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# Coping with Extreme Weather: Strategies of Construction SMEs

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## Abstract

Weather extremes have created a considerable impact on Small and Medium-sized Enterprises (SMEs) in the UK during the recent years, especially on SMEs in the construction sector. Evidence in relation to the recent weather extremes have demonstrated that SMEs are some of the worst impacted by the Extreme Weather Events (EWEs) and have confirmed them as a highly vulnerable section of the UK economy to the impact of extreme weather. This is of particular importance to the construction industry, as an overarching majority of construction companies are SMEs who account for the majority of employment and income generation within the industry. Whilst construction has been perceived as a sector significantly vulnerable to the impacts of EWEs, there is scant evidence of how construction SMEs respond to such events and cope with their impact. Based on the evidence emerged from case studies of construction SMEs, current coping strategies of construction SMEs were identified. Some of the strategies identified were focused at organisational level whereas others were focused at project level. Further, some of the strategies were general risk management / business continuity strategies whereas others have been specifically developed to address the risk of EWEs. Accordingly, coping strategies can be broadly categorised based on their focus; i.e. those focused at project or organisational level, and based on the risks that they seek to address; i.e. business / continuity risks in general or EWE risk specifically. By overlapping these two aspects; their focus and risks that they seek to address, four categories of coping strategies can be devised. There are; general risk management strategies focused at business level, general risk management strategies focused at project level, EWE specific strategies focused at business level, and EWE specific strategies focused at project level. It is proposed that for a construction SME to effectively cope with the impact of EWEs and develop their resilience against EWEs a rich mix of these coping strategies are required to suite the particular requirements of the business.

**Keywords:** Construction, Coping strategies, Extreme Weather, Resilience, SMEs

# 1. Introduction

A range of Extreme Weather Events (EWEs) such as flooding, heavy snowfall, extreme temperatures, and heavy rainfall have affected the UK in the recent years, creating significant economic damages. It is projected that such weather extremes will further increase in number and severity in the future, especially due to climate change impacts (Stern, 2007). As an industry, construction is vulnerable to the impacts of EWEs due to its inherent nature of most of the activities being carried out in the open environment. In fact, the industry is perceived as a sector highly vulnerable to EWE impacts (Mills, 2003, Crichton, 2006, McWilliams, 2009). In addition to direct physical impacts of EWEs, construction can be affected by the indirect effects on the construction sector and those associated with it. Whilst direct effects include disruption to site works as a consequence of the EWE itself (e.g. the site might be flooded); indirect effects include disruption to site works as a consequence of the secondary effects of an extreme weather event (e.g. due to disruptions to deliveries and utility supplies through the supply chain) (Metcalf et al., 2009). Although construction industry SMEs have been aware for many years of the direct affects that weather extremes could have on their operations, and are likely to have developed project programming strategies to deal with such eventualities, there is less evidence to suggest that they are prepared for extreme weather events as a consequence of climate change or have considered in detail the indirect impacts to their operations of disruptions to their supply chain (Berkhout et al., 2004). Therefore, recent weather extremes in the UK seem to have created a noticeable impact on the sector; especially on construction SMEs (Wedawatta et al., 2010b, Wedawatta et al., 2011b). Whilst SMEs are considered as highly vulnerable to external disruptions such as EWEs (Crichton, 2006, Wedawatta et al., 2014), this is specially so in an industry like construction, where their activities are significantly weather dependent (Wedawatta et al., 2010a). For instance, a survey of businesses operating in the Cumbria region found that a majority of businesses that have ceased business following extreme weather events in 2009 and 2010 were found to be construction SMEs (Wiseman and Parry, 2011). 74% of businesses that have ceased trading were from construction, all of whom falling into the category of SMEs. Harty et al (2007) through a review of construction future studies identify EWEs as a specific issue that would be of importance to the construction industry in future.

From a construction SME perspective, their resilience to EWEs is likely to be focused around their projects, which is the core of their practice. This was observed by Hertin et al (2003), where it was noted that construction organisations were mainly concerned about the impact of weather events on construction processes and how weather extremes can affect their ability to deliver the projects within the cost and time constraints. Therefore, whilst the focus is mainly on construction SMEs at the organisational level, how construction SMEs respond to EWEs on their construction projects is also investigated in this study. However, evidence that identifies construction SMEs as being in the majority of businesses who ceased to function following EWEs that affected the Cumbrian region in 2009 – 2010, suggests that organisational level response to EWEs is also important (Wiseman and Parry, 2011). This suggests that EWEs have critically affected the business continuity of construction SMEs, necessitating responses to EWEs focusing both on construction projects (process) as well as their organisations, in order to enhance their long term survival amidst the increasing risk of EWEs. The purpose of this paper is to analyse how the UK construction SMEs are responding to the risk of

EWEs and discuss whether construction SMEs have been active in implementing coping strategies addressing these key business aspects.

## 2. Research method

Case study was adopted as the preferred research strategy to investigate the existing coping strategies of construction SMEs. Dul and Hak (2008) defined case study as “a study in which (a) one case (single case study) or a small number of cases (comparative case study) in their real life context are selected and (b) scores obtained from these case are analysed in a qualitative manner (2008, p4). Justification for adopting case study as the overarching strategy was discussed previously by the authors; see Wedawatta et al (2011a).

Accordingly, two in-depth case studies were developed to explore the context within which construction SME’s interpret and respond to EWEs. The first case study was a building contractor and the second a civil engineering contractor. SMEs studied were medium-sized businesses employing between 50 and 249 employees and are well established construction organisations that have been in business for several decades. These two cases were selected to obtain the perspectives of both building and civil engineering construction SMEs. In order to observe the perspective of construction projects, in each case, a construction project which had been affected by EWEs were studied to obtain an understanding of on-site issues related to EWEs. The projects studied were a residential development and a land remediation and earthworks project for the two case study SMEs respectively. Interviews were conducted with the head office senior management and site management.

## 3. Findings and discussion

### 3.1 Coping strategies of construction SMEs

Key coping strategies that the case study SMEs have put in place or existing strategies that have helped them to minimise the impacts of EWEs are identified in the table 1.

*Table 1 –coping strategies of case study construction SMEs*

<b>Case study SME1</b>	<b>Case study SME2</b>
<ul style="list-style-type: none"> <li>• <i>Estimating and Bidding strategies (1.1)</i> <i>Considering EWE risk when making decisions on whether to bid for a project, and if so, on the prices quoted</i></li> <li>• <i>Project planning (1.2)</i> <i>Minimising vulnerable site activities during the winter. Planning project activities making use of a</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Estimating and bidding strategies (2.1)</i> <i>Considering the risk when quoting for a project in terms of price and time quoted.</i></li> <li>• <i>Diversifying business activities (2.2)</i> <i>Having a diverse range of business activities, being in a position to absorb the impacts of EWE disruptions in some of its projects.</i></li> </ul>

<p><i>mixture of indoor and outdoor activities on their different projects at any given time, so that employees can be re-assigned to projects which are not affected by weather, if a particular project is affected for a long time period.</i></p> <ul style="list-style-type: none"> <li>• <i>Methods of construction (1.3)</i> <i>Addressing weather risks in methods of construction used.</i></li> <li>• <i>Business continuity plan (1.4)</i> <i>Having a business continuity plan in place, outlining the roles and responsibilities of personnel, procedures to be followed during times of disruption such as during EWEs.</i></li> <li>• <i>Employee selection and terms of labour employment (1.5)</i> <i>Changing the terms of employment for its direct labour force, allowing to temporarily lay off staff during periods of low construction activity. Selecting site staff locally.</i></li> <li>• <i>Sub-contracting practices (1.6)</i> <i>Transferring the risk of disruption to sub-contractors by sub-contracting vulnerable trades.</i></li> <li>• <i>Conditions of contract (1.7)</i> <i>Relief for time periods affected by EWEs obtained through the conditions of contract.</i></li> <li>• <i>Health and safety procedures (1.8)</i> <i>Existing health and safety procedures in place that have to be adhered to in carrying out construction work on sites.</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Conditions of contract (2.3)</i> <i>Relief for time periods affected by EWEs and additional costs obtained through the conditions of contract.</i></li> <li>• <i>Project planning (2.4)</i> <i>Minimising vulnerable work activities during winter months.</i></li> <li>• <i>Employee selection (2.5)</i> <i>Employing locally and employing experienced and qualified professional staff across every section.</i></li> <li>• <i>Frequent communications between head office and sites (2.6)</i> <i>Frequent meetings held on sites and in head office were identified as a risk management strategy, where any issues at the time are discussed and actions to be taken are planned in a timely manner.</i></li> </ul>
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Both the SMEs have experienced a range of adverse impacts on their projects and thereby their businesses due to EWEs during the recent years prior to the study. It can be seen that following this range of adverse impacts in relation to the EWEs that affected the UK in recent years, case study SMEs have now put in place a diverse range of response measures. Whilst some of these measures were instigated prior to the EWEs (e.g. sub-contracting practices, terms of employment, etc), SMEs have also developed new measures (e.g. minimising vulnerable trades during winter, method of construction) in direct response to the EWE impacts experienced.

### 3.2 Discussion on coping strategies

Some of the strategies identified in the case study SMEs were focused at organisational level whereas others were focused at project level. Further, some of the strategies were general risk management /

business continuity strategies whereas others have been specifically developed to address the risk of EWEs. Accordingly, coping strategies identified in case study SMEs can be broadly categorised based on their focus; i.e. those focused at project or organisational level, and based on the risks that they seek to address; i.e. business / continuity risks in general or EWE risk specifically. This categorisation is depicted in Figure 1. The following sub-sections outline each of the categories identified above.

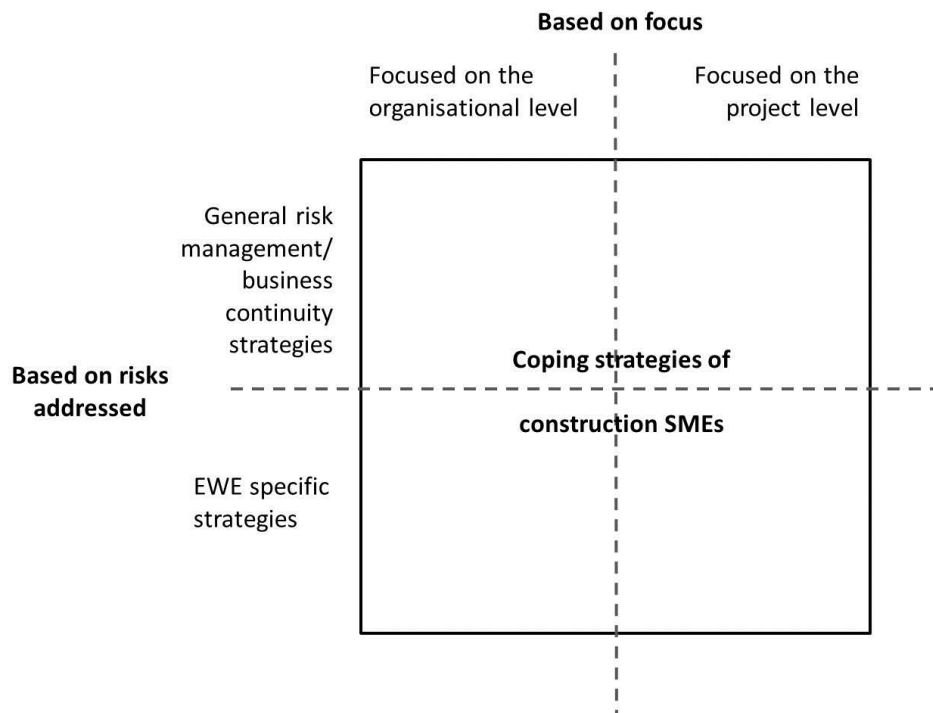


Figure 1 - Categorisation of coping strategies of construction SMEs (Wedawatta, 2013)

### 3.2.1 Categorisation based on risks addressed

#### General risk management / business continuity strategies

Some of the coping strategies that the construction SMEs have found useful were general risk management / business continuity strategies implemented within the businesses. Whilst these have not been implemented specifically to cover the risk of EWEs, having such strategies in place has enabled SMEs to prevent, withstand and recover from EWEs better. Strategies reported by SME1, such as sub-contracting practices, terms of labour employment and business continuity planning, as well as the strategies reported by SME2 such as business diversification and project meetings, are generic risk management strategies implemented to reduce risk, ensure business survival and commercial advantage. Therefore, it is evident that some of the general risk management / business

continuity strategies implemented in construction SMEs could effectively contribute towards their resilience to EWEs.

### EWE specific strategies

However, general risk management strategies alone, as discussed above, may not provide an adequate level of resilience against EWEs. Considering this, the case studies revealed that SMEs have extended general risk management strategies or implemented new strategies specifically addressing the risk of EWEs. In the case study SMEs, these included considering EWE risk in bidding, estimating, and project planning, and usage of conditions of contract for their advantage. Such EWE specific strategies seem to be essential in combination with general risk management strategies, if a construction SME is to achieve a good level of resilience to EWEs.

### **3.2.2 Categorisation based on unit of focus**

#### Coping strategies at project level

Case study findings revealed that the focus of construction SMEs, in regard to EWEs, was mostly on the projects that they undertake. EWEs affecting their projects have created a significant impact on construction SMEs. Consequently, many of the coping strategies that have been implemented focused on construction projects. For instance project pricing, bidding and planning strategies, conditions of contract, sub-contracting practices, and methods of construction can be cited. Given the potential of EWEs to disrupt site activities for prolonged durations as well as intermittent disruptions that can also have a significant impact on construction SMEs, it is important that the risk is adequately addressed at project level.

#### Coping strategies at business level

Whilst a majority of the strategies found in case study SMEs were focused on construction projects, some of the strategies discussed were implemented at business level. For instance, business continuity planning and commercial strategies such as diversification can be identified. As was recognised by the case study SMEs, whilst their businesses were thought to be resilient to EWEs it was also recognised that a future EWE may have the potential to affect the activities of their businesses irrespective of the measures that are in place. Therefore, it is important that the risk is also addressed at business level to account for the resultant impact on the business as a whole and its continuity. Lack of coping strategies at the business level may, perhaps, be argued as a reason for construction SMEs reporting high business failure rates as a result of EWEs. Whilst the case study SMEs demonstrated such coping strategies at the wider business level, many of the smaller SMEs might not have such strategies in place.

### **3.2.3 Types of coping strategies in construction SMEs**

Based on the analysis above, the coping strategies of construction SMEs can be subdivided in to four quadrants, based on their focus and the risks that they seek to address;

- General risk management strategies focused at business level
- General risk management strategies focused at project level
- EWE specific strategies focused at business level
- EWE specific strategies focused at project level

These are depicted in each of the quadrants in Figure 1. Coping strategies observed in case study construction SMEs seem to suggest that most of the strategies implemented by construction SMEs currently fall into the category of EWE specific strategies focused at project level, whilst less attention has been paid to the other three types of coping strategies (see Figure 2). In Figure 2, coping strategies implemented by the case study SMEs have been roughly placed on each quadrant, to best reflect the views expressed by the respondents. Whilst it is an approximate representation rather than a precise one, due to factors such as some coping strategies addressing more than one quadrant, it depicts the bias towards project level coping strategies by construction SMEs.

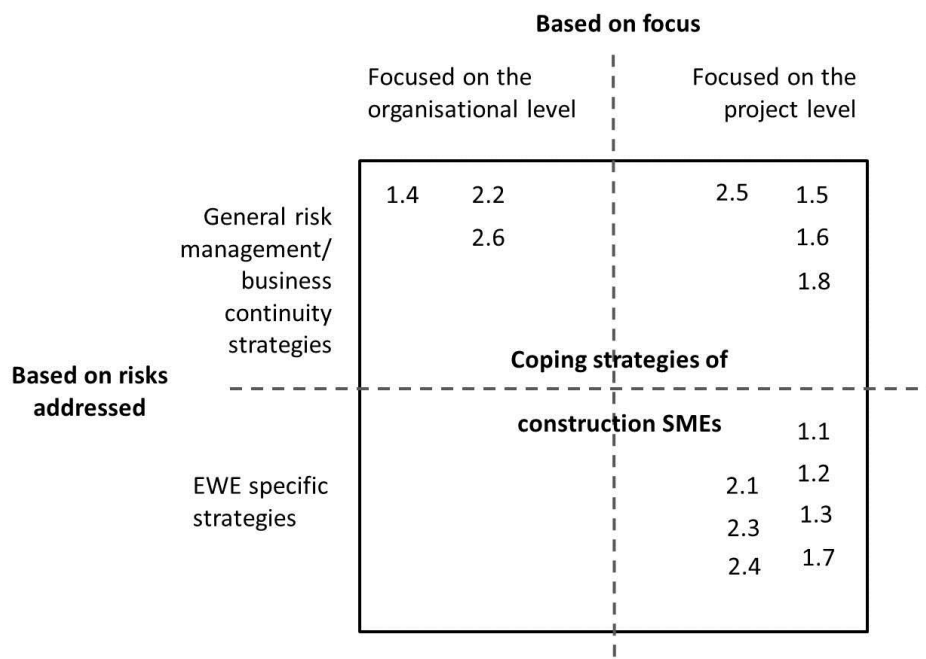


Figure 2 – Coping strategies of case study SMEs allocated to each quadrant

It can be argued that a resilient construction SME will demonstrate coping strategies falling into each of the quadrants, based on their requirements. It is important that a construction SME implements a suitable mix of strategies to achieve the required level of resilience. For example, EWE specific coping strategies at project level can minimise disruption to site activities. However, as noted by construction SMEs, site activities might still be disrupted by EWEs despite such measures being in

place. Therefore, other types of coping strategies at business level are required to address the remaining risk and cope with the impact that disrupted site activities will have on the rest of their business. It may be argued that the lack of coping strategies to cover different types of risk, as identified above, is a reason leading to why EWEs have such a severe impact on construction SMEs and threaten their continuity. For instance, an exploratory survey conducted as a precursor to in-depth case studies showed lower percentages of construction SMEs with business continuity insurance and business continuity planning (Wedawatta et al., 2011b). Categorisation, identified above, presents a novel approach to presenting the coping strategies of construction SMEs, and suggests the importance of having a broad mix of coping strategies in place pertaining to each type of coping strategies identified.

## 4. Conclusion

Both case study SMEs considered EWEs to be a critical risk to their businesses. This was mainly due to significant adverse impacts experienced in relation to recent EWEs that have affected their businesses. As a result, the risk of EWEs has been addressed in a number of ways and the SMEs have sought to increase their resilience to EWEs. Case study SMEs therefore considered their businesses as adequately resilient to EWEs. Although the two case study SMEs considered their businesses as adequately resilient to EWEs, it was also recognised that future lengthy EWEs have the potential to create a significant impact on their businesses. Therefore, whilst the SMEs were confident of their ability to respond successfully to such an event with the help of measures that are currently in place and their resources and competencies, the need for further improving their resilience was recognised.

Categorisation adopted in the study identified four types of coping strategies for construction SMEs; general risk management strategies focused at business level, general risk management strategies focused at project level, EWE specific strategies focused at business level, and EWE specific strategies focused at project level. Findings of the case studies suggested that the case study SMEs have focused mostly on their projects and have implemented EWE specific strategies focused at project level the most. The risk does not seem to have been addressed adequately at the business level, accounting for any negative impacts that EWEs may have on a business if the projects get affected by EWEs. It is important that a construction SME implements a suitable mix of strategies to achieve the required level of resilience. It may be argued that the lack of coping strategies to cover different types of risk, as identified above, is a reason leading to why EWEs have a severe impact on construction SMEs and threaten their continuity.

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