhood design. Arguably, it is no coincidence that these four are also the most complex and potentially multifaceted of the 11 features. For instance, while features for informal socialising can be supportive of social well-being and community development, some people may perceive seating, play or picnic areas as spaces that encourage anti-social behaviour, becoming potentially intimidating places. Similarly, opportunity to get involved in the management and maintenance of housing areas was ranked low by all groups, but this feature is dependent on the existence of public areas within a housing development in the first place.

The apparent preference (or dislike) of certain features may also be a proxy for the like of dislike of other elements. For instance, regarding compatibility with local architectural heritage, RIBA research (Ipsos MORI and RIBA 2012) found a preference among their respondents for 'period features'. However, when prompted for examples, respondents tended to list design elements such as high ceilings, large rooms and windows and the resulting natural light and feelings of spaciousness being the underlying important and preferable qualities associated with ‘period features’. Likewise, while house buyer surveys indicate a general preference for low-density urban environments as opposed to more compact neighbourhood designs, this preference is often qualified with the observation that many homebuyers are in fact attracted to the relative affordability and perceived desirable lifestyle associated with suburban characteristics and life styles (e.g. open spaces, lower height dwellings, low levels of traffic and private gardens) rather than the actual density (CABE, 2005c; Leishman *et al*., 2004; MJB Architects, 2005).

9.5. To what extent are ‘soft’ housing features being provided? (Phase 3)

The overall aim of this final phase of the research was to evaluate the provision of the 11 soft features by recently built housing developments. This was done in two stages; firstly, six housing developments were selected within the geographical scope of the study and assessed for their provision of these features. Secondly, a multi-criteria decision analysis method was applied to rank the performance of these developments against the criteria weighted by the housing users.

9.5.1. Evaluating the performance of new housing developments

In order to evaluate the provision of ‘soft’ features by the housing developments, a suitable methodology had to be found for each feature. For the majority of these features, suitable methodologies for their evaluation already exist either as stand-alone standards (e.g. Lifetime Homes, Secured by Design) or as part of broader sustainability standards (e.g. CSH, SBTool). In few instances where no suitable methodology could be found, guidance from literature was utilised to develop one. Six housing developments were then selected as case studies for the evaluation using the developed ‘toolkit’ of methodologies.

The final evaluation scores revealed that the performance of all six developments in terms of provision of ‘soft’ features was relatively poor. This is perhaps not surprising given that these features are also the least considered by the industry’s best practice sustainable housing standards. When adjusted to percentages, with 100% representing the maximum score, the scores ranged from 55% to 39% - the relatively narrow range is possibly due to the close geographical proximity of the case studies.

In terms of each design feature, provision of private outdoor space was the highest with the performance ratio of 87% across the six developments. This was followed by suitable indoor space, proximity to amenities and to public greenspace with performance ratios of 67%, 67% and 60% respectively. The high level of provision of private outdoor space is a positive result given that this feature rated as second in importance by the housing users group (figure 45). However, the overall low performance ratio of indoor space provision is disappointing given that all stakeholder groups rated this as the most important criterion. Furthermore, it should be noted that indoor space provision specified by the GLA standard (which was used as a benchmark in this study) is already relatively low compared to other western European countries (RIBA, 2011), so it is of particular concern that four of the developments did not meet even these relatively conservative space specifications.

On the other end of the performance scale, provision of 'attractive views to the outside' and 'features for informal socialising' was lowest with performance ratios of 40% and 17% respectively. The low provision of the latter is unsurprising, as this feature was rated relatively low by all housing stakeholder groups. However, low provision of 'attractive views to the outside' is of note given that the housing user group awarded this feature higher ratings of importance than did the housing providers (a difference that was statistically significant).

Unfortunately, it became apparent during the evaluation that it was not possible to carry out a valid assessment of the 'opportunities to get involved in management and maintenance' feature. This is because unlike all the other features, this one was dependent on other factors, namely existence of community facilities (such as public open space, covered in part by 'features for informal socialising' criterion) before management and maintenance opportunities could be afforded in the first place. As explained in chapter 8, and following the approach of other researchers (e.g. Williams and Dair, 2007), it was therefore decided to exclude this feature from the overall analysis, because scoring only some of the developments would lead to a bias in the overall scores of the developments.

9.5.2. Establishing ranking through application of MCDA

The assessment exercise described above was a form of 'objective' scoring as each feature (or criterion) carries equal weight of importance. However, perhaps of greater interest is the assessment of the six housing developments by taking into account the perceived level of importance of each 'soft' feature by the stakeholders. Such assessment was achieved by utilising a multi-criteria decision analysis approach to assess, and thereby, rank each of the developments according to stakeholder determined weights for the features. While weights assigned by the group representing housing users is the focus, rankings were also computed for the housing provider groups for comparison and results are presented in table 54.

Rank	Ranking using scores only:	Ranking using MCDA (COPRAS):			
		Housing users	*Housing Associations*	*Local Authorities*	*Developers*
1st ➞	A (55%)	**A (100%)**	A (100%)	A (100%)	***F (100%)***
2nd ➞	B (48%)	**F (97%)**	F (99%)	F (98%)	***A (99%)***
3rd ➞	E & F (45%)	**E (92%)**	E (95%)	E (96%)	***E (93%)***
4th ➞	D (43%)	**B & D (83%)**	D (86%)	D (87%)	***D (83%)***
5th ➞	C (39%)	**C (71%)**	B (84%)	B (85%)	***B (82%)***
6th ➞	-	-	C (72%)	C (73%)	***C (70%)***

Table 54: Overview of housing developments' performance (rankings) using scores only and MCDA.

Comparing the 'scores only' and MCDA rankings, two major findings can be ascertained from the results outlined in table 54:

Firstly, development 'A' ranked first while development C ranked last in terms of provision of the 'soft' features and these rankings were consistent in both 'scores only' and MCDA methodologies. The only exception to this can be seen in the rankings according to the developer group, however the difference is very small as development 'A' is only one percent below the first ranking. This consistency is a strong indication that development A (built by Taylor Wimpey, 87-unit development in Kidsgrove) offers the highest level of provision of 'soft' features, while development 'C' (built by Seddon Homes Ltd, 62-unit development in Stoke-on-Trent) offers least.

Secondly, unlike the first and last ranks, the remaining rankings from the 'scores only' assessment generally do not match those established using MCDA. For instance, development 'B' (built by Barratt Homes & Aspire Housing, 117 units in Newcastle-under-Lyme) is ranked second by scores, but comes second to last in the MCDA rankings according to all four stakeholder groups. Conversely, development 'F' (Bellway, 81-unit development in Burton on Trent) ranked high by MCDA (second or first), but came third and equal to development 'E' (Trent and Dove, 40-unit development in Burton on Trent). These differences demonstrate the value of applying the MCDA process whereby performance against a particular criterion is mediated by the weight of importance of that criterion assigned by relevant stakeholders.

9.6. Research limitations

A number of research limitations were encountered during the course of this study:

- The choice of the sustainable housing standards for the content analysis was restricted by the availability and accessibility of such standards at the time of analysis (in 2012). Thus, while the chosen standards were checked for any updates at a later date, no new standards were included as the underrepresented criteria (i.e. the 'soft' features) were already utilised in the questionnaire and subsequent assessment of housing developments.

- It was decided to limit the geographical scope of the survey to parts of WM and NW primarily because of the selection of housing developments as case studies. Ideally, it would have been desirable to select developments within the remit of a single local authority which would ensure that the developments were largely built under the same planning regulations and guidance. However, this was not possible due to insufficient number of developments built matching the selection parameters (outlined in section 5.8.3) within any one local authority area. As the 'next best' solution, two case studies were selected from three neighbouring councils; Newcastle Borough Council, Stoke-on-Trent City Council and East Staffordshire Borough Council.

- Due to the desired restriction of the housing developments' location, it was deemed appropriate to also limit the remit of housing stakeholder survey to a similar geographical area. As a consequence, this restricted the number responses that could be gathered from the housing provider groups. However, given the subjective nature of the survey research (i.e. opinions of importance), it was felt that it would be more valuable for the survey to reflect the cultural traditions and preferences of where the developments were located, rather than overlay the opinions from across the country. Furthermore, the pertinence of this local/regional rather than national approach is echoed in the principles outlined in the Localism Act 2011 (DCLG, 2011b).

- It was unfortunate that 'soft' feature number 8, 'opportunities to get involved in the management and maintenance', could not be evaluated in the selected case studies. As explained in section 8.3.8, this was because this feature was directly dependent on the presence of communal facilities and only three of the housing studies had areas of public open space that could potentially be managed by the housing-users. As a result, this feature was excluded from the case study assessment and MCDA calculations as providing scores only for the three developments would introduce bias in the overall scores. Nevertheless, this is a useful lesson to note in case the set of 'soft' features are adapted for different type housing (see 'development of 'toolkit'' in 9.8.2 below), as care should be taken to ensure one feature does not depend on another for its assessment.

9.7. Options for future research

Following the results, and in light of some of the limitations listed above, a number of options for further research can be suggested:

- It would be interesting and informative to carry out an analogous content analysis of house builders' design briefs (both private sector and social housing) to explore the extent to which they take into account each of the 28 features of the framework (outlined in chapter 4), and in particular, whether the same 11 'soft' features are underrepresented. The standards used in this study represent the drivers for sustainable housing construction, but nevertheless they remain largely voluntary. Thus a content analysis of design briefs would illustrate how the current housebuilding practice performs against the proposed framework for sustainable housing with an emphasis on health and well-being.

- With regards to the importance of the 11 'soft' features to housing stakeholders, it would perhaps be valuable to supplement the survey results with a qualitative approach. For instance, a focus group with each of the four housing stakeholder groups could be used to explore the opinions regarding the features' importance as well the reasons behind these opinions.

9.8. Summary and impact of the study

9.8.1. A review of aims and objectives

The basic research question set out in the introduction of this thesis was as follows; *what are the 'soft' non-technical features of housing design that impact on health and well-being, and are these features regarded equally in importance by both housing users and housing providers?* To ensure practical relevance, the study also sought to elucidate *to what extent such features are being provided by new housing developments.*

To address above research questions, a number of aims and objectives were set out, which have all been achieved by this research, as follows:

Aim 1: To conceptualise and identify the 'soft' features of housing design that can impact health and well-being.

- → *Objective i: Carry out an in-depth literature review to establish a holistic understanding of sustainable housing that encompasses the broad spectrum of health and well-being impacts of housing.*
- → *Objective ii: Using this broad understanding of sustainable housing, establish the extent that each of the sustainable housing features are addressed by current industry best practice.*

The 'soft' features were conceptualised and identified through the literature review chapters (chapters 2, 3 and 4), while the content review (chapter 5) of sustainable housing standards demonstrated that these features are largely underrepresented by industry's best practice.

Aim 2**: **To establish whether the opinions of housing users are aligned with those of housing providers in terms of the importance of these features.

- → *Objective iii: Ascertain the level of importance that key housing stakeholders attach to these 'soft' features in order to enable comparison of priorities between these stakeholder groups.*

The level of importance that different housing stakeholders attach to these 'soft' features, and how these compare and differ, were ascertained through analysis of the questionnaire data in chapter 7.

Aim 3**: **To assess the extent to which such features are being provided by new housing.

- → *Objective iv: Develop an assessment methodology for the 'soft' features that could be applied for the evaluation of housing developments.*
- → *Objective v: Select six housing developments, and using the assessment methodology (developed in objective iv) evaluate their provision of the 'soft' features.*

→ *Objective vi: Using the results of the evaluation (objective v) and level of importance attached to these features by stakeholders (objective iii), apply a suitable multi-criteria analysis technique to rank the six developments in terms of their performance according to stakeholder priorities.*

The assessment methodology for the 'soft' features and evaluation of six housing developments was carried out in chapter 8. Subsequently, the results, together with the results from chapter 7 were used in multi-criteria analysis (chapter 8) to demonstrate how these developments rank when stakeholder opinions are taken into account.

9.8.2. Significant contribution to knowledge and potential for application in practice

This thesis has yielded original and significant contribution to knowledge both in terms of the academic discourse on sustainable and healthy housing as well as to the practice of sustainable housing implementation. These academic and practice contributions are as follows:

- ***The linking together of sustainable housing and healthy housing concepts:*** The framework for sustainable housing with an emphasis on health and wellbeing developed in this study uniquely links the agenda of sustainable housing with that of healthy housing. The literature review revealed that within academic discourses, these two fields are still largely developing in parallel to each other with very little conceptual work having been done to integrate the two. However, there is much mutual benefit that can be gained from linking them: The long history of the housing and health research as an academic field has amassed a wealth of knowledge that can greatly inform the development of sustainable housing. While more work needs to be done to bring this research together for its enhanced implementation into practice, the holistic understanding of sustainable housing could be used as a framework to facilitate this process. This study has recognised that both fields share the same goal of enhancing the quality of life, and has used this as the common denominator for integrating the two into the framework outlined in chapter 4. This has illustrated how the conceptual and empirical knowledge from the two can be combined, and by doing so has established a precedent for future research that combines healthy housing and sustainable housing fields.

- ***A systematic way of conceptualising and identifying the 'soft' issues***: While there is much discussion in literature about the various 'soft' housing design features that can impact on health and well-being, existing studies typically focus on one or a small group of such features. This study has illustrated how such features can be conceptualised and identified in a holistic way firstly by defining them, and secondly, by showing how they fit in the broader sustainable and healthy housing framework.

  It is also worth noting that the set of soft features used in this study should not be regarded as definitive, but rather as a core list with sufficient flexibility for adaptation. For instance, it can be refined for different locations and modified to reflect different types of housing (e.g. rural housing, city centre multi-dwelling housing, or non-domestic accommodation).

- ***Demonstration of differences in stakeholder opinion:*** While there are a number of important works exploring the opinions of housing users (e.g. Bender et al., 2000; CABE, 2005b) and those of housing providers (e.g. Brennan and Cotgrave, 2014; Gallent and Carmona, 2004; Pitt et al 2009), at the time of writing, no published study could be found that explicitly focused on comparing the opinions of housing users and housing providers. The findings in this study revealed that there are indeed significant differences between the opinions of these two groups of stakeholders (as well as between the three housing provider groups) with regard to the importance of certain 'soft' features of housing design.

  Importantly, such differences are not merely of academic interest, but have implications for practice necessitating further research in this area. For instance, while all stakeholders selected 'suitable indoor space' as the most important feature relative to others, a statistically significant difference was found between the private sector developers and local authority respondents with the latter scoring this feature lower in importance than the former. This finding has potential significance given the recently introduced national minimum space standards following the Government's Housing Standards Review. The minimum space standard will apply to all new homes across tenures, however the implementation of the standard will be dependent on its adoption by local authorities into their Local Plans (DCLG 2015). Given this dependence, it is of concern that the local authority respondents were found to score this feature lower in importance than all the other stakeholders. It would be interesting and valuable to expand this study to other geographical areas to ascertain whether such prioritisation is found nationally, because if it is, this would have serious implications for the efficacy of the national minimum space standard implementation.

Development of a 'toolkit' for measuring the 'soft' features: Although a regional geographical scope was adopted for the stakeholder survey and location of case studies, the methods used to evaluate the 'soft' features are from national and international standards, and as such can be utilised for the assessment of housing developments in other parts of the country. Potentially, the toolkit of methodologies could be developed into a guide that housing providers can use to maximise the provision of 'soft' features.

- ***Application of MCDA to the assessment of provision of 'soft' features***: The MCDA application provides a structured process that can enable stakeholders to identify housing developments with optimal provision of soft features based on stakeholder preferences. Importantly, it should be noted that this provides a flexible process structure that can be adapted to different regions as housing-users in other areas may assign different weights of importance reflecting local concerns.

  The assessment of housing developments and use of the MCDA approach, demonstrated that even relatively homogenous housing developments (i.e. built in the same region and to similar planning requirements) differ notably in their provision of 'soft' features.

9.8.3. Recommendations for practice

- Given the different levels of importance that housing users and housing providers seemed to attach to most of the 'soft' features, there appears to be substantial scope for initiatives to achieve a better alignment of opinion regarding these features, in particular:

  - Both 'private outdoor space' and 'attractive views to the outside' were regarded much higher in importance by housing users than by the housing providers, suggesting that these features may need greater attention in housing design specifications of the latter. However, this does not mean that housing builders are required to provide all new builds with large gardens and scenic views. Rather, housebuilders need to be aware that occupants often use private gardens as an extension of their living space, and as such, design solutions could be implemented to better cater for this. While regarding attractive views, greater customer satisfaction may conceivably be obtained through clever dwelling orientation patters that minimise or avoid particularly intrusive and unpleasant views (e.g. overlooking into neighbours' homes, busy roads) from the main living areas of the dwelling.

- Housing providers (especially social housing providers) regarded dwelling adaptability and design features to enhance security as more important than did the housing users. However, this does not mean that these design features should be relegated to a lower priority, because as discussed in chapter 4, they all make an important contribution towards the development of communities and positive well-being. The fact that housing users saw these as lower in importance suggests a lower awareness of the benefits of these features. It would therefore be recommended that housing users are educated as consumers of these benefits; for instance, the advantages of dwelling adaptability and of security design features could be explained and used as a positive marketing tool of new dwellings and new housing developments. Greater awareness of these benefits would conceivably lead to the creation of greater market demand for such features.

- While the above three features indicate a lag in the awareness of their importance by housing users compared to housing providers, this research indicated a low regard for features for informal socialising, compatibility with local architectural heritage, opportunities to get involved, and a more compact (higher density) neighbourhood design by *all* stakeholders. However, suitably addressing these could provide opportunities for the advancement of sustainable and healthy housing development as follows:

  Low provision of features for informal socialising and lack of interest in the opportunities to get involved in the management and maintenance of neighbourhoods indicate a disenfranchisement of residents from their living environments. This not only leads to a stunted community development, but also to a lack of ownership and responsibility towards communal areas. Clearly there is a need for education as to the benefits of these features for both the housing providers and housing consumers, as well as how they can be designed and implemented successfully. This could be provided by professional and charitable organisations such as RIBA, the Design Council and Age UK, who not only have done research and are aware of these benefits, but who represent demographics that would benefit from stronger communities.

There is also greater scope for education of housing stakeholders of the environmental and societal benefits of more compact neighbourhoods. However, this would also need to be coupled with education of how higher densities can be achieved without losing some of the qualities of low density neighbourhoods that are desirable to housing consumers. As discussed in section 4.3.18, such qualities can be achieved through innovative design of open spaces, lower height dwellings, high levels of natural light, low levels of traffic and private gardens.

Lastly, the low level of importance attached to compatibility with local architectural heritage suggests that housing providers are perhaps able to steer away from the copy-and-paste neo-Victorian style of dwellings that pervade modern housing developments. Without compromising the architectural heritage, this could be an opportunity to introduce designs that are not only more capable of better meeting the needs of modern housing consumers, but are also better placed to withstand the challenges of climate change (as discussed in section 4.3.11).

- The low level of provision of these ‘soft’ features by newly built housing developments is a disappointing finding given that these features are not technologically demanding nor should be financially prohibitive. This low level of provision indicates the need for a greater systematic integration of these design elements into the drivers for sustainable housing, namely the planning policy and the building regulations. While the relatively recently introduced NPPF may yet lead to more sustainable housing and neighbourhood designs, this study suggests that NPPF needs to be coupled with educational campaigns to enhance the awareness of housing stakeholders with regards to the benefits and successful design examples of such 'soft' features. This is particularly pertinent given that these features are also closely aligned with the characteristics of sustainable communities. While regarding the building regulations, it is hoped that the momentum provided by the Housing Standards Review to consolidate multiple standards and enhance these regulations will offer an opportunity to further incorporate design features (such as adaptability and attractive views) to promote the development of sustainable and healthy dwelling design.

9.9. Final remarks

By integrating sustainable housing and healthy housing discourses, this research has drawn attention to the importance of the 'soft' features of sustainable housing that can impact health and well-being of residents. By comparing the level of importance attached to these features by housing stakeholders it has shown that, with a few exceptions, housing user preferences are not always aligned with those of housing providers, and indeed, opinions tend to differ among private sector and social housing providers. Moreover, assessment of six case studies indicated a rather low level of provision of such features by new housing developments. It is hoped that this study assists housing stakeholders to take on a more comprehensive approach in addressing and providing for these softer features of housing and neighbourhood design necessary for the development of sustainable and healthy communities.

Publications and presentations relating to thesis

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Prochorskaite, A. (2012) Sustainable and healthy housing: exploring stakeholders' views. *25th European Conference on Operational Research. 8-11 July 2012, Vilnius, Lithuania.* Book of abstracts available at https://www.euro-online.org/web/pages/420/last-activity-reports

Prochorskaite, A. Couch, R.A. & Maliene, V. (2013). Sustainable housing: a focus on 'soft' impacts on health and well-being (extended abstract). *8th Annual Built Environment and Natural Environment (BEAN) Conference*, Liverpool, June 6th, 2013.

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Appendices

Appendix I: Content analysis of sustainable housing standards

Nr:	CSH:	BREEAM:	R-2000:
1.	N/A	N/A	N/A
2.	N/A	● Health & Well-being → Hea 03: VOCs → Hea 05: Ventilation	● Indoor Air Quality → At least three (out of nine) indoor air quality features identified in the current version of the *R-2000 Indoor Air Quality and Environmental Features Pick-List* shall be used in the house.
3.	● Category 7: Health & Well-being → Hea 2: Sound insulation	● Health & Well-being: → Hea 02: Sound insulation	N/A
4.	● Category 7: Health & Well-being → Hea 1: Daylighting	● Health & Well-being → Hea 01: Daylighting	N/A
5.	N/A	● Health & Well-being → Hea 03: VOCs	● Indoor Air Quality → R-2000 Pick-List of indoor air quality features includes: carpets, paints and varnishes, flooring adhesives, kitchen cabinets and bathroom, vanities, vinyl flooring, and particleboard underlayment
6.	N/A	● Health & Well-being → Hea 05: Ventilation	● Indoor Air Quality → R-2000 Pick-List of indoor air quality features includes: Indoor moisture control
7.	N/A	● Health & Well-being → Hea 06: Safety	● 5. Mechanical systems → 5.5 CO Detectors
8.	N/A	N/A	N/A
9.	N/A	N/A	N/A
10.	N/A	N/A	N/A
11.	N/A	N/A	N/A
12.	● Category 7: Health & Well-being → Hea 3: Private space	N/A	N/A
13.	● Category 7: Health & Well-being → Hea 4: Lifetime Homes	● Health & Well-being → Hea 02: Inclusive Design	N/A
14.	N/A	N/A	N/A
15.	● Category 8: Management → Man 4: Security	● Management → Man 04: Security	N/A
16.	N/A	N/A	N/A
17.	● Category 8: Management → Man 1: Home User Guide	● Management → Man 01: Home Users Guide	N/A

18.	N/A	N/A	N/A
19.	N/A	N/A	N/A
20.	• Category 1: Energy & CO_2 Emissions → *(Most sub-sections)*	• Energy → (Most *sub-sections*)	• 6. Energy performance targets
21.	• Category 2: Water → *(All sub-sections)*	• Water → *(All sub-sections)*	• 8. Water conservation & environmental features → 8.1 Water Conservation
22.	• Category 1: Energy & CO_2 Emissions → Ene 8: Cycle Storage	• Energy → Ene 8: Cycle Storage	N/A
23.	• Category 1: Energy & CO_2 Emissions → Ene 1: Dwelling Emission Rate • Category 6: Pollution → Pol 1: Global Warming Potential (GWP) of Insulants	N/A	N/A
24.	• Category 6: Pollution → Pol 2: NO_x emissions • Category 4: Surface Water Run-off → Sur 1: Management of Surface Water Run-off from Developments	• Pollution → Pol 01: NO_x emissions → Pol 02: Surface water runoff	N/A
25.	• Category 3: Materials	• Materials → *(All sub-sections)*	• 8. Water conservation & environmental features → 8.2 Environmental features
26.	• Category 8: Management → Man 2: Considerate Constructors Scheme → Man 3: Construction Site Impacts	• Management → Man 02: Responsible Construction Practices	N/A
27.	• Category 9: Ecology → *(All sub-sections)*	• Management → Man 05: Protection & Enhancement of Ecological Features	N/A
28.	• Category 5: Waste → Was 1: Storage of Non-recyclable Waste & Recyclable Household Waste → Was 3: Composting	• Energy → Ene 06: Drying space • Waste → Was 01: Household Waste • Water → Wat 03: Water meter	N/A
Nr	**HQE:**	**CASBEE:**	**SB Tool:**
1.	• Th 6: Comfort and Health (*Confort et Santé*) → Summer heat (*Thermique d'Été*)	• Q_H1 Comfortable, Healthy and Safe Indoor Environment → Q_H1.1. Heating and Cooling → Q_H1.1.1.1 Basic Performance (to ensure the comfort of occupants)	• D2 Air Temperature and Relative Humidity
2.	• Th 6: Comfort and Health (*Confort et Santé*) → QAI: Indoor Air Quality (*Qualité de l'Air Intérieur*)	• Q_H1 Comfortable, Healthy and Safe Indoor Environment → Q_H1.2 Health, Safety, and	• D1 Indoor Air Quality and Ventilation

		Security → Q_H1.2.1. Countermeasures against chemical contaminants → Q_H1.2.2. Suitable ventilation	
3.	• Th 6: Comfort and Health (Confort et Santé) → AI: Acoustic Interior (*Acoustique Intérieure*)	• Q_H1 Comfortable, Healthy and Safe Indoor Environment → Q_H1.4 Quietness	• D4 Noise and Acoustics
4.	• Th 6: Comfort and Health (*Confort et Santé*) → CV: Visual comfort (*Confort Visuel*)	• Q_H1 Comfortable, Healthy and Safe Indoor Environment → Q_H1.3 Brightness → Q_H1.3.1 Use of daylight	• D3 Daylighting and Illumination • F1 Social Aspects → F1.2 Access to direct sunlight from living areas of dwelling units.
5.	• Th 4: Construction industry – selection of materials (*Filière constructive – Choix des matériaux*) → CM: selection of materials (*Choix des Matériaux*) → Impact on the health quality of interior spaces (*Contribution à la qualité sanitaire des espaces intérieurs*)	N/A	N/A
6.	• Th 6: Comfort and Health (*Confort et Santé*) → QAI: Indoor Air Quality (Qualité de l'Air Intérieur)	N/A	• D2 Air Temperature and Relative Humidity
7.	N/A	• Q_H1 Comfortable, Healthy and Safe Indoor Environment → Numerous clauses • Q_H3 Creating a Richer Townscape and Ecosystem → Q_H 3.3. Safety and Security of the Region	• E1 Safety and Security → E1.2 Risk to occupants and facilities from fire. → E1.3 Risk to occupants and facilities from flooding.
8.	N/A	• Q_H2 Ensuring a Long Service Life → Q_H2.3. Functionality → Q_H2.3.1 Size & layout of rooms → Q_H2.3.2 Barrier-free design	• E2 Functionality and efficiency → E2.2 Functionality of layout(s) for required functions. → E2.3Appropriateness of space provided for required functions. → E2.7 Spatial efficiency.
9.	N/A	N/A	• A1 Site Regeneration & Development → A1.9 Provision of public open space(s).
10.	N/A	N/A	• F3 Perceptual → F3.7 Access to exterior views from interior.

11.	N/A	• Q_H3 Creating a Richer Townscape and Ecosystem → Q_H3.1 Consideration of the Townscape and Landscape → Q_H3.4. Utilizing Regional Resources and Inheriting the Regional Housing Culture	• F2 Culture and Heritage → F2.1 Compatibility of urban design with local cultural values → F2.2 Impact of the design on existing streetscapes.
12.	N/A	N/A	• F1 Social Aspects → F1.4 Access to private open space from dwelling units.
13.	N/A	N/A *(N.B. considers measures for 'elderly friendly' design, but not adaptability as such*)	• E4 Flexibility and Adaptabilit → E4.1 Ability for building operator or tenant to modify technical systems. → E4.2 Potential for horizontal or vertical extension of structure
14.	N/A	N/A	• A1 Site Regeneration and Development → A1.10 Provision and quality of children's play area(s). → A1.11Facilities for small-scale food production for residential occupants.
15.	N/A	• Q_H1 Comfortable, Healthy and Safe Indoor Environment → Q_H1.2. Health, Safety, & Security → Q_H1.2.3 Precautions against crime	N/A
16.	N/A	N/A	• F1 Social Aspects → F1.5 Involvement of residents in project management.
17.	• Th 7: Green actions (*Gestes verts*) → IHG: Informing of residents and the manager (*Information des Habitants et du Gestionnaire*)	• Q_H2 Ensuring Long Service Life → Q_H2.2. Maintenance → Q_H2.2.1 Ease of maintenance	• E3 Controllability → E3.4 Degree of personal control of technical systems by occupants.
18.	N/A	N/A	• A2 Urban Design → A2.1 Maximizing efficiency of land use through development density.
19.	N/A	N/A	• A2 Urban Design → A2.2 Reduce need for commuting transport

			through provision of mixed uses.
20.	• Th 3: Energy – reducing the greenshouse effect (*Energie – Réduction de l'effet de serre*) → MCE: Controlling Energy Consumption (*Maîtrise des Consommations Electriques*) → PE: Energy Performance (*Performance Energétique*)	• LR_H1 Conserving Energy and Water → LR_H1.1. Energy Saving through Building Innovation → LR_H1.2. Energy Saving through Equipment Performance	• A3 Project Infrastructure & Services → A3.1 to A3.3, A3.5 • B2 Electrical peak demand
21.	• Th 5: Eau → GE: Water Management (*Gestion de l'Eau*)	• LR_H1 Conserving Energy and Water → LR_H1.3. Water Conservation	• A3 Project Infrastructure & Services → A3.4 Supply, storage and distribution of surplus rainwater and greywater amongst groups of buildings. → *A3.8* Provision of split grey / potable water services. • B4 Use of potable water, stormwater & greywater
22.	• Th 6: Comfort and Health (*Confort et Santé*) → ELC: Common Areas And Facilities (Espaces et Locaux Communs) → ELC 2 bikes → ELC 3 sockets for electric cars or hybrids	N/A	• A1 Site Regeneration & Development → A1.12 Provision and quality of bicycle pathways & parking → A1.13 Provision and quality of walkways for pedestrian use.
23.	N/A	• LR_H3 Consideration of the Global, Local, and Surrounding Environment → 1. Consideration of Global Warming	• C1 Greenhouse Gas Emissions
24.	N/A	• LR_H3 Consideration of the Global, Local, and Surrounding Environment → LR_H3.2. Consideration of the Local Environment → LR_H3.2.1 Control of burden on the local infrastructure (Control of rainwater & wastewater load) → LR_H3.3. Consideration of the Surrounding Environment → LR_H3.3.1 Reduction of noise, vibration, exhaust, and exhaust heat (Control of exhaust or exhaust heat sources)	• A3 Project Infrastructure & Services → A3.9 Provision of surface water management system. • C5 Other Local and Regional Impact → C5.8 Degree of atmospheric light pollution caused by project exterior lighting systems.
25.	• Th 4: Construction industry – selection of materials (*Filière constructive – Choix des matériaux*) → CM : selection of materials (*Choix des Matériaux*)	• LR_H2 Using Resources Sparingly and Reducing Waste → LR_H2.1. Introduction of Materials Useful for Resource Saving and	• B3 Use of Materials → B3.1Degree of re-use of suitable existing structure(s) where available.

		Waste Prevention	
26.	• Th 2: Clean construction (*Chantier proper*)	• LR_H2 Using Resources Sparingly and Reducing Waste → LR_H2.2. Reduction of Waste in the Production & Construction Stages	• A3 Project Infrastructure and Services → B3.3 Material efficiency of structural and building envelope components.
27.	• Th 1: Environmental management (*Management environnemental de l'opération*) → MOE-2 Preliminary studies - Site analysis (*Etudes préalables - Analyse du site*)	• LR_H3 Consideration of the Global, Local, and Surrounding Environment → LR_H3.2. Consideration of the Local Environment → LR_H3.2.2 Preservation of the existing natural environment • Q_H3 Creating a Richer Townscape and Ecosystem → Q_H3.2. Creating the Biological Environment	• A1 Site Regeneration & Development → A1.1 to A1.5 • C4 Impacts on Project Site → C4.3Recharge of groundwater. → C4.4Changes in biodiversity on the site.
28.	• Th 6: Comfort and Health (*Confort et Santé*) → ELC: Common Areas And Facilities (Espaces et Locaux Communs) → ELC 1 Sorting household waste • Th 7: Green actions (*Gestes verts*) → IHG: Informing of residents and the manager (*Information des Habitants et du Gestionnaire*)	• LR_H1 Conserving Energy & Water → LR_H1.4. Well-Informed Maintenance & Operation Schemes → LR_H1.4.1 Presentation of lifestyle advice	• A3 Project Infrastructure and Services → A3.6 Provision of solid waste collection and sorting services

Nr	Green Star:	LEED:
1.	• Indoor Environment Quality → IEQ-5 Thermal comfort • Management → Man-3 Building Tuning	• Indoor Environmental Quality → EQ 6: Distribution of Space Heating and Cooling
2.	• Indoor Environment Quality → IEQ-9 Formaldehyde minimisation	• Indoor Environmental Quality → EQ 1: ENERGY STAR with Indoor Air Package → EQ 2: Combustion venting → EQ 4: Outdoor Air Ventilation → EQ 7: Air Filtering → EQ 8: Contaminant control
3.	• Indoor Environment Quality → IEQ-7 Internal Noise Levels → IEQ-21 Dwelling ventilation → IEQ-22 Natural ventilation	N/A
4.	• Indoor Environment Quality → IEQ-4 Daylight	N/A
5.	• Indoor Environment Quality → IEQ-6 Hazardous materials → IEQ-9 Formaldehyde minimisation	N/A
6.	N/A	• Indoor Environmental Quality → EQ 3: Moisture control
7.	N/A	N/A
8.	N/A	N/A
9.	• Land Use & Ecology	• Location & Linkages

	→ Eco-5 Outdoor Communal Facilities	→ LL 6: Access to open space
10.	N/A	N/A
11.	N/A	N/A
12.	• Indoor Environment Quality → IEQ-20 private external space	N/A
13.	N/A	N/A
14.	• Land Use & Ecology → Eco-5 Outdoor Communal Facilities	N/A
15.	N/A	N/A
16.	N/A	N/A
17.	• Management → Man-1 Green Star Accredited Professional → Man-2 Commissioning Clauses	• Awareness & Education → AE 1: Education of the homeowner or Tenant
18.	N/A	• Sustainable Sites → SS 6: Compact Development
19.	• Transport → Tra-5 Trip Reduction – mixed use	• Location & Linkages → LL 5: Community Resources / Transit
20.	• Energy → Ene-12 Peak Electricity Demand Reduction	• Energy & Atmosphere → *(All sub-sections)*
21.	• Water → Wat-1 Occupant amenity water → Wat-7 Water Efficient Appliances	• Water Efficiency → *(All sub-sections)*
22.	• Transport → Tra-2 Fuel-Efficient Transport → Tra-3 Cyclist facilities	• Location & Linkages → LL 5: Community Resources / Transit
23.	• Energy → Ene-1 Greenhouse Gas Emissions	N/A
24.	• Emissions → Emi-6 Discharge to Sewer → Emi-7 Light Pollution	• Sustainable Sites → SS 4: Surface water management
25.	• Materials → Mat-3 Recycled-Content & Re-used Products and Materials → *(Most sub-sections)*	• Materials and Resources → MR1: Material-Efficient Framing → MR2: Environmentally preferable products
26.	• Materials → Mat-8 Design for Disassembly → Mat-9 Dematerialisation	• Materials and Resources → MR3: Waste management • Innovation & Design Process → ID 1: Integrated Project planning • Sustainable Sites → SS 1: Site Stewardship
27.	• Land Use & Ecology → Eco-1 to Eco-4	• Location & Linkages → LL 2: Site selection • Sustainable Sites → SS 2: Landscaping
28.	• Management → Man-16 Metering • Materials → Mat-1 Recycling Waste Storage	N/A

Appendix II: Survey Questionnaires

Pilot questionnaire (Housing Users / 'Residents'):

LIVERPOOL JOHN MOORES UNIVERSITY

High quality housing: What features are important to you?

0% complete

Page 1: Introduction

Dear Participant,

First of all, thank you for taking the time to respond to this survey, which is part of a PhD research into housing quality and well-being.

Our homes play a central role in our lives. It is where we tend to spend most of our time - resting, recovering from everyday stresses, socialising with family and friends, and taking pride in making a house into a home. For these reasons, *how* homes are designed and built can impact on the quality of these fundamental day-to-day activities.

While building regulations stipulate housing safety and energy efficiency requirements, this research focuses on features not covered by regulations but which can influence our well-being, quality of life and general satisfaction with the place we live in. These factors can include, for instance, the design and layout of internal space, access to a garden, and the ease with which a house can be adapted to suit changing needs. **The purpose of this survey is to understand how important these housing features are to you.**

The survey takes approximately 15 minutes to complete. Please note that responding to the survey is voluntary and the answers you provide remain anonymous. The data will be collated for statistical analysis and research reporting. If you have any questions about this survey or the research subject, please do not hesitate to get in touch with me at *a.prochorskaite@2009.ljmu.ac.uk*, or my supervisor Dr Vida Maliene at *V.Maliene@ljmu.ac.uk*.

Once again, thank you very much for your time and help with the research!

Kind regards,

Agne

Please click the 'Continue' button to start the survey.-----------------------------Contacts:

Researcher: Agne ProchorskaiteEmail: A.Prochorskaite@2009.ljmu.ac.uk

Research Supervisor: Dr. Vida Maliene Email: V.Maliene@ljmu.ac.uk

School of the Built EnvironmentLiverpool John Moores University,Byrom Street, Liverpool, L3 3AF

Submit and continue >

Page 2: Firstly, a few short questions about the property you currently live in:

1 **Is your home...**

- a detached house or bungalow?
- a semi-detached house?
- a townhouse / terraced house?
- a flat / apartment (in a building with fewer than 5 homes in total)?
- a flat / apartment (in a building with more than 5 homes in total)?
- Other

a If you selected Other, please specify:

2 **How many bedrooms does it have?**

- 1
- 2
- 3
- 4
- 5 or more

3 **What is your postcode?**

4 **How long have you lived in this area?**

Please select ▾

5 **When was your home built (approximately)?**

Please select ▾

Submit and continue >

Page 3: High quality housing: What features are important to you?

6 **Thinking about what your ideal home and immediate surroundings would look like (not necessarily where you currently live!), please indicate how important the following housing features and qualities are to you.** Click **'MORE INFO'** button on the right to see further details about each option.

	How important are each of these features to you?				
	1 - Not at all important	2 - Slightly important	3 - Fairly important	4 - Very important	5 - Extremely important
Suitable indoor space design and layout that allows for quiet and privacy, entertaining guests and carrying out of day-to-day activities in comfort and ease.					
Private outdoor space such as a garden or patio.					
Adaptability of the dwelling for future needs of the household for example, due to changes in family size, illness, reduced mobility.					
Compatibility with local architectural heritage and cultural styles					
Features in the neighbourhood for informal socialising such as seating, communal gardens and children's play areas.					
Accessible and good quality public greenspace such as a park, woodland or other landscaped area that can be reached by a short (10 min) walk.					
Attractive views to the outside at least from the main rooms of the property.					
Opportunities to get involved in issues such as housing area refurbishments, management and neighbourhood-level developments.					
House and neighbourhood design features that improve levels of security and promote feelings of safety.					
A more compact (higher density) neighbourhood design that improves transport (less need for private car), energy efficiency and can enhance the sense of community.					
Close to amenities such as shops, healthcare, education, leisure and other facilities (about 10min walk).					

7 **Is the above list missing any housing and/or immediate neighbourhood features that you feel are important to your well-being and satisfaction with your home?** If so, please enter the feature(s) in the box below and write the score (from 1 to 5 as above) next to it.

Submit and continue >

Page 4: How would you prioritise these features?

8 **Which are the 5 MOST important?** Please select from the drop-down list 5 features you think are most important:

Having trouble with the format of this question? View in tableless mode

1st [Most important]	Please select ▼
2nd	Please select ▼
3rd	Please select ▼
4th	Please select ▼
5th	Please select ▼

9 **Which are the 5 LEAST important?** Please select from the drop-down list 5 features you think are least important:

Having trouble with the format of this question? View in tableless mode

1st [Least important]	Please select ▼
2nd	Please select ▼
3rd	Please select ▼
4th	Please select ▼
5th	Please select ▼

Submit and continue ›

Page 5: Your current home and neighbourhood:

10 **Thinking about your current home and immediate neighbourhood, please answer the following questions:**

	Yes	Only partially	No, but this would be important to me	No, this is unimportant to me	Don't know	Not applicable
Does the overall **indoor space design and layout** allow for all day-to-day activities to be carried out in comfort and ease?	○	○	○	○	○	○
Do you have access to a **private outdoor space** such as a garden or patio of suitable size?	○	○	○	○	○	○
Do you think your property could easily be **adapted if your household's lifestyle changed**?	○	○	○	○	○	○
Do you think your home is **compatible with local architectural heritage and cultural style**?	○	○	○	○	○	○
Are there any **features for informal socialising** such as seating, communal gardens and children's play areas a short walk (about 10min) away?	○	○	○	○	○	○
Is there a **good quality public greenspace** such as a park, woodland or other landscaped area a short walk (about 10 min) away?	○	○	○	○	○	○
Do you have **attractive views to the outside** from the main rooms of your home?	○	○	○	○	○	○
Do you have **opportunities to get involved** in issues such as housing area refurbishments, management and neighbourhood-level developments?	○	○	○	○	○	○
Do you feel that your **home and immediate surroundings are designed in a way that ensure a good level of security**?	○	○	○	○	○	○
Do you think your **neighbourhood is suitably compact** in a away that reduces the need for car use and helps to create sense of community?	○	○	○	○	○	○
Do you have access to any **amenities** such as shops, healthcare, education, leisure and other facilities a short walk (about 10min) away?	○	○	○	○	○	○

Submit and continue ›

Page 6: About you...

Lastly, in order to analyse the results in a more meaningful way, we would appreciate if you could answer a few questions about yourself and your household.

11 What is your gender?

- Male
- Female
- Prefer not to say

12 Your age:

- Under 18
- 18 - 25
- 26 - 35
- 36 - 45
- 46 - 55
- 56 - 65
- 66 or over
- Prefer not to say

13 How many adults live in your household?

Please select ▼

14 How many children (under 18s) live in your household?

Please select ▼

Submit and continue ›

Page 7: A few questions about the survey

To help improve the survey, I would be very grateful if you could answer a few questions about the survey itself:

15 Do you think the purpose of the survey was clearly explained in the introduction?

- Yes
- No

a If no, please explain why you found it unclear:

16 Did you find the wording of the questions clear?

- Yes
- No

a If no, which questions did you find unclear and why?

17 Did you find explanations of the housing features clear?

- Yes
- No

a If no, please explain which parts you found unclear?

18 Approximately, how many minutes did it take you to complete the survey?

19 If you have any other comments about the survey, please enter these in the text box below. For instance, were there any ambiguities or areas that you found difficult to complete?:

Finish ✔

End of survey

Thank you very much for your time and contribution to this research!

If you have any questions or comments about the survey, please contact Agne Prochorskaite at: a.prochorskaite@2009.ljmu.ac.uk

Final questionnaire (Housing Users / 'Residents')

LIVERPOOL JOHN MOORES UNIVERSITY

Housing quality and well-being: What features are important to you?

0% complete

Page 1: Introduction

Dear Participant,

First of all, thank you for taking the time to respond to this survey, which is part of a PhD research into housing quality and well-being.

Our homes play a central role in our lives. It is where we tend to spend most of our time - resting, recovering from everyday stresses, socialising with family and friends, and taking pride in making a house into a home. For these reasons, *how* homes are designed and built can impact on the quality of these fundamental day-to-day activities.

While building regulations stipulate housing safety and energy efficiency requirements, this research focuses on features not covered by regulations but which can influence our well-being, quality of life and general satisfaction with the place we live in. These factors can include, for instance, the design and layout of internal space, access to a garden, and the ease with which a house can be adapted to suit changing needs. **The purpose of this survey is to understand how important these housing features are to you.**

The survey takes approximately 10 minutes to complete. Please note that responding to the survey is entirely voluntary, you can withdraw at any time and the answers you provide remain anonymous. The data will be collated for statistical analysis and research reporting. If you have any questions about this survey or the research subject, please do not hesitate to get in touch with me at *a.prochorskaite@2009.ljmu.ac.uk*, or my supervisor Dr Vida Maliene at *V.Maliene@ljmu.ac.uk*.

Once again, thank you very much for your time and help with the research!

Kind regards,

Agne

Please click the 'Continue' button to start the survey.-----------------------------Contacts:

Researcher: Agne ProchorskaiteEmail: A.Prochorskaite@2009.ljmu.ac.uk

Research Supervisor: Dr. Vida Maliene Email: V.Maliene@ljmu.ac.uk

School of the Built EnvironmentLiverpool John Moores University,Byrom Street, Liverpool, L3 3AF

Submit and continue >

Page 2: Firstly, a few short questions about the property you currently live in:

1 Is your home...

- a detached house or bungalow?
- a semi-detached house?
- a townhouse / terraced house?
- a flat / apartment (in a building with fewer than 5 homes in total)?
- a flat / apartment (in a building with more than 5 homes in total)?
- Other

a If you selected Other, please specify:

2 How many bedrooms does it have?

- 1
- 2
- 3
- 4
- 5 or more

3 What is your postcode?

4 How long have you lived in this area?

Please select ▾

5 When was your home built (approximately)?

Please select ▾

Submit and continue >

Page 3: High quality housing: What features are important to you?

6 **Thinking about what your ideal home and immediate surroundings would look like (not necessarily where you currently live!), please indicate how important the following housing features and qualities are to you.** Click 'MORE INFO' button on the right to see further details about each option.

Having trouble with the format of this question? View in tableless mode

	How important are each of these features to you?				
	1 - Not at all important	2 - Slightly important	3 - Fairly important	4 - Very important	5 - Extremely important
Suitable indoor space design and layout that allows for privacy, entertaining guests and carrying out of day-to-day activities in comfort and ease.	○	○	○	○	○
Private outdoor space such as a garden or patio.	○	○	○	○	○
Adaptability of the dwelling for future needs of the household for example due to changes in family size or reduced mobility.	○	○	○	○	○
Compatibility with local architectural heritage and cultural styles	○	○	○	○	○
Features in the neighbourhood for informal socialising such as seating, children's playgrounds or picnic areas.	○	○	○	○	○
Accessible and good quality public greenspace such as a park or woodland that can be reached by a short (10 min) walk.	○	○	○	○	○
Attractive views to the outside at least from the main rooms of the property.	○	○	○	○	○
Opportunities to get involved in issues such as housing area refurbishments, management and neighbourhood-level developments.	○	○	○	○	○
House and neighbourhood design features that improve levels of security and promote feelings of safety.	○	○	○	○	○
A more compact (higher density) neighbourhood design that improves transport (less need for private car), energy efficiency and can enhance the sense of community.	○	○	○	○	○
Close to amenities such as shops, healthcare or leisure facilities a short (10 min) walk away.	○	○	○	○	○

7 **Is the above list missing any housing and/or immediate neighbourhood features that you feel are important to your well-being and satisfaction with your home?** If so, please enter the feature(s) in the box below and write the score (from 1 to 5 as above) next to it.

Submit and continue ›

Page 4: How would you prioritise these features?

8 **Which are the 5 MOST important?** Please select from the drop-down list 5 features you think are most important:

Having trouble with the format of this question? View in tableless mode

1st [Most important]	Please select ▼
2nd	Please select ▼
3rd	Please select ▼
4th	Please select ▼
5th	Please select ▼

9 **Which are the 5 LEAST important?** Please select from the drop-down list 5 features you think are least important:

Having trouble with the format of this question? View in tableless mode

1st [Least important]	Please select ▼
2nd	Please select ▼
3rd	Please select ▼
4th	Please select ▼
5th	Please select ▼

Submit and continue ›

Page 5: Your current home and neighbourhood:

10 Thinking about your current home and immediate neighbourhood, please answer the following questions:

Having trouble with the format of this question? View in tableless mode

	Yes	Only partially	No, and this would be important to me	No, this is unimportant to me	Don't know
Does the overall **indoor space design and layout** allow for all day-to-day activities to be carried out in comfort and ease?					
Do you have access to a **private outdoor space** such as a garden or patio of suitable size?					
Do you think your property could easily be **adapted if your household's lifestyle changed**?					
Do you think your home is **compatible with local architectural heritage and cultural style**?					
Are there any **features for informal socialising** such as seating, communal gardens and children's play areas a short walk (about 10min) away?					
Is there a **good quality public greenspace** such as a park, woodland or other landscaped area a short walk (about 10 min) away?					
Do you have **attractive views to the outside** from the main rooms of your home?					
Do you have **opportunities to get involved** in issues such as housing area refurbishments, management and neighbourhood-level developments?					
Do you feel that your **home and immediate surroundings are designed in a way that ensure a good level of security**?					
Do you think your **neighbourhood is suitably compact** in a way that reduces the need for car use and helps to create sense of community?					
Do you have access to any **amenities** such as shops, healthcare, education, leisure and other facilities a short walk (about 10min) away?					

Submit and continue ›

Page 6: About you...

Lastly, in order to analyse the results in a more meaningful way, we would appreciate if you could answer a few questions about yourself and your household.

11 What is your gender?

- Male
- Female
- Prefer not to say

12 Your age:

- Under 18
- 18 - 25
- 26 - 35
- 36 - 45
- 46 - 55
- 56 - 65
- 66 or over
- Prefer not to say

13 How many adults live in your household?

Please select ▼

14 How many children (under 18s) live in your household?

Please select ▼

Finish ✔

End of survey

Thank you very much for your time and contribution to this research!

If you have any questions or comments about the survey, please contact Agne Prochorskaite at: a.prochorskaite@2009.ljmu.ac.uk

Final questionnaire (Local Authority):

Housing and well-being - exploring the 'soft' features of housing design

0% complete

Page 1: Introduction

Dear Participant,

First of all, thank you for taking the time to respond to this survey, which is part of a PhD research project into housing quality and well-being.

The study seeks to explore the priorities and levels of importance that different housing stakeholders (residents and housing providers) attach to certain housing design elements. The focus here is on the 'soft' features, that is, the non-technological design characteristics that can influence residents' well-being, quality of life and general satisfaction with a housing development.

The aim of this survey is to gain an understanding of how important you think each of these housing features are.

The short survey takes about 10 minutes to complete. Please note that:

Responding to the survey is voluntary and you may withdraw at any time All data collected will be stored securely by the researcher and not shared with third parties All answers will be treated with strict confidentiality.

If you have any questions about this survey or the research itself, please do not hesitate to get in touch with me at *a.prochorskaite@2009.ljmu.ac.uk* or in case of any complaints, my supervisor Dr Vida Maliene at *V.Maliene@ljmu.ac.uk*.

Once again, thank you very much for your time and help with the research!

Kind regards,

Agne **Please click the 'Continue' button to start the survey.**

-----------------------------Contacts:

Researcher: Agne ProchorskaiteEmail: A.Prochorskaite@2009.ljmu.ac.uk

Research Supervisor: Dr. Vida Maliene Email: V.Maliene@ljmu.ac.uk

School of the Built EnvironmentLiverpool John Moores University,Byrom Street, Liverpool, L3 3AF

Submit and continue >

Page 2: Firstly, a few questions about your organisation:

1. **Which Council do you work for?**

2. **What is the approximate dwelling stock currently owned by the Council?**

   Please select ▼

3. **How are most of the Council-owned homes managed?**

   Please select ▼

   a. If you selected Other, please specify:

4. **Approximately, how many properties...**

   Having trouble with the format of this question? View in tableless mode

	Please select:
has your Council built in the last 2 years?	Please select ▼
are planned to be built in the next 2 years?	Please select ▼

Submit and continue >

Page 3: Housing developments: Which features do you think are important?

5 **How important do YOU think are the following features in a council housing development?** Click '**MORE INFO**' button on the right to see further details about each option.

Having trouble with the format of this question? View in tableless mode

	1 - Not at all important	2 - Slightly important	3 - Fairly important	4 - Very important	5 - Extremely important
Indoor space design and layout suitable for privacy, entertaining visitors and carrying out of day-to-day activities in comfort and ease.					
Private outdoor space					
Adaptability of the dwelling for future needs of the household for example due to changes in family size or reduced mobility.					
Compatibility with local architectural heritage and cultural styles					
Features in the neighbourhood for informal socialising					
Accessible and good quality public greenspace					
Attractive views to the outside at least from the main rooms of the property.					
Opportunities for residents to get involved in issues such as housing area refurbishments and management.					
House and neighbourhood design features that improve levels of security					
A more compact (higher density) neighbourhood design					
Proximity to amenities					

6 **Is the above list missing any housing and/or immediate neighbourhood features that you think are important to residents' well-being and satisfaction with their home?** If so, please enter the feature(s) in the box below and write the score (from 1 to 5 as above) next to it.

Submit and continue ›

Page 4: How would you prioritise these features?

7 **Which are the 5 MOST important?** Please select from the drop-down list 5 features you think are most important in a social housing development.

Having trouble with the format of this question? View in tableless mode

1st [Most important]	Please select
2nd	Please select
3rd	Please select
4th	Please select
5th	Please select

8 **Which are the 5 LEAST important?** Please select from the drop-down list 5 features you think are least important in a social housing development.

Having trouble with the format of this question? View in tableless mode

1st [Least important]	Please select
2nd	Please select
3rd	Please select
4th	Please select
5th	Please select

Submit and continue ›

Page 5

9 Thinking about the housing developments being designed and developed by the Council, to what extent would you say the following features are being taken into account?

	Completely taken into account as part of our strategy and/or design brief	Taken into account, but as good practice and not part of the strategy/design brief	Partially or occasionally taken into account	Not taken into account	Don't know	Not applicable
Suitability of indoor space design and layout						
Private outdoor space						
Adaptability of the dwelling for future needs of the household						
Compatibility with local architectural heritage and cultural styles						
Features in the neighbourhood for informal socialising						
Accessible and good quality public greenspace nearby						
Attractive views to the outside						
Opportunities for residents to get involved in issues such as neighbourhood management						
House and neighbourhood design features that improve levels of security						
A more compact (higher density) neighbourhood design						
Proximity to amenities						

Page 6: About you...

Lastly, in order to analyse the results in a more meaningful way, I would be grateful if you could answer a few questions about yourself.

10 Are you:

- Male
- Female
- Prefer not to say

11 Your age:

- Under 25
- 26 - 35
- 36 - 45
- 46 - 55
- 56 - 65
- 66 or over
- Prefer not to say

12 How long have you worked at this Council?

- Less than 6 months
- 6 months - 1 year
- 1 - 3 years
- 3 - 5 years
- 5 - 10 years
- More than 10 years

13 Which of the following best describes your role or area of work?

Please select ▾

a If you selected Other, please specify:

Page 7

14 If you have any comments or thoughts about the research, please enter these in the text box below: *(Optional)*

Finish ✔

End of survey

Thank you very much for your time and contribution to this research!

If you have any questions or comments about the survey, please contact Agne Prochorskaite at: a.prochorskaite@2009.ljmu.ac.uk

LIVERPOOL JOHN MOORES UNIVERSITY

Housing & well-being: exploring the 'soft' features of housing design

0% complete

Page 1: Introduction

Dear Participant,

First of all, thank you for taking the time to respond to this survey, which is part of a PhD research project into housing quality and well-being.

The study seeks to explore the priorities and levels of importance that different housing stakeholders (residents and housing providers) attach to certain housing design elements. The focus here is on the 'soft' features, that is, the non-technological design characteristics that can influence residents' well-being, quality of life and general satisfaction with a housing development.

As housing associations play a key role in delivery of new housing in England, the aim of this survey is to gain an understanding of how important you think each of these housing features are.

The short survey takes approximately 15 minutes to complete. Please note that:

Responding to the survey is voluntary and you may withdraw at any time All data collected will be stored securely by the researcher and not shared with third parties All answers will be treated with strict confidentiality.

If you have any questions about this survey or the research itself, please do not hesitate to get in touch with me at *a.prochorskaite@2009.ljmu.ac.uk* or in case of any complaints, my supervisor Dr Vida Maliene at *V.Maliene@ljmu.ac.uk*.

Once again, thank you very much for your time and help with the research!

Kind regards,

Agne **Please click the 'Continue' button to start the survey.**

-----------------------------Contacts:

Researcher: Agne ProchorskaiteEmail: A.Prochorskaite@2009.ljmu.ac.uk

Research Supervisor: Dr. Vida Maliene Email: V.Maliene@ljmu.ac.uk

School of the Built EnvironmentLiverpool John Moores University,Byrom Street, Liverpool, L3 3AF

Submit and continue >

Page 2: Firstly, a few short questions about your organisation:

1 **Name of organisation:**

2 **How many properties does it manage (approximately)?**

Please select ▾

3 **Where are most of your properties located?**

Please select ▾

a If you selected Other, please specify:

4 **Does your organisation specialise in providing housing for people with particular needs?**

- ○ No, most properties are general needs homes
- ○ Yes

a If yes, please specify for which special-needs group(s):

- ☐ Elderly persons
- ☐ Disabled persons
- ☐ Families
- ☐ Young people
- ☐ Single people
- ☐ Other

i If you selected Other, please specify:

5 **Please indicate the approximate percentage of general needs homes owned by your organisation:**

Please select ▼

6 **Approximately, how many properties...**

Having trouble with the format of this question? View in tableless mode

	Please select:
has your organisation built in the last 2 years?	Please select ▼
are planned to be built in the next 2 years?	Please select ▼

Submit and continue ›

Page 3: Housing developments: Which features do you think are important?

7 **How important do you think are the following features in a *general needs* housing development?** Click '**MORE INFO**' button on the right to see further details about each option.

Having trouble with the format of this question? View in tableless mode

	1 - Not at all important	2 - Slightly important	3 - Fairly important	4 - Very important	5 - Extremely important
Indoor space design and layout suitable for privacy, entertaining visitors and carrying out of day-to-day activities in comfort and ease.	○	○	○	○	○
Private outdoor space	○	○	○	○	○
Adaptability of the dwelling for future needs of the household for example due to changes in family size or reduced mobility.	○	○	○	○	○
Compatibility with local architectural heritage and cultural styles	○	○	○	○	○
Features in the neighbourhood for informal socialising	○	○	○	○	○
Accessible and good quality public greenspace	○	○	○	○	○
Attractive views to the outside at least from the main rooms of the property.	○	○	○	○	○
Opportunities for residents to get involved in issues such as housing area refurbishments and management.	○	○	○	○	○
House and neighbourhood design features that improve levels of security	○	○	○	○	○
A more compact (higher density) neighbourhood design	○	○	○	○	○
Proximity to amenities	○	○	○	○	○

8 **Is the above list missing any housing and/or immediate neighbourhood features that you think are important to residents' well-being and satisfaction with their home?** If so, please enter the feature(s) in the box below and write the score (from 1 to 5 as above) next to it.

Submit and continue ›

Page 4: How would you prioritise these features?

9 **Which are the 5 MOST important?** Please select from the drop-down list 5 features you think are most important in a social housing development.

Having trouble with the format of this question? View in tableless mode

1st [Most important]	Please select ▼
2nd	Please select ▼
3rd	Please select ▼
4th	Please select ▼
5th	Please select ▼

10 **Which are the 5 LEAST important?** Please select from the drop-down list 5 features you think are least important in a social housing development.

Having trouble with the format of this question? View in tableless mode

1st [Least important]	Please select ▼
2nd	Please select ▼
3rd	Please select ▼
4th	Please select ▼
5th	Please select ▼

Submit and continue ›

Page 5

11 **Thinking about the *general needs* housing developments being designed and delivered by your organisation, to what extent would you say the following features are being taken into account?**

Having trouble with the format of this question? View in tableless mode

	Completely taken into account as part of our design brief	Taken into account, but as good practice, not part of the design brief	Partially or occasionally taken into account	Not taken into account	Don't know	Not applicable
Suitability of indoor space design and layout	○	○	○	○	○	○
Private outdoor space	○	○	○	○	○	○
Adaptability of the dwelling for future needs of the household	○	○	○	○	○	○
Compatibility with local architectural heritage and cultural styles	○	○	○	○	○	○
Features in the neighbourhood for informal socialising	○	○	○	○	○	○
Accessible and good quality public greenspace nearby	○	○	○	○	○	○
Attractive views to the outside	○	○	○	○	○	○
Opportunities for residents to get involved in issues such as neighbourhood management	○	○	○	○	○	○
House and neighbourhood design features that improve levels of security	○	○	○	○	○	○
A more compact (higher density) neighbourhood design	○	○	○	○	○	○
Proximity to amenities	○	○	○	○	○	○

Page 6: About you...

Lastly, in order to analyse the results in a more meaningful way, I would appreciate if you could answer a few questions about yourself.

12 **Are you:**

- Male
- Female
- Prefer not to say

13 **Your age:**

- Under 25
- 26 - 35
- 36 - 45
- 46 - 55
- 56 - 65
- 66 or over
- Prefer not to say

14 **How long have you worked at this organisation?**

- Less than 6 months
- 6 months - 1 year
- 1 - 3 years
- 3 - 5 years
- 5 - 10 years
- More than 10 years

15 **Which of the following best describes your position?**

Please select ▾

a If you selected Other, please specify:

Page 7

16 **If you have any comments or thoughts about the research, please enter these in the text box below:**

Finish ✔

End of survey

Thank you very much for your time and contribution to this research!

If you have any questions or comments about the survey, please contact Agne Prochorskaite at: a.prochorskaite@2009.ljmu.ac.uk

Housing & well-being: Exploring the importance of 'soft' features in housing design

0% complete

Page 1: Dear Participant,

First of all, thank you for taking the time to respond to this survey, which is part of a PhD research project into housing quality and well-being.

The study seeks to explore the priorities and levels of importance that different housing stakeholders (residents and housing providers) attach to certain housing design elements. The focus here is on the 'soft' features, that is, the non-technological design characteristics that can influence residents' well-being, quality of life and general satisfaction with a housing development.

The aim of this survey is to gain an understanding of how important you think each of these housing features are. There are no right or wrong answers - it is just your opinion that counts!

The questions only take about 10 minutes to complete. Please note that:

Responding to the survey is voluntary and you may withdraw at any time All data collected will be stored securely by the researcher and not shared with third parties All answers will be treated with strict confidentiality.

If you have any questions about this survey or the research itself, please do not hesitate to get in touch with me at *a.prochorskaite@2009.ljmu.ac.uk* or in case of any complaints, my supervisor Dr Vida Maliene at *V.Maliene@ljmu.ac.uk*.

Once again, thank you very much for your time and help with the research!

Kind regards,

Agne **Please click the 'Continue' button to start the survey.**

-----------------------------Contacts:

Researcher: Agne ProchorskaiteEmail: A.Prochorskaite@2009.ljmu.ac.uk

Research Supervisor: Dr. Vida Maliene Email: V.Maliene@ljmu.ac.uk

School of the Built EnvironmentLiverpool John Moores University,Byrom Street, Liverpool, L3 3AF

Submit and continue ›

Page 2: Firstly, a few short questions about your organisation:

1 **Name of company:**

2 **How many people does it employ (in the UK)?**

- 50 or less
- 51 - 250
- 251 - 500
- 501 - 1000
- 1001 - 5000
- More than 5000

3 **What is the approximate annual turnover?**

- Up to £1 million
- £1 million - £5 million
- £5 million - £50 million
- £50 million - £100 million
- £100 million - £500 million
- More than £500 million
- Prefer not to say

4 **Where does your company build MOST of its residential housing?**

- Cheshire
- Cumbria
- Greater Manchester
- Herefordshire
- Lancashire
- Merseyside
- Shropshire (incl. Telford and Wrekin)
- Staffordshire (incl. Stoke-on-Trent)
- Warwickshire
- West Midlands Metropolitan County (incl. Birmingham, Coventry, Wolverhampton)
- Worcestershire
- Other

a If you selected Other, please specify:

Submit and continue ›

Page 3: ...and a few questions about the type of residential housing developments built by your company:

5 **Please indicate the approximate price range (current market value) of houses built by your company:**

Having trouble with the format of this question? View in tableless mode

	From: (minimum price)	To: (maximum price)
Price range:	Please select ▼	Please select ▼

6 **Approximately, how many properties...**

Having trouble with the format of this question? View in tableless mode

	Please select
has your organisation built in the last 2 years?	Please select ▼
are planned to be built in the next 2 years?	Please select ▼

7 **Does your company build any 'Affordable' housing?**

- Yes
- No
- Don't know

a If Yes, please indicate the approximate proportion of Affordable homes built by your company:

Please select ▼

8 **What size of housing developments does your company typically build?**

- Very small (up to 10 units)
- Small (11 - 50 units)
- Medium (51 - 100 units)
- Large (101 - 200 units)
- Very large (more than 200 units)
- Build individual houses only

Submit and continue ›

Page 4: Housing developments: Which features do you think are important?

9 **How important do you think are the following features in a *residential housing development*?** Click **'MORE INFO'** button on the right to see further details about each option.

Having trouble with the format of this question? View in tableless mode

	1 - Not at all important	2 - Slightly important	3 - Fairly important	4 - Very important	5 - Extremely important
Indoor space design and layout suitable for privacy, entertaining visitors and carrying out of day-to-day activities in comfort and ease.	○	○	○	○	○
Private outdoor space	○	○	○	○	○
Adaptability of the dwelling for future needs of the household for example due to changes in family size or reduced mobility.	○	○	○	○	○
Compatibility with local architectural heritage and cultural styles	○	○	○	○	○
Features in the neighbourhood for informal socialising	○	○	○	○	○
Accessible and good quality public greenspace	○	○	○	○	○
Attractive views to the outside at least from the main rooms of the property.	○	○	○	○	○
Opportunities for residents to get involved in issues such as housing area refurbishments and management.	○	○	○	○	○
House and neighbourhood design features that improve levels of security	○	○	○	○	○
A more compact (higher density) neighbourhood design	○	○	○	○	○
Proximity to amenities	○	○	○	○	○

10 **Is the above list missing any housing and/or immediate neighbourhood features that you think are important to residents' well-being and satisfaction with their home?** If so, please enter the feature(s) in the box below and write the score (from 1 to 5 as above) next to it.

Submit and continue ›

Page 5: How would you prioritise these features?

11 **Which are the 5 MOST important?** Please select from the drop-down list 5 features you think are most important in a social housing development:

Having trouble with the format of this question? View in tableless mode

1st [Most important]	Please select ▾
2nd	Please select ▾
3rd	Please select ▾
4th	Please select ▾
5th	Please select ▾

12 **Which are the 5 LEAST important?** Please select from the drop-down list 5 features you think are least important in a social housing development:

Having trouble with the format of this question? View in tableless mode

1st [Least important]	Please select ▾
2nd	Please select ▾
3rd	Please select ▾
4th	Please select ▾
5th	Please select ▾

Submit and continue ›

Page 6

13 **Thinking about the *typical* housing developments built by your company, to what extent would you say the following features are being taken into account in their design?**

Having trouble with the format of this question? View in tableless mode

	Always and completely taken into account	Usually taken into account	Partially or occasionally taken into account	Not taken into account	Don't know	Not applicable
Suitability of indoor space design and layout	○	○	○	○	○	○
Private outdoor space	○	○	○	○	○	○
Adaptability of the dwelling for future needs of the household	○	○	○	○	○	○
Compatibility with local architectural heritage and cultural styles	○	○	○	○	○	○
Features in the neighbourhood for informal socialising	○	○	○	○	○	○
Accessible and good quality public greenspace nearby	○	○	○	○	○	○
Attractive views to the outside	○	○	○	○	○	○
Opportunities for residents to get involved in issues such as neighbourhood management	○	○	○	○	○	○
House and neighbourhood design features that improve levels of security	○	○	○	○	○	○
A more compact (higher density) neighbourhood design	○	○	○	○	○	○
Proximity to amenities	○	○	○	○	○	○

Submit and continue ›

Page 7: About you...

Lastly, in order to analyse the results in a more meaningful way, I would appreciate if you could answer a few questions about yourself.

14 Are you:

- Male
- Female
- Prefer not to say

15 Your age:

- Under 25
- 26 - 35
- 36 - 45
- 46 - 55
- 56 - 65
- 66 or over
- Prefer not to say

16 How long have you worked at this company?

- Less than 6 months
- 6 months - 1 year
- 1 - 3 years
- 3 - 5 years
- 5 - 10 years
- More than 10 years

17 Which of the following best describes your position?

Please select ▼

a If you selected Other, please specify:

Submit and continue >

Page 8

18 If you have any comments or thoughts about the research, please enter these in the text box below:

Finish ✔

End of survey

Thank you very much for your time and contribution to this research!

If you have any questions or comments about this project, please contact Agne Prochorskaite at: a.prochorskaite@2009.ljmu.ac.uk

Appendix III: Post hoc Kruskal Wallis test results (rating data)

SPSS outputs of post hoc pairwise comparisons for the Kruskal Wallis test to investigate difference in opinion between the four stakeholder groups.

C1:

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Local authority-Housing association	30.841	13.532	2.279	.023	.136
Local authority-Resident	-32.931	11.697	-2.815	.005	.029
Local authority-Developer	41.882	15.122	2.770	.006	.034
Housing association-Resident	-2.090	10.274	-.203	.839	1.000
Housing association-Developer	11.042	14.050	.786	.432	1.000
Resident-Developer	8.951	12.293	.728	.467	1.000

C8:

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Developer-Resident	-22.560	13.376	-1.687	.092	.550
Developer-Housing association	-69.894	15.288	-4.572	.000	.000
Developer-Local authority	-71.761	16.454	-4.361	.000	.000
Resident-Housing association	47.334	11.179	4.234	.000	.000
Resident-Local authority	49.201	12.728	3.866	.000	.001
Housing association-Local authority	-1.867	14.724	-.127	.899	1.000

C2:

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Local authority-Housing association	7.778	14.369	.541	.588	1.000
Local authority-Developer	28.166	16.057	1.754	.079	.477
Local authority-Resident	-63.427	12.420	-5.107	.000	.000
Housing association-Developer	20.388	14.919	1.367	.172	1.000
Housing association-Resident	-55.649	10.910	-5.101	.000	.000
Developer-Resident	-35.261	13.053	-2.701	.007	.041

C9

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Resident-Developer	2.792	13.135	.213	.832	1.000
Resident-Local authority	25.632	12.498	2.051	.040	.242
Resident-Housing association	42.809	10.978	3.900	.000	.001
Developer-Local authority	-22.840	16.158	-1.414	.157	.945
Developer-Housing association	-40.017	15.013	-2.666	.008	.046
Local authority-Housing association	17.176	14.459	1.188	.235	1.000

C3:

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Developer-Resident	-14.256	13.328	-1.070	.285	1.000
Developer-Housing association	-47.348	15.233	-3.108	.002	.011
Developer-Local authority	-70.390	16.395	-4.293	.000	.000
Resident-Housing association	33.092	11.139	2.971	.003	.018
Resident-Local authority	56.135	12.682	4.426	.000	.000
Housing association-Local authority	-23.042	14.671	-1.571	.116	.698

C10

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Developer-Housing association	-.690	15.154	-.046	.964	1.000
Developer-Local authority	-25.891	16.310	-1.587	.112	.675
Developer-Resident	-30.212	13.259	-2.279	.023	.136
Housing association-Local authority	-25.202	14.596	-1.727	.084	.505
Housing association-Resident	-29.523	11.082	-2.664	.008	.046
Local authority-Resident	-4.321	12.616	-.342	.732	1.000

C7:

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Local authority-Housing association	14.082	14.466	.973	.330	1.000
Local authority-Developer	46.503	16.166	2.877	.004	.024
Local authority-Resident	-61.215	12.504	-4.895	.000	.000
Housing association-Developer	32.421	15.020	2.159	.031	.185
Housing association-Resident	-47.133	10.983	-4.291	.000	.000
Developer-Resident	-14.712	13.141	-1.120	.263	1.000

C11

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Resident-Developer	27.115	13.138	2.064	.039	.234
Resident-Local authority	36.745	12.501	2.939	.003	.020
Resident-Housing association	38.861	10.980	3.539	.000	.002
Developer-Local authority	-9.629	16.162	-.596	.551	1.000
Developer-Housing association	-11.746	15.016	-.782	.434	1.000
Local authority-Housing association	2.116	14.462	.146	.884	1.000

Appendix IV: Post hoc Kruskal Wallis test results (ranking data)

SPSS outputs of post hoc pairwise comparisons for the Kruskal Wallis test to investigate difference in opinion between the four stakeholder groups using the ***ranking data***.

C2:

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Residents-Developers	65.073	12.742	5.107	.000	.000
Residents-Housing associations	70.365	10.688	6.583	.000	.000
Residents-Local authorities	80.392	12.914	6.225	.000	.000
Developers-Housing associations	-5.292	14.438	-.366	.714	1.000
Developers-Local authorities	-15.319	16.156	-.948	.343	1.000
Housing associations-Local authorities	10.027	14.591	.687	.492	1.000

C8:

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Housing associations-Local authorities	9.376	14.830	.632	.527	1.000
Housing associations-Residents	-32.620	10.863	-3.003	.003	.016
Housing associations-Developers	33.298	14.675	2.269	.023	.140
Local authorities-Residents	-23.244	13.126	-1.771	.077	.460
Local authorities-Developers	23.922	16.420	1.457	.145	.871
Residents-Developers	.678	12.950	.052	.958	1.000

C3:

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Local authorities-Housing associations	-35.856	14.904	-2.406	.016	.097
Local authorities-Developers	59.873	16.502	3.628	.000	.002
Local authorities-Residents	-71.455	13.191	-5.417	.000	.000
Housing associations-Developers	24.017	14.749	1.628	.103	.621
Housing associations-Residents	-35.599	10.918	-3.261	.001	.007
Developers-Residents	-11.582	13.015	-.890	.374	1.000

C9

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Housing associations-Local authorities	17.518	14.840	1.180	.238	1.000
Housing associations-Developers	27.740	14.685	1.889	.059	.353
Housing associations-Residents	-58.532	10.871	-5.384	.000	.000
Local authorities-Developers	10.221	16.432	.622	.534	1.000
Local authorities-Residents	-41.014	13.135	-3.123	.002	.011
Developers-Residents	-30.793	12.959	-2.376	.017	.105

C6:

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Residents-Developers	2.945	12.907	.228	.820	1.000
Residents-Local authorities	24.690	13.081	1.887	.059	.355
Residents-Housing associations	30.658	10.827	2.832	.005	.028
Developers-Local authorities	-21.745	16.365	-1.329	.184	1.000
Developers-Housing associations	-27.712	14.626	-1.895	.058	.349
Local authorities-Housing associations	-5.968	14.780	-.404	.686	1.000

C11

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Developers-Housing associations	-6.862	14.666	-.468	.640	1.000
Developers-Local authorities	-26.438	16.410	-1.611	.107	.643
Developers-Residents	-49.291	12.942	-3.809	.000	.001
Housing associations-Local authorities	19.575	14.820	1.321	.187	1.000
Housing associations-Residents	-42.429	10.856	-3.908	.000	.001
Local authorities-Residents	-22.853	13.117	-1.742	.081	.489

C7:

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Residents-Developers	58.008	12.995	4.464	.000	.000
Residents-Housing associations	67.212	10.901	6.166	.000	.000
Residents-Local authorities	73.585	13.171	5.587	.000	.000
Developers-Housing associations	-9.204	14.726	-.625	.532	1.000
Developers-Local authorities	-15.577	16.477	-.945	.344	1.000
Housing associations-Local authorities	6.373	14.881	.428	.668	1.000

Appendix V: Indoor space calculations

HOUSING DEVELOPMENT : A Bluebell croft								
Unit type	Storeys	Bed-rooms	No of units	Dwelling type (est'd)	GIA (sqm) per unit	Total GIA (actual)	GLA GIA (sqm) per unit	Total GIA (ideal)
Marlow	2	4	5	4b5p	113.99	569.96	100	500
Redwood	2	4	4	4b5p	113.62	454.48	100	400
Chillbury	2	4	7	4b5p	93.27	652.92	100	700
Draycott	2	4	10	4b5p	107.95	1079.53	100	1000
Barwell	2	3	15	3b4p	69.21	1038.19	87	1305
Brooke II	2	3	6	3b4p	89.65	537.91	87	522
Woodwille	3	3	12	3b5p	101.17	1214.06	102	1224
Severn	2	3	6	3b4p	84.08	504.46	87	522
Ashby	2	2	10	2b4p	57.69	576.93	83	830
Chepstow Ground flat	3	2	4	2b3p	51.10	204.39	61	244
Chepstow 1st & 2nd flat	3	2	8	2b3p	53.88	431.07	61	488
Totals:			**87**			**7263.90**		**7735**
Level of Compliance = 7,263.90 /7,735 = 0.939 or 94 %								

HOUSING DEVELOPMENT : B Gloster Gate									
Unit type	Storeys	Bed-rooms	No of units	Dwelling type	GIA (sq ft) per unit	GIA (sqm) per unit	Total GIA (actual)	GLA GIA (sqm) per unit	Total GIA (ideal)
A	2	2	8	2b4p	635	58.99	471.95	83	664
B	2	2	21	2b4p	687	63.82	1340.31	83	1,743
C	2	3	19	3b5p	836	77.67	1475.67	96	1,824
D	2	3	6	3b5p	904	83.98	503.91	96	576
E	2	3	17	3b5p	956	88.82	1509.86	96	1,632
F	2	3	5	3b5p	1112	103.31	516.54	96	480
G	2	4	8	4b6p	1132	105.17	841.33	107	856
G1	2	4	4	4b6p	1132	105.17	420.66	107	428
DQS A	1	2	8	2b4p	700	65.03	520.26	83	664
DQS B	2	3	6	3b5p	909	84.45	506.69	96	576
DQS C	2	2	2	2b4p	737	68.47	136.94	83	166
DQS C1	2	2	3	2b4p	737	68.47	205.41	83	249
DQS D	2	3	8	3b5p	930	86.40	691.20	96	768
DQS E	2	4	2	4b6p	1103	102.47	204.94	107	214
Total:			117				9,345.67		10,840
Level of compliance = 9,345.67/ 10,840 = 0.86 or 86%									

HOUSING DEVELOPMENT : C Ivy house mills								
Unit type	Storeys	Bed-rooms	No of units	Dwelling type (est'd)	GIA (sqm) per unit (est'd)	Total GIA (actual)	GLA GIA (sqm) per unit	Total GIA (ideal)
Brierfield	2	2	8	2b4p	62.74	501.92	83	664
Adel	2	2	9	2b4p	66.20	595.8	83	747
Shelley	2	3	18	3b5p	72.04	1296.72	96	1728
Bowland	2	3	19	3b5p	82.04	1558.76	96	1824
Kelbrook	3	4	8	4b5p	124.47	995.76	106	848
Total:						4,948.96		5811
Level of compliance = 4,948.96 / 5811 = 0.85 or 85%								
HOUSING DEVELOPMENT : D All saints								
A	2	3	9	3b5b	84.70	762.3	96	864
B	2	2	6	2b4p	73.80	442.8	83	498
C	2	4	2	4b6p	98.10	196.2	107	214
D	2	3	3	3b5b	86.60	259.8	96	288
E	2	3	3	3b5b	82.40	247.2	96	288
Total:						1,908.30		2152
Level of compliance = 1,908.30/ 2152 = 0.89 or 89%								
HOUSING DEVELOPMENT : E Dallow bridge								
Apartm't	3	1	20	1b2p	47.00	940	50	1000
House 1	2	2	10	2b4p	79	790	83	830
House 2	2	3	1	3b4p	90.00	90	87	87
House 3	2	3	1	3b4p	84.00	84	87	87
House 4	2	3	6	3b5p	103.00	618	96	576
House 5	2	4	2	4b6p	108.00	216	107	214
Total:						2,738		2794
Level of compliance =2,738 / 2794 =1.01 or 101%								
HOUSING DEVELOPMENT : F Hydro								
Belfry	2	4	6	4b5p	114.58	687.48	100	600
Dalton	3	3	7	3b5p	95.64	669.48	102	714
Foxton	1	2	1	2b3p	52.36	52.36	61	61
Gleneagles	2	4	8	4b5p	128.56	1028.48	100	800
Kibworth	2	4	12	4b5p	138.56	1662.72	100	1200
Lichfield	2	3	4	3b4p	83.07	332.28	87	348
Orton	2	4	7	4b5p	128.70	900.9	100	700
Packington	2	4	16	4b5p	118.03	1888.48	100	1600
Somerby	2	3	11	3b4p	71.31	784.41	87	957
Tilton	2	2	3	2b4p	59.22	177.66	83	249
Worcester	3	4	6	4b5p	104.25	625.5	106	636
Total:						8809.75		7865
Level of compliance = 8809.75/ 7865 = 1.12 or 112%								

Appendix VI: Provision of attractive views from dwellings

HOUSING DEVELOPMENT : A Bluebell croft					
Unit	**Feature outside living rm window:**	**Pts**	**Unit**	**Feature outside living rm window:**	**Pts**
A1	Front garden	3	A45	Internal road/greenspace	3
A2	Front garden	3	A46	Internal road/greenspace	3
A3	Front garden	3	A47	Internal road/greenspace	3
A4	Front garden	3	A48	Internal road/greenspace	3
A5	Front garden	3	A49	Internal road/housing	1
A6	Front garden	3	A50	Internal road/housing	1
A7	Rear Garden	3	A51	Internal road/housing	1
A8	Rear Garden	3	A52	Internal road/housing	1
A9	Rear Garden	3	A53	Internal road/housing	1
A10	Rear Garden	3	A54	Internal road/housing	1
A11	Rear Garden	3	A55	Rear Garden	3
A12	Rear Garden	3	A56	Rear Garden	3
A13	Rear Garden	3	A57	Rear Garden	3
A14	Driveway	1	A58	Internal road/greenspace	3
A15	Rear Garden	3	A59	Internal road/greenspace	3
A16	Rear Garden	3	A60	Front garden/main road	0
A17	Internal road/greenspace	3	A61	Front garden/main road	0
A18	Internal road/greenspace	3	A62	Front garden/main road	0
A19	Internal road/housing	1	A63	Front garden/main road	0
A20	Internal road/housing	1	A64	Front garden/main road	0
A21	Internal road/housing	1	A65	Front garden/main road	0
A22	Internal road/housing	1	A66	Rear Garden	3
A23	Internal road/housing	1	A67	Rear Garden	3
A24	Internal road/housing	1	A68	Main road/housing	1
A25	Internal road/housing	1	A69	Rear Garden	3
A26	Internal road/garden	3	A70	Rear Garden	3
A27	Rear Garden	3	A71	Rear Garden	3
A28	Rear Garden	3	A72	Rear Garden	3
A29	Rear Garden	3	A73	Rear Garden	3
A30	Rear Garden	3	A74	Rear Garden	3
A31	Rear Garden	3	A75	Rear Garden	3
A32	Internal road/housing	2	A76	Rear Garden	3
A33	Internal road/greenspace	3	A77	Rear Garden	3
A34	Rear Garden	3	A78	Front garden/driveway	1
A35	Rear Garden	3	A79	Rear garden	3
A36	Rear Garden	3	A80	Greenspace	3
A37	Rear Garden	3	A81	Greenspace	3
A38	Rear Garden	3	A82	Greenspace/driveway	3
A39	Rear Garden	3	A83	Rear Garden	3
A40	Rear Garden	3	A84	Rear Garden	3
A41	Rear Garden	3	A85	Rear Garden	3
A42	Internal road/greenspace	3	A86	Front garden/internal road	1
A43	Internal road/greenspace	3	A87	Front garden/internal road	1
A44	Internal road/greenspace	3		**Mean: 2.36**	**Mode: 3**

HOUSING DEVELOPMENT : B Gloster Gate								
Unit	**Feature outside living rm window:**	**Pts**	**Unit**	**Feature outside living rm window:**	**Pts**	**Unit**	**Feature outside living rm window:**	**Pts**
B1	Rear Garden	3	B40	Rear Garden	3	B79	Driveway/ internal road	1
B2	Rear Garden	3	B41	Front garden/internal road	1	B80	Driveway/ internal road	1
B3	Rear Garden	3	B42	Front garden/internal road	1	B81	Driveway/	1

							internal road	
B4	Rear Garden	3	B43	Front garden/internal road	1	B82	Driveway/ internal road	1
B5	Front garden/ internal road	1	B44	Rear Garden	3	B83	Driveway/ internal road	1
B6	Front garden/ internal road	1	B45	Driveway	1	B84	Driveway/ internal road	1
B7	Rear Garden	3	B46	Driveway	1	B85	Driveway/ internal road	1
B8	Rear Garden	3	B47	Driveway	1	B86	Driveway/ internal road	1
B9	Front garden/ internal road	1	B48	Front garden/internal road	1	B87	Rear Garden	3
B10	Front garden /internal road	1	B49	Front garden/internal road	1	B88	Rear Garden	3
B11	Rear Garden	3	B50	Front garden/internal road	1	B89	Rear Garden	3
B12	Rear Garden	3	B51	Front garden/internal road	1	B90	Rear Garden	3
B13	Rear Garden	3	B52	Front garden/internal road	1	B91	Rear Garden	3
B14	Rear Garden	3	B53	Rear Garden	3	B92	Rear Garden	3
B15	Rear Garden	3	B54	Driveway	1	B93	Rear Garden	3
B16	Internal road	1	B55	Driveway	1	B94	Front garden/ Driveway	1
B17	Rear Garden	3	B56	Driveway	1	B95	Front garden/ Driveway	1
B18	Internal road	1	B57	Driveway	1	B96	Front garden/ Driveway	1
B19	Internal road	1	B58	Front garden/internal road	1	B97	Front garden/ Driveway	1
B20	Front garden/ internal road	1	B59	Front garden/internal road	1	B98	Rear Garden	3
B21	Front garden/ internal road	1	B60	Front garden/internal road	1	B99	Rear Garden	3
B22	Rear Garden	3	B61	Rear Garden	3	B100	Front garden/ internal road	1
B23	Rear Garden	3	B62	Rear Garden	3	B101	Rear Garden	3
B24	Driveway	1	B63	Front garden/internal road	1	B102	Front garden/ internal road	1
B25	Driveway	1	B64	Front garden/internal road	1	B103	Front garden/ internal road	1
B26	Front garden/ internal road	1	B65	Rear Garden	3	B104	Rear Garden	3
B27	Rear Garden	3	B66	Rear Garden	3	B105	Front garden/ internal road	1
B28	Front garden/ internal road	1	B67	Front garden/internal road	1	B106	Driveway	1
B29	Front garden/ internal road	1	B68	Rear Garden	3	B107	Driveway	1
B30	Driveway	1	B69	Driveway	1	B108	Driveway	1
B31	Driveway	1	B70	Driveway	1	B109	Driveway	1
B32	Front garden/ internal road	1	B71	Driveway/internal road	1	B110	Front garden/ internal road	1
B33	Front garden/internal road	1	B72	Driveway/internal road	1	B111	Rear Garden	3
B34	Rear Garden	3	B73	Driveway/internal road	1	B112	Front garden/ internal road	1
B35	Rear Garden	3	B74	Driveway/internal road	1	B113	Rear Garden	3
B36	Rear Garden	3	B75	Driveway/internal road	1	B114	Front garden/ internal road	1
B37	Front garden/ driveway/main road	1	B76	Driveway/internal road	1	B115	Rear Garden	3
B38	Front garden/ driveway/main road	1	B77	Driveway/internal road	1	B116	Rear Garden	3
B39	Rear Garden	3	B78	Driveway/internal road	1	B117	Rear Garden	3
						Mean: 1.74	**Mode: 1**	

HOUSING DEVELOPMENT: C Ivy house mills					
Unit	**Feature outside living rm window:**	**Pts**	**Unit**	**Feature outside living rm window:**	**Pts**
C1	Main road	0	C33	Front garden/Driveway	1
C2	Main road	0	C34	Front garden/Driveway/internal road	1
C3	Main road	0	C35	Front garden/Driveway/internal road	1
C4	Main road	0	C36	Front garden/Driveway/internal road	1
C5	Main road	0	C37	Front garden/Driveway/internal road	1
C6	Rear garden	3	C38	Front garden/Driveway/internal road	1
C7	Rear garden	3	C39	Front garden/Driveway/internal road	1
C8	Driveway/main road	0	C40	Front garden/Driveway/internal road	1
C9	Driveway/main road	0	C41	Rear garden/Canal	5
C10	Driveway/main road	0	C42	Rear garden/Canal	5
C11	Main road	0	C43	Rear garden/Canal	5
C12	Main road	0	C44	Rear garden/Canal	5
C13	Rear garden	3	C45	Rear garden/Canal	5
C14	Rear garden	3	C46	Rear garden/Canal	5
C15	Internal road	1	C47	Front garden/Driveway	1
C16	Internal road	1	C48	Front garden/Driveway	1
C17	Internal road	1	C49	Front garden/Driveway	1
C18	Internal road	1	C50	Front garden/Canal	5
C19	Internal road	1	C51	Front garden/Canal	5
C20	Driveway	1	C52	Rear garden	3
C21	Driveway	1	C53	Rear garden	3
C22	Rear garden	3	C54	Rear garden	3
C23	Rear garden	3	C55	Rear garden	3
C24	Rear garden	3	C56	Front garden/Driveway/internal road	1
C25	Rear garden	3	C57	Front garden/Driveway/internal road	1
C26	Rear garden	3	C58	Front garden/Driveway/internal road	1
C27	Rear garden	3	C59	Rear garden	3
C28	Rear garden	3	C60	Rear garden	3
C29	Front garden/Driveway	1	C61	Front garden/Driveway	1
C30	Front garden	3	C62	Front garden/Driveway	1
C31	Front garden/Driveway	1		**Mean: 1.94**	**Mode: 1**
C32	Front garden/Driveway	1			

HOUSING DEVELOPMENT : D All saints					
Unit	**Feature outside living rm window:**	**Pts**	**Unit**	**Feature outside living rm window:**	**Pts**
D1	Small road/houses	1	D13	Driveway/internal road	1
D2	Small road/houses	1	D14	Rear garden	3
D3	Small road/houses	1	D15	Rear garden	3
D4	Small road/houses	1	D16	Driveway/internal road	1
D5	Rear garden/Mature trees	5	D17	Front garden/internal road	1
D6	Rear garden/Mature trees	5	D18	Rear garden	3
D7	Rear garden/Mature trees	5	D19	Rear garden	3
D8	Rear garden/Mature trees	5	D20	Rear garden	3
D9	Mature trees	3	D21	Rear garden	3
D10	Mature trees	3	D22	Rear garden	3
D11	Mature trees	3	D23	Rear garden	3
D12	Driveway/internal road	1		**Mean: 2.65**	**Mode: 3**

HOUSING DEVELOPMENT : E Dallow bridge					
Unit	**Feature outside living rm window:**	**Pts**	**Unit**	**Feature outside living rm window:**	**Pts**
E1	Front garden/fence/main road	1	E22	Rear garden	3
E2	Front garden/fence/main road	1	E23	Front garden/internal road	1
E3	Front garden/fence/main road	1	E24	Front garden/internal road	1
E4	Front garden/fence/main road	1	E25	Front garden	3
E5	Front garden/fence/main road	1	E26	Rear garden	3
E6	Front garden/fence/main road	1	E27	Rear garden	3
E7	Front garden/fence/main road	1	E28	Rear garden	3
E8	Front garden/fence/main road	1	E29	Rear garden	3
E9	Front garden/fence/main road	1	E30	Rear garden	3
E10	Rear garden	3	E31	Rear garden	3
E11	Rear garden	3	E32	Rear garden	3
E12	Front garden/internal road	1	E33	Rear garden	3
E13	Front garden/internal road	1	E34	Rear garden	3
E14	Front garden/internal road	1	E35	Rear garden	3
E15	Front garden/internal road	1	E36	Rear garden	3
E16	Front garden/internal road	1	E37	Rear garden	3
E17	Front garden	3	E38	Internal road/mature trees	3
E18	Rear garden	3	E39	Internal road/mature trees	3
E19	Front garden/internal road	1	E40	Rear garden	3
E20	Front garden/internal road	1		**Mean: 2.10**	**Mode: 3**
E21	Front garden	3			

HOUSING DEVELOPMENT : F Hydro					
Unit	**Feature outside living rm window:**	**Pts**	**Unit**	**Feature outside living rm window:**	**Pts**
F1	Rear garden	3	F42	Front garden/Driveway/internal road	1
F2	Rear garden	3	F43	Front garden/Driveway	1
F3	Rear garden	3	F44	Rear garden	3
F4	Rear garden	3	F45	Rear garden	3
F5	Rear garden	3	F46	Rear garden	3
F6	Front garden/main road	0	F47	Rear garden	3
F7	Front garden/main road	0	F48	Front garden/Driveway	1
F8	Front garden/main road	0	F49	Front garden/Driveway	1
F9	Parking/paved area	1	F50	Rear garden	3
F10	Front garden/internal road	1	F51	Rear garden	3
F11	Internal road	1	F52	Rear garden	3
F12	Rear garden	3	F53	Rear garden	3
F13	Rear garden	3	F54	Driveway/mature trees	3
F14	Rear garden	3	F55	Rear garden	3
F15	Rear garden	3	F56	Rear garden	3
F16	Rear garden	3	F57	Internal road	1
F17	Rear garden	3	F58	Internal road	1
F18	Rear garden	3	F59	Internal road	1
F19	Rear garden	3	F60	Front garden/internal road	1
F20	Front garden/Driveway	1	F61	Front garden/internal road	1
F21	Front garden/Driveway	1	F62	Front garden/Driveway/internal road	1
F22	Front garden/Driveway	1	F63	Front garden/Driveway/internal road	1
F23	Front garden	3	F64	Internal road	1
F24	Front garden/Driveway	1	F65	Front garden	3
F25	Front garden/Driveway	1	F66	Driveway	1
F26	Front garden/internal road	1	F67	Driveway	1
F27	Rear garden	3	F68	Front garden/internal road	1
F28	Front garden/internal road	1	F69	Internal road	1
F29	Front garden/Driveway/internal road	1	F70	Rear garden	3
F30	Front garden/Driveway/internal road	1	F71	Front garden/internal road	1
F31	Driveway/internal road	1	F72	Front garden/driveway	1
F32	Front garden/internal road	1	F73	Front garden/driveway	1
F33	Front garden/internal road	1	F74	Front garden/driveway	1

F34	Rear garden	3	F75	Front garden/driveway	1
F35	Front garden/Driveway/internal road	1	F76	Rear garden	3
F36	Front garden/Driveway/internal road	1	F77	Front garden/internal road	1
F37	Front garden/Driveway	1	F78	Driveway	1
F38	Front garden/Driveway	1	F79	Driveway	1
F39	Driveway/internal road	1	F80	Internal road	1
F40	Front garden/Driveway/internal road	1	F81	Rear garden	3
F41	Front garden/Driveway/internal road	1		**Mean: 1.73**	**Mode: 1**

Appendix VII: Access to amenities within 400m

Type of amenity:	Housing Development					
	A	B	C	D	E	F
Bank	-	-	-	-	-	-
Cash point(s)	Yes	Yes	-	Yes	Yes	-
Community centre	-	Yes	-	-	-	-
Pharmacy	Yes	-	-	Yes	-	-
Food shop(s) (Incl corner shop)	Yes	Yes	-	Yes	Yes	-
Retail shop(s) (non food)	Yes	Yes	Yes	Yes	Yes	Yes
Health care (GP, dentist)	Yes	-	-	-	-	-
Daycare / nursery centre	-	-	-	Yes	-	-
Entertainment (cinema, theatre, arts, etc)	-	-	-	-	-	-
Post office	Yes	-	-	-	-	-
Post box	Yes	Yes	Yes	Yes	Yes	Yes
Police station	-	-	-	-	-	-
Launderette / dry cleaners	-	-	-	-	-	-
Restaurant/café/pub	Yes	Yes	Yes	Yes	Yes	-
Salon	Yes		Yes	Yes	Yes	-
Library	-	-	-	-	-	-
Fitness centre / gym / swimming pool	-	-	Yes	-	-	Yes
Education (primary and secondary schools)	Yes	-	Yes	-	Yes	-
Nodes of public transport	Yes	Yes	Yes	Yes	Yes	Yes
Place(s) of worship	Yes	-	Yes	Yes	Yes	-
Total:	12	7	7	10	9	4

Appendix VIII: Normalised decision matices for housing providers

Criteria, i	d_{ij}						Local Authorities q_i
	A_1	A_2	A_3	A_4	A_5	A_6	
C1	0.022	0.013	0.013	0.013	0.030	0.030	0.12
C2	0.020	0.020	0.020	0.020	0.004	0.020	0.10
C3	0.011	0.011	0.011	0.034	0.034	0.011	0.11
C4	0.006	0.018	0.018	0.018	0.018	0.018	0.09
C5	0.017	0.000	0.000	0.000	0.017	0.050	0.08
C6	0.029	0.029	0.017	0.006	0.006	0.017	0.10
C7	0.021	0.007	0.007	0.021	0.021	0.007	0.08
C8	-	-	-	-	-	-	-
C9	0.017	0.029	0.017	0.017	0.017	0.017	0.12
C10	0.015	0.015	0.015	0.005	0.015	0.005	0.07
C11	0.028	0.017	0.017	0.028	0.017	0.006	0.11

Criteria, i	d_{ij}						HA q_i
	A_1	A_2	A_3	A_4	A_5	A_6	
C1	0.023	0.014	0.014	0.014	0.032	0.032	0.13
C2	0.020	0.020	0.020	0.020	0.004	0.020	0.11
C3	0.010	0.010	0.010	0.031	0.031	0.010	0.10
C4	0.006	0.017	0.017	0.017	0.017	0.017	0.09
C5	0.018	0.000	0.000	0.000	0.018	0.053	0.09
C6	0.029	0.029	0.018	0.006	0.006	0.018	0.11
C7	0.022	0.007	0.007	0.022	0.022	0.007	0.09
C8	-	-	-	-	-	-	-
C9	0.018	0.030	0.018	0.018	0.018	0.018	0.12
C10	0.012	0.012	0.012	0.004	0.012	0.004	0.06
C11	0.028	0.017	0.017	0.028	0.017	0.006	0.11

Criteria, i	d_{ij}						Developers q_i
	A_1	A_2	A_3	A_4	A_5	A_6	
C1	0.024	0.014	0.014	0.014	0.033	0.033	0.13
C2	0.022	0.022	0.022	0.022	0.004	0.022	0.11
C3	0.008	0.008	0.008	0.025	0.025	0.008	0.08
C4	0.006	0.019	0.019	0.019	0.019	0.019	0.10
C5	0.019	0.000	0.000	0.000	0.019	0.056	0.09
C6	0.029	0.029	0.017	0.006	0.006	0.017	0.10
C7	0.026	0.009	0.009	0.026	0.026	0.009	0.10
C8	-	-	-	-	-	-	-
C9	0.016	0.026	0.016	0.016	0.016	0.016	0.10
C10	0.012	0.012	0.012	0.004	0.012	0.004	0.06
C11	0.027	0.016	0.016	0.027	0.016	0.005	0.11