

# Investigating SME resilience and their adaptive capacities to extreme weather events: A literature review and synthesis

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## Abstract

In the UK, extreme weather events (EWEs) such as floods, heat waves and storms are increasing in frequency and severity. The ability of local communities to cope with the immediate impact and recover from the aftermath is critical to the continued well-being of the community that is affected. As part of Engineering and Physical Sciences Research Council (EPSRC) funded projects we investigate how Small and medium-scale Enterprises (SMEs), prepare themselves for the effects of EWEs. SMEs constitute a substantial proportion of the community that is affected as a result of these events. They need to prepare themselves for the effects of EWEs in a way that minimises disruption to them and allows them to return to near normal working conditions as soon as possible after an event. Very few studies have examined how SMEs respond to EWEs. Policy makers and theorists in this field have proposed various models and frameworks to improve the adaptive capacities of SMEs by concentrating on identification of risks and opportunities coupled with strategy development and implementation. Their individual and collective attitudes influence the activities that SMEs perform towards preparation of disaster preparedness plans and post disaster recovery measures. The paper argues that this continuous process of engaging SMEs will develop their adaptive capacities and enhance their coping measures in facing up to the risk of extreme weather events. The paper provides a literature review and a synthesis and a methodological vehicle to guide this research.

**Keywords:** SME, extreme weather events, coping skills, adaptive capacity, built environment

## 1. Introduction and main focus

The World Bank estimates that, in 1998, various natural disasters killed over 50,000 people and destroyed \$65 billion worth of property and infrastructure [1]. This number significantly increased in 2004 due to the tsunami. South Asia Disaster Report [2] states that 2004 – 05

period was the ‘most appalling’ period in the history of South Asia. In the UK, extreme weather events (EWEs) such as floods, heat waves and storms are increasing in frequency and severity. For instance, according to UKCIP [3] climate change is likely to impact on winter peak river flows to rise up to 20% by 2050. Further, insurance industry reports specify that this will double the likelihood of flooding in certain areas [4]. The ability of local communities to cope with the immediate impact and recover from the aftermath of a disaster is critical to the continued well-being of the community that is affected. Small and medium-scale Enterprises (SMEs) constitute a substantial proportion of the community that is affected as a result of these events. They need to prepare themselves for the effects of EWEs in a way that minimises disruption to them and allows them to return to near normal working conditions as soon as possible after an event. Most of the natural disasters affect many organisations and are difficult to predict or prevent. SMEs in particular are often affected directly and indirectly from the very same disasters faced by large companies. However, the former tend to have fewer resources than their larger counterparts with which to plan, respond and recover. As part of UK’s Engineering and Physical Science Research Council (EPSRC) ideas factory project titled “community resilience to extreme weather events through improved local decision making”, we investigate the role of SME’s within a community in response to extreme weather events in the UK. The three year research project commences in February 2008.

The objective of the paper is to conduct a literature review on unique characteristics of SMEs, their general behaviours and decision making. These will inform the investigation of the various coping mechanisms and the importance of SME resilience and disaster risk management (DRM) plans. The literature review and synthesis of the paper will serve as the foundation for research. This paper will also inform policy making in the area of building resilience and coping strategies for SMEs when facing up to EWEs.

The paper is organised as follows. First, it provides insights into the unique behaviour of SMEs and how this behaviour is aligned with improving their coping strategies against extreme weather events. Then, the paper focuses on disaster risk management and discuss cases from various countries on the importance of disaster risk management planning to SMEs. The third section of the paper provides insights into participatory approaches as a potential tool to engage SMEs into generate solutions for them to effectively and efficiently face up to challenges of extreme weather events. The paper then sets out the research problem and the methodology. Finally the conclusions are drawn.

## **2. Literature review and synthesis**

### **2.1 SMEs and their unique behaviour**

Burk [5] presents the European Union based definition for an SME by considering its number of employees and annual turnover. Accordingly an SME could have 1 – 250 employees and a turnover of up to Euro 50 million. This size is relevant to the particular sector in which the SME operates. For example an SME in the oil sector, where there are a number of extremely large corporations, may be classified as small as a comparative measure. A similar size firm in the

fashion design industry may be classified as large as the fashion design industry consists of many large firms [5]. SMEs are socially and economically important to society, “since they typically represent 99% of all enterprises in Europe and America” [5: 14]. According to Robbins et al [6] SMEs are important to the economic vitality of cities, states and the countries due to their significant number and employees. However, they tend to display vulnerability in facing up to various conditions prevailing in a country’s economy resulting in business failure. Ability of SMEs to turnaround their companies is constrained due to their limited access to financial resources and capital [7]. It is therefore pertinent to investigate unique SME behaviour, their coping skills, resilience in facing up to both direct effects of extreme weather events as well as the various indirect economic effects of extreme weather.

Historically, it has been recognised that the SME sector poses various challenges for implementing policies, transfer of good practice and various Government agendas. For instance, studies conducted by researchers at University of Salford [see 8, 9, 10] identified that strategic horizons and organisational capabilities of SMEs did not allow sufficient ‘organisational slack’ to conduct activities outside their main business activities. Therefore for an appropriate SME resilience agenda to emerge it is of strategic importance that mitigating measures against EWE’s are conceptualised as closely associated with the mainstream business activities of these companies. This notion will further strengthen the processes followed for effective engagement, identification of SME coping strategies, role of intermediaries and preparation of interface toolkits and other support material.

SMEs’ ability to effectively react to various EWEs are often affected due to lack of planning, vulnerability to cash flow interruptions, lack of capital for recovery, ineffectual interactions with national agencies, infra-structure problems [11], individual attitudes and organisational culture [12], access to expertise, business sector and perceived exposure to risk [13]. Collectively these factors determine the adaptive capacities and the overall behaviour of SMEs. For SMEs one also needs to consider the general attitudes towards disaster recovery and business continuity planning (BCP). Even though guidance exists for BCP [14], most SMEs do not consider it, or are under-insured against the potential risks [15].

## **2.2 Disaster risk management (DRM) and SMEs**

The severity of extreme weather events has impacted many businesses and individuals and the effect has spread over to various regions in the world. The main risks to any business of EWEs are increased costs and loss of revenue. According to Canadian Chamber of Commerce [16] the risks (within the context of Canada) could include risks of blackouts and damage to property and inventory from floods and high winds as a result of extreme weather events. In addition crop failures from drought will affect farmers, and lack of snow in winter will affect ski resorts. In the UK, Boshier et al [4] identified that most significant threats to the built environment in the UK were considered to be floods, climate change, ageing/inadequate infrastructure, and inadequate urban planning. Figure 1 identifies the perceived threat to the built environment through the multi-sectorial study conducted by Boshier et al [4].

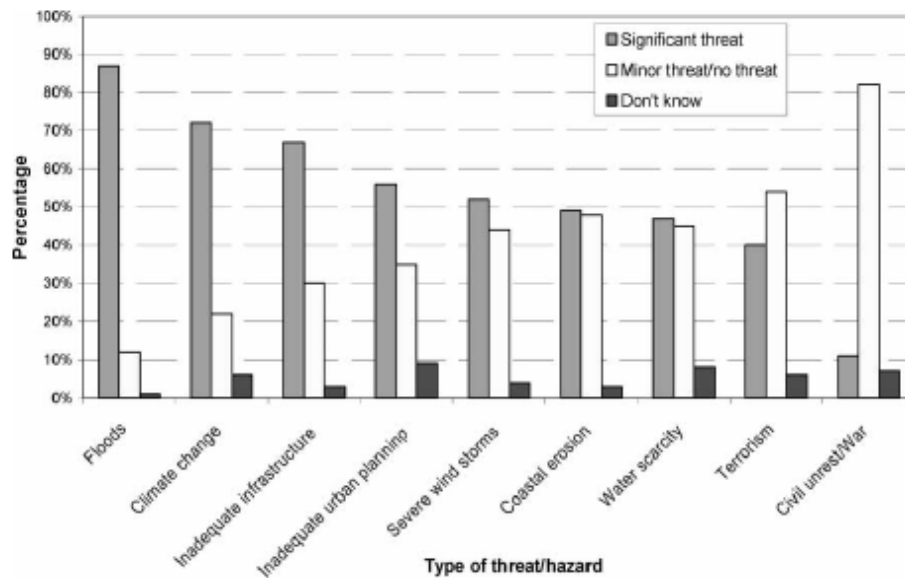


Figure 1: Perceived threats to the built environment through a Multi-sectorial study (Source: [4])

The ability of companies and individuals to insure these losses vary to a large extent. SMEs in particular find it very difficult to insure against EWEs due to the funding restrictions that they have. According to Dunn and Flavin [17], who studied results from the insurance industry, found that losses caused by various extreme weather events have multiplied several times as indicated in Figure 2.

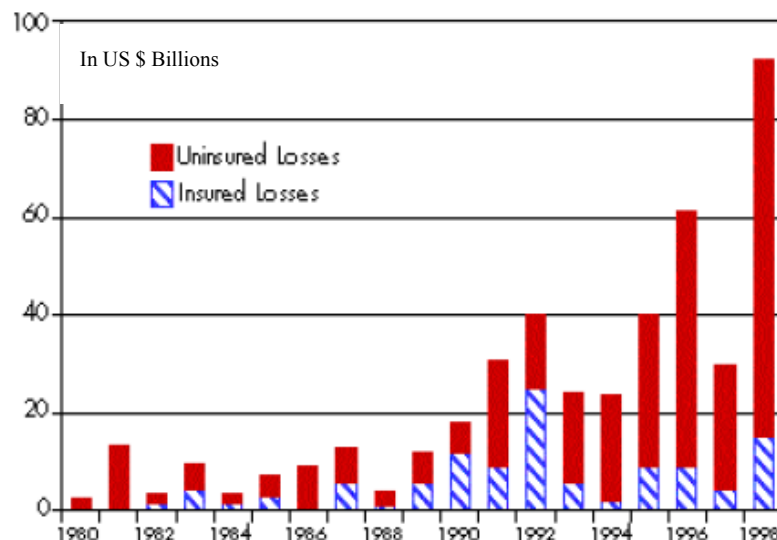


Figure 2: Losses from weather related disasters in the world (Source: [18])

As stated by Raksakulthai [18] insurance companies paid US \$91.8 billion in losses from weather-related natural disasters around the world in the 1990s. This was a significant increase from the previous decade. This report further states that, “as developing nations attempt to build infrastructure and a tourism industry, some may find insurance rates prohibitive because of their vulnerability to extreme weather events” [18: 25]. Many insurers have already raised the premium rates for islands like Jamaica following the destructive hurricane Hugo of the late 1980s, while others have completely withdrawn property insurance”. To a large extent, this phenomenon also applies to SMEs in developed countries. For instance, in the UK, Overall buildings insurance increased by 3% to cover estimated £3 billion flood damage in June and July 2007 and the Association of British Insurers (ABI) in the UK have stressed that £800 million per year additional funding pledged by the UK Government is insufficient and they may conduct a review of providing buildings insurance in the light of these heavy losses [19]. This might result in either significant increases in insurance premium or complete withdrawal of buildings insurance cover for areas subjected to extreme flooding. This was proven within the context of the Caribbean Islands in the 1980’s when they suffered from the effect of hurricanes. This effect will further constrain SMEs in pursuing the insurance route and strengthen calls by policy makers of various other risk management planning, resilience measures and strengthening their coping mechanisms. Due to possible non-availability of insurance schemes in the future to cover business premises in areas of severe flood risk, several opportunities may arise where we can apply case studies and good practices from developing countries in the area of disaster risk management (in developing countries some of the insurance schemes found in developed countries are not available). In contrast to non-availability of insurance schemes, in the recent past, certain countries have witnessed the introduction of new insurance schemes in areas which are prone to various extreme weather events. For instance, according to Raksakulthai [18], the skiing industry is so vulnerable to climatic changes that some resorts protect themselves from decreased snow cover by purchasing ‘snow insurance’. This indicates that some companies are developing or expanding coverage for loss of business due to various weather-related events, which are likely to increase around the world. For the insurance industry, therefore, new opportunities might arise for new products to be introduced.

According to Schneider [20] DRM has often been viewed as a reactive measure because activities such as risk reduction and hazard mitigation are rarely seen as urgent. To reduce risks, Bosher et al [4] suggests various forms of mitigation measures. Some of the non-structural measures address the development of coping mechanisms and consist of various behavioural changes that the companies can make in either avoiding or reducing the impact of risk in facing up to extreme weather events. Within the hotel sector, Raksakulthai [18] lists out various indigenous strategies that large resort hotels adopt such as when the meteorological department predicts high winds making swimming for children dangerous, alternative activities are planned at the man-made lakes located within their resorts. However, small businesses (small hoteliers) do not have adequate resources to adopt the requisite behavioural changes due to unfavourable weather conditions. They face financial, manpower and other resource constraints. For instance, guides working for small hotels who takes tourists on diving excursions or trips to nearby islands such as ‘Phi Phi’ also receives the weather report each day (like large hotels). When rain

is forecasted (or when it starts raining), the guides have no choice but to cancel the trip as they are unable to organize any alternative trips due to constraints in funding.

Jackson [21] studied various stakeholders in the tourism sector, in Caribbean Islands and found that their level of concern about the vulnerability of building in coastal areas despite the damages and economic setbacks caused by hurricanes in recent years was very low. Part of the challenge therefore was to convince the various stakeholder groups who believed that there are no viable alternatives to beach tourism of the risks involved in pursuing existing land use policies without adjustments. Large hotel owners (resorts) on the other hand who construct their premises using multi storied buildings, have a number of advantages such as small building footprints to guestroom floor space ratio that reduced the number of guest units that are vulnerable to storm surge related flooding. But it was found that the SME hotel owners built their hotels with a larger footprint within the coastal areas, thus increasing their vulnerability to the effects of extreme weather. The degree both SMEs and large companies are affected due to extreme weather and the emphasis on risk management can be assessed through various impact assessment tools. As part of disaster risk management, UKCIP [3] proposes a holistic impacts assessment tool for organizations to assess the potential impacts of various EWEs on their business. This tool emphasizes that the scope of risk assessment should not be limited to one particular company and it should be broadened to cover other SMEs that are involved in the supply chain. For instance, it recommends several focus areas for risk assessment such as understanding the vulnerability of the supply chain companies to EWEs, which is important as any delays on scheduled deliveries, power outages and the effect to the transport infrastructure can cause severe problems to another company's operations although it is not directly affected by an EWE.

Aside from some of the above risk assessment tools recommended for businesses, DRM strategies are usually prepared for communities at large and are often conducted by International Non-Governmental Organisations and various agencies in developing countries (Shook, [22]) and local councils and Government policy makers in developed countries. In addition, large multinational companies which have access to financial and other resources conduct their own DRM plans. Sometimes, DRM becomes a mandatory process that large companies have to undertake due to the potential hazard that could be created to the society at large. For example, severe flooding in the area of Surrey in the UK could have caused the recent spread of the "foot and mouth disease" in the area. Investigations into the cause of the epidemic revealed that appropriate measures were not put in place within an animal health laboratory in the area [23]. This is indicative of the inadequate DRM conducted by the private laboratory, mainly against the effect of severe flooding due to the perceived remoteness of such an effect. DRM, therefore is relatively common at the level of the communities and large companies, but SMEs usually do not consider DRM activities as a priority area within their businesses due to the perceived misalignment between the opportunity costs of DRM and potential future profitability of their businesses. As pointed out earlier, SMEs are not usually receptive to Government policy making. Governments, SME associations, supply chain companies should therefore work with the SMEs to facilitate behavioural changes so that SMEs could develop their coping measures and decision making skills. One approach that might benefit is known as adopting of

participatory approaches. Adopting participatory approaches could ensure continuous SME engagement in DRM by understanding of existing SME coping strategies and their adaptive capacities and changing their behaviours by building up their resilience in facing up to EWEs.

The objective of adopting participatory approaches is to facilitate a process of knowledge transfer between the Government policy makers, SME associations, supply chain associates and the targeted SMEs. The key challenge of good practice knowledge transfer is how easily it is absorbed by the transferee. This depends on the absorptive capacity (Cohen and Leventhal, [24]) of the recipient and the appropriateness of the new context to receive the new knowledge. According to Lillrank [25] the transfer process involves three variables. They are; the level of abstraction used in the process, the approach of actors involved in the process and the type of managerial content transferred. Further, Goh [26] citing Zulzanski [27] focuses on transferee characteristics and points out that a recipient's lack of motivation, absorptive capacity and retentive capacity can result in poor transfer of knowledge. Therefore a participatory approach should aim at achieving the above outcomes for SMEs to successfully develop their adaptive capacities.

### **2.3 Participatory approaches for effective engagement of SMEs and synthesis**

The objective of participatory approaches is to gain some of the subtle dynamics of the SME community that is affected due to the EWEs and gaining a thorough knowledge on how their coping skills, BCP measures and their decision making aspects are influenced. This knowledge is gained through a continuous process of engagement between the various elements of the SME network. The continuous process of engagement through adopting of participatory approaches ensures the fulfilment of the three variables cited by [25]. Any disconnection between these elements would result in possible failure of the SME engagement process. A significant part of this knowledge is not available in explicit fashion (as documents). This knowledge exists mainly as tacit knowledge and is embedded and grounded within the SMEs and their actions. (both individual as well as within networks). For example Empson [28] refers to explicit knowledge as the 'tip of the iceberg', because a substantial part of the knowledge is tacit and hidden below the surface. Practical action [29] suggests various tools for participatory assessments as good practice information. Some of the participatory tools are observation, semi-structured interviews, drama, role play, diagrams and visual tools, mapping, modelling of various scenarios. (for a full list of participatory tools – see [29]). The Practical action infopack is tailor-made for individual households and has a community emphasis. We attempt to customise some of these tools to cater for SME engagement. Moving from community to encapsulate companies, is a major step forward considering the change in the unit of analysis.

Several other participatory tools exist in practice. One of the techniques that can be combined with SME engagement in coping with EWEs is to visually model various EWE scenarios to understand SME behaviour, their adaptive capacity, coping skills and the overall resilience. First, this technique can be utilised to present SMEs with different scenarios utilising a very user friendly interface and then it can also be used to capture the different perspectives of the SMEs.

According to Doduras and James [30] fuzzy modelling techniques can also encourage participation and improve communication between different SME groups. Soft systems modeling technique can be used to build up these EWE scenarios. Soft systems modelling utilises the rich picture diagram technique. Sutrisna and Barrett [31] adopted the rich picture diagram (RPD) technique to map a construction process. The rationale for the RPD here was to “acknowledge the complexity and specific characteristics of each construction project in trying to congregate evidences to tell the storyline of the construction project being studied” [31]. Within the context of SME engagement in facing up to EWEs, RPD can be utilised both to transfer the knowledge relating to various EWEs to the SMEs as well as to understand SME coping mechanisms and their decision making processes. Therefore RPD can be used both as a data gathering as well as a data analysis tool.

Further, Brown-Gaddis et al, [32] adopted computer based participatory modeling technique to engage various stakeholders. This has become an important means by which stakeholders are engaged in the scientific process. There are many stages in the modeling process in which stakeholders can engage including model development, data collection, model assumptions, scenario development, interpretation of results, and development of policy alternatives based on model results [32].

The above discussion indicates that simply raising awareness of the problems with the SMEs will not result in behavioural changes. Although large companies will be to a certain extent be receptive to various Government policy making and regulations towards DRMs and improving their adaptive capacities, SMEs perceive such strategies as too remotely connected and misaligned with their business objectives. Therefore, a possible way of making effective changes to SME work practices and behaviour, might be to effectively engage them through a formalized way that is sympathetic to their specific working conditions and needs. Through the literature review and synthesis the paper then sets out the broad research problem so that SMEs are informed of ways and means of improving their adaptive capacity and coping strategies in facing up to extreme weather events.

### **3. Problem identification and research focus**

SMEs as a group constitute an important element in a country's economy. Due to the lack of access to financial resources and capital, they are unable to survive against volatility of markets and adverse economic conditions. Therefore as EWEs can create devastating effects on the economy of a country, they can exert undesirable consequences against the survival of SMEs. Although this effect is well documented in literature (Canadian Chamber of Commerce, [16]; UKCIP, [3]), very few studies have examined the existing coping strategies, adaptive capacities and the SMEs' overall resilience in response to the effect of EWEs. Also it is important to further extend the study to include sector based comparison of how SMEs cope with EWEs. For example, how different would a SME type firm of solicitors and a SME type construction company react to an EWE? The non existence of such studies pertaining to SMEs has also been pointed out by Runyan [11] who studied the area of crisis management.

Policy makers and theorists in the field have proposed various models and frameworks to improve the adaptive capacities of SMEs by concentrating on identification of risks and opportunities coupled with strategy development and implementation. However, the effectiveness of these models and frameworks in practice and how the SMEs' individual and collective attitudes influence their activities have not received adequate attention. This research focuses on this broad area of understanding the SME decision making processes, their coping strategies and their adaptive capacities in facing up to various extreme weather events. The research also tests and validates various solutions that will enhance the overall resilience of SMEs against EWEs.

## **4. Methodology**

The research considers a broad array of approaches to investigate, the current scoping mechanisms and adaptive capacities of SMEs and finding solutions. Engaging SMEs via participatory approaches is the overall guiding methodology for this research. As a first step, a UK wide cross-sectoral survey will be conducted to identify the current coping mechanisms and adaptive capacities of SMEs. The preparation of the survey instruments will be informed by an extended review of literature, gathering existing weather generator data and assembling of documented cases of SMEs and policymaking related to EWEs from other countries. The initial survey sample will include SMEs (in excess of 500) from areas having a very high risk and a low risk of various extreme weather events such as flooding. Then participatory action research is conducted with a target sample of fewer SMEs (about 50) focusing on the coping measures and solutions. The solutions will also be disseminated towards a wider body of SMEs through various networks and supply chain partners. A re-survey is then undertaken of the same initial sample of SMEs to identify any improvements achieved during the course of the research. This methodology integrates with other methodologies of this research and runs parallel with other workpackages of the programme investigating into how various stakeholder groups such as SMEs, individual households and Government policy makers cope with extreme weather events.

## **5. Conclusions**

SME sector is renowned for suffering the most in times of crises such as extreme weather events and prepared the least for such events. The paper provides a literature review and a synthesis on generating various methodologies, frameworks and models for improving adaptive capacities and enhancing coping measures of SMEs. The paper draws upon experiences of other countries in dealing with SME engagement and argues that this continuous process of engaging SMEs will develop their adaptive capacities and enhance their coping measures in facing up to the risk of extreme weather events. It proposes a high level abstraction of the core principles of SME engagement through various participatory techniques associated with appropriate capacity and capability building techniques that will enable the various stakeholders such as SME networks, supply chain partners and policy makers to create a new application to suit the appropriate context of the transferee SMEs.

This research is currently at a very early stage in the developmental life cycle. The key emphasis at this stage is to gather information pertaining to similar initiatives from other countries. The paper through a literature review and synthesis sets out some of the guiding principles and the overall methodology to conduct the research programme. The problem identification and the methodology will enable the various stakeholders of this project to delve into some of the finer details of the research agenda, which will further inform the development of key milestones and tasks.

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