Examination of existing facilities management approaches to climate change and future directions.

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Abstract

It is widely accepted that human activities have contributed to changing the world’s climate and that the pace of this change is ever increasing. Two approaches are being promoted by the international community to address the issue of climate change (1) Mitigation, seeking to reduce the amount of CO2; (2) Adaptation, which seeks to alter the way humankind live and work in response to the changing climate.

Whilst facilities managers and their organisations have prioritised mitigation action, there is less evidence to suggest that they are addressing the implications that a changing climate may have on the demands being placed on their organisation’s hard and soft facilities (adaptation).

This paper reports findings from a case study and questionnaire survey to ascertain the present approach taken by facilities managers to address mitigation and adaptation, their respective drivers, their view on climate change and their environmental inclination.

It concludes that the facilities manager's approach to climate change is derived by a combination of factors; namely a) Organisation approach to climate change b) Legislation and c) the facilities mangers perception of the risks posed by future climate change and of the use of risk assessment methods and climate change projection data. The study concludes that the prevailing measure for addressing climate change impacts is reactive in nature, taking the form of Disaster Recovery and Business Continuity Planning.

The practical implication of the work is in the realization that mitigation, being quantifiable and legislative driven, is viewed as a strategic issue and of importance to an organisations Corporate Social Responsibility agenda which can be planned over the longer term (10-20 yrs). Adaptation on the other hand is measured through successful survival, increased resilience and adaptive capacity (absence of quantitative performance target), each of which are viewed as short term operational issues and as such adaptation struggles to find strategic importance. If organisations are to adapt to inevitable climate change then this situation needs to change.

Keywords: Facilities management, climate change, adaptation, impacts on buildings,
1. Introduction

The IPCC fourth assessment report 2007 reiterated that ‘Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century’ (IPCC 2007). It maintains that ‘There is high confidence that neither adaptation¹ nor mitigation² alone can avoid all climate change impacts; however, they can complement each other and together can significantly reduce the risks of climate change (IPCC, 2007).

In recent years international action on climate change has been ad-hoc without consensus on emission targets or adaptation actions. The UK government has addressed the issue of climate change through its Climate Change Program (2001; 2006) and, more recently, through its Low Carbon Transition Plan (DECC, 2009). The present response to mitigation has manifested itself through increased legislation such as The Climate Change Levy (HMSO, 2001); The Building (Amendment) Regulations 2001 (Part L) (HMSO, 2001); and the CRC Energy Efficiency Scheme Order (HMSO, 2010). These legislations have driven organisations to consider CO₂ reduction targets in their corporate social responsibility strategies.

1.1 Research study and structure of paper

The increasing importance of sustainability and in particular CO₂ reduction and energy efficiency in facilities and operational management are well addressed by Brown & Pitt (2001) and Junnila (2004).

Increased legislation has ensured that mitigation aimed at reducing CO₂ emissions through reduced consumption of fossil fuels and improved energy efficiency has become part of the strategic business agenda, partly due to compliance issues and partly due to corporate image amongst stakeholders and customers. Addressing mitigation strategies has forced the Facilities Managers (FM) to consider their approach to asset management and examine the degree to which alternate FM strategies can contribute to a reduction in CO₂ emissions from business premises and operations. In contrast, the issues related to adapting to the impacts of inevitable climate change (adaptation to building fabric and operations), including approaches to assessment of risk and the ability of existing business and facilities strategies to manage these risks, have received less attention. In recent years the UK has experienced increasing climate hazards as a result of extreme weather events (e.g. heat wave 2003, floods in 2002, 2004 & 2007) that has emphasised the need for disaster recovery planning for such impacts. Further, it

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¹ Adaptation: Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. (IPCC AR4).
² Mitigation: An anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks. (IPCC AR4).
has been suggested that addressing these issues will require modification in the present practice to facilities management away from primarily responsive actions to more predictive approaches that seek to understand the impact of events on the holistic performance of the built asset in-use (Jones & Copper, 2009). This research project addresses these issues and this paper presents the findings of a case study of a major UK commercial organisation and a follow-up questionnaire survey of 474 members of British Institute of Facilities Managers (BIFM), to ascertain whether existing approaches to facilities management can effectively support the development of long term planned mitigation and adaptation strategies for commercial property subjected to climate change. The paper examines facilities managers perception of future climate change impacts and the extent to which risk based models (UKCIP decision-making framework) provide a decision making framework for facilities managers to plan adaptation and mitigation interventions to commercial property that address climate change projections. The paper concludes that if the risk based approach is to be successful then there is a need to establish simpler assessment approaches supported by easy to use climate change projection data for quantifying future impacts than is currently available in the UK. If this can be achieved then it should be possible to formulate asset management strategies based on quantified impact assessment of risk that results in increased resilience of organisational property to climate change.

2. Climate change impacts on commercial built assets.

Climate change impacts on businesses and their premises are twofold: those due to increasing mitigation legislation affecting organisational energy use and management; and those that increase physical risk to business operations and buildings: coastal flooding and erosion, increased cooling load, increased water penetration from driving rain, increased maintenance cost as a result of reoccurring repair due to high winds (Graves and Phillipson, 2000).

2.1 Mitigation initiative and commercial stock

In the UK, none domestic buildings (excluding industrial building) account for 13% of emissions, of which 27% (of the 13%) is attributable to the retail sector; 14% to the hotel and catering sector and 10% to the general commercial sector (Pout and MacKenzie 2005; Carbon Trust, 2009). The majority of emissions are attributed to electricity use (63%) and thus attracts the attention of the Climate Change Levy (CCL) - a tax levied on industrial and commercial use of coal, gas and electricity and reimbursed as a rebate through National Insurance Contributions (NIC). The impact of the levy on the service sector has been positive one. According to the CBI (CBI & EEF, 2002) survey, the service sector benefited from a £417.7 m

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3 At time of the fieldwork only UKCIP 02 projections were available in the UK. The recent probabilistic UKCIP 09 projection could have yielded different results for the study.
reduction in NIC whilst it paid £365.1m in CCL, thus retaining a net profit of £61.6m. The service sector initiated simple climate change measures: appointing personnel with responsibility for energy management and metering; installing low energy lightning; and procuring energy from renewable sources to lower CO₂ emissions to meet their targets. This finding is also emphasised by Ekins and Etheridge (2006) who found that inclusion of renewable energy procurement and setting lower CO₂ reduction targets has encouraged managers (through potential financial gains) to implement simple energy efficiency measures.

In spite of this initial drive for implementing energy efficiency measures there remain barriers to further reducing CO₂ emissions from commercial buildings. These include: low demand for energy efficient buildings; insistence on low operating costs over energy efficiency standards; none ownership (tenant-landlord barrier) of built assets; long refurbishment cycles; lack of awareness/information of mitigation; and lack of transparency in building performance (Scarce 2001; Adyeye et al, 2007; Carbon Trust 2009).

### 2.2 Need for commercial sector to adapt

Whilst there are still issues to be addressed with mitigation regulation, and in particular the need to set more demanding mitigation targets that address the problems of further warming and unavoidable impacts of climate change, it would appear that the existence of regulation has had the effect of raising mitigation up corporate agendas, ensuring that it is now considered as a strategic issue for facilities management. On the other hand the same can't be said for adaptation. Even if global CO₂ levels are held at current values, the effects of the increased levels currently in the atmosphere will mean that the UK will face inevitable climate change over the next 30 years resulting in increased flooding and overheating (amongst others) and requiring adaptation of existing buildings and infrastructure to such impacts (IPCC, 2007). The drivers for adaptation however are not only physical, but also economic. This is emphasised by Frith and Colley (2006) who examined the business case for adaptation, drawing attention to the high initial costs and longer-term obsolescence if adaptation was not undertaken.

In the UK the raised awareness of adaptation can be seen as a result of increasing flood events in 2002, 2004, 2006, 2007 and 2009. The 2007 floods caused damage to 35,000 commercial properties at a cost of £3billion and resulted in increased buildings insurance costs of 3% (ABI, 2007). The ABI also suggested that in the light of the heavy losses a review of buildings insurance would be conducted, with the possible removal of cover (BBC, 2007) if property owners failed to take adaptation measures to reduce flood risk to their individual properties (DEFRA, 2008). A similar recommendation was also made by the Pitt Review (2007) whilst identifying that many of the interventions to reduce flooding did not lie within the remit of business, insisted that the commercial and private sector should consider making their buildings resilient and resistant, This need for businesses to improve the resilience of their built assets and invest in the adaptive capacity to survive future flooding events is indicative of the wider importance placed on adaptation plans that seek to address inevitable climate change.
Developing this resilience and adaptive capacity will require a planned proactive (as opposed to reactive) approach to operation; maintenance and management of their business function and the built assets they occupy. In order to encourage a proactive approach it is essential to assess future risk associated with climate change, and possess the adaptive capacity to plan interventions. Such an approach should include an assessment of the future climate change risks on the obsolescence of an organisation’s built assets and on the role that routine maintenance and refurbishment can play preparing the assets to withstand the risks (Jones & Desai, 2006). Jones & Desai (ibid) further hypothesised that, by combining the UKCIP02 projections with the expert knowledge that facilities managers possess about their built assets, facilities managers would be able to assess future climate change risks (with the aid of the UKCIP decision-making framework) and develop adaptation plans as part of their routine maintenance and refurbishment programmes. This hypothesis was examined through a case study of a major UK commercial organisation and a detailed questionnaire survey of 474 facilities managers.

3. Case study process and observation

A commercial organisation, and in particular its FM department, was chosen as the basis to test the appropriateness of the risk based model described by Jones & Desai (2006). Through a series of formal management meetings; informal discussions with operational managers responsible for the development and implementation of the facilities management strategy and presentations to the senior facilities management board, the research team examined both attitudes towards climate change (mitigation and adaptation) and the organisational response which was believed to be inclined towards increase resilience. During these discussions the research team introduced UKCIP 02 projections and implemented the UKCIP decision-making framework (Willows & Connell, 2003), through an action research programme with facilities management team. Throughout the development and implementation process, regular meetings were held with internal stakeholders to evaluate progress and to develop appropriate tools to operationalise the UKCIP decision-making framework. The following section summarises the key findings from this process.

The results of the UKCIP decision-making framework application are presented in the table 1. Although a range of climate impacts were considered, the two impacts that were perceived to be most important to the organisation were flooding and overheating, with flooding being given the highest priority - primarily because the organisation had already experienced business disruption due to flooding events. With the problem defined, the next stage was to identify which of the organisations built assets were currently at risk, or likely to be at risk as a result of future climate change. This task proved more complicated than was originally envisaged. The climate scenarios (UKCIP 02) available were able to give future projections over wide geographical areas, but lacked specific probabilities of occurrence at micro level due to which site specific quantitative risk assessment proved difficult to undertake. Although higher resolution climate projection data was available, the UKCIP team has stated that this does not imply that detailed climate change information is available at the 5km scale, as there are many local climatic influences and feedbacks at this level that could modify the general pattern of
change. Similar concerns are also noted by Luc Salagnac (2004) and O’Brien et al (2004). In light of these concerns the Environment Agency flooding maps and information from local councils was used to make site specific (at the individual building location level) flood risk assessments. The decision to use the Environment Agency data was a pragmatic one based on the views of the organisations facilities management team who argued that buildings located in areas already prone to the risk of flooding and are likely to face increased risk in the future. These predictions they had confidence in and felt able to defend to senior management. Whilst this may appear a somewhat short sighted approach, it is in line with the suggestions Willows & Connell 2003, who identified lack of understanding of climate change projections and related uncertainties being a key issue in assessing the risks associated with future climate change amongst business decision-makers.

<table>
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<th>Framework stage</th>
<th>Concise Outcome</th>
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<td>Outcome</td>
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<td>Stage 1- Define Problem</td>
<td>The Problem consideration was based on experience of a flood event and consecutive financial loss. The criteria were to look for ways to adapt to present and future climate related flood events (and overheating). Climate change will be an important aspect in deciding on the adaptation measures. The scale of problem was deemed to be at the project level (i.e. operational). The decision were expected to provide short term and long term ≥10 yrs benefits.</td>
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<td>Stage 2- Establish decision making criteria</td>
<td>The attitude of the organisation towards risk was considered along with the level of risk acceptable (risk threshold). The major receptors were business function and built assets. Flood maps were used to decide on upper, medium and lower thresholds of risk to the properties (considering these levels are likely to increase or remain same in event of future climate change).</td>
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<td>Stage 3- Assess risk (tier 1 &amp; 2)</td>
<td>Precipitation, extreme rain fall, costal sea level rise and summer temperature were regarded as variables of interest. The Medium High climate scenario with time scale of 2020 was considered. The limitations of existing measures were considered (resistance and resilience to flooding). Although uncertainty was looked at it proved very difficult to persuade the organisation to consider further data collection and quantitative assessment and thus consider long term planned adaptation interventions. A qualitative and semi quantitative assessment and matrix was developed to assess the likely risk and resilience of sample properties. Due to time constraints this matrix was not fully tested.</td>
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<td>Stage 3-Assess risk (tier 3), Stage 4- Identify options, Stage 5- Appraise option, Stage 6- Make decision, Stage 7- Implement, Stage 8- Monitor were not undertaken at required detail.</td>
<td>Coping strategies As a consequence of the action research programme, the organisation strengthened its business continuity and disaster recovery plans. High-risk properties were placed under ‘ongoing observation’ and flood resistant refurbishment contingencies were identified for at high risk sites. Further research on business value of at risk sites and strategy for disposal or continuing acquisition was considered.</td>
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Table 1: A summary of outcome relating to stages of framework
By way of compromise, the research team extrapolated future flood assessments by combining the existing flood risk maps with the wider macro level climate change projection. These enabled the team to augment the list of buildings that were at "known risk" with those that were at "possible risk". However, much of the implementation process remained qualitative or semi quantitative in nature. The implementation of quantitative risk assessment methods (e.g. Monte Carlo method, Bayesian method) were not pursued for probabilistic risk assessment due to lack of micro level probabilistic climate change projections and unavailability of historic data on property damage (cost) and business interruptions as a result of previous flooding events. It was also difficult to establish validity for investing in elaborate quantification of the impacts of future flooding on built asset management plans (including adaptation strategies) as a result of the unpredictable cycle of acquisition and disposal of built assets in response to business demands (why invest in protecting a building against future flooding if we may not occupy it in five years time?) and the 30 year time line for climate change risk compared to business and facilities management strategy upgrade time period of 3-5 years. As a result, the organisation decided to adopt a responsive strategy for climate change adaptation, (keep a watching brief and only intervene when a problem presents) until such a time as the level of certainty surrounding the impacts was reduced or the risks more clearly quantified. In adopting this strategy a number of "trigger points" were established against which further detailed survey and quantitative assessments could be made.

In case of flooding the most favoured long term strategic option was that of strengthening business continuity planning through risk transfer (insurance) and the provision of temporary flood defences where required (to reduce premiums). Properties rated at high risk and where a recent flood event had occurred had flood resistance and resilience measures planned as part of the next normal refurbishment cycle, depending upon the budget availability (e.g. moving equipment above flood level, replacing carpets with hard floor, installing flood gates etc.). The relocation of the business operation from the property (even on a temporary basis) would be considered if persistent climate related extreme events were experienced.

In terms of immediate operational adaptation, routine maintenance was extended to include more regular gutter cleaning and drainage system testing; maintaining roof tiles and monitoring the façade for any water ingress. The main business operational measure was an extension to home based working (which was already being promoted as a part of a mitigation drive).

The case study identified a number of problems in implementing the UKCIP decision-making framework. These include: uncertainty relating to climate change projection and absence of micro level probability data; organisational and the facilities managers perception of risk, associated with belief in occurrence of climate change; difficulty in translating climate change projections into business operational risk. To test whether these problems were specific to the case study organisation or represented a wider generic view of facilities managers a questionnaire survey was undertaken of professional facilities managers based in the UK (BIFM members).
4. Questionnaire survey and findings

The questionnaire survey made three key inquiries: 1) Are facilities manager’s response to climate change primarily driven by a legislative response? 2) Does past experience of an extreme weather event change a facilities managers perception of climate risk (in terms of business function / asset management) and is this the key to implementing adaptation measures? 3) What is the relationship between adaptation/mitigation, planned and reactive maintenance, operational and strategic planning.

In order to reach the wider facilities management population all BIFM members were chosen as the target population. A web based questionnaire with mix of multiple choice, attitudinal scale questions and open-ended questions was prepared and piloted between 13th February 2008 and the 3rd March 2008, achieving a 9.09% response rate. Minor modifications were made to the questionnaire to remove some ambiguity and confusion with terminology, and the main survey was carried out between 10th March and 30th April 2008. A total of 4,357 e-mail questionnaires were distributed and 474 completed responses were received, a response rate of 10.8%.

Following an initial analysis, a correlation analysis was performed between variables relating to adaptation and mitigation action. The variables influencing adaptation inquired on a) experience of a climate related / extreme weather events b) perception of future impact of climate change as a risk or opportunity c) identification of future impacts of climate change on properties and business functions. The analysis confirmed that past experience of an extreme event and perception of climate change as a risk resulted in consideration of future impacts and their treatment in disaster recovery planning where adaptation was perceived as an operational issue. The correlation established between a) drivers responsible for mitigation action. b) strategic approach for mitigation c) involvement with institutes facilitating mitigation action and d) financial benefit from implementing such measures confirmed that mitigation was primarily a strategic response to legislation.

![Figure 1: Adaptation Process-Mapped through Logistic regression](image-url)
Figure 1 represents the logistic regression carried out to establish the drivers for adaptation which were found to be similar to those observed in the case study. Similar models were proposed by Berkhout (2004) and Grotmann (2005). With regards to coping measures and adaptive capacity only 59% addressed future climate change, primarily through reactive disaster recovery planning.

The survey also threw light on differences between public and private sector organisations to mitigation and adaptation. Although mitigation was found to be a strategic issue for both public and private sector organisations, the private sector identified corporate social responsibility as the prime driver. In contrast the public sector identified compliance with legislation (e.g. The Decent Home Standards, EPC and Building Regulations) as the prime driver. With regards to adaptation, the public sector is more likely to perceive climate change as a strategic risk than the private sector that sees it as an operational risk. Further, within the private sector smaller organisations appear unconvinced about anthropogenic emissions being responsible for climate change (compared to multinational and middle level organisations) and see little financial benefit from mitigation measures (unlike multinational and larger organisations). The slow implementation of energy efficiency and CO₂ reduction are also identified by Bradford and Fraser (2007), Halila (2007) and Hillary (2004).

5. Conclusions

In light of present initiatives for climate change mitigation and adaptation, this study has examined facilities managers approaches for emission reduction from their business function and specifically adaptation of their built asset and business operation to impacts of future climate change. In doing so the paper draws following conclusions.

The first finding of this study is that mitigation and adaptation strategies have played a very different role in most FM's routine practice. Emission reduction (mitigation) is viewed strategically due to a) organisations regarding it as an environmental, moral and market standing issue and b) Government legislation and well defined quantitative targets which encourages long term future planning. Consequently mitigation is considered as capital investment. Adaptation on the other hand, lacks initial drive for action, is not planned for from a long term perspective, remaining reactive in nature. It is treated as an operational issue and thus competes with day-to-day maintenance and refurbishment operational budgets for practical realisation.

The second conclusion is that the strategic importance for adaptation is difficult to make due to the absence of quantifiable risks (in specific quantified probabilities) linked to the business case. The use of probabilistic risk assessment was restricted to qualitative and semi quantitative methods as quantitative risk (probability) assessment tools (e.g. Bayesian methods, Monte Carlo techniques) were difficult to pursue due to:

- the lack of micro level (site level) climate projection, historic property management and maintenance data;
• constrained resources (time & finance) and expertise limiting the use of elaborative quantification methods; and
• limited understanding of facilities managers of climate science/projections to interpret the quantitative data and metrics in the context of their organisation.

Thirdly, there is a need for a tool assisting the assessment and quantification of future risk to building facilities, which can enable facilities managers to prepare the business case for adaptation. This tool kit must be able to: quantify the likelihood of a micro level climate change related event affecting the built assets; quantify the impact that such an event will have on both the physical attributes of a building and the business operations; predicts the degree to which coping strategies, either permanent or temporary in nature, can reduce the impact; and assess the adaptive capacity available to the organisation. Given the current state of knowledge (risk and uncertainty) associated with climate change projections it is likely that such a model will require a mix of both qualitative and quantitative metrics.

Finally, more drivers need to be introduced to stimulate adaptation actions in the private sector in order to protect businesses and their built asset from obsolescence induced through consistent impacts of climate change. For example:

• regulation needs to be introduced which ensures implementation of primary adaptation measure in addition to mitigation in refurbishment and retrofit of existing buildings.
• reporting long term coping strategies against key climate changes (e.g. overheating and flooding) as part of CSR (which will need to be based on overall risk assessment) to inform stakeholders of organisation preparedness.
• Government encouragement for uptake of adaptation measures against the level of insurance cover for long term changes and generating a market for properties with adaptation measures similar to one being presently driven for mitigation.

In addition the government needs to provide easy to use and clear climate projections and promote uptake of risk based planning in long term management of built asset in private sector.

References


