Barriers to build asset adaptation in private service sector

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Abstract

It is becoming increasingly acknowledged that adaptation and mitigation are equally important and often interrelated approaches to climate change. Recent adaptation initiatives in the UK include the promotion of many policies, reporting and economic support in the public sector. However, adaptation in the private sector still lacks such structured initiative and is initiated largely in response to external forces.

This paper presents a review of UK-based adaptation initiatives and presents a study of the adaptation decision-making process for the built assets of a large private sector organisation. The study was undertaken as a part of a PhD research programme that evaluated the usefulness of the UKCIP Risk, Uncertainty and Decision-making Framework as well as the UKCIP 02 climate change projections for facilities management decision-making. The decision-making framework and projections were used by a group of facilities personnel responsible for built asset management to explore various climate risks and develop adaptation solutions. The paper reports on issues associated with implementing the first three stages of the decision-making framework, in particular the problems faced by facilities management professionals in operationalising the risks and evaluating solutions. The following findings were drawn.

A) Adaptation in the private sector is initiated against an external change or signal, for example market forces or experience of a climate-related extreme event. **B)** For many built asset professionals the transformation of scientific climate change data into impacts on their built asset is a demanding task in terms of required knowledge and time. This process is further complicated by the long time horizon (30 years) associated with climate projections compared to the short time horizon (5-10 years) for strategic business decisions, and the uncertainty attached to climate change projections. **C)** As a result of (B), much of the analysis for decision-making remains qualitative and semi-quantitative and lacks gravitas when hard financial decisions have to be made. **D)** The perception and attitude of managerial and strategic decision-making personnel towards climate change shapes the decision-making process and adaptation option selection. **E)** Adaptive capacity, in terms of the time, finance and expertise available to organisations is important to achieving successful adaptation goals.

Although, the new UKCP09 projections have been made available since the completion of the study, many of the findings are generic in nature and directly applicable to these new tools. In conclusion, by conceptualising the observed adaptation process with that of organisation learning, it is suggested that literature on organisation learning is likely to provide an effective basis for understanding and promoting the adaptation in the private sector.

Key words – climate change, private sector adaptation, barriers, organisational learning

1. Introduction

In spite of increasing activities from the global community of scientists and governments, to address climate change through mitigation, recent global weather events have instigated a consensus that adaptation is of equal

importance and that measures, policy and initiatives in this area should be prioritised. The recent IPCC (2012) report is a step towards this, emphasising complementary approaches to address extreme weather events.

At present, the research and policy for adaptation in the UK is focused on adaptation preparedness (risk assessment) and option generation (suggestive measures) in public sector and industries such as water, highways, agriculture and social housing. Much of this work addresses flood risk and overheating scenarios.

Although adaptation measures and policy will be necessary to build in resilience at macro level (regional and national) as per Stern (2006) much of the adaptation will be autonomous (individual and business level), which will require policy support.

In light of this, the paper presents a study of formulating planned adaptation measures in response to future climate change impacts for a private sector organisation in the UK. In doing so, it highlights the issues associated with implementation of first 3 stages of the UKCIP risk, uncertainty and decision-making framework with a team of facilities management professional in a commercial setting. As a concluding note, keeping in mind the private sector organisational context, concepts from organisational learning as highlighted in other adaptation studies (Berkhout. et.al. 2006, Boyd and Osbahr, 2010, Linnenluecke and Griffiths 2010, Wilby and Vaughan, 2011) are referred to as providing future bases for contributing to the private sector climate change adaptation debate.

The structure of the article sets out the UK climate change policy initiatives for adaptation, which has addressed adaptation in the public sector initially through risk assessment and adaptation option generating exercises. The case of private sector built asset adaptation is outlined and concepts of organisational decision making and learning are presented. The methodology of the study is briefly described followed by discussion of noteworthy issues. Organisational decision-making and learning concepts are referred to, to draw out further insights from field data followed by the summary of conclusions.

2. UK policy for climate change

Although the UK has been at forefront of setting and achieving emission reduction targets since 2000, the attention to constructive adaptation initiatives have only began following the Stern (2006) report and the Pitt review (2008). Extreme events such as heat waves in 2003 and 2005 and major flooding in 2007 have also played part in raising the issue.

Both top-down and bottom-up approaches to adaptation can be noted in part due to a changing political scenario in the UK. The establishment of the Climate Change Act 2008 and formation of a Committee on Climate Change for fulfilment of the Act under the past Labour regime observes the top-down approach. The law assigns a central responsibility for reduction in emission targets and preparation of a National Adaptation Plan by assessing risk (Climate change risk assessment – CCRA) across various areas. The fulfilment of CCRA is facilitated by government institutions such as DEFRA, the Environmental Agency and Committee on Climate Change's (CCC) Adaptation Subcommittee (ASC).

The ASC supports the preparation of the CCRA and risks specific to five main areas; land use planning, national infrastructure, designing and renovating buildings, managing natural resources and effective emergency planning (ASC 2010; ASC 2011). The Planning Policy 1 and 25 along with NI 188, which assisted local authorities, were withdrawn by the recent Conservative - Liberal Democratic Coalition Government elected in 2010, and were exemplary of centrally initiated adaptation approaches.

In 1997, prior to the Climate Change Act 2008 and the ASC, the UK Climate Impacts Programme (UKCIP) was established with the sole intention of providing essential information to stakeholders in both public and private sector for planning for the changing climate. The programme has undertaken numerous research activities, for formulating adaptation tools such as the Business Areas Climate Impacts Assessment Tool (BACLIAT) and its

risk, uncertainty and decision-making framework (Willows and Connell, 2003). This is recognised by the United Nations Framework on Climate Change (UNFCC) as a methods and tool to evaluate the impacts of, vulnerability and adaptation to climate change.

In spite of continuation of some of the centrally initiated approaches of climate change act and CCC-adaptation subcommittee, as Ali and Jones (in press) emphasis, the recent Conservative- Liberal Democrat Coalition government has emphasised actions at the local level, and are more explicit with promoting a bottom down approach under the rubric of their Localism concept. This has ostensibly given communities and local authorities greater freedom to address issues and implement solutions. The recent Localism Act 2011 is the primary legislation of this initiative.

Due to these initiatives, the adaptation agenda in public sector realm has been advanced to a greater level than in private sector. This is confirmed by Ipsos MORI (2010) survey which notices that in comparison to private sector organisations, where awareness of the issue had not found roots, all the local authorities had thought about and initiated some adaptation action.

3. Case for private sector adaptation

Underlining the importance of private sector adaptation, both Stern (2006) and IPCC (2007) suggest that in addition to the planned adaptation policies, autonomous adaptation by individual and business is also crucial to build resilient society. The role of business adaptation to climate change has also been emphasized by Frith & and Colley (2006) and Metcalf et al (2010) as businesses across various sectors can expect a complex range of climate impacts, including disrupted supply chains during extreme weather events, changing customer demands, increased business running costs and growing insurance costs. Metroeconomica (2004) has further urged businesses to take a long-term strategic view that is both flexible and resilient enough to accommodate extreme conditions in its climate impact planning. Frith and Colley (2006) approach this through obsolescence, drawing attention to the higher costs and longer-term business obsolescence if adaptation requirements are ignored.

Autonomous, private sector adaptation has been addressed in few research studies, which highlight and conceptualise the adaptation pathways and observed obstacles in accordance with the sector and organisational context.

Comprising of diverse size, sector and age, businesses organisations rely primarily on their existing built asset for their day-to-day function and overall performance. This makes the future management and maintenance of the business-owned, or rented, built asset crucial if they have to successfully support the business functions.

This study's primary assertion is that existing built asset maintenance and management models predict the demands placed on the portfolio depending upon the existing stock condition and do not include climate change impacts as a factor affecting the future condition of the stock, thus being reactive in nature. In order to prepare existing built asset stock for future climate change impacts, a different approach is required whereby the impacts on built asset portfolio are assessed in accordance to climate change projections, and decisions for adaptation measures implementation are taken well ahead in time.

This study addresses the adaptation of a banking organisation's built asset portfolio for formulating a facilities management strategy, which can include pre planned climate change adaption measures. It employs a participatory research approach by implementing the UKCIP risk, uncertainty and decision making frame work, which is am iterative decision making framework with 8 stages of,

Structuring the problem:

Stage 1: Identify problem and objectives

Stage 2: Establish decision-making criteria, receptors, exposure units and risk assessment end points

Analysing the problem (tiered stages):

Stage 3: Assess risk

Stage 4: Identify options

Stage 5: Appraise options

Decision making:

Stage 6: Make decision

Post-decision actions:

Stage 7: Implement decision

Stage 8: Monitor, evaluate and review.

The framework does not generate scenarios and projections; instead it suggests that scenarios and projections be used at Stage 3, the tiered risk assessment stage. With this in mind the UKCP02 climate projections available at the time of study were used in conjunction with the framework. In this way, an adaptation and assessment process archetype is synthesised, highlighting the issues and limits experienced by facilities management professionals whilst implementing the UKCIP framework.

Keeping in mind the adaptation concepts of vulnerability, resilience and adaptive capacity, the study was situated within the context of organisation's strategy, structure, culture, approach to climate change as well as the beliefs and perception of its decision makers. Noting research conclusions from other adaptation studies, the precepts of organisational decision-making and learning are referred to, to gain insight into furthering the adaptation process in private sector organisations.

4. Concepts of organisational decision making and learning

Organisational decision-making

The concepts of organisational decision-making are surveyed here for the benefit of understanding the decision making approach employed with in organisations.

Decision-making is the process of making choices from among two or more alternatives. This process is influenced by political processes, the powers exercised by the individual making the decision, and the tactics used to gain advantage (Knights and WiIlmott 2007; Buchanan and Huczynski 2010). Decision-making within an organisation can be undertaken at three levels, described by Buchanan and Huczynski (2010) as individual, group and organisation. Within these groups two principal types of decision process occur, namely structured and unstructured (McKenna 2006).

The structured approach uses perspective-normative models where linear statistical methods are used (e.g. Bayesian theory) and is more concerned with the process than by the individual or a group (McKenna 2006). It is associated with the classical view where empiricism and positivism is supported through logical reasoning and arguments forms part of organisation's routine problem-solving (Buchanan and Huczynski 2010).

In contrast, the unstructured way adopts descriptive models and takes an approach keeping in mind the individual's cognitive dimensions and are characterised by decisions made in the presence of uncertainty and risk. i.e. where there is a lack of information to estimate likelihood of outcome and associated payoffs such as the case of climate change adaptation decision-making (McKenna 2006).

Adaptive decisions use heuristics and human judgement where, after clarifying certain judgements, the person making the decision is able to use quantitative decision tools and a decision tree to select an option. By using

descriptive models adaptive decisions take into consideration individuals' ability to process information and are influenced by factors such as individual personality, group relationship, organisational power relationships, political behaviour, external pressures, organisational strategy and information availability (Buchanan and Huczynski 2010).

These influencing factors were observed in our study while implementing the UKCIP decision making framework with group of facilities managers for adapting to future climate change impacts. For e.g. the individual belief in climate change occurrence and the availability of micro level climate change and site data were implicit in decision making. The decision making process in the study as identified by Buchanan and Huczynski (2010) was also characterised by incomplete definition, restrictive alternatives of outcomes and political influence on the final decision.

The adaptive decisions are also influenced by individual decision maker's qualitative characteristics – for instance whether the individual is 'divergent' or 'convergent ', what their decision style is, and the culture of the organisation. Organisational cultural influences on each of the five stages of decision making

1) Problem recognition – Proactive cultures promote problem solving

2) Information search – Solution seeking cultures promote more fact gathering

3) Construction of alternatives – future-oriented cultures will seek more alternatives

4) Choice – Culture dictates the level and speed at which decisions are taken

5) Implementation – Culture will determine the speed and accuracy at which the implementation is made (Alder 2002 as cited in McKenna 2006).

These precepts of decision-making are revisited in our discussions and conclusion where factors influencing the observed adaptation processes are detected in context of participatory organisational culture.

Organisational learning

The importance of organisational learning in private sector adaptation is highlighted in studies by Berkhout et al (2004); Pelling et al (2008); Boyd and Osbahr (2010); Wilby and Vaughan (2011). Berkhout (2004) explains learning as encoding in organisational routine of lessons learnt from experiences that leads to change in organisational behaviour, a process referred to as adaptation. Pelling et al (2008) emphasise organisations as social systems where structure and culture shape the learning within them.

Organisational learning occurs when individuals in an organisation experience a problematic situation and enquire into it on organisation's behalf (Argyris and Schon 1996, cited in Wang and Ahmed 2003). Learning can be said to occur at two levels,

1) Single loop learning, related to the learning sufficient to allow organisational survival which does not require major change, and

2) Double loop learning, which describes generative or fundamental learning, which enhances the capacity to create new paradigms (Kloot (1997), citing Argyris and Schon 1996 and Senge 1990).

Organisational adaptation requires double-loop learning practices, which as per the organisational learning literature are associated with four stages of: knowledge acquisition, information distribution, information interpretation and organisational memory. These stages are further influenced by culture and structure of the organisation. In particular, the management structure influences knowledge acquisition and distribution (Kloot 1997). Culture influences knowledge creation and distribution (see Figure 1 below) as it shapes the knowledge, defines relationship between individual and organisation while acquiring new knowledge, contextualises the knowledge distribution in accordance with social interaction and is able to shape the processes, which will use the acquired knowledge (Delong and Fahey 2000).

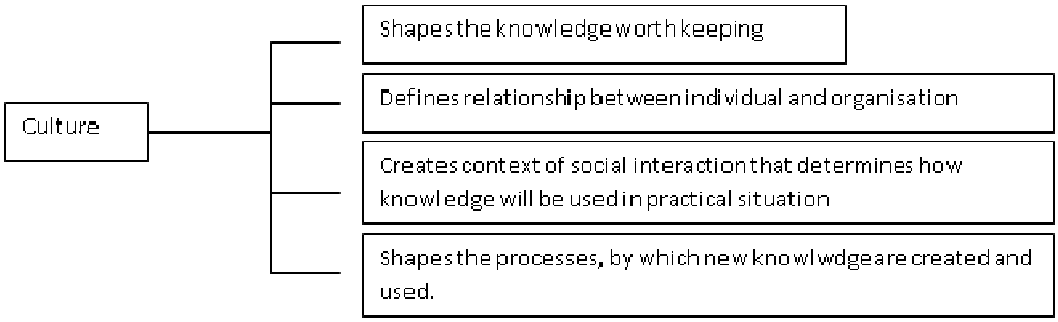

Figure 1: Culture influencing knowledge creation (derived from an explanation based in Delong and Fahey (2000)

These perspectives of organisational learning listens for organisational adaptation as a process of organisational learning and manages to distinguish those aspects of learning which may be used to further the adaptation process.

5. Methodology

Since there is little research on the subject of adapting commercial built assets to climate change through adaptive facilities management, it was necessary to test the suggested concepts of this research on a single entity first. To fulfil the research agenda, the study took a singular approach, and has undertaken a participatory study. It implemented the UKCIP framework (Willows and Connell 2003) with a team of facilities management personnel in a banking organisation .The team consisted of six members: a senior regional manager, two members from the facilities managers' team and three onsite junior managers. From total 8 stages of the framework, the study observed implementation of first three stages of UKCIP framework where by problem and objectives were identified, the decision-making criteria and acceptable risk boundaries were established and the semi quantitative risk assessment was undertaken.

The data were gathered from six organisational strategy documents and four informal interviews to establish organisational context. The direct and participation observation method (Cassel and Symon, 1994) were employed for noting qualitative data. The participation study involved six members of the relevant facilities team with whom the UKCIP framework was discussed and implemented. At each stage input from other members of the organisation was sought at the discretion of the participating team. The discussions and answers to individual questions were noted by the researcher and distributed amongst the participants at end of each stage for confirmation. The final conclusions were drawn at the end of Stage 3 as further work was restricted due to lack of data availability, resources and time commitment required from the participants.

Since the results were noted from a singular study, the issues of validity, lack of controllability, deductibility, repeatability and generalizability was addressed by employing a questionnaire survey of professional facilities managers (BIFM members) based in the United Kingdom. The questionnaire survey was distributed amongst 4,827 BIFM members, resulting in 479 responses representing a 10.8% response rate. After removing the incomplete responses the total 473 responses were analysed using the statistical software SPSS where by frequency count, relationship statistics and logistic regression was carried out, which confirmed the observations made through the participation study.

6. Results

The participant study with the commercial organisation selected and implemented the UKCIP risk, uncertainty and decision-making framework with a group of facilities managers. Made up of eight iterative stages, the framework takes a risk-based approach and frames climate change as a business risk. It remained partially

implemented due to barriers observed during implementation of initial three stages and further lack of data and resources. The importance and concise outcomes of each of the three stages is summarised here.

Stage 1 intended to identify problem and objectives, provided reasoning for decision making and identified decision maker's broad objectives. This stage helped in identifying type and level of decision i.e. climate-sensitive, climate-influenced or climate adaptation decisions and whether the decision making is at policy, programme or project level.

The outcome of the stage observed that consideration of the problem and decision making was based on experience of a flood event resulting in financial loss and higher energy expenditure during summer periods. Thus, the answer was sought for ways to adapt to present and future climate-related flood events and overheating periods. The completion of this stage was achieved through identification of the decision as one of adaptation to climate change and was considered at both policy level (strategic-level decision) and project level (decision with regard to individual property). The time span for the decision implementation was considered to be short term (≤10 years).

The second stage established decision-making criteria against which the final adaptation options are appraised. The various systems and operational built assets (receptors) under likely future impacts were scrutinised. The higher-level and lower-level risk points for the receptors were established for formal risk assessment.

This established the criteria for a decision, dependent upon the attitude to risk (risk averse or risk containing). The criteria were set in accordance with the organisation's set built asset performance targets and budgetary requirements. The built asset with customer service functions were identified as receptors. Reference was made to existing environment agency flood maps, and the organisation's maintenance complaints database, for identifying sample properties that would be at risk. This was in accordance to the existing participant's perception that with climate change the existing at-risk sites will only experience further severe and frequent flooding.

A total of 90 sites were assessed as having some amount of risk of flooding. Out of these, 37 sites were classified as having high risk while another 12 were classified at moderate and low risk in equal proportions, making the total count of at risk sites as 61. The clarity on assessment end points was a crucial element of the stage, whereby the team took account of asset importance to business functions and climate projection data for establishing low, moderate and high-level end points. For instance, climate projections with high probability and high confidence and associated high financial and operational business importance were classified as higher assessment end points, while projections with low probability and low confidence associated with low business function loss were classified as lower assessment end points.

Based on the information gathered through prior stages, Stage 3 assessed the risk and was a three tiered process. Tier 1 assessed the preliminary climate change risk, while Tiers 2 and 3 assessed the qualitative and quantitative climate change risk assessment involving complex tools and techniques. Tier 1 analysis helped to shortlist the climate variables which could potentially affect the receptor and the options for adaptation. It also helped in identifying the climate variables, which could in turn affect the decision and characterised climatic and non-climatic risks. Tier 2 of Stage 3 was adapted to investigate qualitative and quantitative risks on the basis of the climate variables and projection time series identified by Tier 1.

Under the Tier 1 precipitation levels, coastal sea-level rise, and summer temperature were regarded as variables of interest. A matrix of key climate variables and their characteristics affecting the decision was prepared. This allowed a grading of the confidence levels in the assessments of links between variable and decision criteria.

Tier 1 of Stage 3 helped the team in its preliminary risk screening due to climate change by establishing: (a) the time frame of the climate change to be considered (the 2011–2020 time series) while considering medium-high climate change scenario; (b) the climate variables which can affect the decision; and (c) The variability and the confidence level attached to the expected changes according to the UKCIP02 scientific report. The team also acknowledged that the limited finance and expertise available on the subject might affect the final decision.

Tier 2 of Stage 3 was adapted to further assess the qualitative and quantitative risks on the basis of the climate variables and projection time series identified in Tier 1.The probability of identified climate variables was considered with the scientific confidence level attached to them and the changes in climate variable with high and moderate (likely) confidence levels were considered in a further assessment. The assessment made was qualitative and semi-quantitative in nature, owing to the unavailability of historical site-specific climate damage data, an absence of micro-level climate change projections over a short time period (7–10 yr.), participant's relative lack of understanding of detailed scientific projections and lack of resources and expertise for implementing elaborate quantitative risk assessment methods.

Although projection uncertainty was looked at, it proved very difficult to persuade the organisation to consider further data collection and quantitative assessment and consider long term planned adaptation interventions. This was partly due to department's existing culture of planning for short term gain and lack of strategic importance given to the issue. As a result, a semi quantitative assessment and matrix was developed to assess the likely risk to the sample properties.

Further stages of option identification (Stage 4), option appraisal (Stage 5) and decision making, implementation and monitoring (Stage 6, 7 and 8) were not fulfilled due to lack of data, time and resources. In spite of this on the basis of outcomes achieved in Stage 1,2 and 3 the organisation decided to adopt a responsive strategy for climate change adaptation (keeping a watching brief and only intervening when a problem presents itself) 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 surveys and quantitative assessments could be made.

The end of Stage 3 of the UKCIP framework within the participating organisation unfolded an assessment and adaptation process with their associative barriers. The hurdles observed with assessment process were technical in nature i.e. skills required to deal with unfamiliar and complex data transformation for decision making. These were identified as

1) Uncertainty relating to climate change projection and absence of micro level probability data;
2) Difficulty in translating climate change projections into business operational risk;
3) The temporal nature of climate change projections i.e. long time line (30 years) associated with climate projections compared to the short time lime for strategic business decisions.

These barriers had resulted in semi-quantitative risk assessment and lacked gravitas for making hard financial and strategic decisions. The obstacles observed in fulfilment of adaptation process were cognitive and organisational in nature, and included,

1) Dependence and quality of external signal for initiation of the adaptation process;
2) Organisational and the facilities managers perception of risk, associated with belief in occurrence of climate change;
3) Adaptive capacity in terms finance, resources and expertise available to organisation and their deployment, influenced by managerial perception and informed by organisational structure, culture and other contextual factors.

7. Obstacles observed in the assessment process

In spite of being successful generating wider awareness and concern towards adaptation during the study the UKCIP guidance was cited as long and complex by the participants. The hurdles experienced during the study were both technical and cognitive in nature. This is in line with the findings from Demeritt and Langdon (2004), who reporting on surveys of public-sector use of UKCIP information in primary years, suggested that in spite of more accurate and freely available data, 'technical–cognitive and practical–temporal' difficulties in understanding official sources of climate change information and its restrained practical relevance to the administrative functions limited the use of such data and guidance for addressing climate change in local authorities. Comments on nature of guidance also include its limited take up and varied user response, receiving

significant credit in the adaptation community (e.g. IPCC, Stern Review, Australian Greenhouse Office) at one end of the scale while being criticised at the other as difficult to understand due to its technical detail highlighting the inherent difficulty in communicating adaptation to a wider audience (Brown et al 2011).

The assessment process preliminary was restricted due uncertainty associated with climate change projections and absence of micro-level probability data. The lack of site specific data on the frequency and intensity of past weather event was cited pivotal as evident form following comment.

"If I had past data for my property, it would be much easier for me to conduct future enquiries, I guess." (Dec 2006-ID)

Acquiring this information was deemed useful in assessing the loss of business continuity due to infrastructure damage and support provided by local government in such event, while combining this data with the micro-level climate change projections would advance the future risk assessment.

Due to the lack of adaptation policy initiatives at time of study such data was not available from the local authorities and the available climate change projections lacked specific micro-level spatial scale, only providing future projections over wider geographical areas. The adaptation-limits imposed by this (pre-UKCP09) lack of spatial resolution for future risk assessment has also been expressed by Salagnac (2007) and O'Brien et al (2004). The potential options of statistical downscaling and weather generating tools for obtaining micro level projection for quantitative risk assessment were not imagined as result of the existing resource and knowledge boundaries of the organisation.

Uncertainty in this scenario was addressed by referring to the combined knowledge of the scientific expert judgement attached to macro-level climate change projections as per projection guidance and information from Environment Agency flood maps, assisted by team's historic knowledge of property maintenance in areas of concern. In spite of this collective knowledge, such assessment only helped in the qualitative and semi-quantitative screening of risks, providing an outline of impacts on built assets functions. This proved to be less helpful towards future planning and making a business case lacking the 'hard edged' gravitas to support difficult financial decisions.

The secondary hindrance was difficulty in translating climate change projections into business operational risk as whilst working with the UKCIP decision-making framework and the UKCIP02 climate projections, it was difficult for the team to translate the projection into operational risk. This was emphasised by comments as,

"A 2°C rise in temperature or 5% increase in precipitation to the 1960 base line is confusing for me to relate to. What I need to know is what I will face in the next three years so I can budget for it next year."(FM manager).

Such claims have also been found in a recent Ipsos MORI (2010) survey, which found that organisations wanted to know what the effects of climate change would be, not what they *might* be, and to understand their relevance to them.

A lack of expertise in using climate data for risk assessment process was clear from comments to the following effect,

"There are three time [series] projections and each with a different scenario. This is very confusing for a building person like me." (Junior Facilities Manager.)

This managerial unfamiliarity with climate change data was unsurprising as the managers' daily routine is devoid of such data use and interpretation. The conventional practice uses risk assessment principles for hazard risk assessment, which lacks the long-term planning and quantitative characteristics that scientific climate projection use. This discomfort was recognized in the wider business community as, in spite of reporting awareness of climate change, little involvement was cited with adaptation initiatives and actions. Resolve to this obstacle is suggested by encouraging familiarity and work with climate data (Willows and Connell 2003).

The temporally mismatched nature of climate change projections was cited as one of the important hindrance. This temporal mismatch existed due to market dependent the business planning horizon of 5-10 years of participating organisation and 30 years projection time line. The influence of these factors was evident on built asset management as the maximum planning horizon for maintenance was restricted to five years from which, annual reviews and budgeting had to be derived. Due to this, long term projections of 20–30 years and uncertainty were difficult for built asset managers to comprehend and translate into short-term impacts. This reinforces the quest for information on short-term impacts rather than long-term by commercial sector as highlighted by Ipsos MORI (2010).

8. Limitations observed in the adaptation process

The initiation of adaptation process was observed to be dependent on quality of the external signal as experience of an extreme event or the threat of financial loss had forwarded the strategic intention of adaptation in present study. The organisation's agreement to be involved with the study into including adaptation measures in existing built-asset maintenance and management was a result of financial loss experienced due to flooding event and increase in energy expenditure and workplace discomfort in summer months. The wider applicability of this concept was also found in the questionnaire responses, where the extreme event had an influence on the organisation's examination of the future climate change impacts. This agrees with existing research where external signal recognition in terms of event experience or market change is identified as first stage of adaptation cycle (Berkhout et al 2004 and 2006).

The positive or negative impact of such signals informs the intensity of the risk perception. The risk perception influenced the adaptation process and consecutive actions of decision-makers in present study following the sensing of external signal. This is because risk perceptions and a willingness to address climate change matters in predicting behavioural intention, and behavioural intentions concerning climate change is complex: "people are neither non-believers nor complete believers" (O'Connor 1999).

It has been suggested that recognising the causes of global climate change is a powerful predictor of behavioural intentions, independent of belief in climate change, while risk perception and increased knowledge should promote action even in the presence of a 'weak signal' and uncertainty about climate change (O'Connor 1999). During the participant study, the knowledge of the participants regarding causes and impacts of climate change was noticed to be extended. This in association with the experience of a weather event had advanced the risk perception and was pivotal in identifying various action trigger points for built asset stocks, irrespective of the temporal scale and attached uncertainty.

The selection of adaptation options based on the set trigger points was limited by resources availability and deployment, which is in turn, was influenced by managerial perceptions correlated with the organisational structure and culture. The barriers experienced as a result of management system and governance structure were evident in the participant study as in spite of possessing a robust financial capacity to assess and aid adaption, availing these resources to respective departments and personnel within the organisation was observed and reported to be inconsistent. This was due to hierarchical and authoritative management structure which took minimal note of suggestions from lower-level operational teams and required detailed assessment and evidence for investing in new measures. This decision support capability for detailed assessment was curtailed as a result of a lack of technical knowhow and the considerable time investment required in handling climate change projections with uncertainty analysis. The ossified culture of the organisation did little to promote individual progression in learning new skills and had resulted in selection soft adaptation measures.

Furthermore, managerial perceptions of the need to address adaptation played an important role. These perceptions were influenced and reinforced by the organisational culture and strategic intent. A culture of achieving effective financial performance was established amongst the built maintenance and management department, promoting a short-term befits strategy instead of long-term planning. These limitations were accompanied by the managerial view that organisation cannot be seen to be undertaking every adaptation action as all the public facilities apart from the physical built asset stock that were essential to deliver business continuity, such as roads, electricity and telecommunication were not under their remit to address. In summation

the observation made here agrees with Strandholm et al (2004) and Fernàndez et al (2006) who argue that managerial perception, attitude and personal characteristics, along with their organisation's strategic response and organisational characteristics, are decisive in organisational response to any environmental aspects and managers take action for environmental issues depending upon how they relate to them, the external pressures, and how much time and resources the action would attract.

9. Relating organisation decision-making and learning theory

As mentioned earlier, adaptive decisions uses heuristics and human judgement are unstructured in nature and are influenced by the culture of the organisation. Adaptation decisions require dealing with incomplete information and uncertain future scenarios. They are more commonly adopted by divergent individuals as a divergent individual is comfortable with uncertain situations, and will tend to explore numerous avenues to problem-solving (McKenna 2006).

Reflecting on the study, the participants were seen to approach adaptation decisions in an unstructured way but were not completely aligned to divergent ways of operating. This was evident as in absence of the micro level climate change projection the team turned back to tried and tested way of data collection. Although the team tried to gather as much information as possible, a comprehensive search for all possible avenues for problem resolution was not sought. This was informed by short term gain culture and did not advocate detailed data collection or external collaboration.

Along with organisational decision-making, the precepts of organisational learning were useful in understanding the adaption process. During the participant study following observations were made in accordance with organisational learning concepts

1) The organisation's decision for involvement with the research and its initiation in learning was based on the experience of financial loss due to an extreme weather event. A common consensus amongst the facilities management team existed in that such occurrences might increase with climate change, posing a threat to many other properties and business functions within the entire property portfolio. This observation was in accordance with the percept that organisational learning happens in response to an external threat or problem (Argyris and Schön 1996 cited in Wang and Ahmed 2003).

2) The organisation had achieved 'single-loop' learning during the research study as it had learned to alter existing processes and strategies to ensure survival for e.g. the business continuity plans were revisted and strengthened, trigger points were established for at risk properties and soft adaptation measures were preferred over hard adaptation options of refurbishments. The fulfilment of 'double-loop' learning leading to a paradigm shift was not achieved as capacities for assessing and quantifying the future impacts on the business leading to strategic importance given to the adaptation agenda were not developed. This observation supports the concept that learning for adaptation and increasing adaptive capacity has to be 'double-loop' learning (Kloot 1997, citing Senge 1990).

3) In principle learning is multi-staged, involving processes of knowledge acquisition, information distribution, information interpretation and organisational memory (Kloot 1997). These principles are translated by Berkhoutet.et.al (2004) to signal recognition and interpretation, experimentation and search, and knowledge articulation and codification. The participating organisation adopted similar stages in its own learning processes where the experience of the extreme weather event is viewed as signal recognition. The stage of knowledge acquisition, distribution and interpretation (or experimentation and search) is represented in practice by the implementation of the UKCIP decision-making framework and when the data on property portfolio and climate projections were gathered in order to undertake possible impact assessment.

4) Since double-loop learning is generative in nature, it can only take place when all the aspects of an organisation are transformed, including its culture and structure. In the present research, the structure of

the main participating organisation was hierarchical and the culture was found to be resonating between role and power cultures where the decisions are taken by a few and workers adhered to rules and set patterns. There was little room for transformative learning. The structure and culture affected the learning stages as they were decisive in knowledge gathering, conservation, and experimentation and sharing. For e.g. The operating maintenance team had observed the deviation in energy consumption due to overheating and had gathered information on measures for energy efficient cooling systems but this was not communicated to the other regional teams or managerial staff as the culture of the organisation did not facilitate knowledge sharing. Even while such knowledge was shared, the implementations of measures were hindered by the hierarchical structure requiring detail quantitative analysis for investment decision. In case of adapting the properties at high risk of flooding, preference was given to routine practices where disaster recovery plans were strengthened and insurance covers were reviewed allowing very little additional knowledge gathering and experimentation with other measures. These observations confirmed the paradigm that double-loop learning and its stages are influenced by the organisational culture and structure (Kloot 1997; Lopez et. al 2004; Pelling 2008).

Over all it was concluded that climate change adaptation in present study was influenced by organisational decision making and learning capacities, intercepted by the attributes of individual risk perception, belief in climate change, and culture and structure of organisations. In order to shape and promote the future climate change adaptation in wider private sector these attributes need to be addressed.

Conclusion

The paper has presented a study of adapting a private sector built asset portfolio to future climate change impacts. In doing so it has presented a case of implementing UKCIP risk, uncertainty and decision making framework with a banking organisation and has followed participatory study and questionnaire survey approach.

In summary, the study observed that the experience of a recent weather event was an indicator for initiating adaptation in both participant study and the lager business community. Adaptation was not seen as priority in strategic business development till the time a loss had been experienced and a learning process is initiated. This learning allowed organisation to relate and work with climate change projections, to generate assessments using new and existing data for negotiating uncertainty. This process was intercepted by individuals risk perception, organisational culture and strategic approach as climate change adaptation decision are unstructured decision requiring divergent individual to deal with uncertainty, likely to be supported by lateral organisational structure and non-restrictive culture.

The results highlight the technical barriers experienced by the team in the assessment of future risk. This included; 1) uncertainty relating to climate change projection and absence of micro level probability data; 2) difficulty in translating climate change projections into business operational risk and 3) the mismatched temporal nature of climate change projections in comparison to strategic business decision (30yrs vs 5-10yrs).

More organisational barriers to the adaptation process were observed to include; 1) a conservative dependence on the quality of the external signal for initiation of the adaptation process; 2) Manager's perception of risk, associated with their belief in the occurrence of climate change, and 3) adaptive capacity in terms finance, resources and expertise available to and deployed by the organisation.

These conclusions reflect arguments outlined in later adaptation research studies carried out at in the local public sector by the CREW consortium (Community Resilience to Extreme Weather Events) Jones and Few (2009). The results of study (Ali and Jones, in press) revealed that adaptation at local level, as in the present study, consisted of assessing future risk based on known risks and experiences of one or more extreme events.

The provision of short-term climate change projections and risk assessment was found to be a highly resource-intensive task, rarely if ever to be found at the locality level nationwide. This matched the situation of the private-sector organisation in the present study. Needless to say there is an observed appetite for short-term

climate change projections and attached local area risk assessments, which would be welcomed by both public and private sectors.

In conclusion, it is noted that private sector adaptation needs to be supported by policy consideration and initiatives on par with those existing in the public sector. The communication of an adaptation agenda, cognisant of internal organisational conditions and risk perceptions, accompanied by a promotion of learning organisational attributes is likely to enable and catalyse adaptation actions within private sector.

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Adaptive capacity is one of the key concepts of climate change adaptation and is defined by IPCC 2007 as "ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences". In cases of increased vulnerability caused by climate change impacts, the level to which a system is capable of surviving will depend on its adaptive capacity and this will differ as per the business sector, region and nation. In order to achieve climate change adaptation it is necessary to take account of the vulnerabilities and adaptive capacities of different sectors in accordance with their location (O'Brien et al 2004). In case of private sector service based organisations, the use of technical knowhow and financial resources is considered essential in achieving business continuity planning and can be defined as a key organisational adaptive capacity. Additional elements include "strategy, operations, management systems, and governance structure and decision-support capabilities" (Starr et al, 2004).