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# Understanding the Relationship between Resilience and Sustainability: Emergency Planning and the Design of Urban Space

*Julie Fisher, Steven Harre-Young, Lee Boshier*

(Dr Julie Fisher, Loughborough University, School of Civil and Building Engineering, Loughborough, LE11 3TU, [J.Fisher1@lboro.ac.uk](mailto:J.Fisher1@lboro.ac.uk))

(Dr Steven Harre-Young, Loughborough University, School of Civil and Building Engineering, Loughborough, LE11 3TU, [S.N.Harre-Young@lboro.ac.uk](mailto:S.N.Harre-Young@lboro.ac.uk))

(Dr Lee Boshier, Loughborough University, School of Civil and Building Engineering, Loughborough, LE11 3TU, [L.Boshier@lboro.ac.uk](mailto:L.Boshier@lboro.ac.uk))

## 1 ABSTRACT

The compatibility of, and conflict between, resilience and sustainability has received increasing attention in recent years, most notably in relation to the design, construction and operation of urban spaces. Considering that urban spaces can be fixed in time scales that range from several years to several decades and beyond, as well as the heightened influence of fiscal concerns at present and in the future, there is a need to understand and consider such interconnectivities at the earliest possible opportunity. Drawing upon ongoing research into the design of safer urban spaces, the relationship between resilience and sustainability was analysed through the exploration of whether emergency planning and the design of space could further both agendas. A state of the art literature review was conducted, as were eleven interviews with key stakeholders in the fields of emergency planning and resilience in the United Kingdom (UK).

Analysis of the above provided results indicating that a range of promising practice has been occurring in the UK, practice that not only increases the resilience of urban spaces to a range of hazards, threats and major accidents, but that is integral to the sustainability of the built environment itself. However, also apparent is the impact of the current fiscal situation, including the Government's extensive public sector spending cuts that are threatening the progress that has been made in relation to resilience and emergency planning; impacts which emphasise the need to identify long-term incentives and cost-effective solutions to the protection of the built environment. Conclusions drawn purport that whilst resilience is integral to sustainability and not merely compatible or conducive to it, a framework is required to further understand the integrated nature of urban space and how its users are made safer, built assets can be made less vulnerable to damage, and its natural environments are more protected.

## 2 INTRODUCTION

This paper is based on preparatory work for the development of an integrated security and resilience design assessment framework, as part of the Designing Safer Urban Spaces (DESURBS) project, which is funded under the EU Framework Programme 7 Security Programme. DESURBS explores urban space security issues, looking at how the involvement of local stakeholders in integrated security and resilience can improve urban security. The geographic focus of DESURBS is international, but concentrated research is being conducted in the cities of Nottingham (UK), Jerusalem (Israel), and Barcelona (Spain). Outputs of the project will include urban resilient design guidelines and a web-based decision support portal. The DESURBS project is a consortium of eight partners from five countries. This paper is produced by consortium partners at Loughborough University, with a particular focus on the Nottinghamshire region and the City of Nottingham itself.

### 2.1 Aim

The aim of the paper is to examine the relationship between resilience and sustainability, through the exploration of emergency planning and urban and building design, within the UK. This is being conducted in order to further understand the integrated nature of the built environment and how its users and assets can be better protected from the range of hazards, threats and major accidents that pose a risk to them.

### 2.2 Methodology

The methodology for this activity comprises a review of literature, together with semi-structured interviews with eleven key stakeholders involved in emergency planning and resilience in Nottingham and Nottinghamshire. The review used a web-based search of documentation, legislation and organisational

information, most of which is readily available online, through local authority and government websites. Several databases were also interrogated such as the Construction Information Service (CIS), Web of Science, ICE Virtual Library, and Health and Safety Science Abstracts. The key informants were sourced from member organisations of the Nottingham and Nottinghamshire Local Resilience Forum (LRF), which exists to “*establish and maintain effective multi-agency arrangements to respond to major emergencies, to minimise the impact of those emergencies on the public, property and environment of Nottingham and Nottinghamshire*” (Nottingham City Council, 2009).

### 2.3 Nottingham and its LRF

Nottinghamshire is a county in the East Midlands region of England with an estimated population of just over one million, about 350,000 of whom live in the city (Nottingham and Nottinghamshire Local Resilience Forum, 2011). Nottingham has main railway links to London (in the South) and Sheffield (in the North). The M1 motorway runs through the county, as does the A1 main trunk road. East Midlands International Airport is about 15 miles from the city. Nottingham has a vibrant city centre, renowned for shopping and entertainment. It is also home to several sporting facilities, namely the Nottingham Forest and Notts County football clubs, Nottinghamshire County Cricket Club and the National Water Sports Centre.

The LRF has several levels of involvement in emergency planning and resilience. The strategic (Gold) level consists of the Chief Constable, the Deputy Chief Executive of the Council, the local director of the Environment Agency, chief executives from the emergency services, and a representative from Nottingham University Hospital Trust. The tactical (Silver) level comprises middle management personnel, but includes the head of the County Council, and senior emergency planners. The operational (Bronze) level is made up of people who work on the ground responding to emergency situations and incidents. The Nottingham and Nottinghamshire LRF meets three times a year. A number of sub groups with specific areas of responsibility such as chemical, biological, radiological and nuclear (CBRN), pandemic influenza, and flood response meet six times a year and report to the LRF. The process they adhere to in terms of risk assessment and how that influences emergency planned is shown in Figure 1 below.

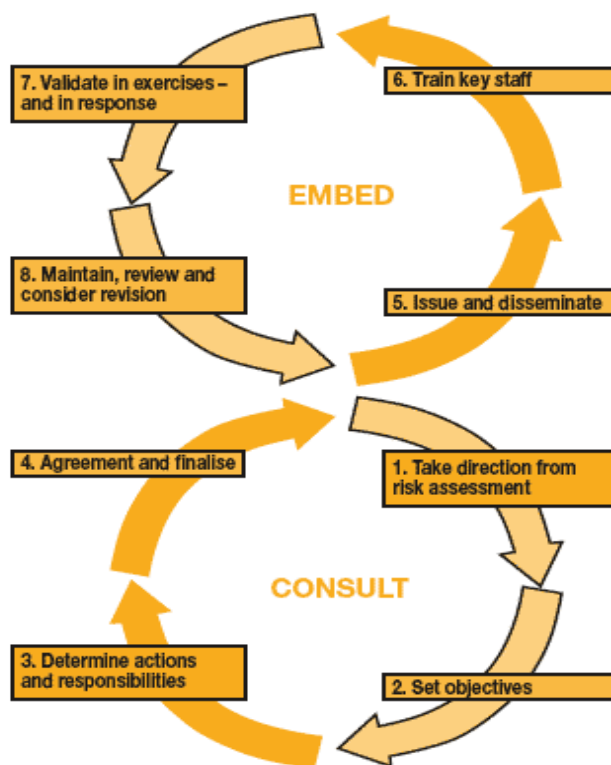


Fig. 1: Cycle of Risk Assessment and Emergency Planning (Nottingham and Nottinghamshire Local Resilience Forum, 2011)

### 3 RESILIENCE AND THE UK

Geis (2000, p.154) states that the ‘built environment’ encompasses the substantive physical framework in which society can function in its social, economic, political and institutional aspects. However, not only does the built environment facilitate the functioning of society, it also represents the majority of national savings and investment (Little, 2002; Ofori, 2008). Yet the built environment itself is not designed purely to accommodate these functions alone, as a vast array of legislated considerations and other options and pressures influence the design, construction and operation of the built environment. Pertinent to this paper is the array of hazards, threats and major accidents that can pose risks to urban space and those who use it, as the consequences of those risks manifesting themselves can be so profound as to nullify years of development and investment (Dainty and Boshier, 2008, p.358). Urban space must therefore be planned, designed, built, managed and operated so that it is, and supporting systems are, ‘resilient’.

#### 3.1 The Concept of Resilience

In order to understand what constitutes a resilient built environment, and what the term ‘resilient’ means, the origins of the term must first be explored. Sapountzaki (2007, p.298) and Klein *et al.* (2003, p.35) highlight that the Latin root of the word is ‘resilio’, which means to ‘jump back’; what could be considered as returning to a previous state. Boshier & Dainty (2011) suggest that the concept of resilience primarily emerged in research concerned with how ecological systems cope with stresses or disturbances caused by external factors (see Errington, 1953; Blum, 1968), but has more recently been applied to human social systems (Manyena, 2006), economic recovery (Rose, 2004), engineering (Hollnagel *et al.*, 2006) and urban planning and recovery after calamitous events (Vale and Campanella, 2005).

Holling (1973, p.14) asserted that resilience is the “*measure of the persistence of systems and their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables*”. However, as asserted by Boshier (2008, p.13), such definitions are evolving to capture that it is not sufficient for systems to simply ‘bounce back’ or return to a previous state, as the system needs to be a more robust version of this. Resilience can therefore be seen as the ability of an asset to cope with disruption, maintain essential operations, return to normal operations after the disruption has ended, and elevate to a more-informed state. Determining an asset’s resilience will, therefore, always result in the question ‘resilience of what, to what?’ (Carpenter *et al.*, 2001, p.779).

#### 3.2 Within the UK

Within the UK, the resilience of the built environment has been given increasing attention over the past decade, with a range of obligations and incentives to aid in reducing the vulnerability of the built environment to the plethora of hazards, threats and major accidents that pose a risk to it (Harre-Young, 2012). Advancements have occurred particularly in relation to the two areas of emergency planning, and urban and building design, each of which will now be explored.

##### 3.2.1 Emergency Planning

The UK has a well established formal system for emergency planning, namely the Civil Contingencies Act (CCA) 2004 (Civil Contingencies Secretariat, 2004). Prior to this, civil protection legislation dated back to 1948 with the notion of hostile attack from a foreign power. The year 2000 is known as ‘the year of the 4 F’s’, as fuel shortages, severe flooding, foot and mouth disease, and Fire Service strikes highlighted the need to re-think emergency planning nationally, regionally, and locally, and that new legislative measures were needed to ensure that there was an adequate framework for such arrangements. The CCA has two parts: local arrangements for civil protection, and emergency powers, and it redefined the concept of ‘emergency’ to cover threats from international terrorism, the loss of communication systems, as well as such risks as biological or chemical contamination of the environment.

The CCA stipulates two categories of front line responders (category one and category two responders) and identifies their duties and responsibilities relating to ‘localised incidents through to catastrophic events’ (Civil Contingencies Secretariat, 2004, p.2). Category one responders, or ‘core responders’, are the emergency services, all principal local authorities, National Health Service bodies and key government agencies. Category two responders comprise ‘co-operating responders’, such as utility companies, transport operators, strategic health authorities, the Health and Safety Executive, and voluntary agencies. The CCA

also describes the duty of these agencies to cooperate in a Local Resilience Forum (LRF), based on each police area (HM Government, 2004), although in many instances, such forums (co-ordinated groups of category one and two responders who undertake risk assessments and carry out mitigative activities accordingly) existed in other forms prior to the Act coming into force.

### 3.2.2 Urban and Building Design

Urban and building design has also been used to advance resilience, and has arguably been seen as a 'universal remedy' to an ever-increasing array of socio-economic problems, policy priorities, and risks and threats that contemporary society faces (Bretherton and Coaffee, 2009, p.35). The use of such design has traditionally been associated with territorial control in the face of terrorist threats, through the regulation, restriction and control of access, and ensuring surveillance coverage (Coaffee *et al.*, 2009, p.489). Rogers and Coaffee (2005, p.323) assert that government policy has been concerned with making the environment of cities more attractive as a whole, whilst also improving safety and security. HM Government (2010, p.5) states that the incorporation of counter terrorism into the built environment is to be achieved within the overall aim of creating high quality public places. Whilst Harre-Young (2012) highlights that the protection of places can occur through the use of organisational measures such as business continuity management, concern regarding the modification of the built environment remains a constant presence, as highlighted by Coaffee (2010, p.940): "*we need to consider the 'physical' changes brought about through counterterrorism measures being embedded in the urban landscape as a result of heightened terror threat levels*". Harre-Young (2012), however, highlighted that urban and building design that leads to increased resilience can have a number of advantages, including the ability of measures for specific risks (e.g. counter terrorism or flood risk management measures) being able to do more than their intended outcome, and that commercial and fiscal gains can be accrued by doing so, all of which furthers the resilience of the built environment and its longevity.

## 4 PROMISING PRACTICE

Evident above are the ways in which emergency planning and the use of urban and building design can increase the resilience of the built environment and those who use it to a vast array of hazards, threats and major accidents. Further still, analysis of literature and of the data collected from the interviews with key stakeholders involved in emergency planning and resilience shows that there is not only promising practice occurring that needs to be highlighted as such, but that increases in resilience can be an integral part of the sustainability of the built environment.

### 4.1 Resilience in its own Right

Feedback from respondents strongly suggested that the Nottingham and Nottinghamshire LRF is an effective mechanism which facilitates an integrated multi-agency response. A number of reasons were suggested for this, which included debriefing practices, the testing and exercising of plans, business continuity planning, communicating with the public, the engagement with and role of voluntary services, and the extent to which community resilience has been encouraged and developed. Three of the most important aspects that were evident were the relationships between stakeholders, emergency response, and the input of stakeholders into urban design itself.

#### 4.1.1 Relationships

At an organisational level, it was raised that the success of the Nottingham and Nottinghamshire LRF is due to: "*the fact that they look at every single department, every single group that should be there, not just it's Police, Fire, council*" [Interview(I)11. Senior Manager, Voluntary Service]. This inclusive approach allows a wide range of sub-groups to be created, which are generally seen to be an effective way of working: "*If you want to produce some meaningful work which is done with cooperation, which is a requirement of the Act, then you really need those sub-groups in place*" [I8. Senior Manager - Planning Organisation]. Good governance and management of those involved was stated as being essential to the effective working of the LRF [I5. Emergency Planner - Planning Organisation]. Noted was the Secretariat to the LRF and that it alternates every two years between the City and County Councils, which results in a slight competitive aspect that typically has positive impacts [I7. Emergency Planner - Fire and Rescue Service].

Individual personalities were emphasised as being an important factor in the effective working of the LRF: “*I think the partners work well as a group. I think it is personality. And the chairs of most of the standing groups all work well together*” [I4. Manager - Care Trust]. The fact that key stakeholders know each other and their ways of working together strengthens the resilience of relationships within the group and ultimately, their effectiveness in planning for and responding to emergencies.

#### 4.1.2 Response

All LRF partners can activate command and control procedures when a situation that cannot be managed using normal management structures occurs [I6. Manager - Health Trust]. When this occurs, a Gold (strategic) Commander is identified from the lead agency, followed by lower levels of Silver (tactical) and Bronze (operational). These roles can be subject to change, as for example, a fire might result in the Fire Service leading Gold, yet the site could become a crime scene, which would result in the Police taking over. The protocols for response are well known and rehearsed among the stakeholders and can be operationalised extremely quickly. Therefore, in a major incident, everyone is familiar with the different roles and who to communicate with: “*a big factory going up in smoke, they [the Fire Service] would let us know... So then we would deploy people to site, we'd open our incident room up at our Nottingham office, that's our area incident room, and we've got a hierarchy of roles that we would send out and they're trained to go to the right place at the rendezvous point and speak to the right people and respond in a professional way*” [I8. Senior Manager - Planning Organisation]. In situations which exceed the capacities of the local agencies, mutual aid is invoked with agencies from other regions, with those arrangements also going through periodical testing and exercising.

#### 4.1.3 Input into Urban Design

The Police, the Fire Service and the Environment Agency have input into the design and planning of urban buildings and environments. Specifically in relation to counter terrorism, domestic extremism, and hazardous sites and substances, the National Counter Terrorism Security Office (NaCTSO) co-ordinates trained Counter Terrorism Security Advisers (CTSAs), who are Police staff embedded within each Police Force to undertake threat and risk assessments and provide advice to a range of stakeholders. The Police also have a number of Architectural Liaison Officers (ALOs), who provide advice to those planning new builds on matters relating to ‘lesser crime’ than terrorism. As there is no legal obligation for organisations to adhere to any advice given, this is therefore couched in terms of developing and increasing business continuity, which is evident in literature (Harre-Young, 2012). Fire regulations exist for all new buildings and the Fire and Rescue Service has legal responsibility for their enforcement. However, the Fire and Rescue service only has statutory rights over enforcement of legislation from “*the point at which the building is finished and then occupied*” [I7. Emergency Planner - Fire and Rescue Service].

## 4.2 Contributions to Sustainability

The relationship between resilience and sustainability has been evident in literature for a number of years, with notions of ‘turquoise design theories’ to denote the typical associations of resilience/security with the colour blue, and sustainability/environmental with the colour green (Perelman, 2008). The developments in resilience, emergency planning, and urban and building design, as previously outlined (Boshier and Dainty, 2011; Coaffee, 2009), have arisen most notably through the emergence of resilience as the key discourse in relation to security, and being an objective of society through to individual buildings. Perelman (2008) states that this is the very essence of ‘turquoise design’ and the true meaning of resilience; resilience is the merging of security and safety concerns with the broader goals of sustainability and sustainable development.

Coaffee (2008, p.4636) states that “*in future decades it is most likely that the sustainability agenda will provide the most appropriate policy vehicle for the achievement of resilience, with security seen as an essential element of corporate and organisational responsibility alongside economic, environmental and social concerns*”. Such assertions are also evident in a range of governmental and non-governmental literature (Fussey *et al.*, 2011; Coaffee and Boshier, 2008; Zimmerman, 2008). However, how such practices are carried out and incorporated is unclear, although a number of synergies have been identified. For example, Harre-Young (2012) identified that the incorporation of counter terrorism measures mitigated the impacts of a range of other threats, hazards and major accidents, prolonging the longevity of buildings and urban space, and also highlighted a range of environmental benefits.

#### 4.2.1 Integrating Resilience and Sustainability Approaches

Coaffee and Boshier (2008) provide examples of how the potential synergies between resilience (specifically security aspects of resilience) and sustainability might include developing landscaping systems that are both 'green' and can conform to Crime Prevention Through Environmental Design (CPTED) principles. For example, ponds and strategically planted trees can be used as physical barriers against vehicle-borne crime such as 'car bombs' and 'ram-raiders', instead of using expanses of concrete and rows of steel bollards. It is also possible that such ponds and landscaping features could be used as part of sustainable urban drainage systems (SUDS) that are designed to reduce the occurrence and impact of flooding in urban areas (Coaffee and Boshier, 2008).

It is also suggested that integrating security systems with other built systems at the design stage (whole building design) can reduce energy use, as can the use of thick thermal walls or window film, which better insulates a building while providing additional blast resistance or fire protection (Coaffee and Boshier 2008). Arguably, in the future a more inclusive and joined-up approach to integrating resilience and environmental sustainability should be advanced through the greater collaboration between a wide range of stakeholders - architects, engineers, planners, the police, insurers, surveyors importantly, the public, who are, or should be, involved with the planning, design, construction, operation and management of urban spaces. However, while the respondents in Nottingham were generally open to these types of integrated approaches, where resilience and sustainability could be coalesced, a number of barriers were identified that would undoubtedly impede the transition from theory to practice; these barriers are discussed in the next section.

## 5 BARRIERS TO PROMISING PRACTICE

Despite the promising approaches that have been identified within Nottingham and beyond, barriers to such practice being further developed and incorporated are evident, most notably the fragmented nature of the construction industry itself (Boshier and Dainty, 2011). However, other factors were also identified through the key informant interviews, those being fiscal constraints, strategic sign-up, communicating with the public, and the use of tools and hardware, all of which impact the potential of emergency planning and the design of urban space and buildings.

### 5.1 Fiscal Constraints

The LRF is not a legal entity and there is no budget for its activities; associated costs are met by the relevant agency or sector involved. All respondents expressed concerns about the current fiscal situation, and in particular, the impact of the UK Government's spending cutbacks to public services such as emergency planning. This has resulted in prioritising resources to the groups that have the '*biggest impact*' [I7. Emergency Planner - Fire and Rescue Service] and staff cut-backs resulting in some issues being left until a later date [I1. Emergency Planner - Local Authority], which ultimately affects resilience [I4. Manager - Primary Care Trust]. The full impact of budget cuts is yet to be quantified or qualified, but the fear is it will result in a lack of insurance against incidents, "*because if you want that insurance policy, you need that resilience*" [I9. Emergency Planner - Police Force]; without it, progress that has been made in relation to resilience and emergency planning could be lost. Within these constraints, there is a need to identify long-term incentives and cost-effective solutions for the protection of the built environment.

Harre-Young (2012) has identified such incentives and solutions in the context of counter terrorism design features, which can include reductions in risk and injuries, competitive gains for engaged stakeholders, revenue generation, increases in reputation, increases in property and area values, and potential insurance incentives. As an example, Harre-Young (*ibid.*) highlights that exclusion of traffic from a given area (measures that can be used to do so are presented in Figure 2) can be a costly approach to incorporate, depending on the size and context of the space being protected, yet there are numerous benefits, apart from the mitigation of not just vehicle-borne terrorism, but: the mitigation of other forms of crime (such as ram-raiding), reductions in noise and air pollution, less soiling of buildings, increased safety of pedestrians within, and increased footfall that has resulted in increased turnover for retail outlets within the protected zone. It is therefore argued that the incorporation of resiliency measures are a fundamental aspect of sustainability, due to the measures being able to protect and sustain the life of urban spaces that they protect. The aforementioned incentives, therefore, could be suitable for making the costs of some resilience measures more viable or acceptable in both financial and aesthetic terms, and therefore aid in supporting business



cases for incorporating what could be costly resiliency measures, as well as the overcoming of the other constraints that are outlined in the rest of this section.

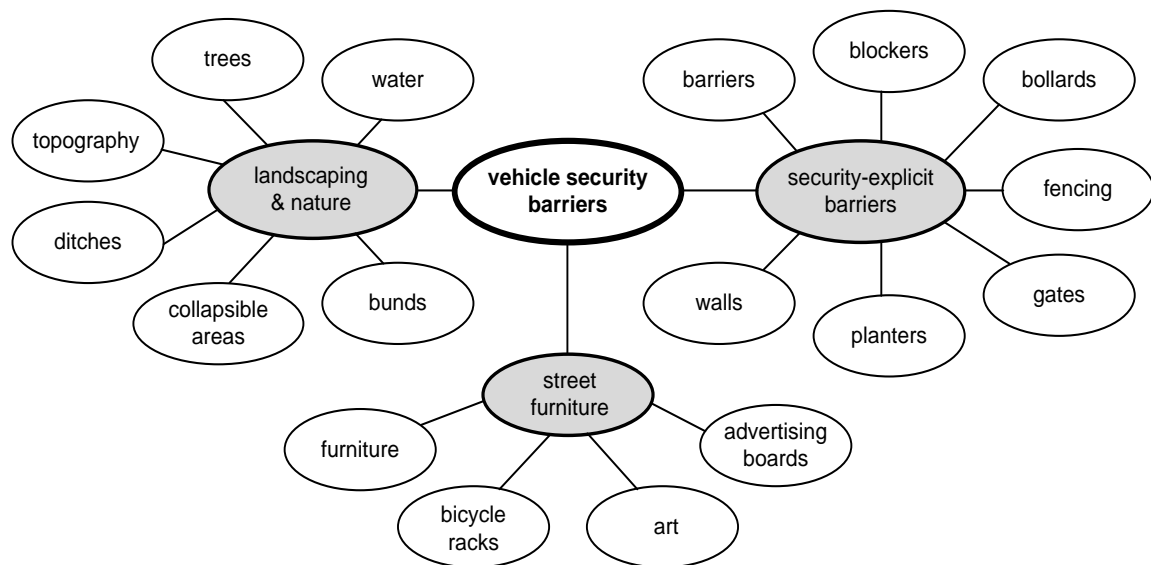


Fig. 2: Measures that can be used to exclude vehicles from a given area (Harre-Young, 2012)

## 5.2 Strategic Sign-Up

Getting senior management to engage with the LRF process was noted as being difficult, as those in senior positions prioritised issues as they saw fit, rather than according to those defined by the LRF. An example is the need for key decision makers to attend meetings: *“you need people there who have got the authority to make decisions, that could spend millions if they needed to”* [I10. Manager - Ambulance Service]. There were also concerns about the quality of the multi agency plans as these are difficult to achieve without high level support; *“it’s about getting people’s buy-in for something that you might perceive as important but actually they think it’s somebody else’s job to do”* [I5. Emergency Planner - Planning Organisation]. Authorising the mainstreaming of resilience issues within organisations is an area for improvement, and a lack of awareness of agency involvement in the LRF prevents personnel from engaging with the process, with an example being given of a community safety department not being involved in a ‘warning and informing’ sub-group, despite the potential benefit of their involvement.

## 5.2 Communicating with the Public

The UK Government’s Community Resilience Programme (HM Government, 2011, p.5) aims to “increase individual, family and community resilience against all threats and hazards”. An important aspect of this aim is the requirement to facilitate discussion between all stakeholders, including central government, emergency services, the voluntary sector and communities on good practice. Giving the general public, and specifically local communities, this shared responsibility in ensuring community resilience is arguably a sub-text to the UK Government’s strategy to devolve resilience decision-making to the regional and local levels so that interventions are more likely to be self-sustaining.

Central to the Community Resilience Framework is effective risk communication at local level to increase awareness and enhance public response. Although there are advances in this area, some interventions that would increase resilience require legislation, in order to, for example, allow mobile phone broadcasts to be made *“and just blast everybody’s mobile phone to say there’s been an incident in Nottingham city centre, please make your way to wherever, and that technology exists”* [I9. Emergency Planner - Police Force]. A flood warning system used by the Environment Agency to warn the public of flood risk exists, however take up of this is low, as homeowners *“don’t want to know because it potentially affects their insurance”* [I8. Senior Manager - Planning Organisation]. Consequently, the Environment Agency is considering how to make membership of this list the default position.

### 5.3 Use of Tools and Hardware

While different agencies use various tools and hardware, there is no common information management system subscribed to by all, although all stakeholders can subscribe to the secure National Resilience Extranet (NRE) which was developed by the Civil Contingencies Secretariat to provide access to restricted documents. Although agencies have been encouraged to do this, not all have done so, with one reason being that it can cost between £15-20,000 per organisation. Atlas Incident Management System (AIMS) is used by several responders however, including the Ambulance service, the Police, the Fire and Rescue Service, and the County and City Councils. The system works through the logging of information and the actions that are required, the allocation of someone to achieve those actions, and whether this has been completed or not [I7. Emergency Planner - Fire and Rescue Service]. The above challenges of strategy, finance and communication are areas that underpin all aspects of resilience; without addressing these broader issues, the success and long-term sustainability of the multi-agency response enshrined in the LRF cannot be guaranteed, despite the skills and efforts of the individuals and organisations involved.

## 6 CONCLUSION

This paper has explored the interconnectivities between resilience and sustainability in relation to emergency planning and urban design within the UK. Ideally, the design, construction and operation of urban space should be based on principles that are both sustainable and resilient. With this as a starting point, ensuring resilient management and operation of these spaces naturally follows. However, a further challenge is to manage the existing urban built environment to ensure that effective emergency planning is in place and resilience is maximised. The Nottingham case study highlights a range of promising practice in the UK that increases the resilience of urban space to a range of hazards, threats and major accidents. Central to such successful practice has been the effective individual and organisational relationships, familiar structures for command and control, and level of input into the design of urban space. These examples demonstrate that resilience is actually an integral part of the sustainability of urban space, and not simply compatible with it.

However, such progress is threatened by the potential impact of fiscal constraints and in particular the public sector spending cuts, the difficulty in securing senior management engagement with the LRF, and communication and engagement with the public and local communities. These factors are inevitably linked as increased prioritisation is demanded by restricted budgets. Research has already shown that incorporating resiliency measures can also lead to environmental benefits and increased sustainability, so there is a need to identify such cost-effective solutions for stakeholders so that they continue to prioritise the protection of urban space. However, further investigation is needed to better understand the integrated nature of urban space, how its users are made safer, how its natural environments are better protected, and how urban space can be made less vulnerable to the vast array of hazards, threats and major accidents that pose risks to it.

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