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How does usage affect the sustainability and environmental footprint of an office building?

Master Thesis in Globalization, Global Politics and Culture

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Abstract

This thesis looks at how usage affects the sustainability and environmental footprint of an office building. The findings are based on interviews with expert witnesses who work for organisations that are directly linked to sustainability and green issues. The interviews reflect on how usage affects sustainability, and then address the challenges in terms of how this is addressed. The findings include: definition difficulties, control and education, technology, common currency and international regulations, and motivation. As well as the statements from interview subjects, I also offer my own position on their arguments. These findings represent a road map for further research into how building usage affects sustainability, by presenting the issues and how they are currently being dealt with. This thesis could have an impact on how research into sustainable usage is studied in the future, and to what degree usage is considered to be of importance in the larger sustainability debate.

Dedication

Throughout the writing of this thesis there have been several people who have provided valuable help and support, who I would like to acknowledge them here.

I would like to thank Morten Arnt Hatling at SINTEF Anvendt Økonomi, who provided me with support from the perspective of both guidance and helping me with my interview subjects. I would also like to thank my supervisor Asbjørn Karlsen for his guidance.

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This thesis is dedicated to my late Grandfather, Tony Jandrell, who encouraged me to better myself and reach my potential. Without his encouraging words many years ago, I may never have taken on so many new challenges.

Key Abbreviations

AL – Adrian Leaman, Managing Director of Building Use Studies

BREEAM - Building Research Establishment Environmental Assessment Methodology

CH – Christian Hemmingsen, head of Marketing for the Unit for Non Residential Buildings at Enova

DF – David Fitzpatrick, Chief Executive of Sustain Wales

HG – Helle Grønli, head of Unit Buildings at Enova

MINDER - Methodologies for Improvement of Non-residential Buildings' Daily Energy Efficiency Reliability

MT – Martin Townsend, Director of Sustainability at BREEAM

NSO – National Scheme Operators (BREEAMs affiliated organisations outside of the UK)

SINTEF - Stiftelsen for industriell og teknisk forskning (English: The Foundation for Scientific and Industrial Research)

SWALEC – South Wales Electricity Company

TB – Professor Thomas Berker, researcher at ZEB

UK – United Kingdom

ZEB – The Research Centre for Zero Emission Buildings

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1 Introduction

1.1 Background

“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland, 1987, p.15)

The above quote is from former Norwegian Prime Minister Gro Harlem Brundtland, in her groundbreaking report from 1987 on sustainable development. More than a quarter of a century has passed since this report, but sustainability is still a hot topic in everything from farming infrastructure to the construction of office buildings. In a world that is becoming increasingly more conscious of its effects on the planet, sustainability is becoming more frontline, and increasingly fashionable.

Offices and workplaces are in many respects increasingly trying to face the challenge of sustainability head on, but they cannot do this alone. With the increasing trend in sustainable building construction, a regulatory framework has begun to form which will give structure and initiative to this movement. Whilst there are a few international initiatives (as large as the Kyoto protocol for example) that reflect green building, there are also important regional bodies that fill this role. Of substantial note, is the Building Research Establishment Environmental Assessment Methodology (better known as BREEAM) from the United Kingdom (UK) who provide a formal rating and assessment system for rating buildings (BREEAM, 2014c). This system has also been applied to countries such as Norway.

An ongoing attempt at creating an international standard for green building and construction is being conducted by the International Code Council (ICC). The ICC has already set out building standards adopted in North America (ICC, 2014), and has set out to create a sustainability code titled the ‘International Green Construction Code’ which was first published in 2010 (ICC, 2013). Whilst it is too early to gauge the international effectiveness of this code (especially as its adoption relies on membership and not legislation), it is a serious attempt at a globalised green building agenda.

With governments also trying to encourage a more productive green agenda, organisations such as Enova in Norway try to facilitate this *“in order to drive forward the changeover to more environmentally friendly consumption and generation of energy in our country”* (Enova, 2013a). The relationship between conscientious workplaces along with governments and

facilitating organisations are not just symbolic, but paramount in moving this change forward in a way that is progressive and functional.

1.2 Motivation

From August until December 2013, I did an internship at SINTEF Technology and Society (Teknologi og Samfunn) in their Applied Economics department (Anvendt Økonomi). During this period I wrote a paper entitled ‘Productivity: Its Enablers and Disablers in the Scandinavian Workplace’, and was keen to follow through with a topic related to the workplace in my thesis. The final topic came out of a discussion with my corporate supervisor at SINTEF, Senior Researcher Morten Arnt Hatling. He relayed a conversation that had taken place between the Director of Enova and himself some months previously. He had been discussing the issue of sustainability, and how despite extensive research and policy formation, the issue of the usage of office buildings appeared to be given comparatively little consideration in this context. In the study of sustainability, the likes of materials and energy have been a part of this study as is the case of Otto (2010) and her look into the transition into the sustainable design of buildings (Otto, 2010), but a building’s operational phase has been offered less attention. Throughout my academic career to date I have always felt at my most engaged when delving into topics that are ignored or under researched, and this topic gripped me in the same way. I feel that the issue of usage (in the context of the usage of spaces and associated technologies) is of real significance when looking at sustainability, and I hope that I can help illuminate this in a way that would be considered useful in the greater debate.

By usage, I am referring to usage of spaces within an office and its associated infrastructure. This will take me on a journey into not just this aspect of the topic, but into the likes of technology and their ‘scripts’, and the relationships between institutions and businesses that move the sustainability agenda forward. After a building is designed sustainably, how it is used after the builders leave and the occupants move in must be considered a part of the ‘green’ agenda enshrined in the construction ethos of buildings. In a handbook on sustainable construction, this issue was articulated by saying that “*aside from an integrated design and work approach, and the development and further development of products and tools, sustainability must be expanded so that the planners are able to gather valuable experience even during the operation of the buildings*” (Bauer, Mèosle, & Schwarz, 2010, p.20).

This topic is also something that I have taken interest in, and the more I read into green buildings, the more the idea of usage caught my imagination. The current status of the usage issue is not just a reflection on the status of existing research, policy or even associated technological advances, but is also a curious reflection on actors in the greater process that make up the relationships that allow sustainability matters in offices to happen at all.

The issues and responsibilities surrounding building usage do not just rest in the hands of business owners themselves, but it is a shared responsibility with governments and grant giving or advisory bodies. Green agendas tend to be ‘pushed along’ to a greater or lesser extent by policy makers and associated institutions, and the sharing of knowledge that allows them to progress their respective agendas. This relationship is also something I am very much interested in, as without this movement and flow of elemental relations, the sustainability agenda is liable to stagnate.

1.3 Research Question

In this thesis, I intend to interview several important actors who I consider to be expert witnesses and who are representatives of funding providing or advisory bodies associated with sustainability. I will look at the issues they raise, and organically form arguments that will be presented here in a more methodical way. The key research question that will form the focus of interviews and discussions, will be the following:

. How is an office building’s usage looked at in the context of sustainability, and vice versa?

As a part of investigating this, I will also be addressing several sub questions:

. How does each actor’s institution approach usage and sustainability? If not, why not?

. What challenges and issue are there when looking at sustainable usage? How are they being dealt with?

I am keen for initial discussions to form in a more explorative way, as I feel that having too many preconceived indicators would restrict my enquiry and risk the mechanical formation of results, something that would be potentially harmful when digging into the heart of the issue. Whilst the written text will be carefully structured, the structure will base itself on common

factors and indicators that form part of the investigatory stage of the thesis. This will be discussed in greater detail in the methodological section of this thesis. In terms of planned structure, the analysis will focus on several core areas. In the first section I will be looking at how each actor deals with the issue of usage and sustainability. If they do not deal with this issue directly, I will ask them why this is the case. I then move on to look at how the actors reflect on the effect of usage on sustainability. Next, I will look at what common factors and challenges these actors have raised, and look at how they are being dealt with.

All of these sections will be viewed critically with an assessment of how each actor responds to each issue compared to others.

This thesis will pose many challenges and raise many questions, not all of which I imagine I will be able to cover here due to restrictions of time, space and resources. Interview subjects were difficult to come by initially and topic theory was not always easy to find, but these were resolved successfully. My aim for this thesis is to move the knowledge of this issue along somewhat, and hopefully lay some groundwork for other scientists to take another more in-depth look at this in the future. Nobody can predict the future of the debate surrounding sustainability and how important factors in it will progress. As social scientists, we have the chance and in many respects an obligation to see what these issues might be, and do our best to help evolve strategies that will allow institutions and businesses to better cope with arising issues.

1.4 Rationale

As with any thesis, the topic I will be writing about must be sufficiently interesting and be worthy of research and investigation. In my judgement, this topic ticks all of these boxes. The sustainability argument is still a developing idea as a grander concept, and the likes of scientists, service providers and architects must aim to be ahead of developments if they are to meet unexpected or rapidly evolving challenges.

Whilst the likes of technology and materials are being sufficiently dealt with on a fundamental level in other research, it is clear that other areas are not. The issues of usage has been left almost completely under researched at this level, yet is so important in the overall sustainability process. How we use our spaces, what we do with them, and how we can use

them better has an effect on how sustainable a building can be considered to be. With the issue of usage seemingly under researched, I felt that I would take the opportunity to fill this research gap myself, and leave something for future researchers to expand upon.

Another aspect of the topic that made me curious to know more, was the essential globalisation element of it. This thesis is a globalisation themed one, and this topic appeared to fit it in a way that was both clear, and in my mind interesting. Sustainability and green building is not just a European consideration, but a truly global one. Dixit *et al* (2010) made this clear when referring to the global resources impact that the likes of construction is responsible for (Dixit et al 2010 cited in Dutil, Rouse, & Quesada, 2011 p.444) . One cursory glance at the internet will show countries such as Indonesia trying to encourage substantial foreign investment, and selling their 'green' credentials as contributing factor to the decision making process of that investment (Groff, 2011). This is a global challenge, and as a result will require a more international approach to resolve. The challenge isn't just that of funding or fighting the campaign, it is also about political will, responsible employers, and innovation in appropriate sectors.

2 Literature and Theoretical Concepts

2.1 Literature Review

Whilst this topic is for the most part under researched, there has been work done that can be considered to relate to the broader themes of sustainability and usage. Some of these relate to case studies and some to other forms of sustainability study. As far as possible in this literature review I will endeavour to relate these to the issues of usage, but due to the nature of the subject matter general sustainability writings have also become part of this section.

Some of the most recent work on building usage that has come to my attention can in fact be found in Trondheim, and funded by the Norwegian Research Council. The authors Berker, Gansmo and Junghans (2014) investigate the impact of usage with regards to non-residential buildings. This paper is a conceptual one, and looks at the findings of a newly established research project called the Methodologies for Improvement of Non-residential buildings' Day-to-day Energy-efficiency Reliability (MINDER) (Berker, Gansmo, & Junghans, 2014, p.1). This is a study that aims to try and reduce the gap in reliability that exists in non-residential buildings (Berker et al., 2014, p.1). In part of the article they mention that efforts to produce better buildings have at times been ignored, and that this is also the case in the context of the daily operations of a building (Berker et al., 2014, p.3).

According to the authors, improvements in day-to-day operations can be reflected through an improvement in the design process. They cite several practical methodologies that can help to improve this process. The first is 'soft landings'. This is when a handover period exists after the building is complete, with members of the design team staying on to receive feedback from occupants and make changes where feasible (Berker et al., 2014, pp.3-4). The second methodology is Energy Performance Contracting (EPC). This is similar to soft landings in many respects, however this involves an (often) third part energy company who are contracted to monitor the energy usage of a building during its operational phase. This allows them to implement, fine tune or even suggest alterations to the buildings' energy processes. Lifetime commissioning (LOT), or Continuous Commissioning (CCx) as it is occasionally referred to in the text, implements a testing procedure that extends through to the entire lifetime of the building. This allows not just a rapid detection of faults but allows continual assessment of the building's actual performance, compared to those projected during the design phase (Berker et al., 2014, p.4). Although less related to building performance,

Continuous Briefing allows scientists, designers and other interested parties to learn from individual building's operation and design in the context of the Building Performance Evaluation (BPE) model (Berker et al., 2014, pp.4-5). These methodologies provide a contemporary and practical means by which to look at usage and buildings' operations that have a contextual grounding in sustainability, and represent how actors are configured differently, and learn from each other.

Another usage approach from the 1990s comes from some of the field's more well-known scholars, Bill Bordass and Adrian Leaman (1999). Their focus is much more related to productivity and seldom mentions sustainability, however their work offers a useful insight into issues surrounding office space usage and operations. In their work they are keen to stress that buildings are in themselves complex systems comprising both human and physical elements, with interaction creating 'emergent' properties (Leaman & Bordass, 1999, p.5). There is also the difficulty in linking the likes of usage to a term such as 'productivity' as an argument for advances in this area. Productivity is notoriously hard to define according to the authors, steeped in difficulties both from a methodological and interpretational perspective (Leaman & Bordass, 1999, p.5). Despite their productivity focus, they do reference energy consumption which is of very real relevance to this thesis. In the context of indoor environmental factors improving output, data from Bordass and Oseland (1997) suggests that factors such management, design and usage characteristics of a building can result in a better energy efficiency, and even an improved perception of individual welfare (Bordass and Oseland 1997, cited in Leaman & Bordass, 1999, p.7).

Leaman and Bordass (1999) also briefly note the importance of technological usage in their work. They note the importance of good practise in terms of energy use and infrastructure, claiming that based on a study of One Bridewell Street in Bristol UK in 1992, their air conditioned office used comparatively little more energy than a good practise more naturally ventilated open plan environment (Eley 1996, cited in Leaman & Bordass, 1999, p.7). Whilst Leaman and Bordass (1999) do not suggest the same level of top down monitoring type of methodologies offered by Berker *et al* (2014), they do claim that responsive facilities management can do their part in ensuring that buildings' spaces are used effectively and improve technological reliability (Leaman & Bordass, 1999, pp.10-12). They are keen to stress a warning regarding technology however. A well-resourced management is the key to

effective technological usage in a building, something that is all too often not considered at design stage (Leaman & Bordass, 1999, p.10). To quote the text directly, they say that “*the buildings that came out best overall either managed technological complexity with high levels of expertise (e.g. Bordass et al., 1995b) or deliberately rid themselves of gratuitous complexity (e.g. Standeven et al., 1996) and a dependence on management. So designers and managers should consider both personal control and response time implications, rather than think that they are the same*” (Leaman & Bordass, 1999, p.11). This reflects a more resource driven perspective on building usage, as opposed to one based more on monitoring such as in the suggestions by Berker *et al* (2014).

As well as the more direct literature on usage, there is a considerable body of important literature on office sustainability that is also important to consider. Dutil, Rouse and Quesada (2011) looked into this quite specifically in their work. They partially focus on the overall need to keep building's sustainable, although this very much from the perspective of the construction stage of a buildings lifecycle. They note the global impact of the construction industry on the world's resources, citing Dixit *et al* (2010) who claims that this industry has already resulted in the depletion of two fifths of the world's raw stone, and annually consumes 40% of the world's energy. In the European Union (EU), this energy consumption rate is closer to 50% (Dixit *et al* 2010 cited in Dutil *et al.*, 2011, p.444). As well as numerical data, the authors also consider sustainability in the context of a building's lifecycle. They go as far to claim outright that the 'in-use' phase is ignored in the larger context of energy consumption, with instead focuses veering more toward factors such as construction, maintenance and decommissioning (Dutil *et al.*, 2011, p.445). In their concluding remarks on sustainability and usage (with a primary focus on energy consumption) they feel that there is still a definition problem with regards to a definition of 'zero emission building', and this lack of standardisation may be effecting research (Dutil *et al.*, 2011 p.455). In terms of practical concerns, they suggest that users' considerations play a greater role at the concept stage, as their energy consumption requirements are essential. There also needs to be a better use of construction materials, as they can effect everything from lifecycle durability, to the needs and requirements for example, of air conditioning if insulation is poor (Dutil *et al.*, 2011, p.455).

If sustainability is considered to be greater than simply low energy output, sustainable design considerations are worthy of inclusion in this literature review. Devanathan, Ramanujan, Bernstein, Zhao and Ramani (2010) point towards the importance of early design in establishing a design's sustainability credentials. I must state at this point that much of their work relates to product design and not buildings themselves, although this is still relevant when taking into account the technology and infrastructure involved in office space usage. They do this through a methodology called the 'Function Impact Matrix' (FIM). Similarly to Dutil *et al* (2011), their research focus has come out of comprehensive building lifecycle assessments (Devanathan, Ramanujan, Bernstein, Zhao, & Ramani, 2010, p.1). They claim that FIM will endeavour to remove the flaws of present day methods, which they establish as being "*not effective for designers with limited experience or too quantitative, costly, and time consuming*" (Devanathan et al., 2010, p.1). To summarise the FIM methodology they use lifecycle assessment as visual tools to help correlate environmental impact and product function. Whilst much of Devanathan *et al* (2010) paper is written in a way more appropriate to engineers, it does make some points on the importance of early design considerations in some sections of the paper. They are keen to stress that there has been little relationship connecting environmental requirements and engineering characteristics (Devanathan et al., 2010, p.2). This would contradict some of the work earlier in this review from the likes of Berker *et al* (2014) who would argue in their work that through their monitoring and service suggestion, engineering may be catching up to sustainability. This also however could be a commentary on the work there is left to do, which the FIM methodology may itself be hoping to solve. In terms of a concluding suggestion, they claim that in order for new sustainable design methodologies to be more widely accepted for application (with a particular emphasis on FIM) , it must be done in a way that requires minimal adjustment for designers (Devanathan et al., 2010, p.8).

In terms of implementation of standards and the development of benchmarking, the 'Better Buildings Partnership' (BBP) (2010) has looked at developing a type of benchmarking system to improve the sustainability of London's housing stock and developing some best practise principles. They note that operational benchmarking can bring with it challenges, mostly through process of data collection. They note that defining effective indicators to employ has affected data collection possibilities. This also partially manifests in the problems there have been in collecting accurate, consistent and verifiable data (Bosteels, Tipping, Botten, &

Tippet, 2010, p.11). They do however, provide some direction by which to measure a building's performance from a sustainability perspective. They suggest, for example, measuring total CO2 emissions over time when compared to a consistent portfolio over time (Bosteels et al., 2010, p.11). Through variables and indicators such as these, sustainability and performance benchmarking indicators can be more easily developed (Bosteels et al., 2010, p.15). They state however that in order to influence correct behaviour and improve performance and sustainability, benchmarks must focus on normalised performance, as opposed to absolute performance (Bosteels et al., 2010, p.11).

This review represents what I believe are some of the major contributing texts to the sustainability and usage topic, however as I stated during the introduction to this thesis, there is little or no literature that specifically covers the impact of usage on the sustainability and environmental footprint of a building, or the other way around. However, the works of Leaman and Bordass (1999) and Berker *et al* (2014) will most appropriate for use in informing my analysis.

2.2 Theory and Theoretical Discussions

The nature of this Master thesis means that directly related theory is hard to come by, despite my extensive research. However, smaller elements of the overarching topic none the less provide a basis by which to investigate the theoretical concepts I intend to use in my work.

I was particularly intrigued by the work of Bogers, Afuah and Bastian (2010) in their work on how users drive forward innovation. In this thesis, I am interested in how usage is treated by institutions and companies, and how these are to some extent influenced by their relationship with each other. I may find that many of the grander advances in the topic are driven by the users themselves, and will evolve from there. Bogers *et al* (2010) discuss this issue at length. They cite Von Hippel (1988) who believed that the user's role in innovation is on occasion under recognised. Von Hippel's claim is that users' input doesn't just 'spark' innovation in sectors such as design, but directly results in innovation itself (Von Hippel 1998 cited in, Bogers, Afuah, & Bastian, 2010, p 858). What is more interesting to me with regards to this thesis, is what the authors have to say on consumer innovation, which is more relevant to the interview subjects I will be working with. They discuss how consumers in their role as 'user innovators' will often 'diffuse their knowledge' within their communities which will allow

development to occur in a more freeform manner (Bogers et al., 2010, p.860). This is interesting considering how the issues surrounding usage and sustainability will develop. If users and consumers (such as companies) innovate and share this knowledge in communities and networks (such as institutions and service providers), it could develop into a form of innovation on usage policy that exists in a more fluid way, outside the restrictions of the laboratory, or Research and Development (R&D) departments, representing the interactive rather than linear model.

The work of Bengt-Åke Lundvall gives an important perspective on the bridge created in innovative processes that spans the user/producer barrier. Lundvall looks at an interesting model that reflects the kinds of innovation I may expect to see in my work. A report from the Organisation for Economic Co-operation and Development (OECD) in 1997 quotes Lundvall's description of National Innovation Systems stating that they are comprised of “ *the elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge ... and are either located within or rooted inside the borders of a nation state*” (Lundvall 1992 cited in OECD, 1997, p.10). Although this thesis has a significant grounding in topic of globalisation, Lundvall's views on the role of the nation state are still wholly valid. National frameworks can in themselves foster the kind of innovation that is needed, and can reflect themselves on how innovation has evolved in other nations, and even learn from it. In one of Lundvall's (1985) own works, he discusses the importance of addressing innovation processes where a distinction must be made from consumer users, to professional ones. According to the author, professional users are more consistent in looking for ways to solve problems, and this in itself feeds back into the innovation process. Consumers on the other hand, will prove to be more passive. Professional users are also more likely to adapt their behaviour and training as new technological opportunities arise (Lundvall, 1985, p.5). The aspect of this theory that interests me is the way that this type of innovative process will work with regards to relationships that exist in the workplaces I am studying. I am interested in seeing if each set of actors reacts more like Lundvall's 'consumers', or 'professionals'. I am interesting in seeing if the users provide feedback to technology creators, and themselves drive innovation, or whether the user offers a more passive role in the innovation process with advances being made more in line with organic advances.

Whilst looking into the work of Lundvall, I also came across a concept I had previously been unaware of, that of ‘innovation ecosystems’. This idea reflects some of my pre-existing expectations on how the concepts surrounding usage could be viewed. In the work of Mercan and Goktas (2011), they illustrate how innovation systems can potentially act in the same way that ecosystems in nature can function (Mercan & Goktas, 2011, p.105). They claim citing the work of Moore (1996) that parallels with nature can help us explain how innovation can flourish. The analogy they describe relates suppliers to producer plants in that actors in economic and innovation communities provide value and services to each other depending on their roles and strengths (Mercan & Goktas, 2011, p.105). Whilst I appreciate that this is superficially abstract in relation to what I intend to write about, there is something very important that can be taken from this type of analogy, especially as processes of innovation can draw parallels with natural processes. The type of relationship structure I am likely to encounter may reflect less something that is planned and organised, but rather an organic relationship construct that is formed by each component part playing to its strengths, and at times, functioning in ways that go beyond their traditionally assigned role.

It is impossible to discuss the topics of this paper without to some extent reading into scholars looking into transition studies. Harald Rohracher (2001) took an extended look at the transition process into sustainable construction. Whilst my work will not be looking directly at construction (although that is also an issue that itself cannot be ignored entirely), the discussions regarding transition are of real relevance to this work. The author quite appropriately sums up the challenge that exists when transitioning to sustainable buildings: “*Sustainable development as an effort to integrate ecological, economic and social dimensions of our future activities has one of its touchstones in the issue of sustainable buildings*” (Rohracher, 2001, p137).

All of these elements, especially as I am a social scientist, must be at the forefront of my mind when assessing the issues and data that I accumulate and investigate over the course of this work.

To be more specific on the author’s extensive discussion, with a greater emphasis on what I will be looking at, he looks at how the behavioural aspects of this challenge can be met or should be met. He mentions that the sustainability of green buildings does not just correlate

with their construction alone, but their behavioural elements also. Only if users understand the performance of a building, can they themselves act in a way that will be compatible with a building's sustainable elements and infrastructure (Rohracher, 2001, p.139). This, in some respects, is also relevant to what I have cited previously from the work of Boger *et al* (2010). Behavioural considerations can increase the understanding of users' and consumers' roles in sustainable environments which could lead to innovation, although Rohracher (2001) is keen to stress that this may only happen through constructive dialogue with partners at design stage, planning and during the construction process (Rohracher, 2001, p. 139). This piece stresses something that is at the very core of what I am trying to achieve in this thesis. Whilst the challenge for green building naturally is embedded in facilitating construction processes and technology, the socially interactive elements associated with these and the issue of usage pose an even more difficult challenge (Rohracher, 2001, p. 139).

This article also goes a step further into usage, and its behavioural consequences, more specifically, the analysis of this issue by Madeline Akrich (1995). Rohracher (2001) explains Akrich's interpretation of users and innovation. Akrich (1995) believes that innovation stimulated through usage helps to align socio-technical networks (as seen in the organisations and institutions I will be looking at) and, that objects cannot be separated from their use (Akrich 1995 cited in Rohracher, 2001, p.147). Actors are also constrained by the 'script' of the designers of the technology at their disposal, an issue that is very relevant in the context of this paper (Akrich 1995 cited in Rohracher, 2001, p.147). The technology used in offices can create a conflict with users in terms of the tension that exists between the designer's intention, and the translation into how it is used. This conflict is appropriately summed up in a quote from the article itself, which states "*technical objects thus not only 'define actors and the relationships between them, but to continue functioning must stabilise and channel these'*" (Rohracher, 2001, p.147).

Following on from this, a look at Bruno Latour and his work on Actor-Network Theory (ANT) gives us an interesting perspective on how to explain some of the elements of usage and their relationship with actors and the technologies associated with it. ANT removes the essentialist approach to looking at socio-technological networks, giving influences that are both social and technological equal weighting when looking for explanations (Latour, 1996, pp. 369-371). In the context of what I intend to discuss here, Latour has something to say

about actors' (or 'actants' as Latour commonly refers them) roles in social sciences which are relevant here. Latour says that we should be cautious about prescribing roles to certain actors and giving them labels that restrict the roles they could potentially fill. Innovations can proliferate where these boundaries are uncertain and can flow in a much freer collection of associations (Latour, 2005, p.11). What can we take from Latours' relationship narrative? Whilst an equal socio-technical understanding is vital to my later empirical analysis, the boundaries theories give me significant food for thought on preconceptions. Despite the superficial narrative roles of all of the actors I will be looking at, I am likely to get more out of the interviews and associated data if I take a less rigid view on the real world applications of their roles and functions. I may find the likes of innovation where I would not normally expect it, and thus I should prepare my investigations appropriately.

With the consistent theme of sustainability running a 'red thread' throughout this thesis, some theory on this topic is essential in giving the topic weight and vital grounding. An article published in 2011 by Dutil, Rousse and Quesada caught my attention, which is interestingly titled "Sustainable Buildings: an Ever Evolving Target". The paper in part deals directly with usage, making it of significant interest in my study. Whilst the authors claim that a special focus is given to the likes of construction, maintenance and decommissioning of a building, matters surrounding the 'usage stage' cannot be ignored (Dutil et al., 2011, p.445). This is especially important when it comes to energy, something I suspect will also come to light when it comes to a more complex and detailed look at the usage of spaces. The authors are also keen to stress the impact of usage on building life cycles (Dutil et al., 2011, p.445-446). This however must be looked at in context, as the authors primarily looks at these issues from the perspective of construction, and not so much from a socio perspective.

2.3 Theoretical Framework and Theory Discussions

In this section, I have considered theoretical concepts that are appropriate for my work, and here I will endeavour to briefly sum this up by defining the way that these will from core concepts to drive the theoretical considerations that will influence the analysis.

The Actor-Network theory will be paramount in affording me a model by which to analyse the technological and the social without being restricted by categorical determinism that could

potentially not reflect the experiences of the topic. Akrich (1995) and her work on the assimilation of objects and their use will afford me a 'scape' by which to help unfold the uses of technology in relations to their success in function, and relationship to their user. I will need to look at a user's role in the innovation process, and the work of Lundvall provides as theoretical framework by which to look at this. Rohrer (2001) remind the scientist to consider all aspects of a building, throughout its life cycle and the elements that create the building from its construction materials, to its occupants. This type of logic will provide a framework to look at all elements of buildings, as components as well as a whole.

With these theoretical concepts and frameworks at the front of my mind, I am freer to consider their impact and relevance in the context of the subject matter I will be surveying and the analytical possibilities the data will provide.

3 Methodology

3.1 Research Type

This study will be qualitative in nature, and more specifically will take place in the form of semi-structured interviews. A copy of the interview guide is presented in full in the appendices. The written questions will merely represent the topic structure of the interview, although this is also liable to change depending on the answers given. There is also likely to be substantial variations between the transcripts and the interview guide in the order of questioning. This will also be a reflection of the answers given at each interview, along with the knowledge and competencies of the interviewee. The wording of some of the questions will vary depending on the interviewee.

I have also written the interview guide with an intentionally malleable quality to it. This, I hope, will allow me to form my questioning more organically and to elaborate on information given that I deem to be relevant to the subject matter I am investigating.

I will interview subjects from Norway and the UK, and I expect their experiences to be different to one another based upon this, and the type of actor they are. This may give the impression that a longitudinal study design might be superficially relevant to get a picture of the issues long term, however as I will carry out the interviews over a two to three week period, this will not be possible. This means that a cross-sectional design will be at the core of the research design.

As per the general format for a cross sectional study, my questioning will aim to find patterns in the responses that will help to form the body of the thesis structure after interviews are completed. I have chosen this format for several reasons. A quantitative interview would not have provide me with the breadth of information I needed, and would have given me little to no scope for the extensive amount of elaboration I required in order be provided with a sufficient level of information from my informants. The semi structured interview format also permits me to engage the interviewee in a more natural way, which will provide for more appropriate and interesting material. This could provide me with real external validity, as much of the material I get from my answers I imagine will be possible to generalise to other actors in similar relationship circles.

3.2 Sampling

Constructive and direct sampling was carried out for this research, as I needed very specific actors for the data accumulation to be sufficient. Subjects were selected primarily for the roles they had in compatibility for this study (such as business managers, architects, institution employees etc). Many subjects were asked based upon internet research to find appropriate comparative partners. I scoured the internet search engine Google, looking for people who were key actors within the areas associated with the research I carried out. To be more specific, I looked at organisations in the UK and Norway that offered similar services to Norway's Enova. Although an exact comparison with Enova was not found, BREEAM was mostly comparative as it advises businesses on sustainability and is directly involved in the progression of knowledge and policy. As a result of this search, I also found Sustain Wales, who I contacted in the hope of seeing how they viewed usage. I also wanted to speak to an expert outside of an institutional background, and successfully found that my first choice, Adrian Leaman was happy to agree to participate. More than 40 respondents were contacted, with an expectedly low response rate. As a result, all successful respondents (5 in all) were selected for interview.

I contacted the institution interviewees at Sustain Wales and BREEAM directly through the main email address on their websites, then discussed with the contact from that email address as to who would be the most appropriate member of staff to be interviewed. In both cases, the company directors were considered the most appropriate. David Fitzpatrick became my interview for Sustain Wales, and Martin Townsend was my interviewee for BREEAM.

The intricacies of who made a suitable interview subject were also discussed with Morten Hatling. This was mainly done as he had the appropriate advisory expertise, and had pre-existing contacts that would be willing to participate in this study. This was reflected in some highly relevant interview participants. Thomas Berker from Zero Emission Buildings (ZEB) and Enova came out of these discussions. Thomas Berker was contacted directly for participation by Morten Hatling, without a mediating body. In the case of Enova, the information officer was contacted, who then made a decision on which of their staff were best suited for interview. Helle Grønli the head of Unit Buildings and Heating, and Christian Hemmingsen the head of Marketing for the Unit for Non-Residential Buildings were decided upon through their enquiries.

3.3 Interviewees

Whilst profiles of the companies will feature in a later chapter, here I will briefly outline profiles of the interviewees. I am approaching the participants as experts in their fields, and in their profiles I will endeavour to note why they warrant recognition as experts.

David Fitzpatrick (DF) – Sustain Wales

Interviewed 26/03/14

Fitzpatrick has been the Chief executive of Sustain Wales since 2012 and has been running charitable organisations for 26 years. Throughout this period his interests have remained in the area of sustainable development, including government panels and work with the United Nations ("David Fitzpatrick, Chief Executive," 2014). He also has competencies in building design, and was formerly the head of the Royal Institute of Chartered Surveyors (Interview with DF 26.03.14).

Martin Townsend (MT) – BREEAM

Interviewed 27/03/14

Townsend is the Director of Sustainability at BREEAM, and has been in this role since 2008. His career has been mostly focused on environmental issues, and he has worked previously for the Environment Agency ("Martin Townsend," 2014). He has also been involved in projects to develop an international framework for a sustainable built environment, and pioneered the 'BREEAM In-Use' scheme to improve the environmental status of buildings in their operational phase ("Martin Townsend - Director," 2014).

Thomas Berker (TB) – The Centre for Zero Emission Buildings (ZEB)

Interviewed 02/04/14

Berker is an Professor at NTNU at the Department for Interdisciplinary Studies, with a focus on technology and its implementation in everyday use. He has significant competencies with regards to the sustainable built environment as he is also a scientist for the Research Centre for Zero Emission Buildings (ZEB) , with a focus that includes and operation of buildings ("Thomas Berker, Professor," 2014). He is currently working on the MINDER project that is

dealing directly with how buildings are used in their operational phase, and the buildings' interface with its occupants (Interview with TB 02.04.14).

Helle Grønli (HG) – Enova

Interviewed 23/04/14

Helle Grønli is the head of Unit Buildings and Heating at Enova, and has worked in the energy business since 2005. Her current role is to promote and devise energy efficiency schemes for the building industry along with renewable heating. Her team are also responsible for the follow up and promotion of the buildings that have adopted these initiatives. She has also previously been a visiting researcher at the Lawrence Berkley research laboratory in California, and a research scientist at SINTEF ("Helle Hertwich Grønli," 2014).

Christian Hemmingsen (CH) – Enova

Interviewed 23/04/14

Hemmingsen is the head of Marketing for the Unit for Non-Residential Buildings at Enova, and has held this position since January 2013. He was formally a lecturer at NTNU and was trained originally as an architect. He takes a particular interest in sustainability concerning building lifecycles, new construction and building refits ("Christian R. Hemmingsen," 2014).

Adrian Leaman (AL)

Interviewed 07/04/14

Leaman has been the managing director of Building Use Studies since 1987 and specialises in office buildings' occupant feedback. He pioneered work on building productivity and building studies in the 1990s, and in 1995 wrote, along with Bill Bordass, one of the most widely cited papers on the topic 'Productivity in Buildings: The Killer Variables'. He is the secretary of the Usable Buildings Trust that focuses not just on building productivity, but sustainability as well ("Adrian Leaman: A Short CV," 2011). He made clear in the interview that he was representing himself for the purpose of this thesis as an expert witness, and not Building Use Studies.

3.4 Ethics

As with any interview-based study, ethical considerations are of paramount importance. I have reflected my ethical contract with the interviewee in my interview guide in the appendices, however I will also summarise it here for completeness. Firstly I have informed interviewees about the nature of the interview and the way in which I intend to include it as a part of a Master thesis. This has given them an opportunity to accept or decline participation in the thesis as a form of informed consent. I have asked all interviewees if they are willing to have the interviews audio recorded. I also asked interviewees to state their name, position and organisation for the recording; however, they are also at liberty to refuse this. After the interview was concluded, I informed them that they would receive a copy of the typed interview transcript (in the case of permitted audio recordings) or notes once they are typed up. All interview audio recordings were destroyed straight after transcription. I also offered to send them copies of the parts of my work that include their interview material, which gave them the opportunity to make changes or withdraw. I also stated that they can pull out their involvement at any time, up until the date of the thesis submission (May 12th 2014).

3.5 Expectations

At the time of writing (prior to initial data collection) it is my expectation that there will be interesting differences in how each institution treats the issue of usage, which will reflect their mandate. I expect there to also be a difference in to what level each of these actors will be dealing with the issue, with possibly a more significant emphasis on usage coming from state actors as they have less of a business driven mandate.

In terms of common challenges, I expect many challenges to be similar across all of the institutions. Solutions and perspectives I expect will vary. I imagine that more research lead organisations such as ZEB will favour more practical solutions, whilst the likes of BREEAM may feel that policy and cultural observation will be the key to resolving these challenges

3.6 Limitations

As with any study, there will be unavoidable limitations. Firstly, the issue of time. This is a one-semester thesis, and the short time frame will be reflected in the work. Whilst this will in no way have an effect on quality, it will none the less have a bearing on the amount of interviews that are feasible to complete. This has also affected my choice of interview

subjects, as time has prevented me from making extensive travel plans to carry out more interviews.

Another limitation of note is that of little pre-existing research. Without a more direct literature grounding I am writing based upon the outcome of data collection and my existing knowledge, and not following on so much from the previous work of other scientists or scholars. Whilst this in my judgement has made my thesis much more interesting to write, I also cannot deny that I am taking a substantial risk in tackling this topic in the way I intend to approach it.

3.7 Theoretical and Empirical Blurring

The data from the interviews will reflect real world examples that may not sufficiently follow the lines the theory I have been looking into, which may in itself a limitation. It is also the case that many of the discussions may reflect theoretical concepts that move away entirely from environmental literature. This I will resolve by applying theory where possible, but addressing the lack of compatibility in a real world context. This type of reflection will also strengthen the further research validity for this topic, and may result in a finding that necessitates further theoretical work to be done.

Some of the interview subjects may also demonstrate a similar theoretical apparatus in their own thoughts as I have mentioned in the theoretical chapter of this thesis. I will need to be aware of this when assessing the findings, so that these concepts from both myself and the interview subject can linked to the empirical findings.

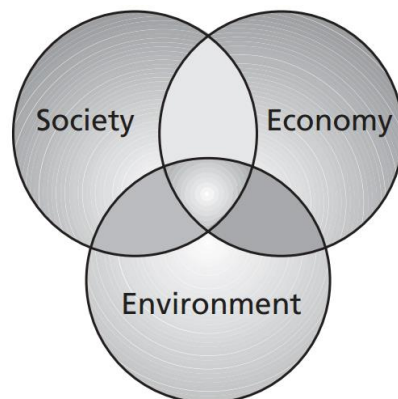
4 Sustainability: The Definition Issue

4.1 A definition for reference

In the chapter covering sustainable usage challenges, I will cover the problems of a definition in the wider context, not just simply with the word ‘sustainability’. In this section I am going to look at how I approach the term ‘sustainability’ in my own usage, and it will be looked at from the perspective of the actors who I have spoken to at interview.

Sustainability is a multifaceted term than cannot, in my mind, be summed up entirely as referring to our use of environmental resources. I will be viewing sustainability from the perspective of ‘environmental’, ‘societal’ and ‘economic’ sustainability. Whilst my own discussions may not implicitly mention these terms, I will endeavour to make their referral context relevant to the reader through usage.

It is this interconnection that leaves scope to consider all of these aspects, especially as usage can potentially cover all of these areas. This approach was also covered by the United Nations General Assembly in 2005, and will provide the definitions which will guide my discussions on sustainability (Nations, 2005). The relationship between these three different forms of sustainability was illustrated in a diagram by Molly Scott Cato in her book ‘Green Economics’ (2009):



(Scott Cato, 2009, p.37)

This triple circle approach has been adopted by many organisations and is commonly referred to as the ‘triple bottom line’.

I have also chosen this type of definition, as it is a guiding business model for companies looking for a more sustainable outlook, and who are defining success not just by pure monetary gain. The implementation of this term was addressed by Charles Holliday, Stephan Schmidheiny, and Philip Watts (2002) who stated that:

“Movement toward corporate concern for the "triple bottom line"—financial, social, and environmental performance—requires radical change throughout the corporation. It is not "either/or." The new paradigm is "and also." A sustainable business excels on the traditional scorecard of return on financial assets and shareholder and customer value creation. It also embraces community and stakeholder success. It holds its natural and cultural environments to be as precious as its technological portfolio and its employees' skills”.

(Charles Holliday, Stephan Schmidheiny, and Philip Watts 2002 cited in "Understanding Sustainability and the Triple Bottom Line," 2014)

Whilst the triple bottom line can feel like it refers to the business world as much as to the context of environmental sustainability, in my judgement it offers a way of better understanding how businesses and stakeholders understand the significance of sustainability in their own office buildings.

4.2 Sustainability Definition and Actors

The issue of definition is a difficult one when it comes to interviews, and I have allowed each actor to interpret sustainability in their own way. When asking each actor, without exception they referred to the Brundtland (1987) definition of sustainable development mentioned in the opening of this thesis, or a minor variation on this definition. I will repeat Brundtland’s definition here, for completeness:

“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland, 1987, p.15)

I chose however to stray from this in my own definition, as each actor went further into other areas of sustainability outside of the Brundtland (1987) definition.

For BREEAM and Enova, the economic arguments were very powerful in understanding sustainability, especially with regards to the cost of energy use and the investment prospects of green building infrastructure. Thomas Berker and Sustain Wales however focused a lot more on the raw environmental impact and how emissions affected the environmental credentials of a building. All of the interviewees however focus on different elements of the triple bottom line, and the differences in emphasis will be reflected in the discussion.

It is for this reason that I will approach this definition issue using the ‘triple bottom line’, as it covers the variety and abstractions that underline the complexity of the sustainability issue in the context of usage. It is difficult to address sustainable development as per the Brundtland (1987) definition without stepping into the territories of the social, environmental and economic impacts of sustainability. This is why in my judgement, the ‘triple bottom line’ and the Brundtland (1987) definition cannot be considered separate when looking at the issues that will be addressed in this thesis.

5 Actors and Sustainability

The core of this topic deals with how usage is treated in the context of sustainability, and I will look at how these actors address this directly in their own institutions. As well as stating each actor's role and considerations in a narrative form, I will also attempt to reflect how each actor's institution approaches this topic and the responsibilities they feel it entails.

5.1 Contextualising Actors

Whilst all of the actors interviewed have competencies with green issues and sustainability, they can not necessarily be compared as equals as institutions. An understanding of their differences provide context not just to their considerations of sustainable use, but also how they approach the topic as a whole.

Enova and ZEB are both state financed and associated organisations. This is likely to give them an outlook where stakeholder considerations could overtake the business cases for the initiatives they promote, and the research that they do. This could have a profound effect on how they approach these issues, compared to other interviewees. Berker however was keen to stress that despite their funding, ZEB operate wholly independently (Interview with TB 02.04.14). Sustain Wales may also feature in this category to some extent. It is Welsh Assembly Government funded, but wholly independent. My expectations are however that their action will reflect more those of a government body, than a business driven institution.

BREEAM is a wholly private organisation, and is a business driven environmental institution that regulates within the industry itself. As the organisation's overarching mandates is driven by businesses, my expectations will be that its responses will reflect more the economic elements associated with the 'triple bottom line'. I also expect it to focus on monetary costs to a more significant level than the state associated actors, who I anticipate will focus more extensively on the greater environmental impact.

In all of these cases, the reader needs to be aware of how these contexts have an effect on the answers given, something I intend to reflect on at the end of this chapter.

5.2 The Centre for Zero Emissions Buildings (ZEB)

Firstly, I will look at the ZEB based in Trondheim Norway. Established in 2011, the organisation represents 200,000 employees focused around its market chain players. ZEB is a joint venture between the Norwegian University of Technology and Science (NTNU) and SINTEF. I spoke to Professor Thomas Berker, a researcher at the centre, about how they treat usage. Berker is in a unique position where he represents ZEB, NTNU and the projects paid for with grant money from the Research Council of Norway (RCN). As a result, many of his responsibilities overlap. Berker explained why this is the case by stating “*the RCN wants to cluster research. It is clear that if I am working on a work package for ZEB, as a project manager, then there will be connections anyway. This is because there are not that many people in Norway who can do this kind of research. We are reusing the same people*” (Interview with TB 02.04.14). The comparatively small amount of social science research into usage and sustainability means that Berker’s crossover experience provides for a valuable insight into this topic.

Berker was keen to discuss the MINDER (2014) project previously mentioned in the literature review, as this is an attempt at a very practical solution to make advances in the study of sustainability and usage. MINDER (2014) has many methodologies associated with it, with the guiding ethos of trying to achieve the likes of sustainability through good design and good use of technology (Interview with TB 02.04.14). The primary goal of MINDER (2014) is to reduce the reliability gap between non-residential buildings, with an emphasis on good design (Berker et al., 2014, p.1). Soft landings is one of the aspects that deals more specifically with that of usage. The soft landings idea means that buildings are less likely to be used as ‘guinea pigs’ for design ideas, which can be reflected in how the building is used (Berker et al., 2014, p.4). In this scheme, the design team will stay on at the building for a time, even beyond the three year Default Liability Period. This allows occupants to interact with elements of the design team (Berker et al., 2014, p.4). The design and operational phase of the building become intertwined (Berker et al., 2014, p.1) and give users a more substantial role in participating in the process and design briefings (Berker et al., 2014, p.5). Giving occupants the opportunity to give feedback to designers does not just give them opportunity to make buildings operate better, but can also give occupants are greater understanding of the building’s function, and thus how they interact with it. It is also worth mentioning Energy Performance Contracting (EPC) from the literature review (Berker et al., 2014, p.4), which

Berker claims will offer a similar approach to soft landings but with service driven energy efficiency schemes and systems.

The MINDER (2014) approach to usage is innovative, but could be criticised on the grounds that the systems have to work well to be effective. Leaman and Bordass (1999) covered this point in their article ‘Killer Variables’. Buildings can have low performance if they have poor building management (Leaman & Bordass, 1999, p.11), something that much of the MINDER (2014) projects success relies on. Adrian Leaman agreed to speak to me as a part of this thesis, and when I approached the current situation of building management with him, his opinion was clear. He said “*Bill (Bordass) and I wrote that article (Killer Variables) 20 years ago. It has become a bit of a classic, and translated into something like 12 languages. But it is still as relevant today. Everyone has been talking about it, but nobody has done anything to solve any of these problems. Nothing what so ever*” (Interview with AL 07.04.14). It would take a building with a good quality and well-resourced facilities management to work effectively in improving the situation with regards to usage and sustainability in office buildings.

5.3 BREEAM

BREEAM is an international organisation that has developed an assessment system for grading the sustainability of buildings in the form of a balanced scorecard. They take a wide range of environmental and sustainability factors that look at everything from building construction materials to emissions output. They have been doing this since 1990 and have helped to develop benchmarks for 250,000 BREEAM assessed buildings (BREEAM, 2014c). Whilst BREEAM has its genesis as a British organisation, it has expanded its operations to other countries, one of which being Norway (BREEAM, 2014c). BREEAM operate under a license scheme called BRE Global, where they find local partners called ‘National Scheme Operators’ (NSO) to help them to adopt BREEAM assessment standards (BREEAM, 2014b). In the case of Norway, the local NSO is the Norwegian Green Building Council (BREEAM, 2014b). Bream operates and shares a core technical standard for its schemes, with appropriate adjustments for individual countries regulatory frameworks and needs (Interview with MT 27.03.14).

With regards to specific work on usage and sustainability, BREEAM has a section of the organisation dedicated specifically to dealing with this and associated issues called 'BREEAM In-Use'. This section of the organisation also has a BRE Global strand to its structure, but does not yet have any certified assets in Norway (BREEAM, 2014a). BREEAM In-Use uses a user-friendly methodology to establish a building's optimal performance. They create benchmarks to establish optimal environmental performance for a building, optimise sustainable management practices and attempt to reduce the operational costs of running a building asset. I spoke to the Director of BREEAM, Martin Townsend to ask him about how the organisation is approaching usage and sustainability. He said that although the likes of construction materials are crucial to the sustainability credentials of a given building, looking at its performance at the operational stage is crucial to its long term sustainable viability (Interview with MT 27.03.14). Its refurbishment cycle is also essential, as sustainability can be improved by implementing performance improvements based on data collected through the foundation itself. Directed towards their 'In-Use' criteria, they view a building as being made from three component parts:

1. The fabric of the building. The decisions made in its construction, and how it was constructed.
2. What is 'poured' into the building in terms of the likes of heating, lighting, and how this is used.
3. The building's management. How it is managed, how its employees are educated to use the building better and using the best procurement process to employ the most sustainable products and services that are possible.

Through these components, analysis can be done to work out if the building is performing to the level it should be. Townsend went on to state that in many cases, by looking at these three components, simple modifications to building usage can result in substantial improvements in building performance (Interview with MT 27.03.14). BREEAM In-Use also take into account the kinds of decision making that managers and business owners have to consider when looking at how to use their already sustainably constructed buildings, better. By using lifecycles to capture best practise, business owners can better establish how to save money by employing BREEAM assessment methods. Townsend offered the example of lighting. If a building uses a BREEAM assessment method, they can see if their lighting system is market leading and effectively uses energy. If this is not the case, then a business case can be formed

to improve the lighting of the building in a way that could result in a return on this investment through a decrease in energy use. A similar strategy is used when deciding on the likes of building refurbishment plans (Interview with MT 27.03.14).

I was also keen to discuss how BREEAM focused its work on usage with its international partners. Like other areas of its work, they have a standard but partially adaptable framework which they export. He noted the challenges that this causes, as usage requirements differ depending on the country. He noted that in Norway, the climate is so cold at times that getting the indoor requirement right is vitally important. In Spain, climate and cultural practises mean that there is much greater emphasis on outdoor spaces between buildings (Interview with MT 27.03.14). I will be discussing this issue later, but this raises the inherent problems in developing a common currency and international standards on sustainable building usage.

In terms of BREEAMs contribution to the usage issue, their role is more advisory as opposed to related to the provision of services. Their assessment tools may provide suggestions for technological improvements and associated developments, but BREEAM do not develop the technology themselves. In my interview, Townsend was clear to state that BREEAM is very much in the realm of being a research based charity (Interview with MT 27.03.14), but this is research that focuses more on advisory roles and best practise, as opposed to technological development. Based upon my research and interview, BREEAM clearly are making considerations on the link between usage and sustainability, and are employing strategies to better utilise building management, technology and operating mechanics to their optimum.

The BREEAM approach however, is not without criticism. Berker offered some of the more substantial criticisms about this type of balance score card approach to sustainable design and usage. He said that some people do not find this scheme 'holistic enough' and risk some poor results in the end. He explained what he meant by this saying that under the BREEAM system, you can make up for a poor score in one area, by making up for it in another. This, he said, has been criticised by those who feel that everything should be ecological, and not just have token sustainable elements of building design (Interview with TB 02.04.14).

David Fitzpatrick of Sustain Wales also had his own concerns with regards to BREEAM, as he felt that although a building can have a high rating, it can get a relatively low score during

the in-use phase, and wasn't seeing the intended return as a result. He also had a much more favourable opinion of the Passive House idea as opposed to a BREEAM type balance scorecard system, feeling that Passive House was more ecological overall (Interview with DF 26.03.14).

5.4 Enova

Enova formed in 2001 and is an organisation that is dedicated to improving the access of environmentally friendly energy sources, and encouraging better energy consumption. It is wholly owned by the Norwegian Ministry for Petroleum and Energy (Enova, 2013a). Enova are based in Trondheim and have around 60 employees. The organisation is funded through the Norwegian energy fund, and "*wants to become the driving force in the comprehensive work to create an energy efficient and renewable Norway*" (Enova, 2013a). In the context of this thesis, Enova provide investment support to commercial organisations to help them improve their energy efficiency. They also have an extensive follow-up program with customers who receive their support, to ensure that investment support is used correctly, and that their systems are as sustainable as they aim for them to be (Interview with CH & HG 23.04.14).

When I asked them to reflect on how they deal with usage and sustainability, Hemmingsen and Grønli cited the example of Trondheim's Sparebanken headquarters, a project that they funded with 2 million Norwegian kroner (Interview with CH & HG 23.04.14). This project was run as a 'Passive House' style project, where insulation and energy efficiency systems are used to ensure that the building requires little or no heating or cooling (Enova, 2013b). They claimed that with systems like this, the importance of usage could be diminished when reflecting environmental usage on energy output, and that 20-25 percent of new office buildings in Norway are now adopting this model (Interview with CH & HG 23.04.14). They also say that their investment support may indirectly positively impact a building's usage, as the investment can result in a greater integration of technology within a building and reduce its energy use during the operational phase.

I moved on to asking if Enova deals more directly with usage in buildings, and they claimed that this type of issue was "*not in our mandate*" (Interview with CH & HG 23.04.14). In their eyes, the job of Enova is to provide practical investment support to organisations and

companies who want to “*make the sustainable choice*”, but they leave many of the practicalities of how a building is used, to the customers themselves. In their investment support program, the monitoring of results focuses more on the energy performance of a building, and less so on how space is used and how technologies are used in relation to the operational phase of a building (Interview with CH & HG 23.04.14). Although it is a business driven initiative, both Hemmingsen and Grønli were supportive of the BREEAM ‘In-Use’ scheme, and felt that this served many of the functions of making a building accountable for considering how it uses its building sustainably (Interview with CH & HG 23.04.14).

Despite Enova feeling that their financing and consultancy schemes did not and were not intending to focus on sustainable usage, other aspects of the organisation do potentially address this more comprehensively. Enova provides investment support to innovative research projects that have real world operational applications. The technology must have specific innovation goals in mind, and must be driven to reduce and have a more efficient use of energy (Enova, 2014). Hemmingsen noted that through the innovative arm of their organisation, they support development and innovation of technological systems that could have an impact on usage, especially in terms of automation (Interview with CH & HG 23.04.14). It is through this strand of Enova that they feel that they can best address sustainable building usage, although they are not directly promoting this as a part of their overall research mandate (Interview with CH & HG 23.04.14).

Enova offer a different take on how they address energy and usage. Whilst they acknowledge its importance as an issue, the Enova structure both in terms of investment and research, does not account for usage as a grander motivating theme in its own right. There is however something to be said for it being indirectly addressed. The use of the buildings and its spaces will have an effect on its sustainability in relations to mandatory contracted energy consumption figures that Enova customers are meant to achieve. That being said, they do not take the BREEAM In-Use approach of directly impacting the usage and control of spaces. This places the issue of sustainability very much in the realms of surface discussions in the case of Enova, as opposed to being endemic in its sustainability strategies.

5.5 Sustain Wales

Sustain Wales is a group established as a sustainability network allowing people and organisations to learn from each other about environmental and sustainability issues. As an organisation they promote sustainable development and “*act as a forum within Wales for the development, canvassing, exchange and dissemination of views, information and policies on sustainable development*” (Wales, 2013). I spoke with the project director David Fitzpatrick about how Sustain Wales approaches usage and sustainability. When I asked him if his organisation was looking into the issue his response was “*yes and no*”. To elaborate further he mentioned that this is as much down to the mandate of Sustain Wales, as opposed to any active avoidance or lack of importance surrounding the issue. He described Sustain Wales role as being that of a ‘catalyst’ for the issue, and keeping ‘up to date’ with what was going on with these issues (Interview with DF 26.03.14). He did believe, however, that this was an effective way of dealing with this issue and keeping it in the minds of builders and designers. By keeping up to date on issues surrounding good and bad practise, they ensure that their partners such as Construction Excellence Wales make people of aware of how these issues should be handled (Interview with DF 26.03.14). As opposed to the organisations mentioned previously, Sustain Wales is an organisation that appears to not be dealing with usage and sustainability as an issue in its own right. This is attributed mainly to Sustain Wales’ role as a ‘catalyst’ organisation, as opposed to research and benchmarking institutions such as BREEAM. Despite this, the point of good practise is an important one. BREEAM is an organisation that itself is trying to promote sustainability, in part through good practise methods (BREEAM, 2014c), and Sustain Wales appears to acknowledge this also. Even if they are not directly a usage focused institution, keeping knowledge moving on best practise is in itself a useful exercise that actors can exploit.

Despite Sustain Wales not acting directly on usage, Fitzpatrick clearly thinks this is important. When I addressed main research question with him, he said it was “*absolutely critical*” (Interview with DF 26.03.14) and was keen to explore this avenue much more if circumstances allowed.

5.6 Summarising Actors and Sustainable Usage

Out of the four core institutional actors that participated in my discussions, there was an equal split on the question of direct discussions concerning use. BREEAM and ZEB were directly considering this as an idea, with BREEAM even having an entire arm of its organisation

dealing with sustainable use. BREEAM appeared to have a more life cycle based approach to its sustainable use strategy, whilst ZEB and its MINDER project (which are both funded by the NRC) were placing considerations more around progressive research in the period after construction with an aim of improving the new building directly, or advancing research for future construction. There less of an emphasis on retrofits, although Berker believes that maintaining existing buildings is the ideal solution over large new builds or refurbishment projects (Interview with TB 02.04.14).

There is also a divide between the actors that reflects their mandate, as per my expectations in the introduction of this chapter. BREEAM very much focuses on practical business applications for their clients and customers, which had an effect on the bottom line in terms of costs. Whilst saving costs is a core part of BREEAMs work, this is implemented in a way that improves the sustainability of the buildings that they work with. This is an organisation driven by businesses, with a closer focus than the other actors on the environmental impact.

The state associated actors took a perspective more based on real energy use, although cost was still a factor. Enova had a greater cost element to its work than ZEB, due to their more specific energy based mandate that focused on reducing energy consumption (thus costs) for businesses. Whilst ZEB had a similar motivating factor at its heart, it focused on more overall infrastructure and maintenance based operations that reduce emissions as well as energy impact. The difference between these two state actors is a reflection of their individual mandates, as opposed to varying focus. It is however without dispute that ZEB deals directly with sustainable use, whilst Enova deals with it less directly. Sustain Wales offered a different position, as the comments on usage reflected more the thoughts of the interviewee and less those of the organisation. Sustain Wales does not deal with the issue directly and presently has no strategies it is exploring to deal with it beyond best practise. That said, the issue seems to be very much at the front of the mind of Fitzpatrick, who has opinions on how to look at this problem.

6 How Does the Issue of Usage Affect an Office Buildings Sustainability and Environmental Footprint?

As a part of the data gathering process for this thesis through interviews, I posed the main research above question directly to the interviewees and asked them how they regard this topic themselves. I also asked how they regarded the opposite, and if they felt that the sustainability of a building had an impact on the building's usage. All of the actors I have spoken to have felt that this is an issue of importance, regardless of how their respective organisations deal with the issue.

6.1 Sustain Wales

David Fitzpatrick, as mentioned in the previous chapter, felt that this topic was “*absolutely critical*” (Interview with DF 26.03.14) and was keen to cite a very specific example of what he meant by this. He discussed the BedZed project in London. BedZed was a sustainable housing development near London completed in 2002. They were built with recycled or reclaimed materials where possible, and built with ‘thermally massive’ materials that retained heat during periods of cold weather, and released it during warmer periods. They also tried to incorporate some innovative sustainability energy conservation initiatives (“BedZed,” 2014). According to Fitzpatrick, they also had the highest BREEAM rating at the time (Interview with DF 26.03.14). With regards to the project, he said that some of the tenants, especially the second set of tenants, were overwhelmed by the lower cost of energy the building provided. Due to the low energy costs, they kept their old habits and did things like keep windows open with the heating on. This, he felt was a very visible example of the issue of usage (Interview with DF 26.03.14).

When asking him to reflect on sustainability's impact on usage, he placed particular emphasis on retrofit buildings. This leads to some extent into some of the challenges of the sustainability debate, and mainly issues surrounding technology. He discussed how in these types of circumstances, there can be a ‘problematic’ way in which technology is installed in retrofit projects (Interview with DF 26.03.14). The example he gave was ‘smart metres’ installed by the South Wales Electricity Company (SWALEC). Smart metres are the next generation of electricity metres that do not require metre readings. They evaluate electricity usage up to every 30 minutes and communicate directly with the power company. They also

have interface for customers to use to show them how their electricity was being used and in many cases, what type of appliances are using the most energy. This can give owners of these metres the opportunity to evaluate where they are using the largest amount of energy, and adjust their usage accordingly. SWALEC has plans for every home in the UK to have smart gas and electricity metres by 2020 (SWALEC, 2013) . Despite its intentions, these kind of retro fit technologies intended to improve sustainable usage, can be problematic. According to Fitzpatrick, people are offered these kinds of technologies, taught how to use them and then left with them to use. They can go on to ignore the technology, as they do not carry forward in their own lives the sustainability ethos intended by the service provider (Interview with DF 26.03.14). Whilst Fitzpatrick did discuss office buildings when discussing the challenges associated with sustainability and usage, he was less specific on this when discussing the main essay question. Despite this, the point with regards to the disjuncture between sustainable buildings and their often not so sustainable users is a theme in keeping with other actors' views more specifically associated with offices.

6.2 BREEAM

As with David Fitzpatrick, Martin Townsend from BREEAM was equally as blunt in his view on how usage affects sustainability. Townsend took a slightly different approach to Fitzpatrick, in saying that it is vital to take into account how usage can affect sustainability over time, as a key issue surrounds change of use over design intention. He was also keen to stress that designers need to be keenly aware of how different offices are, compared to other kinds of commercial spaces (Interview with MT 27.03.14). He suggested that the key issue is the malleable usage problem, and that designers do not take future use into account often enough at design stage. To quote him directly, *“it is very easy to build a sustainable building, but when we start to look at how it’s used and how it changes over time, it has a massive impact on the parameters of sustainability”* (Interview with MT 27.03.14). To take the point further, he notes along with the other actors, that a building cannot just be sustainable from the perspective of its materials or energy, but must also be good from the perspective of being good for its users (Interview with MT 27.03.14). Townsend also shared the opinion of Fitzpatrick, that there is usage deficit between the user and the technology (Interview with MT 27.03.14). In terms of future use being neglected as a consideration, this was directly referenced by Akrich (1995), who claimed that technology all too often is at risk of constraining users, and are very bad at allowing themselves to be reshaped by users, and

therefore *“technical objects thus not only ‘define’ actors and the relationships between them, but to continue functioning must stabilise and channel these”*(Akrich 1995 cited in Rohracher, 2001, p.147).

With regards to reversing the topic and seeing how sustainability can affect usage, Townsend cited a very interesting example of the new Cooperative Group UK headquarters in Manchester where a green structural initiative had an effect on how the building was used in its operational phase. When they designed this building, they went to extraordinary lengths to make it sustainable and *“got down to massive level of detail”* as far as the technology was concerned. In a more specific example with the property, amongst other technologies it had installed combined heat and power plant (CHP) (Interview with MT 27.03.14). CHP is a combined heat and power generation system that is often referred to as ‘cogeneration’. It often runs off renewable energy sources and even captures the heat used in the generation process to heat the building it operates in (“What is CHP?,” 2014). In the case of the Cooperative Group, they went as far as to consider buying a farm to produce the oil needed to run the CHP plant. They later realised that instead they would use the left over cooking oil from their food production processes in their supermarkets as fuel, as first generation crops themselves would be less sustainable as a CHP fuel source (Interview with MT 27.03.14). This is also an example how sustainability can be transferred to other fields of activity within buildings. In terms of this building’s sustainability’s larger impact on usage, he noted that the Cooperative Group went to great lengths to educate their staff on the sustainability of their new building. When their staff were moved from their existing building to the new one, they kept them fully informed of the philosophy behind all of the decisions they had made. They also had fewer printers in the building, better facilities, and even some involvement in employees travel plans to and from work.

The Cooperative Group placed sustainability at the heart of their credibility and their business philosophy, and brought this process through from their management, to their most junior member of staff (Interview with MT 27.03.14). Townsend summed this example up by saying *“they want to lead by example and now as a consequence when you talk to the staff and the people who have been to the building, it is inspiring, because they truly understand that sustainability isn’t just a ‘nice thing’, it’s not just about being green, it is about a business philosophy. This basically echoes through all of the staff and all of the people who now visit*

that headquarters” (Interview with MT 27.03.14). To Townsend, sustainability can affect usage positively if there is a ‘side-loaded’ attitude by employees that suits the building’s sustainability initiatives. In Fitzpatrick’s example of a new build (in this case the ‘BedZed’ project) the extent by which these sustainability initiatives and technologies can fall short can be considerable if not placed in understanding or cooperative user hands (Interview with DF 26.03.14). This seems to demonstrate the relatively small room for error that exists when it comes to occupancy philosophy and user building compatibility, something considerably different than traditionally emphasised design challenges.

6.3 Enova

To Enova, usage was something that they viewed very much in the context of their mandate as an organisation. Grønli felt that without a consideration for usage, it is much more difficult for their customers to meet some of the emissions demands required of them as a part of their investment agreements (Interview with CH & HG 23.04.14). For Enova, the difficulties surrounding this topic very much focused on how human nature works alongside a building’s green infrastructure. According to Hemmingsen *“there is a big problem here. If we have really good air conditioning in a building that is really low energy, it if is used badly it is all to waste. In Enova all of our staff have low energy computers, but what good is that if I leave it on all weekend? The impact on energy consumption here would be significant, all because I used my energy efficient device very badly”* (Interview with CH & HG 23.04.14). To them, it is an important responsibility on the part of the user to play their role in their own building.

For Enova, there was also a side issue about the responsibilities of employers. Grønli felt that there was a lack of understanding of this issue amongst building owners. They all want to reduce their energy costs, and many are making important steps investing in the technology and infrastructure to do this. However, they don’t always consider the huge impact that the user can have on the bigger picture. Grønli said that *“We have all been to buildings where they have light sensors to control the lighting, and excellent ventilation. Business owners are really proud of this. When you look again though, you see that so often all of the computer screens are turned on when desks are empty. Their energy consumption is much more than just their lighting”* (Interview with CH & HG 23.04.14).

Enova viewed this issue for the most part from the perspective of raw energy consumption, but none the less acknowledged that user behaviour and its technologies do impact on how usage can affect sustainability. When asking them the reverse of the topic, the answer was straight forward. They hoped that sustainability can affect usage, by encouraging people to think more about how they use their buildings. According to Hemmingsen *“If we are proud of our green buildings, maybe we will be better at using them sustainability. We need to believe it in though, and be better trained on how to be more sustainable users”* (Interview with CH & HG 23.04.14). They also agreed with the other interviewees, that change of use is also an important sustainable usage factor. Grønli noted that buildings have to be more easily adapted for future use, and this problem is having a considerable impact on how long builds last. This is a point in keeping with the views of Townsend, who said that viewing buildings in a lifecycle context is very important when addressing sustainable usage (Interview with MT 27.03.14). Hemmingsen stated in this regard that *“buildings built 30 years ago were designed to last 100 years, today it is nearer 40. We need to do something about that”* (Interview with CH & HG 23.04.14).

Hemmingsen also noted how architecture can be seen to have an impact on sustainable use. He was viewing this from the perspective of having been trained as an architect originally. He stated that at the moment there is not a culture in architecture to address this problem, meaning that they are not considering the impact this has on space and usage. He noted that many buildings try to be green, but their office layout does not reflect this. He does however see a change on the horizon and said that *“sustainability will change ‘fix’ architecture, instead of the other way around”* (Interview with CH & HG 23.04.14).

6.4 The Centre for Zero Emission Buildings (ZEB)

Thomas Berker’s approached the topic of usages impact on sustainability from a different perspective. Whilst he agreed with the other interviewees that this was an important issue, he said that approaching an understanding of the topic is extraordinarily difficult, given the substantial definition problem this issue entails. He said that the terms I used i.e. ‘sustainability’ and ‘environmental footprint’ are so varied in their usage, that they can in theory mean almost anything. Berker also stressed the importance of the dynamic relationship between a building and its users through technology, in keeping with Akrich (1995) views discussed earlier. He agreed with Townsend’s and Fitzpatrick’s views on the relationship, but

made a link between this and Bill Bordass' work on 'virtuous circles'. In virtuous circles, Bordass is referring to the feedback that can be generated from the user experience of a building. When looking at a building, but acting even on small amounts of feedback from users of the building, a vicious circle can turn into a virtuous one which will improve how the building functions and how it is used (Bordass, 2003, p.8). This is of course simplifying the solution, as the causality is not so straight forward, but represents the potential for form of potential incremental improvement. Berker looked at the other side of this idea, saying that people who are bored and dissatisfied with their buildings will often adjust their practises accordingly in a negative way for that building's sustainability.

How usage affects a building's sustainability and its associated approach is also dependant on if it is believed that users and occupants should play a role in its environmental outcome, according to Berker. You can, for example "*push the technology hard*" and minimise personal control to potentially ensure a more sustainable outcome. Or, you could provide a greater level of control which itself could result in an increased level of risk, but could be a considerable asset if users are informed, educated and cooperate with the environmental initiatives and technologies in place (Interview with TB 02.04.14). This is reminiscent of the two of the previous interviewees and the problems associated with Fitzpatrick and his BedZed example, and the award winning sustainable Cooperative Group building where users cooperated with its environmental infrastructure. Berker claimed that a building could function like a "*perfect machine*" where the user would have little control, and facilities management or a good janitor could better regulate aspects such as energy use. He notes however, that in this situation there is no real way of knowing how satisfied occupants would be within that office environment. He was however clear to state that he doesn't necessarily favour this solution over personal control (Interview with TB 02.04.14).

6.5 Reversing the Main Research Question

When approaching the reverse of topic and asking the interviewees felt that an office buildings sustainability impacted on usage, Berker made a similar point to Townsend and Enova on issues surrounding future use, although Townsend was referring to how usage can affect sustainability, and not the vice versa as is the case here. To Berker, a green building can only be as green as its design intentions, so its intentions on how it is to be used during its operational life are important to keep in mind when looking at this topic. Addressing this

topic he says creates a problem for scientists, as a sustainable building's impact on users is hard to quantify or study. It is easy to measure more tangible aspects of a sustainable space such as energy use (mainly as it is an output that costs money), but aspects such as employee satisfaction and productivity are hard to measure and quantify (Interview with TB 02.04.14). These two aspects have posed a problem for scientists studying offices for decades. Mawson (2002) made the point that a quantifiable productivity measure is the "holy grail" of productivity research (Mawson 2002 cited in Haynes, 2008, pp., p.39), instead scientists tend to use measures such as 'perceived productivity' which without a consistent measurement in its own right, causes its own extensive list of problems such as its poor association with actual productivity (Leaman & Bordass, 1999, p.7). Satisfaction is also often measured perceptively, although Leaman and Bordass (1999) chose to use this as a measure, despite the scientific difficulties that perceptive measures bring with them (Leaman & Bordass, 1999, p.7). Without a more scientific answer to these variables, according to Berker, sustainability's impact on usage can only be discussed as far as tangible variables such as energy consumption are concerned.

6.6 Commonalities

In all these topics, all of the interview participants have noted commonalities with both the issues of usage's effect on sustainability, and the effect of sustainability on usage. All of the participants have noted with significance how the users' interface with the building is of considerable significance to this debate. In the case of Berker, Enova and Townsend, this is also very much linked to users' use of technology within a building. These note an Akrich (1995) type of relationship with technology, noting that technological scripts must adapt to users' usage of them, if they are to not hinder the buildings' sustainability through their usage. Fitzpatrick however tended to edge towards a different perspective and focus on building energy as an important usage factor. To him it was the users' and occupants' energy consumption through usage that remains of paramount importance, however he linked many of these points to residential buildings. The point however, can be considered still relevant in the case of commercial properties such as offices, as suggested by Berker. One aspect that Fitzpatrick and Enova did share with other interviewees, however, was that a certain part of the usage and sustainability battle can only be done through education. All of the participants noted how the education of users must be compatible with the design philosophy of the building, although Berker suggested that this can be solved through good facilities

management and removing a degree of control from occupants, with uncertain effects however on employee satisfaction.

All of the interviewees also touched on the issue of ‘future proofing’ buildings, as usage changes over time. This they feared can create a problematic backwards linkage where a building’s usage changes to a different scope than that of the design intention, which itself would result in a potentially sustainability diminishing disjuncture. This was a point particularly emphasised by Berker. The participants are calling for buildings with more malleable properties, to help the structures themselves adapt to the increasingly changing actions of users. This was put quite simply by Hemmingsen who stated “*however we choose to view these issues, we must begin by looking at them in a ‘lifecycle’ type of way, because buildings are always changing*” (Interview with CH & HG 23.04.14).

7 Usage and Sustainability: Findings

In the course of the interview process numerous issues were illustrated by the interviewees that reflect both the existing discussions and ongoing challenges that usage faces in the context of sustainability in the office environment today. In the introduction to this thesis, I predicted that the larger issues and topics for discussion would themselves form organically as a part of the interview process. Whilst this caused an endemic issue in terms of planning, my original thoughts came to fruition and when comparing the interviews, as several common factors arose when looking at the data collected.

The usage and sustainability debate can also be considered hindered at times due to the challenges that are associated commonly with the topic. This was an opinion shared by all interview participants, regardless of the degree of attention and sufficient study that they felt usage and sustainability was presently being given. This section will be headlined according to the substantial topics covered by each interviewee, that being the issues of term definition, behaviour and scripts, technology, common currency and motivation. The heading will also be titled to guide the reader through the theory related concept of which they are associated. The purpose of this section of the thesis is to illuminate and ultimately consolidate these challenges that may offer a road map for their resolution. Some of the interviewees also offered their own thoughts on solutions to these challenges, either theoretical or with existing real world applications.

7.1 Defining the Term – The Practical Implications

All of the interview participants raised this as an issue that divides and slows the debate on many sustainability discussions, and not just those surrounding usage. Terms such as ‘sustainability’ and ‘zero emissions’ can be subject to numerous forms of interpretation that depend on numerous factors from legislation, institutional use or even simply that of opinion. The most commonly cited definition can be found in the Brundtland report which describes it as “*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*” (Brundtland, 1987, p.15), however a brief search on Google can provide a number of other vastly different definitions. To give an example, the website of the New South Wales government provides a definition that places less of an

emphasis on environmental resource use, and place a greater emphasis on a more equal distribution of these resources ("What is sustainability?," 2013).

This demonstrates a part of the difficulty that this issue of definition may cause those who wish to look at it further, although as the introduction to this thesis stated, usage is a much easier term to define despite occasional tangibility issues.

Terms like 'sustainability', 'green' and 'environmental footprint' are at risk of causing a significant stumbling block when looking at these issues in conjunction with a term like 'usage', which is must more easily defined. When approaching this topic with Adrian Leaman, he commented that "*I know exactly how to define the word 'lighting' to you, and I can give you a definition that you will understand, a builder will understand, or an academic in Japan will understand. It is an easy term to define. If you ask me to define a 'sustainable building', I can still give you a definition, but it will probably not be the same one that you will be given if you ask 20 more people the same thing*" (Interview with AL 07.04.14). This is a problem that all of the interviewees were keen to discuss to a greater or lesser degree.

Berker felt that the issue of definition has held back the development of not just a common currency for sustainable buildings in general, but also for usage. He referenced the difference between the term 'zero emissions' as it is used in both Norway and Denmark. He said that Norway has invested a substantial amount of money in zero emissions building research and construction (ZEB itself being an example of such investment), yet Denmark has often had lower emissions scores than Norway. This, according to Berker, is due to Danish zero emissions criteria not counting emissions from electronics such as laptops in their buildings. According to him, it is a lack of a universally accepted definition for this kind of term, that makes it more difficult to create a common currency for usage, as it does not have a compatible framework with a commonly accepted definition for sustainability terminology (Interview with TB 02.04.14). This causes scientists, social or otherwise, a considerable challenge in looking as sustainability and zero emissions. He said also, that if sustainability means CO2 emissions or energy use, then facilities managers have an important role to play (Interview with TB 02.04.14).

To Berker, there was also a concern that a top down and international focus may be causing problems in addressing the issue in the first place. If common ground on universal definitions

proves to be too a significant problem, then a less top down approach may be the only way forward. Less top down approaches can be equally as productive at helping us to better address concerns such sustainable usage. Berker stated how the examples of Enova an BREEAM demonstrate that sustainability as a broader issue can addressed from a less bottom down perspective, especially where international regulations have been less effective (Interview with TB 02.04.14).

Fitzpatrick also found definitions to be problematic, but looked at it much more from the perspective of the greater scope of the term, and what it may or may not encompass. To him, a lack of commonality in terms of a definition can result in the terms accounting for one aspect of a building, but completely ignore another. The example he cited, was one of the construction process (Interview with DF 26.03.14). A considerable amount of emissions are created during the construction process of a building. This is occasionally referred to as 'embodied carbon'. Although difficult to define, as per the subject of this section, Skanska defined embodied carbon as "*the total carbon emissions related to construction materials and construction activities*". Skanska also state that embodied carbon can make up around 20 percent of a building's environmental footprint (Skanska, 2010, p.1). In this regard, Fitzpatrick was concerned that in construction emissions figures, the definition did not always include aspects such as traffic to and from the construction site, or if this is even taken into account after the building is completed (Interview with DF 26.03.14). Whilst Berker was keen to cite the fluidness of the definition, Fitzpatrick appears to focus more on how many aspects of a building it could encompass. Berker also had something to add on this point. He said that people who commission or design buildings use this type of definition issue to create their own type of benchmark as to what the term means. He noted that one of his PHD students had followed the construction of a building in Norway that claimed to be sustainable. This particular building 'sold' itself as being sustainable, despite the fact that the most considerable aspect of its sustainable design was a seawater heat pump. As a result, the entire project was focused on getting this part of the design as good as possible. Whilst he believed that it was a good thing that they tried to get this right, it would also be difficult to truly class this as a sustainable building off the back of this one sustainable technology (Interview with TB 02.04.14).

Townsend held a view more in keeping with Fitzpatrick, in feeling that there is a concern over what people mean by aspects of a sustainability definition. He claimed that some confusion can arise by mentioning the word ‘sustainability’ and not be more specific about what aspect of this term they may be referring to. Townsend stated that *“we have to really unpick the word ‘sustainability’ as historically I think we have been mainly talking about environmental sustainability, carbon emissions or water consumption. When we talk about true sustainability we need to talk about the environmental issues, and the economic”* (Interview with MT 27.03.14). Whilst very much also within the realm of a definition issue, Townsend takes the perspective of actors using the term being less than specific in their usage of sustainable terminology.

Enova followed a line closer to that of Leaman, noting the futility at times of trying to find a commonly accepted definition of zero emissions and sustainability. Grønli claimed there was *“little point in trying to untangle”* these terms, as all countries approach a definition differently (Interview with CH & HG 23.04.14). Enova was not avoiding the issue however, as Grønli went on further to say that *“we tackle this in our own way, and base our work on tangible assets such as energy costs. If we can reduce energy consumption and improve energy efficiency in buildings, then I think that what we are doing will fit in with how most people will define a term like ‘sustainability’”* (Interview with CH & HG 23.04.14). Grønli however did not specify as to whether the ‘energy’ costs included construction materials. To Enova international regulations are the responsibility of BREEAM who are *“doing a very good job at looking at things outside Norway”*, with Enova looking at hitting energy and emissions targets from a purely Norwegian perspective (Interview with CH & HG 23.04.14). To Enova, result driven initiatives are of the top priority.

From how this is being approached, the issue of how to define the key terms around this theme will continue to cause a problem for addressing usage. The matter of Denmark’s emission criteria is an example of this, as it would have a considerable effect on how we even define usage and sustainability from a policy perspective. If electronics do not count in emissions criteria, then this will be wholly ignored by organisations that look at sustainable use. There is, however, the comment by Enova that needs to be considered. If initiatives are implemented concerning sustainable building usage that work with tangible assets such as energy consumption costs, then a definition can be considered less important. This could be due to resultant actions superseding some of the problems that could arise from conflicting

definition usage. If a building in Denmark focused on the costs of energy, its contributing usage factors may be the same as Norway or the UK, and the tangible assets of focus are then removed from the conflicting emissions definitions.

7.2 Education and Control – Actants at work

A topic in my discussion with the interviewees that was raised was that of the difficulties surrounding behaviour and educating office occupants, and how that can fit in with personal control and facilities management issues. Whilst this did to some extent represent a challenge for usage and sustainability, it also represented a difference of opinion on how to best approach this issue, something that will be looked at with more depth in the next chapter. This spread of different approaches on a similar topic has the feeling of a Lundvall (1992) innovation system where relationships can stimulate the diffusion of innovative technologies and systems (Lundvall 1992 cited in OECD, 1997, p.10), although these differences supersede some of the nation state inclusive ideas Lundvall (1992) had in mind.

All of the interviewees acknowledged that users have a very substantial impact when it comes to looking at how a building is used in the operational stage of a building, and that there is an impact that needs attention in relation to the technologies in the buildings and how they are utilised by occupants. Their differing stances on this are a key point of discussion in the next chapter on findings analysis. There was a debate raised on what level users should be provided more control over their environment (which is risky for sustainability) or if facilities managers are better suited to this task (potentially risking employee satisfaction).

Attitudes and Education

To the interview subjects, the issues of behaviour, control and facilities management were to be considered to have an influence on building occupant usage behaviour and how they interact with their buildings. For example, the Cooperative Group headquarters in Manchester had a very high level of employee environmental education (Interview with MT 27.03.14), so approached the issue of usage very differently from the example of Berker and his concept of an office where the facilities management team adopted the sustainable usage control responsibility over that of occupant education (Interview with TB 02.04.14).

Rohracher (2001) discussed in his work the behavioural element of users in building sustainability, and how vital this was in maintaining a building's green and sustainable credentials. According to the author, it is only through a user understanding of how the building performs, that they will be able to play their role sufficiently in its sustainability (Rohracher, 2001, p.139). The issue of user behaviour was to some extent a consistent 'red thread' throughout the data gathering for this thesis, and something all of the interview participants were keen to emphasise.

The issue of user and occupant behaviour is a matter that was of paramount concern for much of my discussion with Thomas Berker. Although this was discussed previously in the chapter on consideration of usage and sustainability, it is worth repeating here briefly. According to Berker, too much control to the individual in a building risks diminishing how sustainable it can be considered to be, as individuals may not understand or simply not cooperate with the building's sustainable design initiatives and intent. Whilst Berker suggested that this could be resolved through removing control and improve facilities management, he was concerned about the overall impact this may have on user and occupant satisfaction (Interview with TB 02.04.14).

Fitzpatrick made a behavioural distinction in a different context to that of Berker, by claiming that there is an attitude deficit to some extent, as opposed to poor implementation and building environmental policy. He cited that people in buildings rely too much on technology to make their environment comfortable, and focus less on adjusting their general practises (Interview with DF 26.03.14). He said that people no longer do things such as put on more clothing when the temperature begins to cool, and "*we have forgotten that we all don't have to be wandering around in shorts for 24 hours a day, 365 days a year, that we can respond better by using better clothing, and we don't. Particularly, dare I say, in offices. This is a huge way of effecting how the office itself is then run*" (Interview with DF 26.03.14).

Fitzpatrick also felt that behavioural change to adapt to sustainable initiatives is not automatic, and that people need to be conscious of their changing environment and how they can better use their office spaces. He gave the example of a journalist on BBC Radio 4, who noted the behaviour of his teenage daughters. When they use the bathroom, they don't leave the water running when they leave, as they think this is wasteful. However, when they leave

their bedrooms they will leave the lights on and their music playing. They do not realise that both actions are the same thing and are in fact focused on wasting or not wasting energy and resources (Interview with DF 26.03.14). This type of analogy can be easily applied to the office environment, and the example I will give is that of computer monitors. If a computer monitor is left with the power on outside of general working hours, during evenings and weekends, then the time when it is used accounts for 75 percent of its total power consumption, resulting in a substantial saving if occupants turn their monitors off at the end of the working day. The same source also claims that around half of all monitors are left on outside of working hours (Bray, 2006, p.2). To demonstrate the point even further, computer equipment is the second highest consumer of energy in an office, only second to that of office lighting (Picklum et al: 1999. Roth et al: 2002, cited in Bray, 2006, p.6).

Despite this, two of the interviewees noted how changes in behaviour, both on a staff and facilities management level can turn around problems with unsustainable office usage. In a previous section, I discussed Townsend's example of the new Cooperative Group headquarters in Manchester. In this example, not only was the building design sustainably to a high level of detail, but its occupants were briefed and educated in these processes, which resulted in the highest BREEAM classification at the time, and an industry nominated award (Interview with MT 27.03.14).

Personal Control Versus Facilities Management

Berker offered a very different solution to solve a similar problem to that of Townsend. He looked at this entirely from the perspective of facilities management, and how it can override potential failings on occupant behaviour and its interface with buildings. This topic was addressed by Leaman and Bordass (1999), although once again focussing on productivity as opposed to sustainability. They claimed that the best performing buildings had less in terms of personal control and performed at their best when the facilities managements system operated effectively. By this they meant that problems were usually solved before occupants were even aware of them, and if they were reported by occupants the outcome was swift and the person making the complaint was kept constantly informed of their issue's progress (Leaman & Bordass, 1999, p.11). I asked one of this papers authors, Adrian Leaman if this type of problem solving could be used in the context of sustainability and usage, and he said it was

more than relevant. He said that if good facilities management can solve building problems, they can also solve building energy and performance issues. This covers many areas of a building's usage, from monitoring and adjusting the office temperature for effective use of air conditioning, or ensuring that the likes of computer monitors are turned off after employees have left work for the day (Interview with AL 07.04.14). This feeds in to a more practical example offered by Berker during his own research process for the previously mentioned MINDER project (Berker et al., 2014).

Berker offered an example of a building where one of his PHD students gathered data as a part of their work, that gives an example of how facilities management can contribute positively to how a building functions in its usage and operational phase. She interviewed a janitor for an office building where the facilities management team had access to technologies that allowed for a certain degree of environmental control. This janitor (and also leader of the facilities management team) was an electrician by education, but also had very good people skills. He accepted that 'intelligent machines' were not able to solve all of the problems that could arise in the building, and understood that a degree of 'hands on' interaction with employees and users was essential to functionality of that building. Whilst Berker was reluctant to class this individual as anything like a 'green champion' for this building, he claimed that the janitor had another quality that served a similar purpose. The janitor was very aware of the level of performance expected of the building, especially in terms of saving energy and creating a comfortable environment for the users. This combination of technical expertise on the part of his previous qualifications, and his personal skills meant that he in many ways became the face of the building and the building performed in terms of comfort, maintenance and energy use to a very high standard (Interview with TB 02.04.14).

This example of sustainable user control makes for the bridge I suggested earlier along with Adrian Leaman that you can bridge the 'productivity' enhancing qualities of Leaman and Bordass' (1999) responsive and almost automatic facilities management (Leaman & Bordass, 1999, p.11), but also improve the sustainable usage of office buildings. This bridging concept gives weight to comments from the MINDER (2014) report which states that at initial building design level "*facility managers should be key members of the design team*" (Berker et al., 2014, p.3), which could provide the design qualities and infrastructure to allow

attentive, technically competent and well-resourced facilities management teams to perform at their best level.

The interviewees from Enova shared much of the same line of thought as Berker. To Grønli, one of the biggest problems that a building can have is the people inside them. Grønli felt similarly to Berker that the risk factor for sustainability can be too significant if people are given too much control. She said “*I favour technology, as then we can be better at looking how much energy these buildings will be using. We need people help though, buildings cannot operate by themselves*”. She also stated that user preferences can be a big problem. She stated in her own workspace that she felt the cold more than her colleagues, so her preference was to have a better heated environment. If another colleague disagrees, this could create a conflict of use and result in poor use of the technologies. It is for this reason that she felt control was better kept in the hands of good facilities managers (Interview with CH & HG 23.04.14). In another nod to the comments by Berker, she made clear that facilities management and their assistive technologies are only as good as the team receiving the data.

This was a view also shared with Hemmingsen, but he also felt that a building’s overall design can stimulate good usage. Hemmingsen cited the case of the Enova project of the Sparebanken Headquarters in Trondheim. He stated that “*this building can only work as real Passive House (sic), if the occupants know how to use it properly*”. By this, Hemmingsen was referring to the value based targets that are associated with a Passive House project. He explained that when approaching a concept like Passive House, the behaviour of the occupants has to some extent to reflect the environmental values inherent in the project. That said, he was keen to make clear that “*in our Passive House projects, we hope that the building itself will do most of the work*” (Interview with CH & HG 23.04.14). Enova offer little in the way of a clear strategy on how this issue should be dealt with.

Townsend when discussing the idea of behaviour and facilities management, felt that both the user and the facilities manager had to go hand in hand in their roles, a view quite different from Berker’s suggestion of the office being a ‘perfect machine’ where users may not need to necessarily serve a substantial role in its building’s sustainable performance mission. Townsend noted discussions he had been present at with facilities managers of high performing buildings. These facilities managers believed that a certain level of control needed

to be in the hands of users, but also this had to be a part of a ‘governing structure’ where the majority of the control was placed in corporate hands. If users did have a very substantial level of individual control over their environment however, they needed to be able to constantly see how their usage is effecting the “*performance envelope*” and be aware of how their temperature usage is helping the building to perform or under-perform with regards to it optimal performance (Interview with MT 27.03.14). Whilst this is an interesting alternative example of initiating personal control with an emphasis on sustainable use, a governing performance structure of a review of individual energy use and/or an individual ingrained sustainable and green work and usage ethic would have to be in place for this to work as intended.

The balance of user control over responsive assistive technologies and facilities management is a difficult one to find consensus on. Townsend felt that a greater weighting should be placed on users, although he accepts that not all businesses may be willing to put in the same level of input as the Cooperative Group. The others favour mostly a non-user based approach, with Fitzpatrick even stating at one point “*I am the kind of person who thinks a dictatorship can be a good idea, as long as I am the one who is the dictator*” (Interview with DF 26.03.14), stating his how management should place emphasis on this point.

The risk factor can be reduced through monitoring, and I favour responsiveness over more control-orientated solutions, based on my own research and the discussions I have had with interviewees. However, this affords an opportunity to leave users without an education in a sustainable way of using their buildings, as educated staff can help these buildings reach any sustainability goals they may have. There is also the issue of employee satisfaction when removing control, an issue that would require more research in order for the balance of control and good facilities management to be effective. I also believe that facilities management are only as good as how their staff operate, which is something that must also be considered when looking at the effectiveness of both approaches.

7.3 Technology, Scripts and Socio-technical Networks

The debate over technology took many forms through my interview discussions, and interestingly there was a broad consensus as to which aspects of the issue of technology appeared to be important.

Most of the discussion can be seen as reminiscent of the discussions assembled by Leaman and Bordass (1999) which focuses primary concern on technological usability, complexity in the face of occupant usage, and maintenance ease by business owners or facilities managers (Leaman & Bordass, 1999, pp.8-9). The key findings in my data showed a disjuncture between technological intention, and how this was commonly reflected in the monitoring of this technology and how well its users are educated in its function, as per Akrich (1992). This also fits in with some of the discussions around complexity, where a technology can cease to be of use for its intended function if it is too complex for an office user to handle. Whilst the issue of technological maintenance was given less weight by interview subjects, it did feature in a superficial way, especially when looking at the issue of technological complexity.

In any office building, regardless of its sustainability, there is always technology that users have to interface with to a greater or lesser degree. Technology in offices in this instance can mean anything from computers, to personal control technologies, or even air conditioning systems. In a world where technology exists to assist our work and our environment, we are faced with these technologies that have a varying degree of competence in their intended task, varying degree of use and even varying degrees of ease of maintenance. Technology has to some extent become a part of the socio framework of the workplace from coffee machines to internal messenger systems in what Bruno Latour (2005) described as being ‘social-compatible’ (Latour, 2005, p.10). In many respects, the interviewees for this thesis expressed their thoughts on technology’s role in sustainable office usage, and the difficulties this could potentially bring with it.

An example mentioned previously in this thesis, was that of David Fitzpatrick from Sustain Wales and the case of SWALEC’s smart metres in properties. This technology was put into properties, and owners were simply left to operate these metres and use them without further involvement from service providers. Without a substantial degree of education on how to use them and regular monitoring of their performance, this effort at making sure people use their spaces more sustainably was all too often, he felt, wasted (Interview with DF 26.03.14). Following on from this, he also mentioned how important it is for the complexity of the technology to be kept to a minimum with regards to the interface with the user. Adrian Leaman (2003) made this point regarding technology in his paper discussing the needs of users in office buildings. He stated that in the case of the best performing office buildings:

“technology which is intended to work ‘in the background’ really does, so there is no need for constant management vigilance where there is need for intervention, interfaces are easy for users to understand, and give clear feedback about their operating status (i.e. whether or not they are working) and their effects (i.e. what change has been induced) users may over-ride systems, so they always have other options, especially in emergencies” (Leaman, 2003, p.4)

I asked Leaman to elaborate on how he felt this type of technological function can be of relevance in sustainable usage. He said *“if you have air heater in an office that is meant to keep you warm but occupants can’t turn it off when it gets too warm, the first thing you do is open the window. This thing (air heater) is still going and using up energy, yet you have controlled your office in a way that is dreadful for the environment”* (Interview with AL 07.04.14). He also noted an example of a building in Cardiff, where a technological problem had a very drastic effect on energy usage. The building installed automatic blinds controlled by sensors on the outside of the building. Once the light levels increased the blinds would fall, and occupants would turn on the office building’s electric lighting to compensate for the lack of natural light. The summer after the installation, the UK suffered a period lasting several weeks where the weather was poor and cloud coverage substantial. The sun did return, resulting in the blinds coming down. The users of the building wanted the blinds to go up so that they could enjoy the sunshine, but could find no way to manually override the blind. This did not just result in poor office satisfaction amongst employees, but also a substantial increase in energy use due to the necessity to use electric lighting all day (Interview with AL 07.04.14). This is an example of the level of problems that are complicated or made difficult to manage by technology, which can still effect sustainable building usage.

According to Berker, a part of the problem regarding the usage of office technologies and their sustainable output, is in part due to the technological culture that exists today. Inside the office environment and outside, there is an expectation that technology should ‘empower’ the people that intend to use it, increasing the influence they have over its function (Interview with TB 02.04.14). This also has a link with some of the previous discussions on user behaviour in office buildings and how their interaction with its technological infrastructure can also affect its usage. According to Berker, this cultural context makes it difficult for designers to remove the previously mentioned levels of control, as this does not fit in with the expectations of business owners or the occupants. The balance would then be to find to what

extent culture and functionality can result in an effective ‘interplay’ between users of technology. This can have both a positive impact on the notably difficult to quantify satisfaction office occupants, and easier to quantify (especially in terms of cost) impact on energy usage and sustainability.

Only one interviewee, Martin Townsend, took forward the issue surrounding how technology is developing in the area of sustainable office usage. According to Townsend, there was a noticeable lack of pace in this regard. He made a comparison with mobile phone technology. He stated that the mobile phones available today are radically different from those available a few years ago, as the pace of advancement and innovation is rapid in this sector and has momentum. In the case of sustainable technologies, he felt that far too much of the technology is too similar to what we were installing in buildings 20 or 30 years ago (Interview with MT 27.03.14). On a side note however, the lack of technological change does not represent in his eyes a lack of advances in other parts of the industry. He notes that 20 years ago, if you demanded a zero accident record on a building project, the contractor would likely charge you extra. Today, this type of scheme is covered under law in most of Europe, and all building projects can expect building contractors to be trained and have the correct safety equipment. Townsend hoped to see technological advances move in a similar way making advanced and sustainable user technology an expectation and a standard, and not a luxury (Interview with MT 27.03.14).

Townsend is also keen to see changes made in terms of business models when it comes to technology, as he feels that the private sector will be the area of the economy that is likely to drive sustainable usage and green buildings in general. For him, a good example of a business model that reflects sustainable usage is the progressive move from a product sales system, to one of service sales. He feels that a service based system will address some of the challenges mentioned earlier, especially concerning technological usage and the changing use of a building. A service sales system will not sell you an air conditioning system, but will set up and run the system for you on a retainer and rental service. This is likely to be more cost effective than buying a system outright, resulting in the business that have, for example, an air conditioning system installed be responsible for the costs of upgrade, alterations, replacement and maintenance. A service sales system allows a provider to make suggestions such as “*I can see that your system is no longer optimised, because I have been monitoring what we have*

installed whenever that times was. I can now upgrade that system for you to make sure that it is delivering the service you need” (Interview with MT 27.03.14), which combined with the service providers other stated roles can have a positive impact on sustainable usage. Berker noted a potential concern regarding with this approach. If a building already has a good facilities management in place, allowing a third party be a responsible for a part of the buildings technology may cause difficulties and tensions when the facilities managers try to address the buildings energy and performance expectations (Interview with TB 02.04.14).

When approaching this topic, Helle Grønli from Enova felt that technology scripting could be too narrow and not flexible enough to account for all of the potential uses of a building. She gave a non-commercial building example of this. She recently attended a handball tournament with her son, which required sleeping overnight in the school auditorium. The lights were controlled entirely by sensors, with no ‘human’ interface. This meant that the lights could not be turned off when it was time to sleep, with no ability for occupants to turn them off. Eventually janitorial staff had to be called to the school to turn off all of the power to the auditorium, this being the only option to resolve this (Interview with CH & HG 23.04.14). This she said represents a problem seen in many buildings, and echoes the comments of Berker and Leaman on technological complications. Hemmingsen reflected similar points, but stated that some of the buildings they had been monitoring had performed poorly because the technology was not fit for purpose, and was difficult to operate or alter the script for. This problem is similar to both the views of Akrich (1992) and Latour (2005), where technology with too static a function can cause friction and conflict between the socio elements of a space, and the technological elements that support it.

Grønli was also a supporter of monitoring technologies. She stated that when they install heat pumps in buildings they always need to be monitored to see if their performance matches their intention. Like Fitzpatrick, she also supports the use of smart metres than can help educate occupants about their more literal environmental impact on their space. She states though that in her experience, there are not enough metres in the buildings they provide funding to, and these meters don’t give a detailed enough analysis of how much energy is being used in the buildings and on which devices (Interview with CH & HG 23.04.14).

When looking at the challenge of technology, from the analysis of the interviews there appears to be a drive and desire to create a degree of balance when looking at sustainable usage's connection with technology. The participants want technology to be malleable in usage and easy to maintain with a low level of complexity for the user. The analysis on control and facilities management may demonstrate a difference in opinion between participants on what form usage based technologies should take, but there seems to be broad consensus on what basic criteria this technology should have. Townsend also expressed a concern on technological innovation within buildings, but hoped for it to eventually follow a similar path to that of safety and materials regulations that are more commonly regulated during building construction.

In keeping with my earlier views on facilities management, monitoring is the key to this issue and monitoring technology must reflect building performance. There should be a greater level of malleability in technology, as buildings' lifecycles seem to struggle to reflect the original scripting of many technologies.

7.4 Common Currency, International Regulation and Globalisation

When asking interview participants why usage was not being given the same level of attention as other sustainability aspects (although not all of the interviewees agreed with me on this), the issue of a common currency was raised more than once. Whilst issues such as what constitutes sustainable lighting were points of common ground between the participants, the lack of more substantial common sustainable usage factors was an acknowledged concern. Whilst some of the interviewees do consider usage and sustainability to be important, their views on possible implementation are varied.

There is notable lack of strict international regulations on how to best deal with sustainable usage, with organisations such as BREEAM and similar institutions operating a voluntary solution to this regulatory deficit. When looking at common currency, the data gathered through interviews represents a conflicting set of views as to what degree there is a lack of a common framework by which to approach sustainable use. Whilst varying regulations exist to cover other areas of sustainability, such as Enova's Norwegian Energy Fund funded research projects on energy use (Enova, 2013a), there is less apparent when it comes to a building's usage and operations during its 'in-use' phase. Whilst frameworks such as the Kyoto Protocol

have introduced emissions standards, the lack of ratification by countries with high emissions such as the United States of America (USA) means emissions themselves are not being universally addressed, even before we look at usage and sustainability.

Despite the lack of a broader international regulatory framework by which to establish a set of usage criteria, BREEAM would disagree that no common currency exists. When I approached Townsend, he was keen to emphasise how the work of ‘BREEAM In-Use’ is filling this void to some degree (Interview with MT 27.03.14). He stated that even if international standards at governmental level are not substantial, there can be “*momentum for regulation by the industry itself. If governments in the world still cannot agree on the emissions and greenhouse gases standards, then the industry has to do it itself. The very fact that you can see BREEAM standards in Britain, Norway and other parts of the world shows that this is working as an idea. We still need governments to play their parts too though*” (Interview with MT 27.03.14). In this sense, BREEAM is claiming to be the international regulatory framework that does not exist elsewhere, but motivated by businesses themselves rather than the likes of collective political will. This also related to Lundvall (1992) and the national innovation systems ‘knowledge diffusion’ characteristic, and how this drives innovative processes (Lundvall 1992 cited in OECD, 1997, p.10). When I approached Townsend on this, he stated that “*our international partners have a part to play in what we do. We are better for not just sharing our knowledge with them, but them also sharing it with us. Globalisation gets a lot of criticism from many of people, but I am of the belief that this is one of the better aspects of it. I really believe that this type of knowledge sharing is the only way we can move sustainability in general, and not just sustainable usage, forward at a reasonable pace*” (Interview with MT 27.03.14).

In Townsend’s judgement, this currency is also focused on the operation life cycle of a building and the different phases of use a building may go through in this regard. BREEAM In-Use look at how technology is operated and used in a building during its phases of use, and recommend upgrades and alterations with a strong consideration for how this can result in a good return on the investment put in to fund the recommended upgrades. From the common currency perspective, BREEAM have created a ‘core technical standard’ for usage which they employ as a common currency in its own right.

When I addressed with Townsend if there were problems with applying this common technical standard to all buildings, he said this was especially difficult from an international perspective (Interview with MT 27.03.14). When looking at the difficulties of BREEAM's core technical standard, he said the main problems were evident from different usage needs of buildings in different countries. Whilst I discussed this specific issue earlier in this thesis, it is worth repeating here. BREEAM In-Use exports its technical standard abroad in cooperation with local NSOs, who then adapt the technical standard so it better suits that country's needs and regulations. This can cause problems with regards to just how transferable this standard could be. The example Townsend gave was that due to Norway's climate there was a need for good indoor spaces, whilst the Spanish climate and culture necessitates a greater regard for usage of office buildings' outdoor spaces, meaning that the spaces between buildings are much more important. There even basic resource concerns as a part of this, such as the adjustment of usage criteria due to Spain having a poorer water infrastructure than Norway (Interview with MT 27.03.14). Despite this, Townsend was of the belief that in most cases with use, many universally applicable performance matrixes can be brought down to a tangible level and have an internationally useful effect on sustainable usage (Interview with MT 27.03.14).

To Enova, a common currency of usage doesn't necessarily cause a problem if it is attached to a tangible asset, as per the view of Townsend. Grønli, as I stated earlier, mentioned that some of the most significant problems in a building can be caused by the people in them. The variety of possible actions amongst human beings makes this issue of a common currency problematic (Interview with CH & HG 23.04.14). Whilst environmental technological elements can form common currency, usage variety and space requirements make this difficult, instead, Enova feel that linking usage to a tangible asset such as energy costs is the way forward. Hemmingsen stated in this regard that if a building is under performing in terms of its energy use, then looking at its operational and usage elements might be a way of developing a way to further reduce energy consumption (Interview with CH & HG 23.04.14). To Enova, the issue of a lack of a common currency can be resolved by addressing periphery assets, and adapting them to usage. Policy across borders must also better reflect a move to using buildings sustainably. With regards to international regulations, Hemmingsen feels that whilst looking at Norway is important, zero emissions are a part of a global effort. He stated that *"if we in Norway try and use our buildings well and reduce our emissions, and Sweden*

do not, then much of our effort is wasted” (Interview with CH & HG 23.04.14). Whilst he stated that BREEAM Global was attacking a key part of this problem overall, there was not enough momentum in governments to address it. He also hoped that if governments better addressed regulations on how buildings are operated, then innovation may increase and move the situation forward faster, he said *“I would rather rules change over innovation speeding up, but we could still do with bigger improvements to ideas and technology done much faster than they are now”* (Interview with CH & HG 23.04.14).

According to David Fitzpatrick of Sustain Wales, this lack of a common standard is due to a lack of attention, and less to do with a lack of research and a prevailing standard. Firstly, he believes that a lack of a substantial usage framework has been held back due to research on the topic getting *“slopped (sic)”* elsewhere in other research, and not being given the level of attention it deserves in its own right (Interview with DF 26.03.14). This is in opposition to the position of Martin Townsend from BREEAM, who would disagree on the basis that a part of the research based charity he is the director of, is dedicated entirely to that of sustainable usage during a building’s operational phase (Interview with MT 27.03.14). The example Fitzpatrick gave was that of a conference he attended a few years ago when he was head of the Royal College of Chartered Surveyors in Dubai. He and other delegates were discussing the idea of sustainable use, and felt that the issue had been addressed in *“bits and pieces”* in many research papers. They, however, were incredibly frustrated that this body of research was not coming to the attention of architects, who were not placing this type of issue at the heart of their own philosophy when designing their buildings (Interview with DF 26.03.14).

Thomas Berker of ZEB, approached this issue slightly differently from the other participants with the exception of Enova, saying the drive should be less towards a common currency and instead focus on making sustainable adaptations to the range of buildings we already have. According to Berker, a common currency or framework would not make sense due to the huge variety of buildings we have in the world (Interview with TB 02.04.14). This somewhat touches on the point raised by Townsend, that there can be such vast differences (in his example, country dependant) which make a completely universal framework that works in the same context as the likes of lighting, almost impossible (Interview with MT 27.03.14). It is also worth repeating that a larger international standard may not even be the best approach if

an effective bottom down scheme such as Enova does the job to a better standard than international framework could do (Interview with TB 02.04.14).

To Berker, the answer to this problem is for people to be ‘green beings’ as a common factor, and to act in a way that is green and sustainable in our everyday lives. People, he says, are more interested in being involved in the usage of their own homes than of their place of work. Then, we adapt our buildings to be green as well, but more on a ‘bespoke’ basis due to the aforementioned difficulties that arise from building variety (Interview with TB 02.04.14). The common currency challenges, according to Berker are due to the different degree that occupants are involved in usage of a building. People in Kindergartens use their buildings to a different degree that they would use them in hospitals, or offices (Interview with TB 02.04.14). This range of challenges makes it difficult to create a standard for each classification of building, which may also bring with it a further complication when you take into account Martin Townsend’s views of the usage complications associated with an international standard (Interview with MT 27.03.14). Also of note, is Berker’s previously expressed opinion of buildings being a “*moving target*” which places further strain on the pursuit of finding a common standard (Interview with TB 02.04.14).

This part of the topic has been filled with differences in opinions, even of the idea for a need of a core technical standard by which to define how sustainable use should be conducted. The larger differences however seem to be based on the degree by which this technical standard exists, although there is some consensus on the idea that any kind of standard would need to be malleable enough to account for not just the differences in the buildings themselves, but also the country, climate and culture in which then intend to be built or refurbished. There must also be a consideration of metrics, and Enova offer surrogate assets such energy costs, that can have an effect on ta buildings usage if addressed as a performance factor. In my judgement, the points made by Townsend and Berker represent the core of the problem. There are encompassing standards that affect all buildings, but the inconsistencies of culture, building usage and occupant behaviour make it difficult to find a universally applicable common currency. This could further give weight to a greater consideration of Berker’s ‘bottom up’ approach .

7.5 Motivation and Innovation

By motivation I am referring to what degree business owners, designers and architects are willing to involve the issue of usage as part of their building construction and usage strategy, and in some cases why usage and sustainability can be ignored and given comparatively little attention. There was debate here regarding to what degree usage was ignored or not ignored, but motivation as a general topic sparked a discussion that makes for important consideration by interested parties, especially in terms of future strategies for addressing usage and sustainability.

At the beginning of this thesis, I stated that I was looking into this topic in part due to the lack of attention this topic it is afforded in general. Motivation and momentum is a vital part of this consideration, and a topic I was very keen to discuss with the interviewees.

Martin Townsend expressed the view that a lack of motivation to address sustainable use in a building is in part due to poor marketing by those who intend to design or propose these buildings. Townsend states an example of the element of the thought process that is a part of the problem *“So, if you walked into a board room and said to them that you were going to talk to the about green buildings and sustainable buildings, many of those board members would be disinterested straight away. However, if I walked into the board room and said to the HR (human resources) director that I had a way of making their staff more productive, and if I said to their head of finance that I can give them a bigger return on their investment by reducing their energy bill, if you give me a certain amount of money that will allow me to improve your buildings, they become much more engaged”* (Interview with MT 27.03.14).

Townsend also mentioned that many businesses may also be willing to become more sustainable if opportunities arose that could allow them to market themselves as green, and sustainable usage could be marketed in this way. To Townsend, many green and sustainable initiatives and systems not only improve the working environment and make it more pleasant for employees, but also save money in the long term. One Bridewell Street in Bristol, for example, had such a good quality air conditioning system that its energy usage was little more than that of a naturally ventilated office building (Leaman & Bordass, 1999, pp.10-11). Townsend believed that a considerable amount of research was in place when it comes to the performance enhancing qualities of an office that is used sustainably, but it is marketed incorrectly to those who commission those buildings as something that is purely green, with

no substantial commercial or operational advantage. Townsend also said that not enough is being done to show just how much a green and sustainable workplace will do to affect a company's credibility and reputation (Interview with MT 27.03.14). To quote Townsend again, the bottom line for momentum and motivation is that "*sometimes I think where we do not engage the industry enough is in talking to them in the right way, to demonstrate that this is not about being maverick, or being different, or necessarily about playing a green agenda, it is about doing good business*" (Interview with MT 27.03.14). He, however does feel that things are moving in a positive direction, claiming that the conversations he has about these issues today are very different from the ones he was having five years ago (Interview with MT 27.03.14).

Fitzpatrick feels that motivation and momentum problems for the topic are steeped in a culture problem that exists in the design stages of building construction. He notes the new building for the Millennium Centre opera house in Cardiff Bay in Wales, which opened in 2004. The designers went to great lengths to make the building sustainable, and usage considerations formed a major part of their strategy. Air ventilation was very good, and doors and fittings were designed to be at the optimum of their usage. The building, as a result of these efforts won some awards both locally and internationally. Although Fitzpatrick says that the building was very good, what disappoints him is that it won awards because it represented the exception compared to other buildings. These types of considerations when looking at buildings are not yet a part of the mainstream when designing a building, and he feels that all new buildings should account for sustainable use at design stage like the case of the Millennium Centre (Interview with DF 26.03.14). He also felt disappointed that despite the Global Association for Building Sustainability trying hard to educate designers and making these sorts of decisions endemic in their own thoughts and design processes, this has not happened in practise (Interview with DF 26.03.14).

Berker feels differently about this, as it is his opinion that things are changing, mainly because we are having more and more energy efficient buildings in use. To him, it is momentum as opposed to motivation that causes a much larger problem. The example he gives, is in evaluation and monitoring of energy efficient buildings. Far too many of the evaluations in these projects are done by those who have built them, which he feels is a flawed process. This is also compounded, he feels, by the fact that a lot of people who do

these evaluations of their own buildings have done other things in the past, and are not necessarily experts on the kind of green evaluation that these buildings really require, and are further complicated by the previously mentioned tangibility difficulties surrounding measurement of productivity and employee happiness (Interview with TB 02.04.14).

Berker does also briefly touch on the difficulties the issue of sustainable use has in getting suitable attention. He notes how difficult it was for the MINDER project to get funding (which to a significant degree deals with usage), and that it was one of the only social science projects to receive substantial funding to look at this topic to this level of depth (Interview with TB 02.04.14). He claims that the social sciences have given comparatively little attention to many of these issues, with much of the key work is being done by British scientists such as Adrian Leaman and Bill Bordass (Interview with TB 02.04.14). I mentioned earlier my discussion with Adrian Leaman has raised the point of Leaman's increasing frustration that much of his work on this issue, acclaimed today by scholars, has not been dealt with sufficiently, leaving many of the issues untouched and uninitiated (Interview with AL 07.04.14).

Enova adopt a similar stance to Berker, claiming that progress is being made off the fact that more and more of these buildings are being used. To them, some of their most recent Passive House projects in Trondheim such as the Sparebanken Headquarters and the Kunnskapssenteret at St Olav's Hospital in Trondheim, are representative of this (Interview with CH & HG 23.04.14). According to both Grønli and Hemmingsen, these types of projects are also driving some of the innovative technologies that are also being funded at research level by Enova (Interview with CH & HG 23.04.14). They also both noted the problems that policy can cause in motivating change. Grønli stated that Enovas Passive House support scheme has ended, because the Norwegian Building Code is being revised, resulting in Passive House being a part of new regulations. She stated that *"this is all going in the right direction. We provide support for areas where no support would exist otherwise. As Passive House becomes a part of the building code, I guess it is good that we don't need our support scheme anymore"* (Interview with CH & HG 23.04.14).

Whilst Enova feel that the momentum is improving, they do feel that there is a problem at business level about how to approach this topic. Hemmingsen felt that occupants still have

bad habits, and that owners do not always encourage change beyond recycling and other smaller ideas. To Enova, larger changes can happen if attitudes within those who commission buildings also go on to reflect some of the changes that are “*happening a lot in BREEAM, and maybe a bit with us too*” (Interview with CH & HG 23.04.14). Hemmingsen also felt that there needs to be more momentum within the world of designers and architects too. He felt that design teams need to be more integrated with the occupants, and if this type of attitude becomes commonplace, so may sustainable use (Interview with CH & HG 23.04.14). This is a strategy that feels very in keeping with some of the work being done in the MINDER (2014) project.

The issue of momentum and momentum is once again a source of disagreement amongst the interviewees, who all feel differently about the problem, especially with regards to responsibility. There is some agreement on the fact that the issue is not given the attention it is needed, although there is a difference why this they feel that this is the case. There was also some agreement on the level of research done on the topic of sustainable use, which most agree is not being taken up by designers, architects and those who commission these buildings’ construction or refit.

There was however an optimistic feeling amongst all of the interviewees that change was moving in the right direction, although the pace seems to frustrate many of the people that I spoke to. I share the frustrations of the interviewees, but feel very much like Berker, Grønli and Hemmingsen, that with an increase of greener buildings in use, the momentum may pick up too.

8 Conclusion

From the conclusions gathered from the data, it is clear that usage in the context of sustainability is being dealt with at varying degrees by the interview subjects. The main research question of "*how usage had an impact on the sustainability and environmental footprint of an office building*" was, however, universally considered to be an important topic by all of the interview subjects. In this concluding chapter, I will briefly demonstrate the findings of the paper, look at the transferability of these findings to other fields and countries, and then finally look at what abstractions I am able to take from the writing of the thesis.

8.1 The Findings

The findings demonstrated a broad spectrum of issues related to the usage and sustainability.

The defining of terms such as 'sustainability' and 'zero emissions' has caused a difficulty that was reflected more in the term 'zero emissions', than it did with 'sustainability'. This definition issue represented a policy concern that has sometimes hindered and occasionally fragmented progress in sustainable usage, as far as the interviewees were concerned. The example of an emphasis on a 'bottom up' approach to definitions and standards may be a means by which to address concerns over definitions.

With regards to the behaviour of occupants, their interface and interactions with buildings and potentially negative effects this could have on sustainability, there appeared to be two main opinions on how this can be addressed. Some of the actors felt that poor usage of buildings due to occupant behaviour can be resolved through the better education and training of these occupants, which will then give reason to offer these occupants more substantial control over their environment. Other actors suggested the contrary. By removing the risk of the human factor, and instead suggesting that facilities management and associated technology take on the sustainability role. This reflected a shared concern on how users' impact on sustainable usage, but vastly differing views on environmental philosophies. This in itself demonstrates a key challenge in further addressing issues surrounding users roles in using an office building in a sustainable way, and may express further complications in standardisation of a sustainable usage program. This demonstrates that differences occur not just in the realms of

global standardisation, but from the perspective of a how this should be treated on a more philosophical level.

Technological complexity and scripting was also an issue that resonated with interviewees, and is somewhat linked in with the previous point on behaviour. There are often difficulties with technological maintenance and complexity in building spaces, meaning technology is poorly used and resulting in a negative sustainability knock-on effect. Interviewees also noted that building lifecycles cause problems in this regard, with technology and its associated infrastructure not being sufficiently malleable to cope with the changes of their use as buildings move through their operational phase and lifecycle.

In terms of motivation and momentum surrounding the issue, the interviewees noted a confidence issue as being partly to blame. By confidence I am referring to the forward momentum and collective will of actors from all sectors to address sustainable issues. Townsend also noted that sustainable usage was poorly marketed to those who commission buildings, something that BREEAM In-Use is trying to address. Almost all of the interviewees also stated that a policy framework at governmental level must exist to support this. This is both to encourage further research and development, and to make sustainable usage more endemic within the industry.

Common currency became an overarching globalisation factor in sustainable use, and reflected how difficult sustainable usage can be implemented from an international perspective. Opinions ranged from the UK's BREEAM In-Use and Martin Townsend's view that this can be an internationalised framework (should adjustments be willing to be made in certain contexts), to Thomas Berker and Enova from the Norwegian side who believe that this is an issue too complex to solve, mainly due to the unpredictability of the human factor in buildings. These differences may demonstrate different strategic approaches in different countries, and is an issue that would be useful to consider in future research. The issue of common currency drove a substantial theme of globalisation into this thesis, and reflects some the institutional, policy and cultural challenges that exist when finding common sustainable use criteria. This area of the findings went further than simply showing that there was a superficial degree of international consideration and standardisation for sustainable usage, as was demonstrated by the international presence of BREEAM In-Use. It also brought to light

the fact that despite there being many internationally transferable elements of a core technical standard for usage, there were none the less localised cultural and regulatory differences that have to be considered when looking at an international implementation of sustainable usage initiatives.

8.2 Generalisations and Transferability

This thesis and its findings have not just reflected both the opinions commonly by the interviewees, but also how different their views and proposed strategies are.

There was a commonly held belief about how important this issue is, but substantially differing opinions on to what degree this was under-researched. In many respects there was a forward momentum on sustainable use, mostly held by BREEAM with their 'In-Use' program, which was directly dealing with many of the factors and challenges discussed here. MINDER (2014) also dealt with this issue, but more from the perspective of research and future implementation, as opposed to the more 'day to day' initiatives offered by BREEAM. Sustain Wales' and Enova's lack of direct involvement seemed to reflect more their mandates, and less their weighting of the issue's importance.

From a socio technical perspective, there were substantial differences on how these should be addressed. Whether the actors favour control and education, or the facilities management approach, it highlights a notable disjuncture on how a strategy can be formed to move these types of issues forward from both a research and practical perspective.

In terms of the transferability of this work, the findings could be applied to many aspects of sustainability and energy management. To be more specific, energy reduction schemes at a tangible cost level and programs that take sustainability deeper than construction materials, could all benefit from the research and findings of this thesis. The interviewees noted the impact of usage on tangible assets such as energy costs, and these findings could be reflected on how best to build a larger building energy infrastructure. These findings could also be generalised to research on building socio technical networks, and the roll of technology within buildings. There could also be some applications in other sectors. The likes of the transportation sector could benefit from a greater consideration for sustainable usage, or even the construction industry, as suggested by Fitzpatrick.

One of the most substantial transferable qualities of this work is its issues concerning globalisation. Sustainability itself is an important issue globally, and the findings represent the challenges that exist when looking at usage in this context. Whether addressed from the policy, cultural or social context, these challenges represent the considerations for future research when looking at strategies and metrics for transferring sustainable usage ‘currency’ to other commercial buildings in different countries. This work can bring together the idea that there are common technical factors that can affect usage, but cultural and policy based differences on a country level need to be taken into consideration for more substantial elemental common currency factors to be addressed. The differences as suggested by Townsend may even go beyond regulation and culture, and go into the realms of access to clean water or climate considerations. There is also the issue of political will, summed up well by Fitzpatrick who stated that "*there is no consistency at a political level, as politicians 'beat to a different drum'*" (Interview with DF 26.03.14). As mentioned earlier in this thesis, a lack of more universal commitment such as the case of Kyoto Protocol, demonstrates an existing and endemic problem at policy level. This issue of usage however is not entirely distant from the Kyoto agreement, and sustainable usage and lower emissions could help nations reach the targets set out by the agreement. A local level ‘bottom up’ approach may be a good way of approaching these issues whilst international regulations progress towards becoming more widely adopted. Whilst the research here could be useful at policy level to create a more productive approach to create environmental policy consistency which could drive industry confidence, it may also allow for business driven institutions like BREEAM to better understand how to globalise their initiatives and help them work better at an international level.

8.3 Abstractions

Whilst this thesis proposes new questions arising from the challenges illuminated by interviewees, it also fills a gap in research. When I began this work I set out to investigate a topic that was under researched, and I feel that this thesis has provided an outline for further discussion. This work has proposed common factors and challenges that arise when moving sustainable usage forward, and will be important to keep in mind when future work is done on this topic. An interesting outcome was that in some respects this topic is given more attention

than I expected, especially concerning the existence and scope of the BREEAM In-Use scheme.

This topic also reflects an expectation that this is a topic steeped in globalisation, both in terms of sustainable usages' international adaptability and also the difficulties in transferring it from country to country. An unexpected outcome was the statement by Townsend that the real driver for change has been businesses themselves, and not international regulations (Interview with MT 27.03.14). The complexities surrounding sustainable usage's wider implementation throw up interesting future discussions on sustainable usage. This will need addressing for a common currency to be developed, and for a broader acknowledgement and understanding of the importance of the sustainable usage of offices.

This thesis did not strive to offer concrete answers to these problems, but instead aimed to illuminate what the issues are, and how they are being dealt with. In this regard, the work has been successful. The recent debate surrounding sustainability and usage now has a set of common factors and challenges for further research to address, and the topic is now, to use a term by Fitzpatrick, no longer “*slopped*” in with other research. In this thesis, sustainable usage has been given attention in its own right, for those interested to research and develop beyond what is written here. I hope that this thesis has addressed a concern noted specifically by Fitzpatrick, that this topic is rarely addressed on its own. In essence, I offer the final words to American anthropologist Zora Neale Hurston, who summed up the spirit of this thesis by saying that:

“Research is formalized curiosity. It is poking and prying with a purpose”

(Zora Neale Hurston cited in BrainyQuote.com, 2014)

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Appendix A

Interview Guide

“How is a building’s usage looked at in the context of sustainability, and vice versa?”

This interview guide represents the key questions and points for consideration that will take up the bulk of the interview. The interview will be semi structured, so there a likely to be more elaborative questions that will take place as the interview progresses and are likely to be qualitative in nature. The nature of the structured elements of the interview may also necessitate jumping back and forth between topics.

The interview will take no more than 45 minutes, and it is possible that not all questions will be covered, depending on time and answers given.

1. Introduction

- . Outline of Master Thesis project
- . Confirmation of use of personal details, information and interview transcript
- . Outline of the structure of the interview
- . State for the record you name, position and organisation (if permission is granted)

2. Main Research Question

- . Please can you reflect on how usage can influence the sustainability and the environmental footprint of a building?

Sub questions:

- . What usage factors specifically do you consider to be of particular significance when discussing usage in the context of sustainability?
- . How relevant and important is the issue of usage in the context of other aspects of sustainability?

3. Reversing the Main Topic

. Please can you reflect on how sustainability affects the usage of a building?

Sub questions:

. How does this relate into some of the usage factors discussed earlier?

. Are the effects on usage profound or mostly superficial based upon the experiences you have?

. Do you think the effects on usage greater reflect sustainable technology used in buildings, or a greater sense of 'environmentalism' amongst staff, accompanying actors and the corporate ethics?

4. Sustainability and Usage: The Current Situation

. How does your organisation treat issues of usage and sustainability?

Sub questions:

. If you do not look at these issues, why not?

. How could you address the issue of usage and sustainability, given what you already know about both topics?

. Do any examples come to mind?

. Why do you treat the issues in this way?

. Do you discuss issues surrounding usage and sustainability with your partners directly?

Sub questions:

If so, in what context does this occur and how is the issue treated?

If not, why not?

. In your experience, who takes the lead in usage and sustainability issues? *E.g. organisations, technology, office staff, service providers etc.*

5. The Outlook for Usage and Sustainability

. In ideal situation, how would you address the issues surrounding usage and sustainability?

. Sustainability is a 'hot topic' concerning office environments; to what extent do you feel usage will feature in future discussions on sustainability?

. What challenges do you feel are ahead for this topic, and do you think they are being addressed?

. Do you have a 'vision' as to how you would like to see not just your company/organisation addresses this in the future?

. To what extent can actors and stakeholders play their part in addressing issues surrounding sustainability and usage?

Thank you for your time