



## DESURBS Deliverable 2.2: Tools for the assessment of security threats

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## **Executive Summary**

This report constitutes Deliverable 2.2 of the FP7 Security Program research project 'Designing Safer Urban Spaces' (DESURBS, Grant Agreement no. 261652). The purpose of this report is to highlight the examples of open access online security and resilience approaches and tools and key documents that support decision making in regard to the Integrated Security and Resilience (ISR) framework (WP2.3), the structure of which has been incorporated into all the WP2 deliverables.

The report presents information on the approaches mentioned above, found during the course of an extensive literature review, and from data collection that has been undertaken in the Nottingham (UK) and Jerusalem (Israel) case study cities of the project. This deliverable demonstrates that there is a great number of tools and documents available online, however the majority of them are context-specific and can only provide partial information that can be useful in disaster risk management.

It has been identified that many of the tools are multi-hazard and can be used in conjunction with international documents and guidelines. There is however a lack of open-access tools for specific hazards, in particular industrial accidents and ground movements. This is due to a high specificity of these events and a necessity to use high-tech equipment for identification of these hazards and their mitigation.

### **Acknowledgements**

We acknowledge the work of all the partners involved in the DESURBS project, as their own work, thoughts and perspectives have informed, and will continue to inform, the work that the DESURBS partners at Loughborough University undertake.

We acknowledge the time, effort and knowledge of all those who have been engaged with and interviewed, to-date, and that without the considerable data collection that has already taken place, the significance, rigour and value of WP 2 and others' work would not be in line with the aim and objectives of the project.

We acknowledge the work and continuing influence of Dr Julie Fisher and Dr Steven Hare-Young, who worked on the DESURBS project for Loughborough University during the first two years of the project.

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## **1. Introduction**

This report constitutes Deliverable 2.2 of the FP7 Security Program research project 'Designing Safer Urban Spaces' (DESURBS, Grant Agreement no. 261652). The geographic focus of DESURBS is international, but with specific attention to two case study city locations: Nottingham (UK) and Jerusalem (Israel). This report on Work Package (WP) 2 of the DESURBS project, which draws on work undertaken across each of the case study cities (and countries), is chronologically the second deliverable of this work package. WP2 encompasses the development of an Integrated Security and Resilience (ISR) framework, specifically for identifying urban vulnerabilities and improving urban spaces with respect to security threats. It will be informed by:

- identifying the public and private sector stakeholders responsible for the management of security risks and understanding their roles and interconnectivities (WP 2.1)
- assessing security and resilience approaches suitable for urban spaces (WP 2.2)
- consolidating security and resilience approaches suitable for urban spaces (WP's 2.3 and 2.4)

### **1.1 Purpose of the report**

The purpose of this report, in line with the above, is to report on the identification and assessment of security and resilience approaches suitable for urban spaces. This report demonstrates some examples of open access online security and resilience approaches and tools and key documents that support decision making in regard to the ISR framework (WP2.3).

### **1.2 Structure of the report**

In order to provide consistency across all WP2 outputs and deliverables, this report has been structured around the ISR framework, and therefore presents security and resilience approaches, tools (detailed in Appendix 1) and documents (detailed in Appendix 2) in regard to identifying hazards and threats, assessing their consequences, determining risks, and identifying and prioritising risk reduction measures.

## **2. Methodology**

In line with the methodology carried out for Deliverable 2.1, this report was also created through undertaking an extensive literature review, as well as data collection in the case study cities of Nottingham and Jerusalem. In regard to the review of literature, several databases were interrogated using keyword searches in MetaLib, which included the Construction Information Service (CIS), Web of Science, ICE Virtual Library, and Health and Safety Science Abstracts. References of key publications were also examined in order to provide up to date and appropriate material. The literature identified was of international origin, yet in regard to work on Nottingham, UK-based publications and sources were predominantly used. Material that was more than 10 years old was generally avoided as there have been rapid developments on this topic in recent years. Searches for literature were undertaken in accordance with the themes and structure of the ISR framework, and hazards and threats explored in this project.

The literature review was supplemented by a number of key informant interviews with public and private sector stakeholders in both Nottingham (UK) and Jerusalem (Israel). Data collection in each case study city was co-ordinated by researchers at Loughborough University in accordance with UK, Israeli, and European Commission data collection and data protection rules and regulations and ethical obligations.

The tools presented in this deliverable are web-based and publically accessible. The documents presented in this deliverable are also web-based, publically accessible and represent key regulations, guidelines and reports in the area of disaster risk reduction and management. However it is apparent that new tools and documents are being developed at an increasing pace over recent years, therefore it is acknowledged that the information contained within this report is applicable at the time of publication (November 2013).

### 3. Tools in the ISR framework context

A number of web-based public access tools and key documents that help to assess security and resilience will be presented in this section, in line with the structure of the ISR framework that is being developed for WPs 2.3 and 2.4.

It is important to emphasise that the list of tools and documents presented here are by no means exhaustive; its purpose is to demonstrate some examples of the tools and documents rather than to create an extensive list of all the available tools. It is envisaged that when the ISR framework is 'live', and hosted within the decision-support portal created as part of the DESURBS project (WP5), then applicable tools and documents will be available as users' progress through the framework.

There is an increasingly complex amount of information and guidance on how natural hazards can be eliminated/reduced/mitigated/designed-out through urban planning and design interventions. The range of guidance, tools and approaches typically vary depending on the types of hazards/ threats that need to be addressed and many are context/country specific in their requirements.

Key publications and resources that cover man-made threats include the services of Police Architectural Liaison Officers (ALOs) and CTSA's, guidance published by NaCTSO, the Centre for Protection of National Infrastructure (CPNI) and the Royal Institute of British Architects (RIBA), and guidance published by NaCTSO in partnership with DESURBS partners at Loughborough University (see Harre-Young 2012).

While there is a great number of decision support tools, only the examples of the 'open access' tools and documents relevant to DESURBS themes (storms, earthquakes, tunnelling and ground movement, crowded events, terrorism, and industrial accidents) will be discussed in the following sections. For the full list of tools and documents, and web-links, see Appendices 1 and 2.

Some of the documents and tools presented in this deliverable are multi-hazard, and cover more than one stage of the ISR; however, for the purposes of the simplification they will be used as a single-hazards tools and documents in the following tables, with the full information about all the hazards and stages covered by a particular tool or document provided in the Appendices. Chapters relevant for each particular ISR stage and a brief description of the tools are indicated in the Tables. In some cases, it was not possible to identify open access web based tools, thus no information will be provided. This however does not indicate that the tools do not exist – rather, most of the tools either require payment or subscription.

#### 3.1 ISR framework concept

The ISR framework has been designed to help users to design safer urban spaces, through a stage-by-stage process that has emerged through the project's methodology (section 2.1). The ISR framework will act as the backbone of the Decision Support System Portal (DSSP) tool that is being developed on WP5 by IT Innovation, Southampton. Central to the development of the ISR framework has been the adherence to, and further development from, an international standard on risk management (British Standards Institution, 2011; 2009).

The international risk management standard ISO 31000 '*Risk management – Principles and guidelines*' (British Standards Institution, 2011; 2009) presents four stages, those being risk identification, assessment, evaluation, and treatment. In the ISR framework, 'treatment' has been

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expanded into two stages, to aid end users to 'identify' what measures can be used, and to 'prioritise' them in relation to their effectiveness (see Boshier, 2014). The five key stages of the ISR framework are:

- Identification, characterisation and assessment of hazards and threats
- Assessment of the vulnerability of urban spaces to the identified hazards and threats
- Determination of the risk, i.e. the expected consequences of hazards and threats on assets
- Identification of ways to reduce the identified risks
- Prioritisation of risk reduction measures.

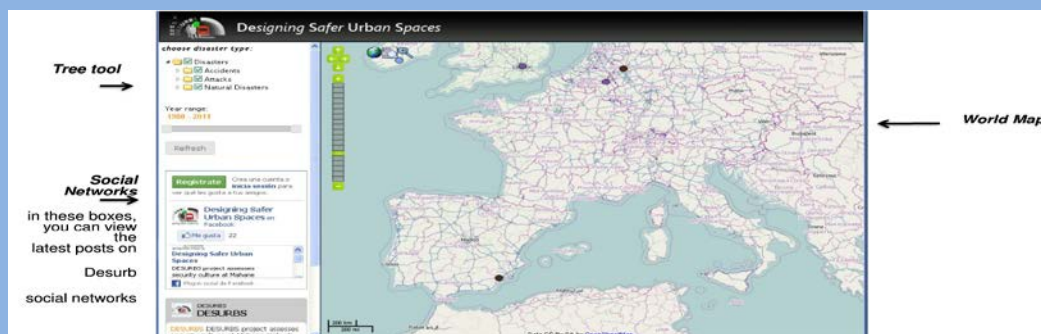
The characteristics of the stages will be described in more detail in the following sections, and the ISR framework itself is further explored in Deliverable 2.3.

### 3.2 Tools for identification, characterisation and assessment of hazards/ threats

Tools described in this section can be used in ISR Stage 1, i.e. they can aid the process of finding, recognising, and describing hazards/threats to which the space is exposed. Their objectives are to identify type of hazard/threat; the events/circumstances when the hazard/threat is prevalent; their causes; and their potential consequences. This could be done by employing the assessment of historical data, theoretical analysis, or/ and informed by expert opinions.

Boxes 1 and 2 illustrate examples of the tools that can be used at ISR Stage 1; these tools (and all the following tools described in the Boxes) have been developed by the DESURBS project partners.

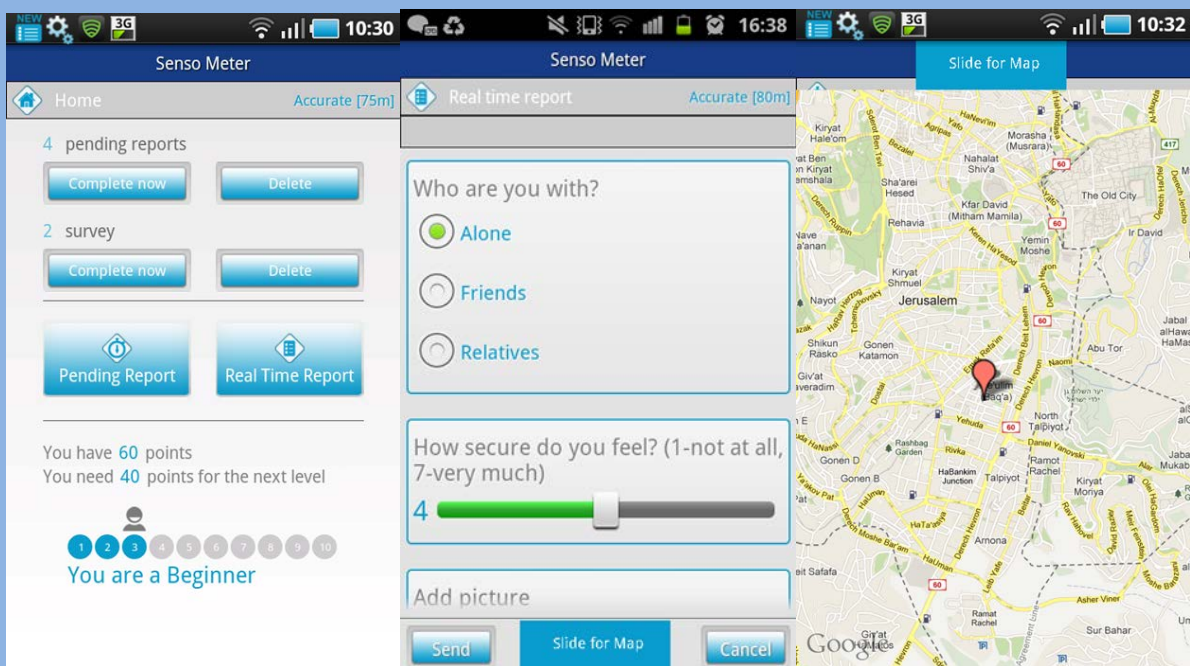
#### Box 1: Event visualization tool (CIMNE)



Event visualization tool developed by CIMNE displays the occurrence of natural hazards as events in time on the world map. Each event is provided with a brief description, photos and other information. The tool is also linked to various social networks, which allows it to be updated in real time.



**Box 2: SensoMeter (HUJI)**



SensoMeter developed by HUJI allows generating, disseminating, collecting, storing, analysing and presenting the results of surveys and reports that are sent via a smartphone application. A central server controls the settings of the reports allowing the users of the system high flexibility in managing mobile clients, configuring surveys campaigns and modifying them in real time. The Senso-Meter system utilizes smartphones and turns them into efficient real-time data collection units that can deliver both subjective reports of people (surveys) and objective sensorial information. The system is constructed of three main components: 1) smartphone application, 2) data base 3) web interface. Its aims are to incorporate volunteered participatory sensing in organizations in order to allow them to better understand the spatial distribution of a security related phenomena and events, and to conduct specific surveys about security related issues.

Table 1 presents the examples of the tools and documents that can be used for identification, characterisation and assessment of hazards/ threats.

**Table 1 Examples of the tools and documents that can be used to aid ISR Stage 1**

Hazard/ threat	Tools		Documents	
	<i>Title</i>	<i>Description</i>	<i>Title</i>	<i>Relevant chapters</i>
Floods and storms	EA flood maps	The maps demonstrate the likelihood of flooding from rivers and the sea in various areas in the UK.	Keeping the country running: natural hazards and infrastructure	3
	ASA inundation tool box	A software system that connects storm surge model predictions to GIS mapping and analysis capabilities to generate maps of areas at risk to inundation from the predicted surge.	Six steps to flood resilience: guidance for local authorities and professionals	1 and 2
Earthquake	Broadband ground motion simulation	Generation of ground motions for a particular earthquake in order to improve ground motion attenuation models, resulting in more accurate predictions.	Putting down roots in earthquake country	1
Tunnelling and ground movements <sup>1</sup>	Deepsoil	A software tool for the analysis of 1-D seismic response of soil columns allowing to qualitatively assessing the influence of soil layers of varying stiffness on the propagated ground motion during a seismic event.	Peat landslide hazard and risk assessment guide	2,3
	BGS National landslide database	The most extensive GIS database of the landslides in the UK documented as fully as possible with information on location, name, size and dimensions, landslide type, trigger, damage caused, movement date, age and with a full bibliographic reference.	Geotechnical investigation and testing - Geotechnical monitoring by field instrumentation - General rules	All
Crowded events	<i>Not identified</i>	<i>Not identified</i>	Managing crowds safely	3

<sup>1</sup> Most of the risk reduction measures and evaluations are currently carried out by private consultants, thus there is a very low number of open access web-based tools.

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Terrorism	<p>Political violence map</p> <p>The Hats simulator</p>	<p>The map measures the risk of political violence to international business in 200 countries and territories.</p> <p>A lightweight proxy for many intelligence analysis problems, such as to identify and arrest harmful agents before they carry out their plans.</p>	<p>Handbook for rapid visual screening of buildings to evaluate terrorism risks</p> <p>RIBA guidance on designing for counter-terrorism</p>	<p>3,4,5</p> <p>Part 1</p>
Industrial accidents <sup>2</sup>	Strategos	Provides suggestions on how to plan an industrial site for a long-term.	ILO Prevention of Major Industrial Accident	1

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<sup>2</sup> Due to a variety of types of industrial accidents and specific strategies developed by the managers of the industrial sites, a very low number of public access web-based tools are available.

### 3.3 Tools for assessment of the vulnerability of urban spaces to specific hazards/ threats


Tools described in this section can be used during the ISR Stage 2: they support the process of assessing the susceptibility of the intrinsic properties to a hazards/ threat that can lead to an event with a consequence. These tools support the assessment of both structural and design vulnerabilities.

#### Box 3: Citizen (Bezalel Academy)


**CitiZen system elements**




Mobile app



GPS



Internet connection



Control Room

Citizen, developed by Bezalel Academy, is a free GPS enabled mobile application featuring near real-time security reporting coupled with back-end monitoring application. Together, they create a platform for Citizen – Authorities Communication, providing for a more accurate and efficient reporting process. The app allows users to report accidents, security hazards, criminal activities and more using video, sound and text. Users can view events reported around their location, give feedback upon other's reports and be updated about their handling by the authorities. The back-end application presents the reported events to policing authorities providing accurate GPS location and picture which can be filtered according to reliability and urgency.

The aim of the tool is to create a location-based, social network which allows authorities and citizens act together in order to improve the quality and safety of their environment in times of peace and of disaster.

Table 2 gives examples of the tools and documents that can be used for assessment if the vulnerabilities of urban spaces to a specific hazard or threat.

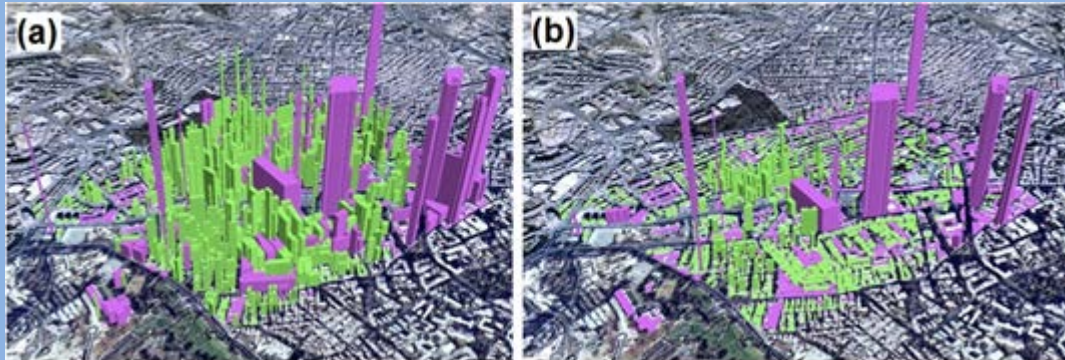
**Table 2 Examples of the tools and documents that can be used to aid ISR Stage 2**

Hazard/ threat	Tools		Documents	
	<i>Title</i>	<i>Description</i>	<i>Title</i>	<i>Relevant chapters</i>
Floods and storms	The land use portfolio model  Hazus	It is designed to help public agencies and communities understand and reduce their vulnerability to, and risk of, natural hazards. Models for estimating potential losses from earthquakes, floods, and hurricanes.	Designing for flood risks Planning policy statement 25 The planning system and flood risk management guidance for planning authorities	Part A 3 Part A
Earthquake	Seismic design maps  Scenario assessment for emergency	This tool to gather a preliminary assessment of the seismic design parameters for a certain area. Software that produces realistic natural hazard impact scenarios for better planning, preparedness and response activities.	Earthquake resistant construction of buildings: curriculum for mason training	6
Tunnelling and ground movements	ERN landslide	Landslide hazard assessment	Peat landslide hazard and risk assessment guide A code of practice for risk management of tunnel works	4,5 4
Crowded events	Ped-net  STEPS	Community resource for pedestrian and crowd simulation professionals  Designed to predict pedestrian movement under both normal and emergency conditions.	Crowd Control at venues and events	Part 2
Terrorism	A how-to guide to mitigate potential terrorist attacks against buildings	Outlines methods for identifying the critical assets and functions within buildings, determining the threats to those assets, and assessing the vulnerabilities associated with those threats.	Handbook for rapid visual screening of buildings to evaluate terrorism risks  Estimating terrorism risks	6  All
Industrial accidents	<i>No open access tools identified</i>	-	OECD guiding principles for chemical accident prevention, preparedness and response	Part A

### 3.4 Tools for determination of the risk

The aim of the tools described in this section is to determine the expected consequences of specific hazards/ threats on specific assets. These tools support identification of the level of risk, i.e. the magnitude of a risk (or combination of risks), expressed in terms of the combination of the likelihood and the impact of an incident caused by the hazard/ threat.

#### Box 4: Dynamic Agent Based Simulation Tool for Urban Disasters (HUJI)



Agent-based simulation, developed by HUJI, decomposes the complexities of the urban system into the operation of 'agents'. This tool helps individuals and organisations to cope with the chaos and uncertainty inherent in these events and thus contributes to make cities, safer, less vulnerable and more resilient. The tool can be used in real time events or more likely, as a training and capacity building measure.

The aim of the tool is to simulate both short run (temporary) and long run (permanent) urban shocks. This results in the following practical applications: Evacuation routing; reducing chaos period; estimating return time to equilibrium; rejuvenation of land use and economic activity; predicting change in urban morphology; evaluating effectiveness of policy instruments.

Table 3 demonstrates the examples of the documents and tools that are openly available for risk determination activities.

**Table 3 Examples of the tools and documents that can be used to aid ISR Stage 3**

<b>Hazard/ threat</b>	<b>Tools</b>		<b>Documents</b>	
	<i>Title</i>	<i>Description</i>	<i>Title</i>	<i>Relevant chapters</i>
Floods and storms	Identifying population and assets at risk	Web-based mapping tool that helps to identify the risk of flooding at the Israeli coast line.	The role of land-use planning in flood management	All
	The Coastal resilience decision-support framework	Visualisation of future flood risks from sea level rise and storm surge, and identification of areas and populations at risk.	Improving the flood performance of new buildings	Part 1
			Resource manual on flash flood risk management	All
Earthquake	Openquake	OpenQuake is used to model and assess integrated earthquake risk.	Guidelines for seismic vulnerability assessment of hospitals	All
	Flash environmental assessment tool	Helps to identify existing or potential acute environmental impacts.		
	ZeusNI	3D static and dynamic analysis platform developed for earthquake engineering applications.		
Tunnelling and ground movements	The land use portfolio model	Designed to help understanding and reduce vulnerability to, and risk of, natural hazards.	Geotechnical engineer's portable handbook	All
Crowded events	ViCrowd	Permits the simulation of the movement and behaviour of virtual crowds.	The event safety guide	All
	BlenderPeople	Allow the generation of large scale crowd dynamics.		

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Terrorism	BICADS  VAPO	Approximates the number of human injuries from the building debris generated by a blast load on the structure.  Supports force protection evaluators and planners with the ability to address modern asymmetric threats such as improvised explosive devices (IEDs) and chemical and biological weapons.	Handbook for rapid visual screening of buildings to evaluate terrorism risks	7
Industrial accidents	BlastX	BlastX performs calculations of the shock wave and confined detonation products pressure and venting for explosions, either internal or external, to a structure	ILO Prevention of Major Industrial Accident  OECD guiding principles for chemical accident prevention, preparedness and response	5  Part A



### 3.5 Tools for the identification and prioritisation of risk reduction measures

The tools presented in this section focus on aiding the identification of ways to reduce the risks and to prioritise risk reduction measures. The risks can be reduced in a number of ways, such as: inherent safety, prevention, detection, control, mitigation, and emergency response. It is however important to identify what the best way to reduce the risk is and whether the chosen risk reduction measures are feasible and suitable for the context.

#### Box 5: TASKit Balloon (Bezalel)

The TASKit balloon, developed by Bezalel Academy, is an efficient, cost-effective, accessible and portable product to ease communication challenges with crowds. It was designed as component of the supporting auxiliary infrastructure with uses during emergency and planned scenarios. Emergency situation management of urban disasters or large-scale planned events necessitates meticulous planning and requires effective operating procedures and product support. A planned event, such as marathons and concerts, necessitates communication with a large amount of participants on how to navigate the urban space in a clear and safe manner.

The Balloon provides both passive and active means of conveying messages to the public as well as absorbing information from the surrounding environment in real time to present a situation overview to event managers and to assist in the crowd navigation. The Balloon is inflated with helium and set aloft to a height of up to 50 meters. It has a distinct hue that is visible in daytime; while at night-time LED lights provide illumination. The Balloon project has two versions. The Passive Balloon has the ability to aid in promoting the visibility of a point that provides medical assistance or distributes fresh water after security or natural incidents, or marking a route or point during a planned event.

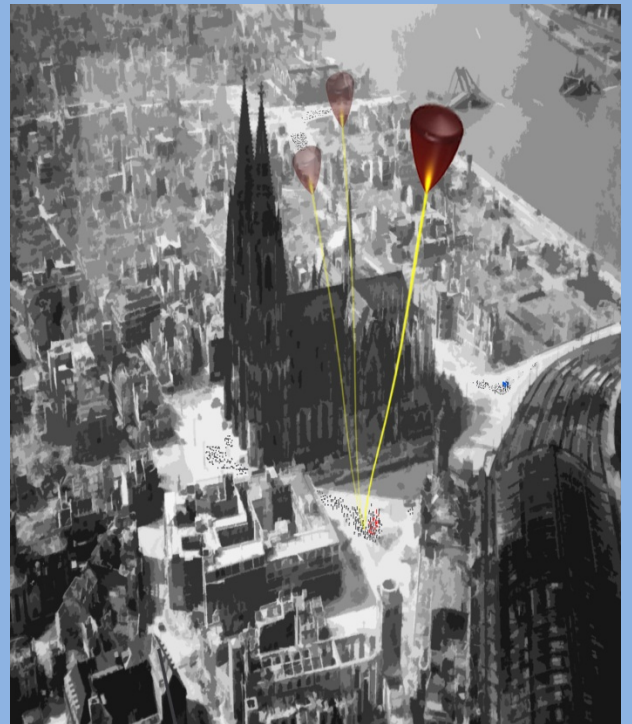


Table 4 provides some examples of the tools and documents that can aid in the identification of risk reduction measures and their prioritisation.

**Table 4 Examples of the tools and documents that can be used to aid ISR Stages 4 and 5**

Hazard/ threat	Tools		Documents	
	Title	Description	Title	Relevant chapters
Floods and storms	Pre-empt  FEMA natural disasters: storm	Helps key decision makers in the UK to systematically embed hazard mitigation and resilience considerations into new and existing developments.  Information about the actions that should be taken before, during and after the flood.	Civil Contingencies Act  Designing for flood risks  Handbook of flood risk mitigating for existing properties	All  Part B  All
Earthquake	Global disaster alert and coordination  Hazard mitigation benefit cost analysis tool  FEMA natural disasters: earthquake	Alerts, information exchange and coordination in the first phase after a major natural hazard occurrence.  Evaluation of BCA from major natural hazards  Information on how to act before, during and after the earthquake	Eurocode 8 - Earthquake	All
Tunnelling and ground movements	FEMA natural disasters: landslides	Information on how to act before, during and after the landslide	Peat landslide hazard and risk assessment guide	5
Crowded events	PathFinder  ADMS Control	Simulation of pedestrian and evacuation dynamics  A virtual reality team training system that provides hands-on experience in crowd control tactics and strategies.	Crowd control and venues and events  Managing crowds safely	Part 3  All

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Terrorism	Counter-terrorism protective security advice	Guidance published by NaCTSO to provide protective security advice to those who own, operate, manage or work in environments that are vulnerable to acts of terrorism.	Handbook for rapid visual screening of buildings to evaluate terrorism risks  RIBA guidance on designing for counter-terrorism	8  Part 2
Industrial accidents	<i>No open access tools identified</i>	-	ILO Prevention of Major Industrial Accident  OECD guiding principles for chemical accident prevention, preparedness and response  Hazardous materials incidents (FEMA)	All  Part B&C  All

## **4. Conclusion**

Based on the ISR framework, this deliverable has presented some examples of the tools and documents that can be used for the characterisation, identification and assessment of security threats in urban spaces, as well as for the identification and prioritisation of risk reduction measures.

The tools and documents discussed in this deliverable are open access web-based and cover relevant to DESURBS themes (storms, earthquakes, tunnelling and ground movement, crowded events, terrorism, and industrial accidents) and of potential use to stakeholders involved in the planning, design, construction operation and maintenance of urban spaces.

This deliverable demonstrated that there is a great number of tools and documents available online, however the majority of them are context-specific and can only provide partial information that can be useful in disaster risk management.

It has been identified that many of the tools are multi-hazard and can be used in conjunction with international documents and guidelines. There is however a lack of open-access tools for specific hazards, in particular industrial accidents and ground movements. This is due to a high specificity of these events and a necessity to use high-tech equipment for identification of these hazards and their mitigation.

The identification of the tools and documents facilitates further development of the Decision Support System Portal, which will be discussed in further detail in Deliverable 2.3.

## 5. References

Bosher L.S., (2014), 'Built-in resilience' through Disaster Risk Reduction: Operational issues', *Building Research & Information*, Vol. 42, No.2

British Standards Institution (2011) *BS 31100:2011: Risk Management: Code of Practice and Guidance for the Implementation of BS ISO 31000*. London: British Standards Institution

British Standards Institution (2009) *BS 31000:2009: Risk Management: Principles and Guidelines*. London: British Standards Institution

Harre-Young, S. (2012) *The Relative Performance and Consequences of Protecting Crowded Places from Vehicle Borne Improvised Explosive Devices*. Unpublished PhD thesis, Loughborough University

**Appendix 1: List of identified online open access tools**

HAZARD	ISR STAGE	NAME	URL	DESCRIPTION
accident	1,4,5	Strategos	<a href="http://www.strategosinc.com/site_planning.htm">http://www.strategosinc.com/site_planning.htm</a>	Planning of the long-term site use
accident	4,5	Hazardous materials incidents (FEMA)	<a href="http://www.ready.gov/hazardous-materials-incident">http://www.ready.gov/hazardous-materials-incident</a>	Advice on actions to be taken before, during and after the industrial accident
accident	4,5	Nuclear power plant incident	<a href="http://www.ready.gov/nuclear-power-plants">http://www.ready.gov/nuclear-power-plants</a>	Advice on actions to be taken before, during and after the nuclear power plant incident
accident	1,2,3,4,5	Flash environment assessment tool	<a href="https://docs.unocha.org/sites/dms/Documents/FEAT_Version_1.1.pdf">https://docs.unocha.org/sites/dms/Documents/FEAT_Version_1.1.pdf</a>	helps to identify existing or potential acute environmental impacts
accident	3	BlastX	<a href="https://pdc.usace.army.mil/software/blastx">https://pdc.usace.army.mil/software/blastx</a>	BlastX performs calculations of the shock wave and confined detonation products pressure and venting for explosions, either internal or external, to a structure
earthquake	1,2,3	Earthquake and hazards programme	<a href="http://quake.abag.ca.gov/earthquakes/">http://quake.abag.ca.gov/earthquakes/</a>	Maps of potential liquefactions, faults and landslides caused by earthquakes in the USA
earthquake	1,2,3	Google Earth/ KML files	<a href="http://earthquake.usgs.gov/learn/kml.php">http://earthquake.usgs.gov/learn/kml.php</a>	Earthquake data displayed in Goggle earth
earthquake	4,5	FEMA natural disasters: earthquake	<a href="http://www.ready.gov/earthquakes">http://www.ready.gov/earthquakes</a>	Information on the actions that should be taken before, during and after the earthquake
earthquake	1,2	Java ground motion parameter	<a href="http://earthquake.usgs.gov/hazards/designmaps/gmotion.php">http://earthquake.usgs.gov/hazards/designmaps/gmotion.php</a>	Seismic design values from the 2009, 2006, 2003, and 2000 editions of the International Building and Residential Codes
earthquake	1,2	Worldwide seismic design values	<a href="http://earthquake.usgs.gov/hazards/designmaps/worlddesign.php">http://earthquake.usgs.gov/hazards/designmaps/worlddesign.php</a>	Information about seismic design parameters worldwide
earthquake	1,4	Global disaster alert and coordination	<a href="http://www.gdacs.org/">http://www.gdacs.org/</a>	Alerts, information exchange and coordination in the first phase after major disasters
earthquake	1,2	Seismic design maps (US)	<a href="http://geohazards.usgs.gov/designmaps/us/">http://geohazards.usgs.gov/designmaps/us/</a>	Information and seismic maps for the USA
earthquake	1,2,3	Openquake	<a href="http://www.globalquakemodel.org/openquake/about/">http://www.globalquakemodel.org/openquake/about/</a>	OpenQuake is GEM's community-driven, open-source software suite used to model and assess integrated earthquake risk. It refers to all tools, apps and IT-infrastructure being developed to support our stakeholders in assessing risk.
earthquake	1,2,3,4,5	Scenario assessment for emergency	<a href="http://inasafe.org/">http://inasafe.org/</a>	Produces realistic natural hazard impact scenarios for better planning, preparedness and response activities
earthquake	1,2,3,4,5	Flash environmental assessment tool	<a href="https://docs.unocha.org/sites/dms/Documents/FEAT_Version_1.1.pdf">https://docs.unocha.org/sites/dms/Documents/FEAT_Version_1.1.pdf</a>	Helps to identify existing or potential acute environmental impacts
earthquake	1,2,3,4,5	Pre-empt	<a href="https://preempt.lboro.ac.uk/">https://preempt.lboro.ac.uk/</a>	Decision supporting tool that help key decision makers in the UK to systematically embed hazard mitigation and resilience considerations into new and existing developments
earthquake	1,2,3	Advanced national seismic system	<a href="http://earthquake.usgs.gov/monitoring/anss/">http://earthquake.usgs.gov/monitoring/anss/</a>	Provides accurate and timely data and information products for seismic events, including their effects on buildings and structures
earthquake	1,2,3,4	MaeViz	<a href="http://mae.cee.illinois.edu/software_and_tools/maeviz.html">http://mae.cee.illinois.edu/software_and_tools/maeviz.html</a>	An advanced tool for seismic loss assessment and management
earthquake	1,2,3	ZeusNI	<a href="http://mae.cee.illinois.edu/software_and_tools/zeus_ni.html">http://mae.cee.illinois.edu/software_and_tools/zeus_ni.html</a>	A state-of-the-art 3D static and dynamic analysis platform specifically developed for earthquake engineering applications
earthquake	1,2,3	Deepsoil	<a href="http://mae.cee.illinois.edu/software_and_tools/deepsoil.html">http://mae.cee.illinois.edu/software_and_tools/deepsoil.html</a>	A software tool for the analysis of 1-D seismic response of soil columns. It allows engineers and researchers to qualitatively assess the influence of soil layers of varying stiffness on the propagated ground motion during a seismic event
earthquake	1,2,3	Broadband ground motion simulation	<a href="http://scec.usc.edu/research/cme/groups/broadband">http://scec.usc.edu/research/cme/groups/broadband</a>	Generation of ground motions for a particular earthquake scenario.
earthquake	1,2,3	Hazus	<a href="http://www.fema.gov/hazus">http://www.fema.gov/hazus</a>	Standardized methodology that contains models for estimating potential losses from earthquakes, floods, and hurricanes.
earthquake	1	Global risk data platform	<a href="http://preview.grid.unep.ch/index.php?preview=home&amp;lang=eng">http://preview.grid.unep.ch/index.php?preview=home&amp;lang=eng</a>	Spatial data information on global risk from natural hazards. Users can visualise, download or extract data on past hazardous events, human & economical hazard exposure and risk from natural hazards

earthquake	1,2,3,4,5	RADIUS Tool for Earthquake Damage Estimation	<a href="http://www.gripweb.org/gripweb/?q=countries-risk-information/methodologies-tools/radius-tool-earthquake-damage-estimation">http://www.gripweb.org/gripweb/?q=countries-risk-information/methodologies-tools/radius-tool-earthquake-damage-estimation</a>	Provides practical guidance on earthquake risk estimation and reduction
earthquake	1,2,3,4,5	The land use portfolio model	<a href="http://geography.wr.usgs.gov/science/lupm.html">http://geography.wr.usgs.gov/science/lupm.html</a>	It is designed to help public agencies and communities understand and reduce their vulnerability to, and risk of, natural hazards. The LUPM is adapted from financial-portfolio theory, a method for evaluating alternative, regional-scale investment possibilities on the basis of their estimated distributions of risk and return. Financial-portfolio theory can be linked with natural-hazard, land use, mitigation and emergency preparedness information to estimate risk to a community from natural disasters at the regional scale and to identify cost-effective pre-disaster risk-reduction policies
earthquake	5	Hazard mitigation benefit cost analysis	<a href="http://www.fema.gov/benefit-cost-analysis">http://www.fema.gov/benefit-cost-analysis</a>	Estimation of cost-benefit of the reduction measures
event	2,3,4	Ped-net	<a href="http://www.ped-net.org/">http://www.ped-net.org/</a>	Community resource for pedestrian and crowd simulation professionals
event	2,3,4,5	PathFinder	<a href="http://www.thunderheadeng.com/pathfinder/">http://www.thunderheadeng.com/pathfinder/</a>	An emergency egress simulator that includes an integrated user interface and 3D results visualization. Pathfinder allows you to evaluate evacuation models more quickly and produce more realistic graphics
event	2,3,4	ViCrowd	<a href="http://www.arena.kth.se/crowds.html">http://www.arena.kth.se/crowds.html</a>	Simulation of the movement and behaviour of virtual crowds. Based on detailed study of real crowds, this model also permits different levels of behaviour control, so that the crowd can be guided in real time, or be programmed to carry out certain kinds of activity, or be granted autonomy.
event	2,3,4,5	STEPS	<a href="http://www.mottmac.com/skillsandservices/software/stepssoftware/">http://www.mottmac.com/skillsandservices/software/stepssoftware/</a>	Designed to predict pedestrian movement under both normal and emergency conditions. It originates from the Group's extensive experience in building design and in developing simulation tools for engineering design helping to identify natural bottlenecks and preferred exits, as well as testing evacuation routes and timings for different emergency scenarios.
event	2,3,4,5	ADMS Control	<a href="http://www.trainingfordisastermanagement.com/products/incident-command-training-for-police-and-law-enforcement/">http://www.trainingfordisastermanagement.com/products/incident-command-training-for-police-and-law-enforcement/</a>	A virtual reality team training system that provides hands-on experience in crowd control tactics and strategies, use of force principles and de-escalation maneuvers, operation planning and rehearsal, contingency testing and resource management.
event	2,3,4	BlenderPeople	<a href="http://www.harkyman.com/bp.html">http://www.harkyman.com/bp.html</a>	Allows the generation of large scale crowd dynamics
ground movement	4,5,	FEMA natural disasters: landslides	<a href="http://www.ready.gov/landslides-debris-flow">http://www.ready.gov/landslides-debris-flow</a>	Advice on the actions that should be taken before, during and after the landslide
ground movement	1,2	Deepsoil	<a href="http://mae.cee.illinois.edu/software_and_tools/deepsol.html">http://mae.cee.illinois.edu/software_and_tools/deepsol.html</a>	A software tool for the analysis of 1-D seismic response of soil columns. It allows engineers and researchers to qualitatively assess the influence of soil layers of varying stiffness on the propagated ground motion during a seismic event
ground movement	1,2,3,	BGS National landslide database	<a href="http://www.bgs.ac.uk/landslides/NLD.html">http://www.bgs.ac.uk/landslides/NLD.html</a>	The most extensive source of information on landslides in the UK based on GIS surveying
ground movement	1	Global risk data platform	<a href="http://preview.grid.unep.ch/index.php?preview=home&amp;lang=eng">http://preview.grid.unep.ch/index.php?preview=home&amp;lang=eng</a>	Spatial data information on global risk from natural hazards. Users can visualise, download or extract data on past hazardous events, human & economical hazard exposure and risk from natural hazards
ground movement	1,2	ERN landslide	<a href="http://www.ecapra.org/ern-landslide">http://www.ecapra.org/ern-landslide</a>	Landslide hazard assessment
ground movement	1,2,3,4,5	The land use portfolio model	<a href="http://geography.wr.usgs.gov/science/lupm.html">http://geography.wr.usgs.gov/science/lupm.html</a>	Helps public agencies and communities understand and reduce their vulnerability to, and risk of, natural hazards. The LUPM is adapted from financial-portfolio theory, a method for evaluating alternative, regional-scale investment possibilities on the basis of their estimated distributions of risk and return. Financial-portfolio theory can be linked with natural-hazard, land use, mitigation and emergency preparedness information to estimate risk to a community from natural disasters at the regional scale and to identify cost-effective pre-disaster risk-reduction policies
ground movement	1,2,3	Landslide maps	<a href="http://quake.abag.ca.gov/landslides/">http://quake.abag.ca.gov/landslides/</a>	Landslide maps and information for the Bay areas in the USA
Storm and flood	1,2,3,4,5	The Coastal resilience decision-support framework	<a href="http://www.csc.noaa.gov/digitalcoast/tools/coastalresilience">http://www.csc.noaa.gov/digitalcoast/tools/coastalresilience</a>	With the interactive decision-support framework, users can visualize future flood risks from sea level rise and storm surge. They can also identify areas and populations at risk and gain a better understanding of ecological, social, and economic impacts from coastal hazards

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Storm and flood	1,2,3,4	The Critical Facilities Flood Exposure Tool	<a href="http://www.csc.noaa.gov/digitalcoast/tools/critical-facilities">http://www.csc.noaa.gov/digitalcoast/tools/critical-facilities</a>	Initial assessment of a community's critical facilities and roads that lie within the 1% annual chance flood zone established by the Federal Emergency Management Agency (FEMA). The tool helps coastal managers quickly learn which facilities may be at risk
Storm and flood	1,2,3	Ern-flood	<a href="http://www.ecapra.org/ern-flood">http://www.ecapra.org/ern-flood</a>	The analysis of river flooding based on a set of stochastic rainfall scenarios.
Storm and flood	5	Hazard mitigation benefit cost analysis tool	<a href="http://www.fema.gov/benefit-cost-analysis">http://www.fema.gov/benefit-cost-analysis</a>	Estimation of cost-benefit of the reduction measures
Storm and flood	4,5	FEMA natural disasters: storm	<a href="http://www.ready.gov/floods">http://www.ready.gov/floods</a>	Advice on the actions that should be taken before, during and after the flooding
Storm and flood	1,2	Global disaster alert and coordination	<a href="http://www.gdacs.org/">http://www.gdacs.org/</a>	Alerts, information exchange and coordination in the first phase after major disasters.
Storm and flood	1,2,3,4,5	Scenario assessment for emergency	<a href="http://inasafe.org/">http://inasafe.org/</a>	free software that produces realistic natural hazard impact scenarios for better planning, preparedness and response activities
Storm and flood	1,2,3,4,5	Flash environmental assessment tool	<a href="http://ochanet.unocha.org/p/Documents/FEAT_Version_1.1.pdf">http://ochanet.unocha.org/p/Documents/FEAT_Version_1.1.pdf</a>	Identification existing or potential acute environmental impacts.
Storm and flood	1,2,3,4,5	Pre-empt	<a href="https://preempt.lboro.ac.uk/">https://preempt.lboro.ac.uk/</a>	Decision supporting tool that help key decision makers in the UK to systematically embed hazard mitigation and resilience considerations into new and existing developments
Storm and flood	1,2,3	Hazus	<a href="http://www.fema.gov/hazus">http://www.fema.gov/hazus</a>	Standardized methodology that contains models for estimating potential losses from earthquakes, floods, and hurricanes.
Storm and flood	1	Multi-year flood hazard identification map	<a href="http://www.fema.gov/national-flood-insurance-program-0/multi-year-flood-hazard-identification-plan">http://www.fema.gov/national-flood-insurance-program-0/multi-year-flood-hazard-identification-plan</a>	Flood hazard data and maps for the United States
Storm and flood	1,2,3	EA flood maps	<a href="http://www.environment-agency.gov.uk/homeandleisure/floods/31650.aspx">http://www.environment-agency.gov.uk/homeandleisure/floods/31650.aspx</a>	Flood hazard data and maps for the UK
Storm and flood	1	Levee simulator	<a href="http://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/levee_simulator.jsp">http://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/levee_simulator.jsp</a>	Shows different ways a levee can fail. It covers every type of levee failure and reminds everyone that simply living near a levee doesn't guarantee your home's protection.
Storm and flood	1,2,3	Hydrodynamic flood simulation	<a href="http://sanders.eng.uci.edu/brezo.html">http://sanders.eng.uci.edu/brezo.html</a>	Simulation of flood flows with the focus on shallow waters
Storm and flood	1	Global risk data platform	<a href="http://preview.grid.unep.ch/index.php?preview=home&amp;lang=eng">http://preview.grid.unep.ch/index.php?preview=home&amp;lang=eng</a>	Spatial data information on global risk from natural hazards. Users can visualise, download or extract data on past hazardous events, human & economical hazard exposure and risk from natural hazards
Storm and flood	1,2,3	Simplified Flood Risk Assessment Tool (FRAT)	<a href="http://www.gripweb.org/gripweb/?q=countries-risk-information/methodologies-tools/simplified-flood-risk-assessment-tool-frat">http://www.gripweb.org/gripweb/?q=countries-risk-information/methodologies-tools/simplified-flood-risk-assessment-tool-frat</a>	provides an estimation of the inundation area caused by riverine floods in plain settings
Storm and flood	1,2,3	Simplified flood risk assessment tool	<a href="http://www.gripweb.org/gripweb/?q=countries-risk-information/methodologies-tools/simplified-flood-risk-assessment-tool-frat">http://www.gripweb.org/gripweb/?q=countries-risk-information/methodologies-tools/simplified-flood-risk-assessment-tool-frat</a>	provides an estimation of the inundation area caused by riverine floods in plain settings
Storm and flood	1,2,3	Identifying population and assets at risk	<a href="http://ccg.huji.ac.il/dynamicmap/index.html">http://ccg.huji.ac.il/dynamicmap/index.html</a>	Web-based mapping tool that helps to identify the risk of flooding at the Israeli coast line
Storm and flood	1,2,3,4,5	The land use portfolio model	<a href="http://geography.wr.usgs.gov/science/lupm.html">http://geography.wr.usgs.gov/science/lupm.html</a>	It is designed to help public agencies and communities understand and reduce their vulnerability to, and risk of, natural hazards. The LUPM is adapted from financial-portfolio theory, a method for evaluating alternative, regional-scale investment possibilities on the basis of their estimated distributions of risk and return. Financial-portfolio theory can be linked with natural-hazard, land use, mitigation and emergency preparedness information to estimate risk to a community from natural disasters at the regional scale and to identify cost-effective pre-disaster risk-reduction policies
Storm and flood	1,2,3,4,5	The Coastal resilience decision-support framework	<a href="http://www.csc.noaa.gov/digitalcoast/tools/coastalresilience">http://www.csc.noaa.gov/digitalcoast/tools/coastalresilience</a>	With the interactive decision-support framework, users can visualize future flood risks from sea level rise and storm surge. They can also identify areas and populations at risk and gain a better understanding of ecological, social, and economic impacts from coastal hazards
Storm and flood	1	Coastal hazards wheel	<a href="http://orbit.dtu.dk/ws/files/33438569/The_Coastal_Hazard_Wheel.pdf">http://orbit.dtu.dk/ws/files/33438569/The_Coastal_Hazard_Wheel.pdf</a>	Supports identification of the potential risk of flooding



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Storm and flood	1,2,3	SUDPLAN	<a href="http://www.smhi.se/sudplan/About-SUDPLAN">http://www.smhi.se/sudplan/About-SUDPLAN</a>	a web-based planning, prediction and training tool to support decisions in long term urban planning
Storm and flood	1,2,3	ASA inundation tool box	<a href="http://www.asascience.com/software/housetools/inundation-toolbox.shtml">http://www.asascience.com/software/housetools/inundation-toolbox.shtml</a>	a software system that connects storm surge model predictions to GIS mapping and analysis capabilities to generate maps of areas at risk to inundation from the predicted surge.
terrorism	1	Political violence map	<a href="http://www.aon.com/risk-services/terrorism-risk-map/register.jsp">http://www.aon.com/risk-services/terrorism-risk-map/register.jsp</a>	The map measures the risk of political violence to international business in 200 countries and territories
terrorism	1,2,3,4	The Hats simulator	<a href="http://crue.isi.edu/cgi-bin/page.cgi?page=project-hats.html">http://crue.isi.edu/cgi-bin/page.cgi?page=project-hats.html</a>	A lightweight proxy for many intelligence analysis problems, such as to identify and arrest harmful agents before they carry out their plans.
terrorism	1,2,3,4,5	CT protective security advice	<a href="http://www.nactso.gov.uk/publications">http://www.nactso.gov.uk/publications</a>	Guidance published by NaCTSO to provide protective security advice to those who own, operate, manage or work in environments that are vulnerable to acts of terrorism.
terrorism	3	BICADS	<a href="https://pdc.usace.army.mil/software/bicads">https://pdc.usace.army.mil/software/bicads</a>	The BICADS (Building Injury Calculator And Databases) computer program approximates the number of human injuries from the building debris generated by a blast load on the structure.
terrorism	3	BlastX	<a href="https://pdc.usace.army.mil/software/blastx">https://pdc.usace.army.mil/software/blastx</a>	BlastX performs calculations of the shock wave and confined detonation products pressure and venting for explosions, either internal or external, to a structure
terrorism	3	VAPO	<a href="https://pdc.usace.army.mil/software/vapo">https://pdc.usace.army.mil/software/vapo</a>	APO is designed to support force protection evaluators and planners with the ability to address modern asymmetric threats such as improvised explosive devices (IEDs) and chemical and biological weapons.

**Appendix 2: List of identified key documents**

HAZARD	ISR STAGE	TITLE	YEAR OR PUBLICATION	URL	DESCRIPTION
accident	1,3,4,5	ILO Prevention of Major Industrial Accident	1991	<a href="http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/normativeinstrument/wcms_107829.pdf">http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/normativeinstrument/wcms_107829.pdf</a>	Guidance in setting up the administrative, legal and technical system for the control of major hazard installations
accident	4	Inherent safety	n.i.	<a href="http://www.csb.gov/videos/inherently-safer-the-future-of-risk-reduction/">http://www.csb.gov/videos/inherently-safer-the-future-of-risk-reduction/</a>	Video guidance to risk reduction of the chemical incidents
accident	1,2,3,4,5	Accident prevention publications by OSHA	Various	<a href="https://osha.europa.eu/en/topics/accident_prevention/@oshtopic-view?tp=/directory/accident_prevention/Publication">https://osha.europa.eu/en/topics/accident_prevention/@oshtopic-view?tp=/directory/accident_prevention/Publication</a>	List of guidance for the accident prevention
accident	4	Safety signs and colour	n.i.	<a href="http://www.iapa.ca/Main/documents/pdf/safsigns.pdf">http://www.iapa.ca/Main/documents/pdf/safsigns.pdf</a>	Guidance to the choice of signs and colour to prevent incidents
accident	1,4,5	Innovative solutions to safety and health risks in the construction, healthcare and HORECA sectors	2011	<a href="https://osha.europa.eu/en/publications/reports/innovative-solutions-OSHrisks">https://osha.europa.eu/en/publications/reports/innovative-solutions-OSHrisks</a>	Describe a wide range of innovative and, preferably, evidenced-based preventive solutions that organisations can integrate into their daily workplace practices
accident	1,2,3,4,5	OECD guiding principles for chemical accident prevention, preparedness and response	2003	<a href="http://www.oecd.org/chemicalsafety/risk-management/2789820.pdf">http://www.oecd.org/chemicalsafety/risk-management/2789820.pdf</a>	Helps public authorities, industry and communities worldwide to prevent chemical accidents and improve preparedness and response in the case of an incident
earthquake	1,4,5	Civil Contingencies act	2004	<a href="http://www.legislation.gov.uk/ukpga/2004/36/contents">http://www.legislation.gov.uk/ukpga/2004/36/contents</a>	An Act of the Parliament of the United Kingdom that establishes a coherent framework for emergency planning and response ranging from local to national level
earthquake	1,4,5	Keeping the country running: natural hazards and infrastructure	2011	<a href="https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/61342/natural-hazards-infrastructure.pdf">https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/61342/natural-hazards-infrastructure.pdf</a>	The Guide sets out the principles underpinning infrastructure resilience and provides advice and practical guidance on risk assessment for natural hazards, standards of resilience, corporate governance, information sharing and the role for economic regulators.
earthquake	1,2,3,4,5	Putting down roots in earthquake country	n.i.	<a href="http://www.earthquakecountry.org/roots/contents.html">http://www.earthquakecountry.org/roots/contents.html</a>	Provides information about earthquakes in Southern California, and advice on what to do to be safe and reduce damage
earthquake	4,5	Earthquake resistant construction of buildings: curriculum for mason training	n.i.	<a href="http://sheltercentre.org/sites/default/files/guidelines_for_training_instructors_curriculum_for_mason_training.pdf">http://sheltercentre.org/sites/default/files/guidelines_for_training_instructors_curriculum_for_mason_training.pdf</a>	The curriculum for training the mason on the skills of earthquake resistant techniques in non-engineering construction
earthquake	1,2,3	Guidelines for seismic vulnerability assessment of hospitals	2004	<a href="http://www.preventionweb.net/files/1954_VL206311.pdf">http://www.preventionweb.net/files/1954_VL206311.pdf</a>	This Guideline is for assisting health-sector professionals and authorities to implement qualitative assessments of structural and non-structural earthquake vulnerability of hospitals and health institutions
earthquake	4	Eurocode 8 Earthquakes	2009	<a href="http://www.eurocodes.co.uk/EurocodeDetail.aspx?Eurocode=8">http://www.eurocodes.co.uk/EurocodeDetail.aspx?Eurocode=8</a>	Eurocode 8 explains how to make building and civil engineering structures resistant to earthquakes, though the UK is deemed to have very low seismic risk.
event	1,2,3,4,5	Crowd Control at Venues and Events	2007	<a href="http://www.worksafe.vic.gov.au/_data/assets/pdf_file/0013/10354/crowd_control.pdf">http://www.worksafe.vic.gov.au/_data/assets/pdf_file/0013/10354/crowd_control.pdf</a>	This Guide identifies common safety problems and suggests solutions to ensure crowd control work is conducted as safely as it reasonably can be.
event	4,5	Guide to safety at sport grounds	2008	<a href="http://www.safetyatsportgrounds.org.uk/sites/default/files/publications/green-guide.pdf">http://www.safetyatsportgrounds.org.uk/sites/default/files/publications/green-guide.pdf</a>	Provides guidance to ground management, technical specialists such as architects and engineers, and representatives of all relevant authorities, in order to assist them in the assessment of how many spectators can be safely accommodated within a sports ground.
event	1,2,3,4,5	Managing crowds safely	2000	<a href="http://www.hse.gov.uk/pubns/priced/hsg154.pdf">http://www.hse.gov.uk/pubns/priced/hsg154.pdf</a>	Provides practical guidelines on managing crowd safety in a systematic way by setting out an approach which can be utilised by organisers of any event or venue

event	1,2,3,4	The event safety guide	1999	<a href="http://www.qub.ac.uk/safety-reps/sr_webpages/safety_downloads/event_safety_guide.pdf">http://www.qub.ac.uk/safety-reps/sr_webpages/safety_downloads/event_safety_guide.pdf</a>	The event safety guide aims to help everyone who organises music events so that events run safely
ground	1,2,3,4	A code of practice for risk management of tunnel works	2012	<a href="http://www.britishtunnelling.org.uk/downloads/2013/ITIG_TCOP_01_05_2012.pdf">http://www.britishtunnelling.org.uk/downloads/2013/ITIG_TCOP_01_05_2012.pdf</a>	It sets out practice for the identification of risks, their allocation between the parties and the management and control of risks
ground	2,3,4,5	A landslide handbook - a guide to understand the landslides	2008	<a href="http://pubs.usgs.gov/circ/1325/">http://pubs.usgs.gov/circ/1325/</a>	A resource for people affected by landslides to acquire further knowledge, especially about the conditions that are unique to their neighbourhoods and communities
ground	3,4,5	Resource manual on flash flood risk management	2012	<a href="http://www.preventionweb.net/files/30062_30062resourcemanualonflashfloodrisk.pdf">http://www.preventionweb.net/files/30062_30062resourcemanualonflashfloodrisk.pdf</a>	Provides the materials needed to help people working in risk prone areas understand the problem and manage the risk
ground	1,2,3	Geotechnical investigation and testing standards	various	<a href="http://shop.bsigroup.com/Browse-by-Sector/Building--Construction/Geotechnical-investigation-and-testing/">http://shop.bsigroup.com/Browse-by-Sector/Building--Construction/Geotechnical-investigation-and-testing/</a>	BSI's geotechnical investigation and testing standards establish the basic principles for the identification and classification of soils and rock
ground	1,2,3,4	Geotechnical engineer's portable handbook	2012	<a href="http://accessengineeringlibrary.com/browse/geotechnical-engineers-portable-handbook-second-edition">http://accessengineeringlibrary.com/browse/geotechnical-engineers-portable-handbook-second-edition</a>	Geotechnical and construction related information in a convenient, quick-reference format
ground	1,2,3,4	Geotechnical engineering standards	various	<a href="http://www.astm.org/Standards/geotechnical-engineering-standards.html">http://www.astm.org/Standards/geotechnical-engineering-standards.html</a>	List of standards for specifying, testing, and investigating the physical/mechanical properties and characteristic behaviours of surface and subsurface earth materials that are relevant to a construction projects
ground	1,2,3,4	Eurocode 7 Geotechnical	2009	<a href="http://www.eurocodes.co.uk/EurocodeDetail.aspx?Eurocode=7">http://www.eurocodes.co.uk/EurocodeDetail.aspx?Eurocode=7</a>	Geotechnical design code
ground	1,2,3	Geotechnical investigation and testing - Geotechnical monitoring by field instrumentation - General rules	2013	<a href="http://drafts.bsigroup.com/Home/Details/51363">http://drafts.bsigroup.com/Home/Details/51363</a>	This Standard applies to performance monitoring of the ground, structures interacting with the ground and geotechnical works
ground	1,2,3	Building regulations: Structures	2000	<a href="http://www.lbhf.gov.uk/Images/Main_Changes_Part_A_tcm21-19836.pdf">http://www.lbhf.gov.uk/Images/Main_Changes_Part_A_tcm21-19836.pdf</a>	Part A of the UK building regulations that deals with loading, ground movement and disproportionate collapse
ground	4,5	Lyme Regis Environmental Improvements Phase IV Preliminary Design Stage: landslide recession scenario	2009	<a href="http://www.dorsetforyou.com/media.jsp?mediaid=140330&amp;filetype=pdf">http://www.dorsetforyou.com/media.jsp?mediaid=140330&amp;filetype=pdf</a>	This report is about how the area may be affected by coastal erosion and the associated land sliding in the future
ground	1,2,3	Guidelines for landslide susceptibility, hazard and risk zoning land use planning	2007	<a href="http://australiangeomechanics.org/admin/wp-content/uploads/2010/11/LRM2007-a.pdf">http://australiangeomechanics.org/admin/wp-content/uploads/2010/11/LRM2007-a.pdf</a>	Guidelines and advice on risk assessment of the landslides in Australia
ground	1,2,3,4	Peat landslide hazard and risk assessment guide	2007	<a href="http://www.scotland.gov.uk/Publications/2006/12/21162303/0">http://www.scotland.gov.uk/Publications/2006/12/21162303/0</a>	Provides best practice methods to identify, mitigate and manage peat slide hazards and associated risks in respect of consent applications for electricity generation projects in Scotland
Storm and flood	1,4,5	Civil Contingencies act	2004	<a href="http://www.legislation.gov.uk/ukpga/2004/36/contents">http://www.legislation.gov.uk/ukpga/2004/36/contents</a>	An Act of the Parliament of the United Kingdom that establishes a coherent framework for emergency planning and response ranging from local to national level
Storm and flood	1,2,3,4,5	Designing for flood risk	2009	<a href="http://www.architecture.com/Files/RIBAHoldings/PolicyAndInternationalRelations/Policy/Environment/2Designing_for_floodrisk.pdf">http://www.architecture.com/Files/RIBAHoldings/PolicyAndInternationalRelations/Policy/Environment/2Designing_for_floodrisk.pdf</a>	Gives users a general understanding of the main issues that flood risk gives rise to, provides an overview of current policy and legislation, and outlines potential design responses
Storm and flood	5	Exercise Watermark	2011	<a href="https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69476/pb13673-exercise-watermark-finalreport.pdf">https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69476/pb13673-exercise-watermark-finalreport.pdf</a>	Recommendations for the UK government on how to improve resilience to floods
Storm and flood	4	Handbook of flood risk mitigation for existing properties	n.i.	<a href="http://www.rabconsultants.co.uk/uploads/Handbook%20of%20Flood%20Risk%20Mitigation%20for%20Existing%20Properties%20Issue%201%20Low%20Resolution.pdf">http://www.rabconsultants.co.uk/uploads/Handbook%20of%20Flood%20Risk%20Mitigation%20for%20Existing%20Properties%20Issue%201%20Low%20Resolution.pdf</a>	Overview of risk reduction measures

Storm and flood	1,4,5	Keeping the country running: natural hazards and infrastructure	2011	<a href="http://www.cabinetoffice.gov.uk/sites/default/files/resources/Guide-NaturalHazards-Infrastructure-2011-consultation.pdf">http://www.cabinetoffice.gov.uk/sites/default/files/resources/Guide-NaturalHazards-Infrastructure-2011-consultation.pdf</a>	The Guide sets out the principles underpinning infrastructure resilience and provides advice and practical guidance on risk assessment for natural hazards, standards of resilience, corporate governance, information sharing and the role for economic regulators.
Storm and flood	1,4	National planning policy framework	2012	<a href="https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf">https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf</a>	Sets out the Government's planning policies for England and how these are expected to be applied
Storm and flood	1,2,3,4	Planning policy statement 25	2009	<a href="https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7772/pps25guideupdate.pdf">https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7772/pps25guideupdate.pdf</a>	Explains the role of planning policy in flood mitigation
Storm and flood	1,2,3,4,5	The planning system and flood risk management guidance for planning authorities	2009	<a href="http://www.environ.ie/en/Publications/DevelopmentandHousing/Planning/FileDownload,21709,en.pdf">http://www.environ.ie/en/Publications/DevelopmentandHousing/Planning/FileDownload,21709,en.pdf</a>	Explanation of flood risk assessment for Ireland
Storm and flood	2,3,4,5	The role of land-use planning in flood management	2008	<a href="http://www.apfm.info/?page_id=771">http://www.apfm.info/?page_id=771</a>	Identifies the processes and policy principles that necessitate a linkage of land use planning in integrated flood management.
Storm and flood	1,2,3,4,5	National flood forum	various	<a href="http://nationalfloodforum.org.uk/?page_id=38">http://nationalfloodforum.org.uk/?page_id=38</a>	List of various documents
Storm and flood	1,2,3,4,5	Flood risk management: a local issue of national importance	2011	<a href="http://www.preventionweb.net/files/33832_floodin_gc03v12noembargoweb.pdf">http://www.preventionweb.net/files/33832_floodin_gc03v12noembargoweb.pdf</a>	The aim of the report is to assess the likely impacts the Flood and Water Management Act (2010) (England and Wales) will have on the authorities responsible for the preparation for, protection against and response to flooding events
Storm and flood	1,2,3,4,5	Six steps to flood resilience: guidance for local authorities and professionals	2013	<a href="http://www.sed.manchester.ac.uk/research/cure/research/documents/SMARTeST-Six-Steps-To-Flood-Resilience-Local-Authority-Professionals.pdf">http://www.sed.manchester.ac.uk/research/cure/research/documents/SMARTeST-Six-Steps-To-Flood-Resilience-Local-Authority-Professionals.pdf</a>	Provides guidance on making flood resilience technologies
Storm and flood	4,5	Best practices for reducing the risk of future damage to homes from riverine and urban flooding	2013	<a href="http://www.iclr.org/images/Alberta_flood_risk_2013_PDF.pdf">http://www.iclr.org/images/Alberta_flood_risk_2013_PDF.pdf</a>	Sets out recommendations on how to reduce damage from floods
Storm and flood	2,3,4	Improving the flood performance of new buildings	2007	<a href="http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf">http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf</a>	Provides guidance to developers and designers on how to improve the resilience of new properties in low or residual flood risk areas by the use of suitable materials and construction details
Storm and flood	1,2,3,4,5	RIBA, Designing for flood risks	n.i.	<a href="http://www.architecture.com/FindOutAbout/Sustainabilityandclimatechange/Flooding/DesignGuide.aspx">http://www.architecture.com/FindOutAbout/Sustainabilityandclimatechange/Flooding/DesignGuide.aspx</a>	gives users a general understanding of the main issues that flood risk gives rise to, followed by an overview of current policy and legislation
terrorism	2,3,4,5	Assessing crime and disorder in public places through planning and design	2011	<a href="http://www.bcsc.org.uk/media/downloads/CIRIAC710-AddressingCrimeAndDisorder.pdf">http://www.bcsc.org.uk/media/downloads/CIRIAC710-AddressingCrimeAndDisorder.pdf</a>	considers how the issues of crime may be considered at the planning and design stages to assist a successful outcome in operation
terrorism	3,4,5	Crowded places: The planning system and counter-terrorism	2012	<a href="http://nactso-dev.co.uk/system/cms/files/107/files/original/Crowded_Places-Planning_System-Jan_2012.pdf">http://nactso-dev.co.uk/system/cms/files/107/files/original/Crowded_Places-Planning_System-Jan_2012.pdf</a>	Provides guiding principles on counter terrorism and good design
terrorism	3,4,5	Protecting crowded places: design and technical issues	2012	<a href="http://nactso-dev.co.uk/system/cms/files/106/files/original/Crowded_Places-Design_and_Tech-Jan_2012.pdf">http://nactso-dev.co.uk/system/cms/files/106/files/original/Crowded_Places-Design_and_Tech-Jan_2012.pdf</a>	Provides advice about counter-terrorism protective security design to anyone involved in the planning, design and development of the built environment from the preparation of local planning policy to the commissioning, planning, design and management of new development schemes through to detailed building design.
terrorism	1,2,3,4,5	Reference Manual to Mitigate Potential Terrorist Attacks against Buildings, 2nd Edition		<a href="http://www.dhs.gov/bips-06fema-426-reference-manual-mitigate-potential-terrorist-attacks-against-buildings-2nd-edition">http://www.dhs.gov/bips-06fema-426-reference-manual-mitigate-potential-terrorist-attacks-against-buildings-2nd-edition</a>	BIPS 06 provides an updated version of risk assessment techniques, a new concept on infrastructure resiliency, and identifies new protective measures and emerging technologies to protect the built environment. The objective of this manual is to reduce physical damage to structural and non-structural components of buildings and related infrastructure, and also to reduce resultant casualties during conventional bomb attacks, as well as attacks using chemical, geological, and radiological agents. This manual provides design guidance to the building science community of architects and engineers, to reduce physical damage caused by terrorist assaults to buildings, related infrastructure, and people.

DESURBS Deliverable 2.2: Tools for assessment of security threats

terrorism	1,2,3,4	Site and Urban Design for Security: Guidance against Potential Terrorist Attacks	2007	<a href="https://s3-us-gov-west-1.amazonaws.com/dam-production/uploads/20130726-1624-20490-9648/fema430.pdf">https://s3-us-gov-west-1.amazonaws.com/dam-production/uploads/20130726-1624-20490-9648/fema430.pdf</a>	Provides information and design concepts for the protection of buildings and occupants, from site perimeters to the faces of buildings
terrorism	2	A how-to guide to mitigate potential terrorist attacks against buildings	2004	<a href="http://www.fema.gov/media-library/assets/documents/4608">http://www.fema.gov/media-library/assets/documents/4608</a>	Outlines methods for identifying the critical assets and functions within buildings, determining the threats to those assets, and assessing the vulnerabilities associated with those threats
terrorism	1,2,3,4,5	Counter-Terrorism protective security advice for major events	2009	<a href="http://www.cleveland.police.uk/downloads/Publications-Emergency-Planning/MajorEvents.pdf">http://www.cleveland.police.uk/downloads/Publications-Emergency-Planning/MajorEvents.pdf</a>	Gives protective security advice to those who are responsible for organising major events and event security
terrorism	1,2,3	Estimating terrorism risks	2005	<a href="http://www.rand.org/content/dam/rand/pubs/monographs/2005/RAND_MG388.pdf">http://www.rand.org/content/dam/rand/pubs/monographs/2005/RAND_MG388.pdf</a>	Discusses various approaches to estimating terrorism in the urban areas
terrorism	1,2,3,4,5	Handbook for rapid visual screening of buildings to evaluate terrorism risks	2009	<a href="https://www.fema.gov/media-library/assets/documents/2298?id=1567">https://www.fema.gov/media-library/assets/documents/2298?id=1567</a>	Provides guidance for building inspectors, architects and engineers on quickly and effectively determining what, if any, are the risks posed to the building by natural hazards, terrorist attacks and other threats to the building's structural integrity
terrorism	2,3,4,5	Reference manual to mitigate potential terrorist attacks against buildings	2011	<a href="http://www.dhs.gov/bips-06fema-426-reference-manual-mitigate-potential-terrorist-attacks-against-buildings-2nd-edition">http://www.dhs.gov/bips-06fema-426-reference-manual-mitigate-potential-terrorist-attacks-against-buildings-2nd-edition</a>	Provides design guidance to the building science community of architects and engineers, to reduce physical damage caused by terrorist assaults to buildings, related infrastructure, and people
terrorism	1,4,5	RIBA guidance on designing for counter-terrorism	n.i.	<a href="http://www.architecture.com/Files/RIBAHoldings/Communications/Press/General/RIBAGuidanceoncounterterrorism.pdf">http://www.architecture.com/Files/RIBAHoldings/Communications/Press/General/RIBAGuidanceoncounterterrorism.pdf</a>	Informs built environment professionals of recent government work to protect crowded places and sets out CT design guidance
terrorism	1,2,3,4,5	UK strategy for countering international terrorism	2009	<a href="http://www.official-documents.gov.uk/document/cm75/7547/7547.asp">http://www.official-documents.gov.uk/document/cm75/7547/7547.asp</a>	Describes principles that set out UK CT strategy