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# Resilience and adaptation of Small and Medium-sized Enterprises to flood risk

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## Abstract

### **Purpose (mandatory)**

The UK experienced a number of flood events during the recent years, and the intensity and frequency of such events are forecast to further increase in future due to changing climatic conditions. Accordingly, enhancing the resilience of Small and Medium-sized Enterprises (SMEs); which form an important segment in a society, to flood risk, has emerged as an important issue. However, SMEs often tend to underestimate the risk of flooding which tends to have a low priority in their business agenda. The paper undertakes an investigation of adaptation to the risk of flooding considering community-level measures, individual-level property protection, and business continuity and resilience measures.

### **Design/methodology/approach (mandatory)**

Four short case studies were conducted among SMEs to identify their response to flood risk, and what measures have been undertaken to manage the risk of flooding.

### **Findings (mandatory)**

It was observed that SMEs have implemented different property-level protection measures and generic business continuity/risk management measures, based on their requirements, to achieve a desired level of protection.

### **Practical implications (if applicable)**

SMEs are likely to positively respond to property-level adaptation following a post-flood situation. It is important that information such as costs/benefits of such measures and different options available are made accessible to SMEs affected by a flood event.

### **Social implications (if applicable)**

Implementation of property-level adaptation measures will contribute towards the long term adaptation of the existing building stock to changing climatic conditions.

**Originality/value (mandatory)**

The paper contributes towards policy making on flood risk adaptation and SME decision making, and informs policy makers and practitioners.

**Key words:** Adaptation, Climate change, Flooding, Property, Resilience, SMEs

**Paper type:** Research paper

## **1. Introduction and focus**

Evidence suggests that there has been a long-term upward trend in the number of Extreme Weather Events (EWEs) since the latter part of the 20th century (Munich Re Group, 2008), which has experienced over 170 “billion-dollar events” related to weather extremes, in particular windstorms, floods, droughts and heat waves (Beniston and Stephenson, 2004). Such EWEs are expected to further increase in number and severity in the future, due to climate change impacts (Environment Agency, 2005; Stern, 2007; Munich Re Group, 2008). For instance, the Stern review predicted that the fraction of land area in extreme drought at any one time will increase from 1% to 30% by the end of this century (Stern, 2007).

Flooding is one of the main weather extremes that have affected the UK in the recent years. Floods in years 2004, 2005, 2007 and 2009 are some examples. The Pitt Review (2008) and the Environment Agency (Chatterton et al., 2010) estimated that flooding of 2007 affected 48,000 homes and about 7,000 businesses in the UK and caused damage to the value of approximately £3 billion. National Risk Register for the UK (Cabinet Office, 2010) identifies coastal and inland flooding as risks that have a relatively high likelihood and impact. Further, Environment Agency estimates the expected annual damages to residential and non-residential properties in England at risk of flooding currently to be more than £1 billion (Environment Agency, 2009a). Recent flood events in the UK have caused significant disruptions to the business sector, especially Small and Medium-sized Businesses (SMEs), which are often affected disproportionately hard by such events and are less prepared to manage the consequences (Crichton, 2006; Bmg Research, 2011). Adaptation to the risk of flooding has thus become an issue of significant importance to SMEs, in preventing any potential disasters and disruptions to communities, if they are at risk of being flooded.

The main focus of this paper is on adaptation of SMEs against the risk of flooding, enabling them to prevent and/or limit adverse impacts of flooding on their business activities. The paper undertakes an investigation of adaptation to the risk of flooding considering community-level measures, individual-level property protection, and business continuity and resilience measures.

## **2. Climate change, flooding and consequences**

Environment Agency recognises that about 5.2million properties in England remains at risk of flooding currently (Environment Agency, 2009a). The expected annual damages to properties from river or coastal flooding is estimated to be around £1bn (Environment Agency, 2009a), whereas the figure could be significantly higher if the property damage from surface water flooding is also taken into account. Flood risk in the UK is expected to further increase in the future (Evans et al., 2004), especially due to the impacts of climate change (Pitt, 2008). As flooding is a hazard, which could possibly occur due to weather condition (e.g. heavy rainfall, heavy snowfall) coupled with other causes (e.g. inadequate drainage, overflowing river banks, etc), increased intensity and frequency of such weather extremes are likely to increase the risk of flooding. For instance, Fowler et al (2005) reported that the recent increases in rainfall intensity seen in the UK as consistent with the predicted increases in frequency and intensity of heavy rainfall in the high latitudes of the Northern Hemisphere. As many of the flood events that affected the UK in recent years were induced by heavy rainfall, increases of such flood events are likely in the future, according to the above mentioned evidence. Pall et al (2011) in their modelling of the impact of anthropogenic greenhouse

gas emissions on floods occurring in England and Wales in autumn 2000 found that former has significantly increased the risk of the latter event. Whilst this situation may not be common for any flood event; as flooding can occur due to a number of factors, the work of Pall et al (2011) suggests that greenhouse gas emissions can be one of the causes. Hence, a rising atmospheric greenhouse gas concentration (Stern, 2007) may increase the risk of flood events similar to that of autumn 2000.

Further, Evans et al (2004) in Foresight: Future flooding report identified urbanisation, environmental regulations, rural land management, increasing national wealth, and social impacts as the main drivers for increased future flood risk in the UK, in addition to climate change. Environment Agency (2009b) highlights deterioration of assets and continuing pressure to build in areas at risk of flooding as factors contributing towards increasing risk in addition to climate change. This suggests that the society is likely to become increasingly vulnerable to flood risk, irrespective of the debate as to whether climate change will increase the intensity and frequency of future flooding. Consequently, adaptation of societies to flood risk and weather extremes has become an important aspect of building resilient communities. The need for building resilient communities, which can bounce back from the impacts of such hazards, has become a focal point of discussion during the recent years (Manyena, 2006; Paton, 2007; Cutter *et al.*, 2008).

Flooding can have a critical impact on a business if affected either directly or indirectly. Damaged or lost stock, damage to building / premises, damaged or lost building equipment, inability to conduct business, and inconvenience to staff were the main short term impacts experienced by small businesses in Yorkshire affected by 2007 summer floods (Ekos Consulting (Uk) Ltd, 2008). Long term impacts included disrupted cash flow and lost income, staff anxiety from flooding to business, and higher insurance premiums as some of the long term impacts. In a survey of businesses affected by flooding in the event of 2009 Cumbria floods (Bmg Research, 2011), businesses were requested to estimate the costs that have been incurred as a result of damage or loss caused by the storms and flooding, during the event (November 2009) up to August 2010. The mean costs incurred per business were found to be about £35,000, as per the estimates by a sample of 324 businesses. Whilst there may be significant variations in costs incurred by larger businesses and SMEs, the figure suggests how costly flooding can be to a business. Although direct impacts are often highlighted, indirect impacts of flooding can also create negative consequences on businesses. Woodman (2008) identified staff unavailable for work -53%, premises flooded (offices, shops etc) – 38%, and suppliers disrupted – 27% as the main impacts of flooding experienced by a sample of 255 businesses affected by 2007 flooding, suggesting that the impacts of flooding extend well beyond the direct impacts.

Above facts suggest adaptation to the risk of flooding as important for businesses; particularly for SMEs which are said to be highly vulnerable to disruptions compared to larger businesses, if such negative impacts are to be managed. Whilst many of the studies addressing adaptation has focused on long term climate change, the importance of adapting to short term climate stimuli such as flooding is also recognised. For instance, one of the principals of the adaptation policy framework developed by Spanger-Siegfried et al (2004: pp10) is that “adaptation to short-term climate variability and extreme events serves as a starting point for reducing vulnerability to longer-term climate change”. In this respect, adaptation to flooding is important not only as a response to current risk of flooding, but also as a starting point to long term adaptation to changing climatic conditions. Further, given that climate change mitigation is likely to come before adaptation to many

(Morton et al., 2011), flood risk adaptation can be used to highlight the need for adaptation rather than mitigation alone.

### **3. Forms of adaptation to flooding**

Dawson et al (2011) asserted the ability of reducing the risk of flooding by implementing a portfolio of structural as well non-structural flood risk management measures, and claimed that “society is capable of adapting and significantly reducing flood risk using currently available measures” (pp644), suggesting the importance and feasibility of flood adaptation. Whilst it is the responsibility of the relevant authorities to introduce some of the measures such as land use planning policy, responsibility of implementing some of the measures; such as resilient property construction, lie with the individual property owners. However, such individual-level adaptation measures are likely to be limited in the UK, partly due to relying on the state to provide full protection (Harries and Penning-Rowsell, 2011).

In a study of the effects of climate change on UK small businesses, Crichton (2006) found that 70% of businesses located in high flood risk areas were not concerned that flooding might affect them. Further, a similar percentage of businesses were found to have no form of business continuity plan in place, summarising the level of concern of UK businesses on flood risk and adaptation. It has to be noted that this is not limited to the UK context alone, but has been observed in other contexts; for instance Germany (Kreibich *et al.*, 2007; Kreibich *et al.*, 2008), France (Pivot and Martin, 2002), Australia (Gissing et al., 2005), and USA (Tierney, 1994) as well; where businesses were found to be less concerned about flood risk adaptation. Crichton (2006) identified that home or flexible working, commercial insurance, reviewing risks to the premises, obtaining more advice and considering moving elsewhere as actions that UK small businesses were willing to implement to cope with the risk of flooding. In addition to such generic strategies, some businesses with previous flood experiences have implemented various strategies specific to their business.

Kreibich et al (2007) noted differences in flood preparedness of businesses based on industrial sector, flood experience and knowledge, size of businesses, and building ownership. Early warning was identified as an important factor affecting emergency responses in a flood event. They also noted an increase in flood preparedness of businesses after being affected by a flood event, more in property-level protection measures than behavioural precautionary measures. Similarly, a study conducted on behalf of Yorkshire Forward (Ekos Consulting (Uk) Ltd, 2008) identified increases in flood preparedness activities of businesses affected by flooding. However, Crichton (2006) noted that only a few small businesses had installed flood protection measures even after being flooded. He attributed this mainly to the type of property ownership of small businesses; which are likely to be based in leased properties, rather than in freehold properties.

Above discussions suggest that some businesses decide to address the risk of flooding through property-level adaptation strategies focusing on their building fabric and contents, whereas some seek to address the risk through generic business continuity strategies. Thurston et al (2008) noted that some businesses believe that collective measures have been put in place locally to reduce the risk of flooding significantly, thereby requiring no individual-level adaptation. Hence, community-level flood protection schemes can be identified as a level of defence that businesses tend to rely on, in addition to their individual-level adaptation strategies.

### **3.1 Community-level flood protection**

Community-level flood protection schemes can be considered as the first line of defence against flooding, and is largely a preventive response. Examples for community-level flood protection schemes include storage basins, raised river embankments, coastal defences (Bichard and Kazmierczak, 2010), maintained river channels, floodwalls and barriers (Environment Agency, 2009a). Such community-level flood protection schemes attempt to reduce the risk of flooding to local communities; infrastructure, households, businesses. Environment Agency predicted that flood defences managed by them had protected about 100,000 properties from flooding in the case of 2007 summer floods which affected many parts of the UK (Environment Agency, 2009a). Still, over 55,000 properties were flooded due to the event (Pitt, 2008). As Environment Agency recognised that over 99% of flood defences performed as designed (Environment Agency, 2009a), it can be identified that flooded properties were the ones left without protection from community-level flood protection schemes. Providing further evidence, Environment Agency reckons that even with increased investment on flood risk management, about 500,000 properties, even at the most favourable scenario out of five scenarios modelled, will still be left at high risk of flooding by 2035 (Environment Agency, 2009b). Moreover, as flooding is a multifaceted risk, there is the risk of properties being affected by localised flooding, whilst having community-level flood protection schemes in place against river or coastal flooding. For instance, despite the presence of Thames barrier and other flood management initiatives, some parts of London still remains at risk of flooding (Environment Agency, 2009c), and have in fact been flooded in recent years.

### **3.2 Business continuity / risk management measures**

For a SME or for a business in general, adaptation to flood risk may come via business continuity / risk management strategies. Whilst some of these measures may be general; for instance, property insurance and business interruption insurance, business continuity planning, and home or flexible working, etc, some of the measures can be flood specific; for instance, signing up for a flood warning system, having a flood plan, and carrying out a flood risk assessment, etc. According to Crichton (2006), businesses are likely to implement various generic coping strategies that aid business continuity, rather than property-level protection measures against flooding. Confirming this, Ingirige and Wedawatta (2011) reported that SMEs tend to mostly rely on general business continuity/ risk management strategies, although the uptake of those strategies was also found to be minimal. Generally, the level of uptake was higher among the SMEs with previous flood-related hazard experience, and such businesses were more likely to implement property-level protection measures than the SMEs without such experience. Obtaining property insurance, having a business continuity plan, using a business data backup system, and obtaining business interruption insurance were the commonly implemented business continuity measures by SMEs (Ingirige and Wedawatta, 2011).

However, as generic strategies for business continuity can only limit adverse consequences on a flood hit business and aid recovery process; rather than preventing/limiting damage to property and its contents, some form of property-level protection is desirable if a business is located in a high flood-risk area. A report on businesses in Cumbria affected by 2009 flooding (Bmg Research, 2011) found that more than half of the businesses (52%) that moved to temporary premises; as their business premises were flooded, have not returned to the original premises even after 6 months

from the event. In fact, as flooding can create extensive damage to internal building fabric (Thurston et al., 2008), refurbishment is likely to be time consuming. This suggests how long it can take for a flooded property to be reinstated and, thus, how important having property-level protection measures in place are.

### **3.3 Property-level flood protection**

Given that it is being practically difficult to protect every property at risk of flooding through community level strategic flood protection schemes (Environment Agency, 2009a), adapting properties to the risk of flooding; i.e. implementing property-level flood protection measures, is considered an effective means of managing the flood risk to existing buildings. It was discussed previously that despite the presence of community-level flood protection measures, there is the risk that properties will still be left at risk of flooding. Business organisations can further manage the risk by opting for generic business continuity strategies as mentioned above. However, presence of generic business continuity strategies will not prevent their business properties from being flooded. Therefore it can be recognised that property-level flood protection as a prominent feature that has to be included in a businesses' response to flood risk. This process however is not without external hindrances. For instance, Boshier et al (2009) argued that the UK "construction sector is currently ill-prepared to build-in resilience to flooding" (pp20), implying that businesses are likely to encounter difficulties in implementing such adaptation options.

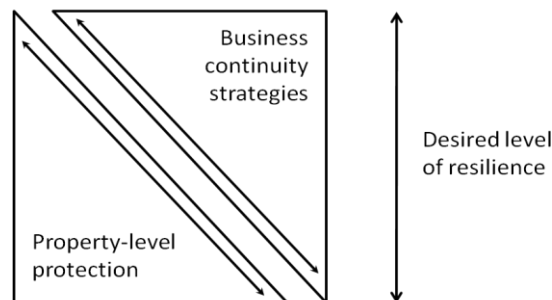
One of the recommendations (recommendation 13) of the panel appointed by the UK government to review the lessons to be learned from the summer floods of 2007 (The Pitt Review) was to encourage the take-up of property flood protection by businesses (Pitt, 2008). It was recommended to task this responsibility to local authorities, as part of discharging their responsibilities under the Civil Contingencies Act 2004 to promote business continuity. Further, it was recommended to revise building regulations to ensure all new and refurbished buildings in high flood-risk areas are flood resistant or resilient. Given that the UK government has expressed that it "supports changes in response to all of the recommendations in the review" (Defra, 2008); such possible regulation changes will have an immediate impact on construction of new buildings or refurbishments of existing buildings by businesses. Therefore, for businesses located in high flood risk areas, improved flood protection measures; both resistant and resilient, will become important.

Thurston et al (2008) reported that only 22% of non-flooded businesses located in an area at significant risk of flooding (over 1/75 return period) had taken measures to protect their properties whereas this was about 50% in flooded businesses, whilst several other studies; for e.g. Crichton (2006), Ingirige and Wedawatta (2011), have reported low levels of property-level adaptation. The most common measure was availability of sand bags. Thurston et al (2008) identified a range of factors that act as barriers for implementation of property-level protection measures by businesses, including the economical aspects (costs and benefits). Thurston et al (2008) pointed out that a package of property-level flood resistant measures (either temporary or permanent) will be economically beneficial for a SME if the annual chance of flooding is over 4% (1/25 risk of flooding). Although the benefits associated with a package of resilient measures will outweigh the costs at the same level of risk, it will be considerably economically beneficial if the annual risk of flooding is over 10% (1/10 risk of flooding). In addition, perceptions that it would be too expensive, property is adequately protected by community level protection measures, not being able to decide for



themselves what measures to be implemented, and being covered by insurance were identified as some of the reasons given by SMEs for not implementing property-level measures. Some businesses have recognised that they would still be able to continue their business activities uninterrupted, even if the premises get flooded.

The latter (above) suggests that businesses associate varying levels of importance to their property. For some businesses, premises being flooded may critically affect their ability to continue their operations uninterrupted, whereas some may consider it as of little importance to the ability to continue. Previous research; for e.g. Tierney (1994), Kreibich et al (2007), BMG Research (2011), has noted differences in impacts of flooding and responses to flood risk in businesses operating in different industry sectors. Hence, it can be noted that a similar level of property-level protection may not be desirable across SMEs in all industry sectors. Instead, a business can opt for a mix of property-level adaptation strategies and generic risk management / business continuity strategies to effectively manage the risk of flooding and consequences (See Figure 1). Establishing priorities and investing resources accordingly is important in planning for disasters like flooding (Frost, 1994); especially for SMEs, which are by definition constrained by resources.



**Figure 1 – Achieving a balance between property-level protection and business continuity strategies**

The above discussion reveals the importance of all three types of flood adaptation. Community-level flood protection mechanisms are widely available in the UK. However, their usage and value has been undermined due to significant localised flood events in the recent times. Therefore despite Government funding and measures for community-level flood protection schemes, for SMEs' individual property-level and business continuity measures could enhance their sustainability and business continuity. Therefore there should be initiatives taken by relevant policy makers to improve knowledge and understanding of these individual measures and popularise their take up by SMEs. Further, relationships of the optimum measures adopted should be appropriate with the nature of the businesses and their operations. The paper therefore tests the proposition that:

*'Individual property-level measures taken against flood adaptation are wide and varied and depend significantly on the type of business operations and the general risk management strategies adopted by SMEs. However, once appropriate measures are adopted by SMEs, they are likely to contribute towards their long term resilience and sustainability'.*

The above proposition provides an opportunity to conduct an exploratory study on SMEs on their measures against adaptation to flood risk and how appropriate they are in comparison with the nature of the business and operations.

## 4. Research method

In order to test the above proposition, four short exploratory case studies were conducted with SMEs. Table 1 shows the profile of SMEs studied and reported here. Three of these were flooded within the recent years, and have responded to the risk of flooding by varying degrees. One SME has responded to the risk without being affected in the past. The SMEs studied were closely located, within the South-East London Resilience Zone, and were at risk of surface water flooding. South-East London resilience zone was selected for the study, as the area has a very high risk rating for flooding (South East London Local Resilience Forum, 2008). London is susceptible for flooding by five sources; tidal, fluvial, surface water, sewer, and groundwater flooding possibly as a combination of several sources simultaneously (Greater London Authority, 2010). Semi-structured interview technique was used to elicit information from the SMEs studied. The interviews were conducted in April-May 2010. Purposive sampling was utilised to select the SMEs for the study, based on the fact whether the risk of flooding has been considered within their business decision making and whether the risk has been addressed by some means in business planning. Either the owner-managers or the managers were interviewed, who contribute to decision making within the business.

**Table 1 - Profile of SMEs studied**

SME	Number of employees	Flood experience	Respondent	Age of business	Property ownership	Main business activity
SME1	<10	Directly affected	Owner	4	Own	Interior decoration
SME2	<10	Directly affected	Owner	25	Own	Retail grocery
SME3	<10	Directly affected 3 times	Owner	12	Own	Estate agent
SME4	10 - 49	No previous flood experience	Manager	7	Lease	Air conditioning

## 5. Findings and discussion

### 5.1 Adaptation strategies of SMEs studied

As mentioned above, the SMEs interviewed have addressed the risk of flooding to their business by various means. Responses of each of the SMEs will be discussed in the following sections with a brief description of the context of the SME. The way how the impacts and responses of SMEs are presented here has been adapted from Johnstone (2011), where the work of UK Climate Impacts Programme (UKCIP) on business consequences of climate change were reported.

SME1 was a business specialised in interior decoration, and it used its business premises for multiple purposes; as a showroom, workplace and to store material and finished products. It was flooded in

2007, within the first year of its inception, and was put out of business for 3 months. Figure 2 shows the main consequences that were created on SME1 by the flood event. As the business already had property insurance cover as well as business continuity insurance cover, some of the damages were recovered from insurance.

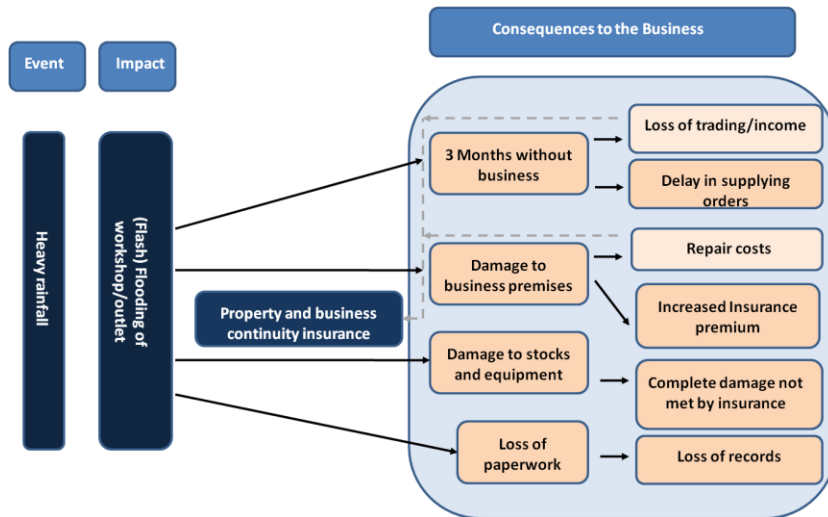


Figure 2 – Impacts of flooding on SME1

Following the flood event SME1 has implemented a range of adaptation options. Figure 3 shows the main adaptation options implemented by the business. Accordingly it can be seen that SME1 has prepared itself for a similar flood event, and have covered every consequence related to the previous flood event. It can be seen that SME1 has implemented property-level measures such as installing flood gates, opting for flood-resilient flooring, and under floor grill and drain to dispose water quickly if it enters again as well as generic business continuity measures such as using an online data backup system. Despite various measures being implemented, insurance premium has stayed at the post-flood level, which was said as considerably higher than the pre-flood level.

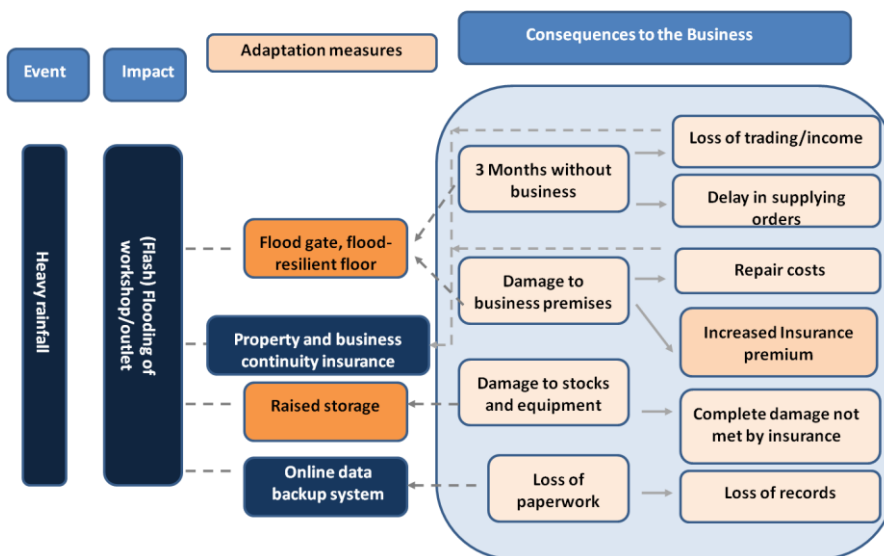
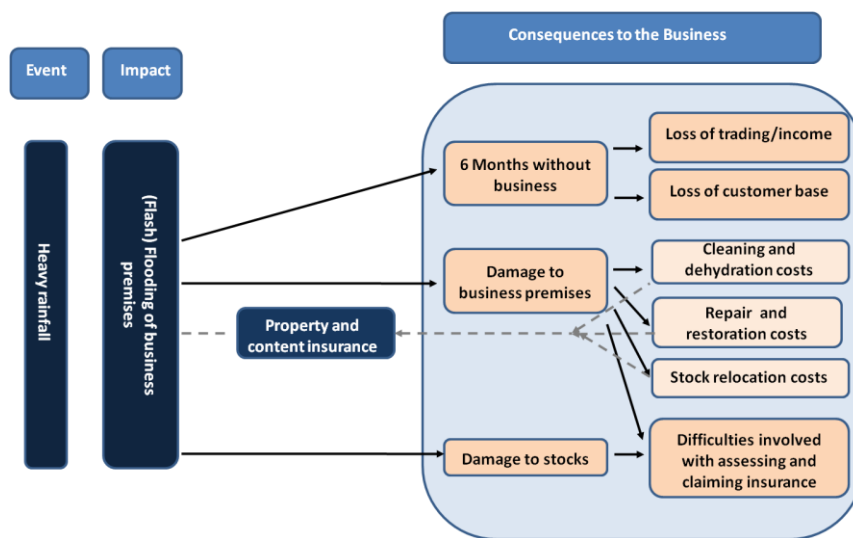


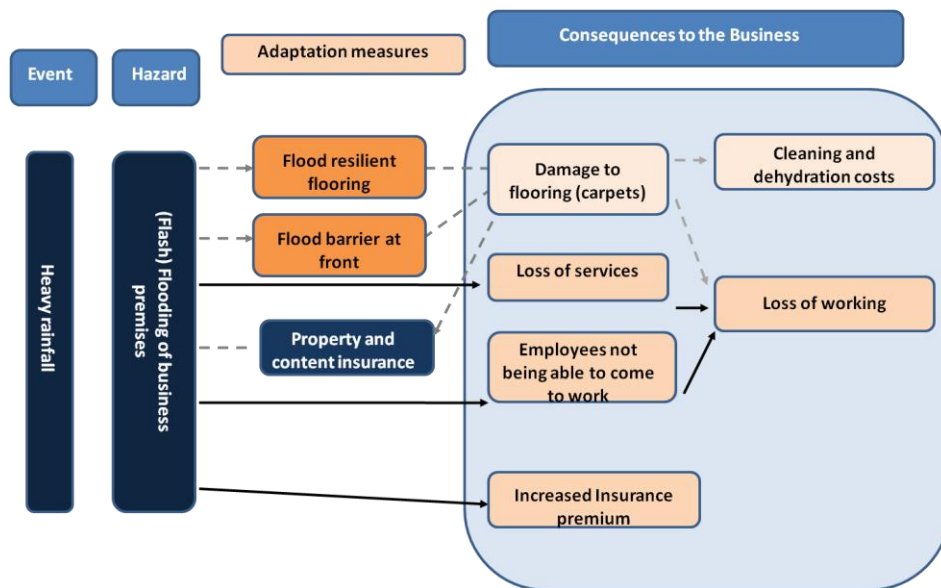
Figure 3 – Adaptation options implemented by SME1

SME2 was a retail grocery that has been in business in the same location for about 25 years. It has been flooded once in the year 2007 (See Figure 4). This has put it out of business for about 6 months, and has taken about further 2 months to start trading fully. Although the damages were met by the property insurance cover, it has lost income for the entire period it was out of business, and claimed that the business never managed to reach the pre-flood status. However, this has not resulted in any other protection measures being implemented, except for having property insurance which it already had by the time of flooding. Business owner considered that there *“is only a limited amount of preventive measures that you can take”* against flooding. The business was content with the transfer of risk through insurance, and recognised that it will have to get back to business as quickly as possible if it floods again.



**Figure 4 – Impacts of flooding on SME2**

SME3 offered a different perspective to the two cases discussed above, in terms of its flood experience, as it has previously been flooded thrice, in the years of 2001, 2003 and 2007. Unlike the two cases discussed above, flooding however has not led to a long term loss of business activities in the case of SME3. In the third time, this has only been about few days. As it is a service provider, being an estate agent, it had been able to continue its operations offsite, after the initial loss of work of 3 days, until the premises were cleaned and de-hydrated, and carpet flooring was replaced with flood resilient tile flooring. Following the third flood event it has installed flood gates to the premises. Coupled with their insurance cover, the SME considered it as adequately protected against a future flood event.



**Figure 5 - Impacts and adaptation options of SME3**

SME4 was an air conditioning service provider / contractor. Although it has not been affected by flooding before, it was concerned about the risk of flooding, due to the location of its premises. The business considered that flooding can have a critical impact on its business premises, and most of its equipments. Therefore the business has addressed the risk by keeping a supply of sand bags readily available at the business premises. Whilst sand bags is a very common form of property-level adaptation measures (Thurston *et al.*, 2008; Bichard and Kazmierczak, 2010), it is often considered as an ineffective resistance measure (Thurston *et al.*, 2008). SME4 was aware of this, and identified that it will raise the issue with the landlord, in order to examine permanent protection measures applicable, if the risk of flooding increases. It has opted for an offsite data backup system on a weekly basis, in order to prevent any loss of office data due to any damage caused to premises by flooding or any other hazard like fire.

## 5.2 Discussion

The 4 short cases briefed above presented different perspectives on flood adaptation of SMEs. SME1 has been affected by flooding once, and has implemented a range of adaptation strategies. However, SME2 was content with its insurance cover as its only protection, even after being flooded. SME3 has been affected by flooding three times, and has implemented a range of measures after the third time. SME4 has opted for several measures, even without having any pre flood experience. Whilst the relatively smaller sample size used here and the heterogonous nature of SME sector make it difficult to make strong generalisations across the whole SME sector, based on the SMEs studied it can be recognised that property-level adaptation options that go along with their general risk management strategies can significantly contribute towards the long term resilience of SMEs. Although they still can get adversely affected by flooding even with having protection measures in place, the case studies portray that some SMEs are now adequately prepared to face a similar type of flood event they have previously encountered. In all four cases the SMEs were content that they have implemented adequate adaptation options to ensure the continuity of their business against flooding. However, disruptions that flooding can create on its supply chain is an issue that none of the SMEs have considered and planned for. Even the SMEs with previous flood experience, who

have implemented various coping measures, have not considered how the flooding can affect its supply chain.

It can be noted that different SMEs have given different levels of priority for property-level adaptation within their business risk management. For instance, SME1 has implemented various property-level protection measures, whereas another; SME2, has opted to rely on insurance. It can be argued that SME1 being an interior decoration firm and SME2 being a retail grocery, business premises are critical for their business continuity, especially in the case of SME2. The impact of previous flood experience, SME2 being out of business for 6 months and this being 3 months in the case of SME1, suggests that it would have been logical for SME2 to be more proactive in implementing property-level protection measures than SME1. However, this has not been the case, due to a number of reasons. Age of the business and experience of owners can be highlighted. Owner of the SME2 has been in business for over two decades and has only been flooded once, whereas SME1 has only been in business for about 1 year when it was flooded. This has led the two SMEs to allocate a different risk profile to flooding itself and property-level protection, which are reflected in their response to flood risk. As opposed to the other three SMEs where the number of employees was less than 10 (micro sized businesses), SME4 had 15 employees (small sized business). This would have enabled SME4 to address the risk of flooding, even without previous flood experience. Previous research has identified business size as a factor that affects the flood preparedness of businesses (Dahlhamer and D'souza, 1997; Crichton, 2006; Kreibich et al., 2007). As SME4 was a business larger than the others, being likely to have access to more resources, and being able to extract from a much larger employee base, could have enabled them to identify and address the risk of flooding.

In all the situations where a business experienced flooding, its insurance premium for property and contents cover has increased. The premium for business continuity insurance has also increased where available. SME1 reported that the insurance premium for its property insurance doubled following the flooding. This however has occurred even after the business implementing various physical coping strategies. After being out of business for about 3 months following the flooding, it has implemented various physical protection measures such as installing a flood gate at the front, flood resilient flooring, and a grill system for water to escape if it floods again. It has opted for an online data storage system, as some of the business records were lost during flooding. Despite implementing such measures, the business has experienced a significantly high insurance premium. A similar situation has been observed in other studies as well. For instance, a study on businesses affected by 2007 summer floods in Yorkshire revealed that more than 50% of small businesses and more than 80% of medium and large businesses have experienced higher insurance premiums following the floods (Ekos Consulting (Uk) Ltd, 2008). If the premiums will reflect the property-level protection measures; i.e. if the premium is reduced when a business implements coping strategies, this will be a significant driver for implementing various coping measures by SMEs. However, if not, this may also discourage SMEs from doing so, and push towards relying only on insurance. Moreover, increased premiums may lead SMEs to undervalue their property, reducing the amount of damages that will be covered by insurance if affected by flooding.

## 6. Conclusions

Community-level flood protection measures are the first line of defence available for properties located within flood-risk areas. In the UK, a significant amount of funds is invested in commissioning and maintenance of such schemes annually. However, it is important that individual properties are also equipped with a second line of defence, as it is not possible to protect every property at risk of flooding through community-level schemes. For businesses, the second line of defence could be a mix of property-level protection measures and generic business continuity/risk management measures, based on their particular requirements. In case of SMEs, it is important that a suitable mix is selected and undertaken, in order to ensure their long term survival against flooding, given that SMEs by definition are limited by resources. From a policy making perspective, it can be noted that SMEs are likely to opt for property-level adaptation following a flood experience to their business. Information with regard to the importance of property-level protection, options available and costs/benefits of options are likely to be better received by SMEs after a flood experience. Hence, it is important to make sure that such information is readily available and accessible to SMEs. As property-level adaptation requires cost and time commitments to implement, it is important that SMEs implement measures that best serves their business continuity and survival. A post flood situation offers a good opportunity to make improvements to the existing building stock in terms of flood protection. Given that the risk of flooding is expected to further increase in future due to changing climatic conditions as well as other factors, it is important that the existing building stock is kept up to date in terms of flood protection. From the point of view of SMEs which have not yet experienced flood events, but are exposed to the risk of flooding, it is important that they are aware of the impact of flooding on their business. As the next step in this project, cases of such SMEs will be studied in detail to communicate good practice guidance to enable them to appropriately consider developing their second line of defence by a combination of property-level protection measures and generic business continuity/risk management measures.

Findings presented here were limited to four short case studies, and hence the ability to replicate the issues identified across the broad SME sector is limited. As the study was conducted as an exploratory study, it will be further developed to elicit information from a range of SMEs representing different industry sectors and sizes. The case studies will involve SMEs who have / do not have previous flood experience and implemented / not implemented flood adaptation measures. Next stages of the study will further investigate the perspectives of SMEs on flood risk adaptation in-depth, and how these differ among flooded and non-flooded SMEs.

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