		Final Report

Project No: 261652

Project Acronym: DESURBS

Project Full Name: Designing Safer Urban Spaces

Final Report

Period covered: from 01/01/2011 **to** 31/12/2014

Start date of project: 01/01/2011

Project coordinator name:

Dr. James Rydock

Date of preparation: 19/03/2015

Date of submission (SESAM):

Project coordinator organisation name:

Research Management AS

PROJECT FINAL REPORT

Grant Agreement number:	261652
Project acronym:	DESURBS
Project title:	Designing Safer Urban Spaces
Funding Scheme:	FP7-CP
Project starting date:	01/01/2011
Project end date:	31/12/2014
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Final publishable summary report

1. Executive summary

DESURBS was a 48 month FP7 security project that developed tools to assist built environment professionals and urban managers to create and maintain safer urban spaces. The scope of the project was to make improvements by contributing new methodologies to aid in planning, design and engineering of urban spaces to make them less vulnerable to security threats. DESURBS had as a primary objective the creation of a range of databases, tools and approaches that can be used, alone or in combination, by urban space stakeholders to create new, safer spaces or to reinforce existing urban infrastructure to make them more secure for people and for the surrounding environment. The range of threats and hazards covered in the project included terror, industrial accidents, crowd control issues such as stampede threat, and natural hazards like earthquakes, flood, landslide and volcanoes.

The consolidative tool of the project is the DESURBS Decision Support System Portal (DSSP). The web-based interactive technology was realized to help enable users to distinguish between strengths and weaknesses in urban spaces. This will allow them to recognize, minimize or remove the threats they face. It combines a number of the project's technologies and results in a user-friendly package targeting urban planners, designers and engineers. The DSSP comprises an integrated security resilience design and assessment framework incorporating supporting tools to engage and support local stakeholders in recognizing weaknesses and enhancing urban spaces that might be subjected to security threats. The portal also contains an evolving urban space security event database that includes incidents with negative or potentially negative consequences, as well as preventive cases that illustrate current best practice.

Other DESURBS tools are modeling and computation based and include a strength-of-materials database incorporating failure calibration curves to optimize structural engineering materials decisions; a vulnerability curves database and visualization application for analyzing weak points in buildings and structures subjected to earthquake and blast; and an agent-based dynamic modelling tool for simulating urban catastrophe management scenarios. Additionally, cell phone applications for crowd monitoring and tracking, as well as two-way communication between authorities and citizens for security reporting have been developed and tested. A second tailored security incidents mapping and visualisation tool has been realized in the project. It is accessible without any username or login credentials on the Internet and is extremely intuitive and user-friendly, enabling one to search worldwide for security incidents such as accidents, attacks and disasters, and then view photos, comments and downloadable documents about the incidents. Finally, a rapidly deployable, self-contained tethered signaling balloon system has been developed to simplify crowd communication at large events and as an emergency communication tool in case of disaster in crowded urban spaces.

2. Context and main objectives

Security risks to urban areas are widespread. From crime and public order to terrorism, “securitising” cities has been a focus of policy responses. This has occurred alongside ongoing natural threats such

as earthquakes and flooding, which include in many cases increasingly human induced risk – and the ever present risk of accidents in evermore crowded urban areas. As security-related risk in cities has intensified our concern with anticipating, preventing, preparing, responding and recovering from the associated disruptive challenges has become a key concern of urban managers and built environment stakeholders such as urban planners, urban designers, civil engineers and architects. Through it all enhancing resilience – the capacity to adjust to threats and mitigate or avoid harm – has become the aim for urban stakeholders. Shaping new and existing urban spaces through planning, design and management is central to this. Resilient design is therefore a holistic process involving a range of activities which shape and manage the built fabric so as to reduce its vulnerability to a range of hazards and threats. It is concerned with both the spatial form and redesign of the built environment as well as the processes that help shape it. Yet designing and redesigning urban spaces to make them more secure is often constrained by the limited local knowledge and experience of dealing with these different types of hazard and security threats. There is thus a continuing need for widely relevant, generically applicable tools to help diverse users identify strengths and weaknesses in urban spaces and take the most appropriate steps to identify, mitigate against or eliminate the risks to them through enhancing resilience.

Our objective in DESURBS has been to produce relevant, exploitable and high impact tools and methodologies. More specifically, to establish a comprehensive urban space security events database containing a representative number of incidents or 'near miss' incidents resulting from security threats in urban areas including incidents involving auxiliary infrastructures supporting the urban space; protection of human lives and the surrounding natural environment; old and new cities as well as different security cultures; public transport terminals, sport venues, shopping and business centres. Additionally, to create an Integrated Security and Resilience (ISR) design framework that is based on engaging local stakeholders and that is charged with finding weak points and consequently strengthening urban space designs, and to develop and incorporate an objective rating scale for quantifying safety of different urban space designs and use it to show that ISR design recommendations result in urban spaces less prone for and less affected by security threats.

Furthermore, we have aimed to develop Geographical Information System (GIS)-based mapping and visualization tools based on urban design case studies; to develop comprehensive supporting models, technologies and tools for quantifying vulnerabilities and strengthening weaknesses, including: new (industrial design) security products for urban spaces; urban simulation modeling, probability estimation, optimal location modeling; tracking technologies; urban space materials database/advanced computational (finite element) methods for characterizing and reducing the vulnerability of 'weak' points; and finally, to develop and implement a Decision Support Portal integrating, where feasible, the ISR framework, the incidents database the comprehensive supporting models, technologies and tools.

3. Main S & T results/foregrounds

A short description of the main DESURBS results/foregrounds is as follows:

1. ISR security incidents database:

This database is populated with a set of ISR case examples, that is to say, a set of hazard specific examples which highlight the importance of addressing each stage of the ISR. This database is thus nested within the ISR workflow. Case examples appear in the ISR as vignettes of good and bad practice at each stage. As such, the ISR security incidents database is not easy to access or update externally and is not viewable/searchable directly on the Internet. The purpose of this database is to provide examples within the ISR that illustrate to end-users why taking appropriate action at each stage of the ISR will be beneficial and enhance urban safety.

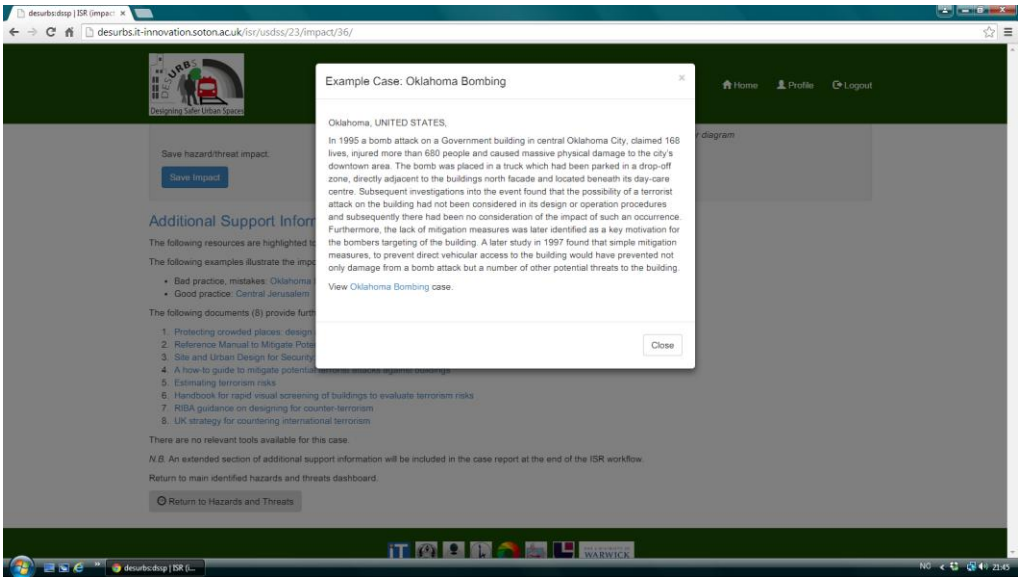

Figure 1: Example security case accessed with the ISR workflow during report creation for a test urban space evaluation for terrorism and crime.

2. Urban Space Design Safety Scale (USDSS)

There is a clear need for a generic model of risk assessment that is easily used and understood by a range of users and applicable to a diverse set of hazards and threats. The development of the USDSS moves beyond current practice to develop a bespoke and easily applied tool to assess risk in the built environment, linked to correlated measures developed to increase resilience to these potential threats.

The USDSS is based on standard risk assessment protocol. It uses a systematic process to establish ratings for the exposure to risk and the likelihood of that risk occurring, combining to provide an overall risk rating for each hazard or threat identified for a site. Outcomes are measured non-numerically, from very low to very high, reflecting the qualitative basis of the process.

The USDSS follows a course of 5 steps that are tightly integrated with, and embedded in, the ISR design framework discussed below, where users provide information on potential hazards and threats, which are themselves embedded into the wider ISR stages.

The USDSS steps are as follows:

- Step 1 – Hazard Identification
- Step 2 – Impact Assessment
- Step 3 – Assessment of Site Vulnerabilities
- Step 4 – Assessment of Design Vulnerabilities
- Step 5 – Overall Risk Rating

The approach is qualitative, with individual users making their own judgements about the levels of impact, vulnerability and thus risk.

The strength of USDSS approach is that it relies on users' individual understanding of potential risks, making it quick to use and simple to understand. Ultimately, the process allows users to identify and decide on their own acceptable level of risk.

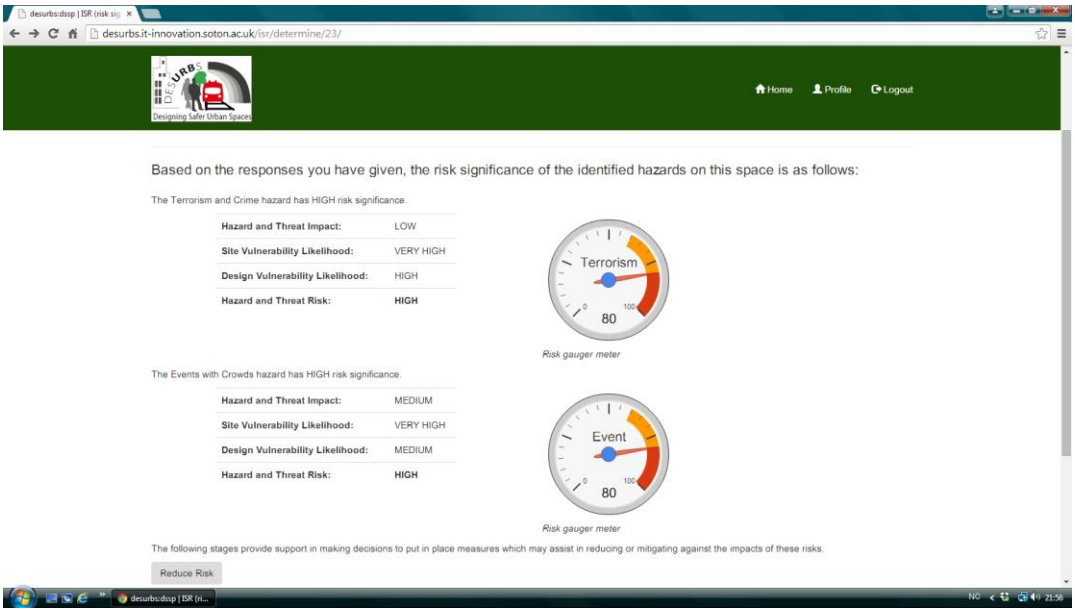

Figure 2: Use of Urban Space Design Safety Scale (USDSS) embedded in ISR analysis and reporting .

3. Integrated Security and Resilience (ISR) design framework:

The ISR framework guides users in how to design safer urban spaces, through a stage-by-stage process that has emerged through the DESURBS project's methodology. The ISR framework is a primary component of the Decision-Support System Portal (DSSP), see number 17 below. 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).

This standard presents four stages in the risk management process: risk identification, assessment, evaluation, and treatment. In the DESURBS ISR framework, 'treatment' has been expanded into two stages, to aid end users to 'identify' what measures can be used, and to 'prioritise' them in relation to their effectiveness.

By basing the ISR framework on an accepted international standard such as ISO 31000 it is anticipated that the ISR will provide suitable relevance (in functionality and terminology used) across Europe and globally.

The five stages of the DESURBS ISR are as follows: 1) Identify, characterise, and assess hazards/ threats; 2) Assess the vulnerability of urban spaces to specific hazards threats; 3) Determine the risk (i.e. expected consequences of specific hazard/ threat on specific assets); Identify ways to reduce those risks; and 5) Prioritise risk reduction.

For each identified hazard, possible impacts are categorized. Vulnerabilities are separated into site vulnerabilities and design vulnerabilities. The identification of vulnerabilities is based on a grouping of 'weaknesses' as follows: planning, design, managerial, structural, material, maintenance, mitigation, emergency response and stakeholders. These are then self-assessed and categorized by overall 'scores' from 1 to 5. Overall vulnerability is then determined as a combination of the highest design vulnerability score and the highest site vulnerability score. Risk is then determined as a combination of the exposure to and impact (consequences) of a hazard, and the likelihood (change of something happening) of a hazard. The scores from stages 1 and 2 provide information for the determination of the risk illustrated in a risk rating matrix. A course of action to address and treat the hazards/ threats and risks associated with them is then identified. Once the potential course of action has been identified, the most suitable options are prioritised. At the end of this stage the end-user is provided with case examples where, with hindsight, the correct or wrong options have been chosen. Similarly to the previous stages, they are also signposted to relevant tools and documents where appropriate. Once all the stages are completed, the end-user receives a report which incorporates the results of all the stages.

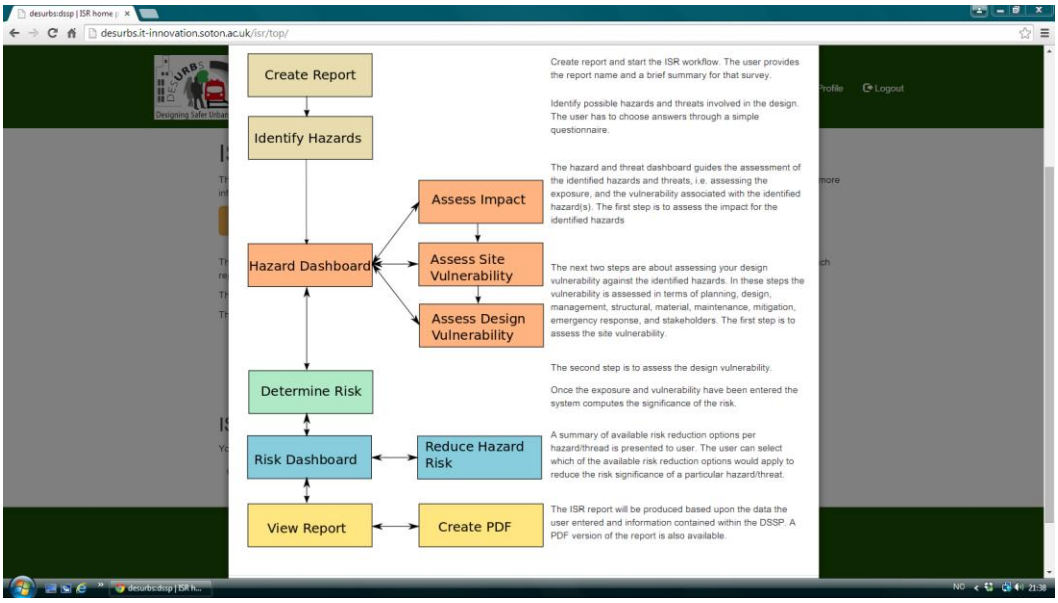

Figure 3: ISR workflow explained within DSSP.

4. Web-based, open source security incident mapping tool:

An adaptive and user-friendly GIS-based mapping and visualization framework has been created, based on Open Street Map and Open GIS. Open Street Map is an open source free editable map with geographical information from all around the world and fully integrable using JavaScript map libraries. Open Street Map does not need a username and password to work with, and there are no restrictions in its license to use it.

The preliminary visualization tool has the capability to visualize accidents and security related events as color-coded points on a global map. The information related to each register includes pictures, comments and downloadable documents. The visualization tool has two frames: the Front Office and the Back Office. In the first one the end user is able to search for incidents and visualize on the world map at a very close resolution. The Back Office corresponds to the data administration framework.

Feeding the visualization tool with disaster information can be done in a completely online way with a very intuitive interface. Also the classification class criteria are fully customizable.

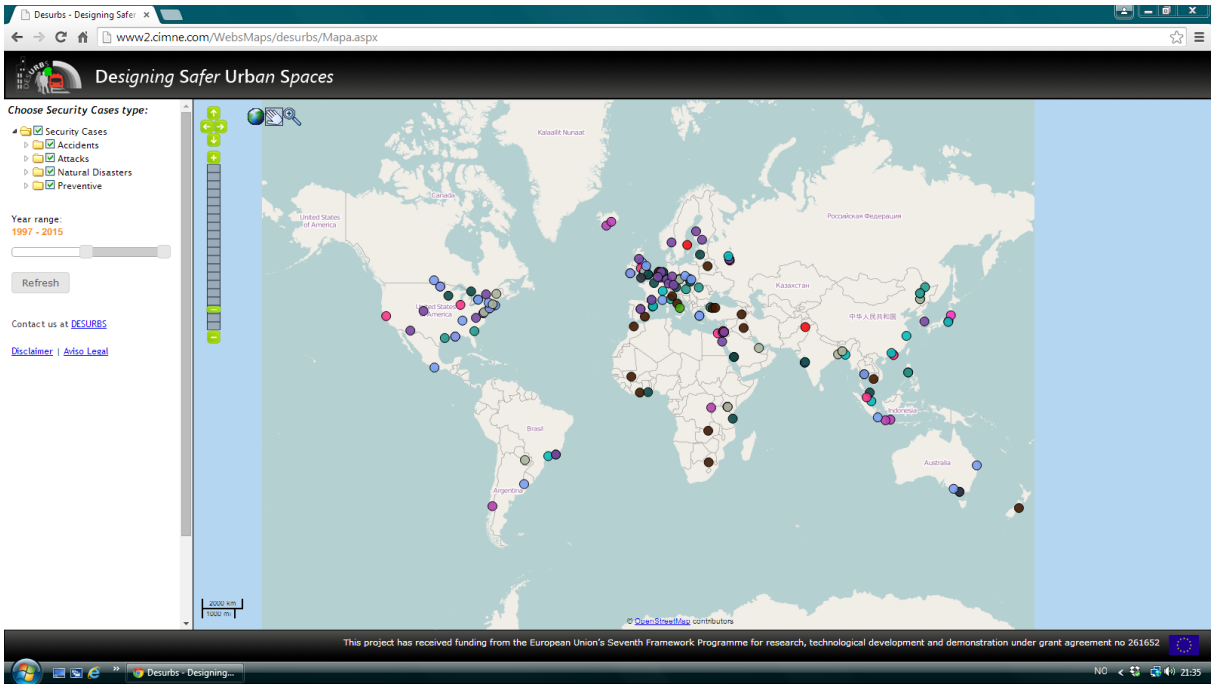

Figure 4: CIMNE security incident mapping tool using Open Street Map.

5. Security incidents mapping tool database:

This is the security incidents list and database that is associated with (and integrated into) the open-source mapping tool described above. This database is easily be updated and modified externally in the mapping tool back office by users with editor privileges. It is accessible directly on the Internet. Third parties can comment on cases and incidents by sending an email through the mapping tool home page.

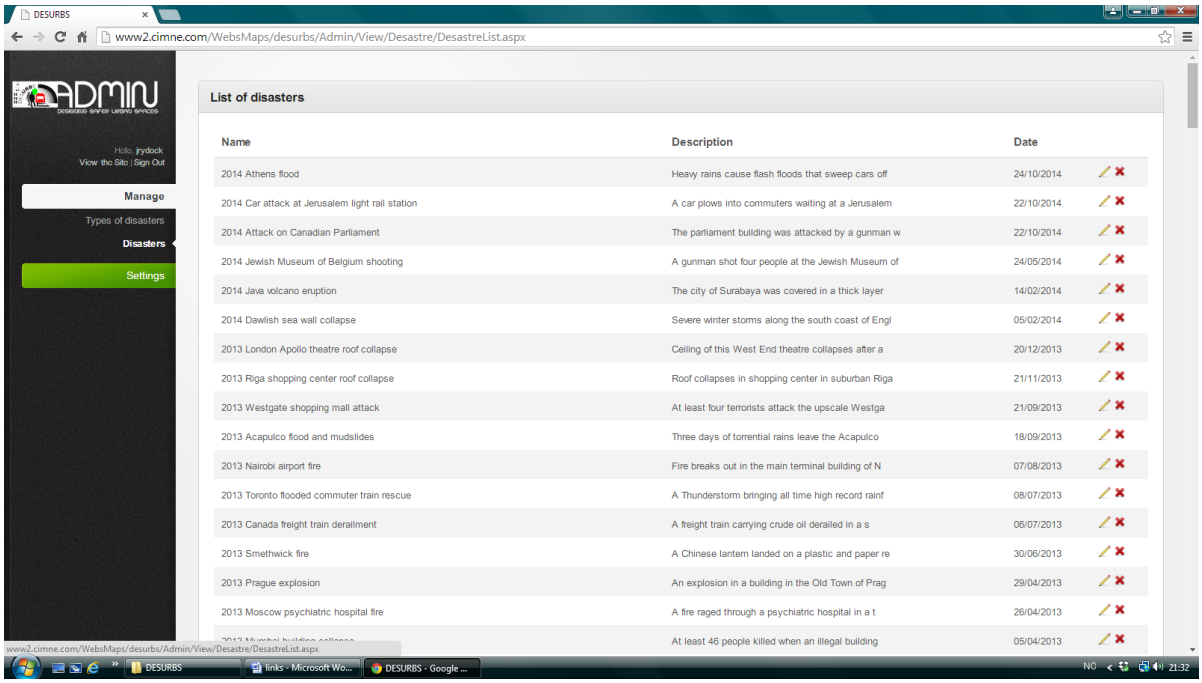

Figure 5: Back office view of security incidents mapping tool database embedded in CIMNE mapping tool.

6. RISK-AT visualization and mapping tool

A second generic visualization tool has emerged in DESURBS in order to be able to map and illustrate the risk to buildings and other urban infrastructure from various hazards. In this case, the test city has been Barcelona. To implement the tool, geographic information is needed, preferably cadastral maps in order to define properly each building inside the city of interest. Additionally, information relative to buildings and other infrastructure and their responses to specific shocks and actions is required. With these, different kinds of graphical results can be generated.

The first kind of result that can be obtained is a function of the distance between a fixed point shock and a structure. This can be defined as a point on a map, and because it requires some extensive calculations only a small region to display the results is defined. The calculations need to be performed at the server and involve determining the distances between all the structures selected and the reference point and with the proper vulnerability curve to obtain the damage index to be presented in a color scale, based on the severity of the impact. This kind of result is applicable when a single event occurs in a specific location.

A second type of result in involves a line definition. In this case the outputs that can be obtained are a function of the distance between a structure and a line shock. This can be defined as a path on a map. The calculations that need to be performed at the server evaluate the distance between all the structures selected to the reference path and with the proper vulnerability curve to obtain the damage index to be presented in a color scale. This kind of result is designed, for example, to evaluate the best path for some dangerous transport along the city and other similar situations.

A third instance corresponds to a situation in which the results do not depend on the distance to a point or a line, such as an earthquake or a flood. For this type of impact, an area can be selected for graphical display.

The visualization tool developed is called RISK AT and allows presenting the cadastral map and combining all the elements described above with a friendly user interface. The tool allows selecting the kind of event and evaluates automatically the distance of the parcels to this point (or line). It generates a file with the parcel type (based on the vulnerability classification) and distance to the event and passes this information to the interpolator code which reads the vulnerability curves database and calculates for each record the IDAD value in other files which are passed, once finished, to the visualization tool. At this point the tool represents in a color code all the IDAD values. The RISK AT program visualizes the cadastral information in a layer format and allows to mix different kinds of layers like Google Maps, satellite photographs or Bing Maps. Also all the GIS features are implemented like zoom in/out, pan, distance calculator and layer manipulation.

A complete print facility is implemented in the RISK AT program. PDF, paper print or photographs can be extracted from the results generated, increasing the tool capabilities for creating reports. Also direct picture to web posting is under design.

Figure 6: RISK AT visualization of building vulnerability along the path of a hypothetical line path urban shock.

7. Generic security product design methodology:

A specialized master process was created as the framework for all progress in new industrial design security project development in DESURBS. The process incorporates a design-thinking methodology with the product development process. The master process puts an emphasis on co-creation of

values with end users. The stages are: A) Plowing (months 1-6) – joint writing of the project's brief and social environment; B) Sowing (months 5-12) – includes research observation, strategic formulation and technological benchmark; C) Sprouting (months 12-15) - ideation of up to 50 ideas, skimmed into ten concepts and their presentation to end-users; D) Budding (months 15-19) – development of selected options; E) Blooming (months 20-31) – creation of 1:1 model and presentation to end users; F) Ripening (months 27, 32 and 39) – Actual field testing; G) Harvesting (months 40-48) – dissemination within the end users.

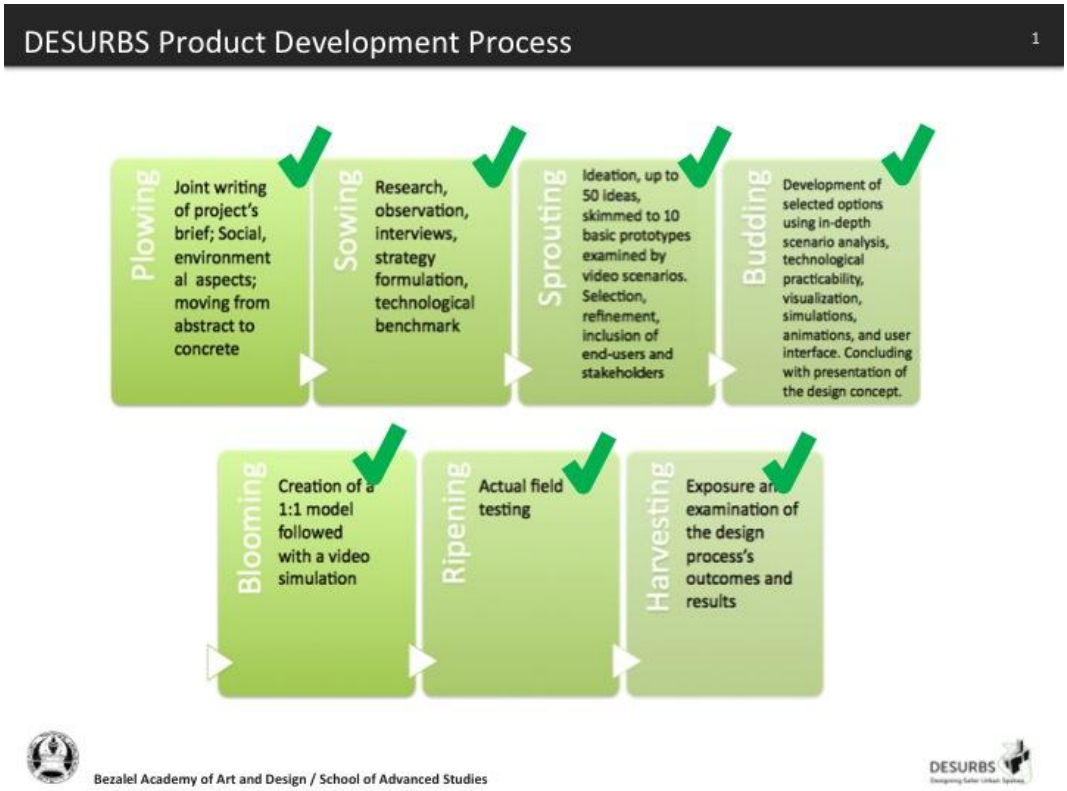

Figure 7: DESURBS product design methodology developed by Bezalel Academy.

8. TASKit – The all situation crowd control kit

As a result of the end-user field research and the double-loop design process, the DESURBS team developed a new concept that aims to maximize strengths and value to the end-users. The design concept is named TASKit "The All Situation Crowd Control Kit"; it can be used to strengthen identified weak points in the city without redesigning and replacing the urban infrastructure itself. It is composed of several industrial design products: a directive balloon (later named "Hope Spot"), an image and GPS reporting Smartphone application (later named CityZen), and the Urban Resilient Design Guidelines- a mapping methodology that aids in the identification of vulnerable urban areas.

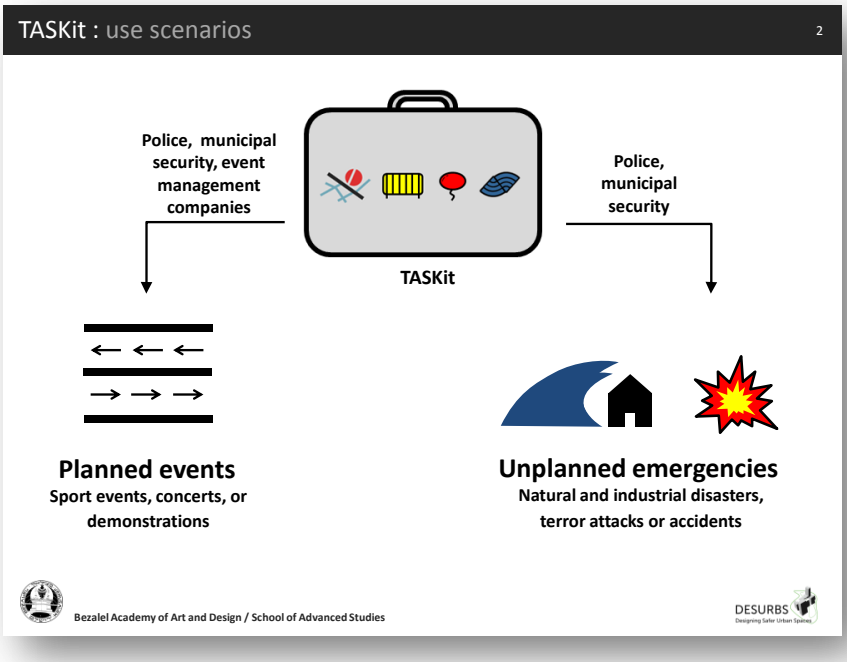

Figure 8: Concept for TASKit all situation crowd control kit developed by Bezalel Academy.

9. HopeSpot signaling balloon:

Urban environment emergency situations create major challenges for city residents, security forces and DESURBS end-users. Management of urban scale disaster events (tens and hundreds of thousands of people) requires meticulous planning, building effective operating procedures and supporting products especially in situations of power failure. The DESURBS project characterized a number of events such as crime, terror, accidents and natural disasters as all are threats to the urban environment and its inhabitants.

The HopeSpot's objective is to provide an efficient, cost-effective, accessible and portable product to ease communication challenges with crowds. It was designed as a flexible component of the supporting auxiliary infrastructure with uses during emergency and planned scenarios. Planned events, such as marathons and concerts, necessitate communication with a large amount of participants on how to navigate the urban space in a clear and safe manner. The 'Security Sensitivity Index' model can assist by identifying the best location for deploying the Hope Spot balloons in urban areas

The HopeSpot balloon has two versions: 1) An active version that includes electronic components enabling it to convey messages to the public as well as absorbing information from the surrounding environment, using different sensors such as photography, gas identification, radio/cellular network rehabilitation and the ability to transfer text messages and sound to the surroundings in real time to present a situation overview to event managers and to assist in the crowd navigation. In some development scenarios, the balloon may also produce energy for itself and perhaps its immediate environment. At this point, the active version will not be developed into a working prototype.

2) A passive version which has been developed into a prototype, focuses on the creation of a mark in the sky pointing survivors of large scale disasters to the place where they can get help, or be used in the same manner in a planned event by pointing people toward first aid locations. The balloon is inflated with helium and set aloft to a height of up to 50 meters (the height is set according to aviation regulation in Israel, yet the balloon is capable of reaching a height of 300 meters and more). It has a distinct hue that is visible in the daytime, at up to 300 meters; while at night an LED lighted cable points toward the ground with an effective visibility of up to five kilometers.

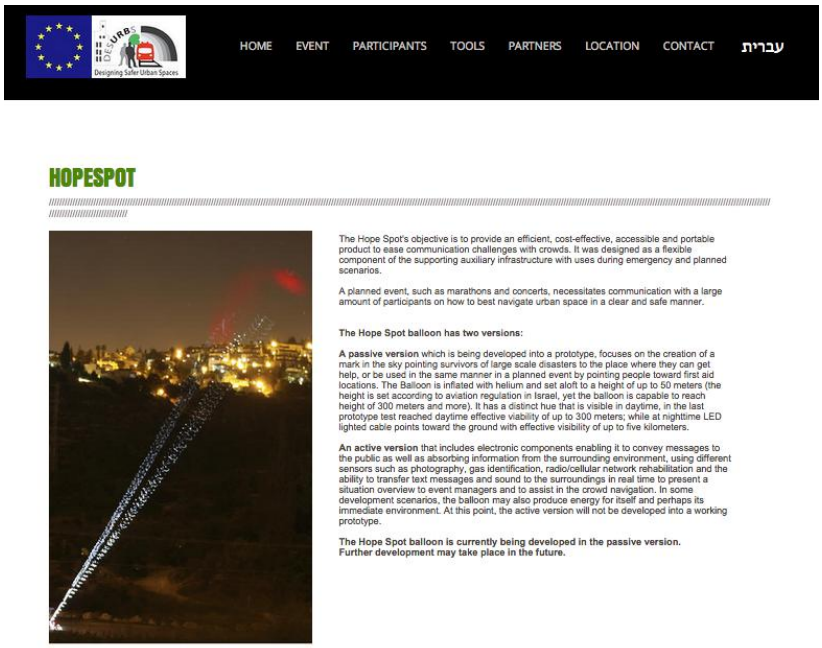

Figure 9: Night test of HopeSpot balloon, shown on Bezalel DESURBS website.

10. CityZen smartphone application:

CityZen is a free GPS enabled mobile application featuring near real-time security reporting coupled with a back-end monitoring application. Together, they create a platform for two way communication between citizens and the authorities, providing an accurate and efficient reporting process. The app allows users to report accidents, security hazards, criminal activities and more using images, video, sound and text. Users can view events reported around their location, give feedback on other reports and receive updates about their handling by the authorities. The back-end application presents the reported events to the policing authorities providing accurate GPS location and images, which can be filtered according to reliability and urgency. The aim of the tool is to create safer urban spaces through a location-based social network that allows authorities and citizens to act together in order to improve the quality and safety of their environment in times of peace and of disaster.

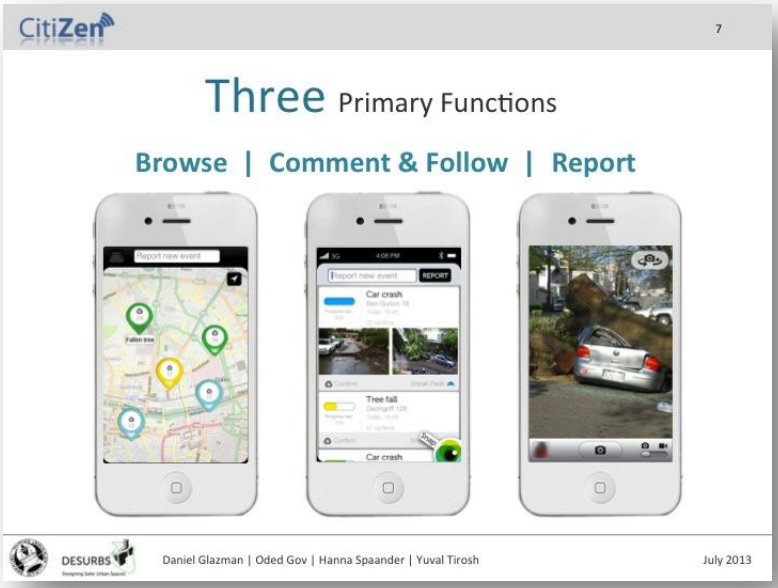

Figure 10: Functionality of CityZen application.

11. CityTalk smartphone application:

Approaching the end of the project, the DESURBS team identified a weakness in the urban design of public spaces and saw it as an opportunity to develop a new tool, which aims to increase the inclusion of elderly populations in the urban design process. The inclusion of populations that tend to be marginalized during the planning process can greatly aid both the physical and social resilience of urban spaces, the physical space will better reflect elder needs and their inclusion and participation raises social cohesion.

Figure 11: Brochure for CityTalk smartphone application.

12. Urban Resilient Design Guidelines:

The DESURBS Urban Resilient Design Guidelines mapping methodology proposes a GIS (Geographical Information System) based tool to support the DESURBS security products and provide planners with detailed information on the layers required to help identify vulnerable areas in an urban space. The combination of layers and information is essential for understanding the evolving urban space in greater detail, helping planners and stakeholders map vulnerabilities and design possibilities as part of the statutory process. A literature review of urban resilience manuals and GIS highlights the lack of relevant methodologies that utilize GIS as a tool for urban resilience.

The methodology details the layers recommended to assist urban planners and decision makers in identifying areas that are at risk and enable them to make spatially informed decisions utilizing the GIS platform. The guidelines will be published as a graphically designed booklet as well as an online pdf for architects and planners. The guidelines are a standalone entity in the way that they have their own content- how to take principles for Designing Safer Urban Spaces and factor it into urban analyses using GIS, while showcasing the industrial design products and pilots developed by the

DESURBS team, and providing suggestions on how to integrate them into plans (i.e. take CityZen data and apply it to a decision making process or decide on the best placement spot for a HopeSpot.)

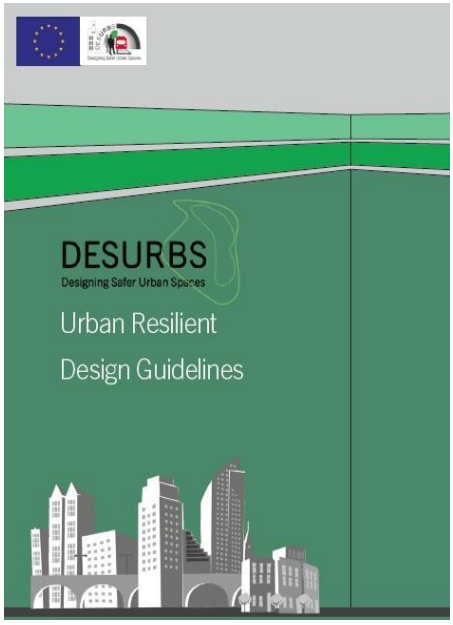

Figure 12: Urban Resilient Design Guidelines, in print form.

13. Dynamic simulation tool for urban disasters (DySTUrbD):

The DySTUrbD tool supports decision making and event management. The tool aims to serve urban managers, engineers and planners and evacuation and intervention forces. A primary objective of the tool is to mitigate the disruptive effects of an urban disaster and thereby contribute to urban resilience. Effective results of the tool are gauged by its contribution to returning the urban system to equilibrium in the aftermath of a disaster. The tool is designed in a modular and generic format calling on readily available platforms, data layers and tools.

The simulation tool conceptualizes urban citizens as the basic agents within an urban system in equilibrium. Their decisions, based on interactions amongst themselves and with the environment, are what drive the urban routine. The disaster is conceptualized as a shock to this routine. Therefore, a conceptualization of "normal city life" is necessary to serve as the baseline conditions against which to gauge the effects of the simulations. These conditions of "normal life" consist of the system of interdependencies between citizens' actions, market change and the physical environment

The tool is developed in a generic fashion to be applicable in any urban context. As such, the procedures of behavior and change articulated within the system require user inputs that characterize the environment and the scenario. These are divided into global inputs and scenario specific inputs. The former require actual data which does not vary over scenarios and is used to characterize the baseline conditions for the simulation. The latter are scenario dependent inputs and can be set by the user to any arbitrary value.

The DySTUrbD tool is aimed to serve in the decision making processes in the wake of an urban disaster. As such, the results it produces capture the aggregate trends of change which may be hard to predict and otherwise identify. The results uncover the effects of the shock in two different forms: by comparing initial conditions to final conditions and by presenting the change in the value of a variable over time. The first is presented in maps in three spatial scales - roads, buildings and tracts – with different variables available at each scale (e.g. traffic loads for roads, values for buildings, population size for tracts. The latter presents in graphs the change in area-level variables such as residential stock total value.

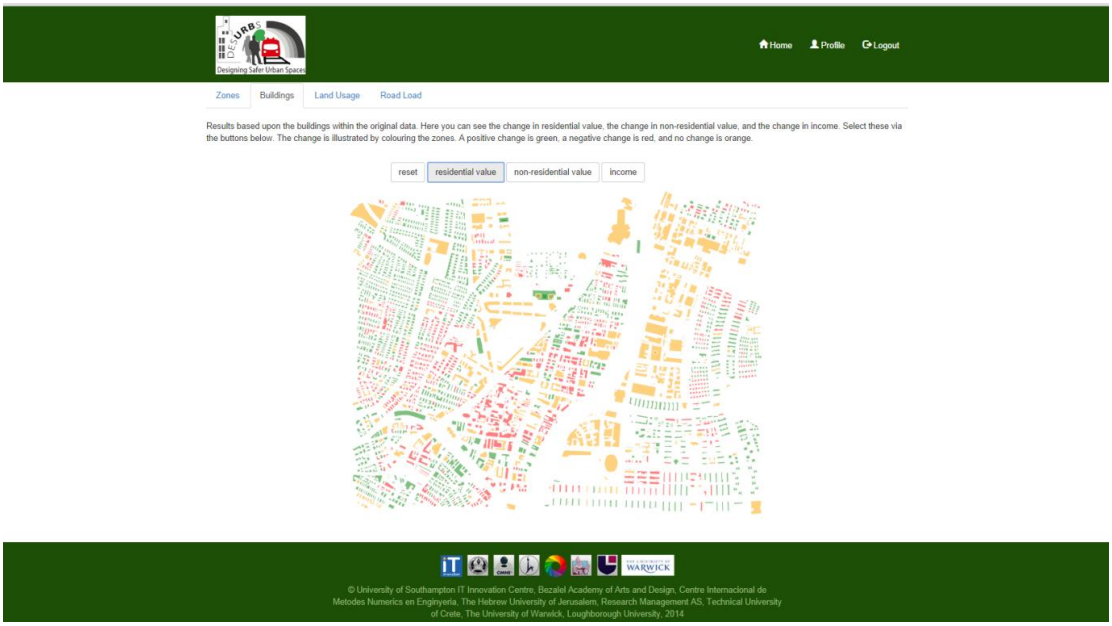

Figure 13: Change in residential values after an earthquake, simulated using DySTUrbD.

14. Crowd monitoring smartphone application (SensoMeter):

During the DESURBS project we have characterized, developed and tested a smartphone tool which can be used to monitor the capacity of highly vulnerable sites and determine threshold limits for site capacities under different security and natural hazard scenarios. The tool, which is called the SensoMeter system, is based on using a smartphone application in which multiple users can report to a central administrator their sense of security in a particular urban space. The SensoMeter includes two main components: a) *Mobile application* - available for both iPhone and Android OS - which allows participants to send reports about their sense of security (either secure or insecure) and to report about predefined hazards based on location and time parameters. b) *A web interface* - that allows administrators to configure surveys and surveys' triggers, manage clients and web users, view location data in real time, export data and send messages to a specific user or groups of users.

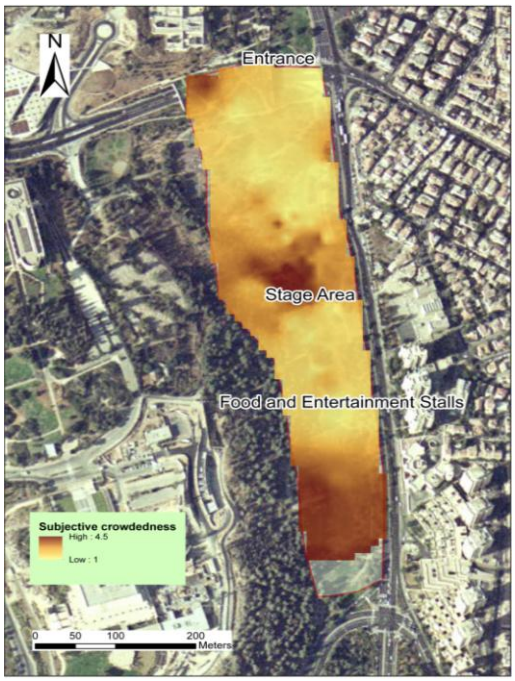

Figure 14: Subjective sense of crowdedness level at concert in Jerusalem, based on sensometer reporting.

15. Materials database (STREMA-DB):

A new web driven materials database called *STREMA-DB* has been developed in DESURBS to achieve the following: (1) A large range of possible types of structural materials that can be used in a given engineering application with their parameters that are useful for their selection, or their performance evaluation under certain loads, are included in the same relational database, and (2) on the same platform, tools for identification of model parameters from static (monotonic or cyclic) or dynamic tests are included in order to produce valuable 'metadata' (like yield stress, damage or plasticity parameters and so on) of geomaterials and other structural materials often used in geotechnical and urban constructions (e.g. steel, concrete mixes, wood etc).

The main database structure is written by virtue of the SQL open source database management system (i.e. MySQL has been used as a Relational Database Management System [RDBMS]). Additional experiment (test) types are implemented as additional tables (modules) into the database.

The following six (6) classes of engineering structural materials are considered in the database: wood, rock/soil, glass, concrete/ceramic, metal/alloy, and polymers/composites. Every material contains basic information, applications, composition, suppliers and indicative unit price. In addition relevant images of the material referring to appearance, commercial applications, color, texture, microstructure etc, are also included. The user may easily edit and import properties and images of materials and associated applications in the database. Besides the database itself, a web application has been developed that controls the database and permits an easy and quick access to the stored data.

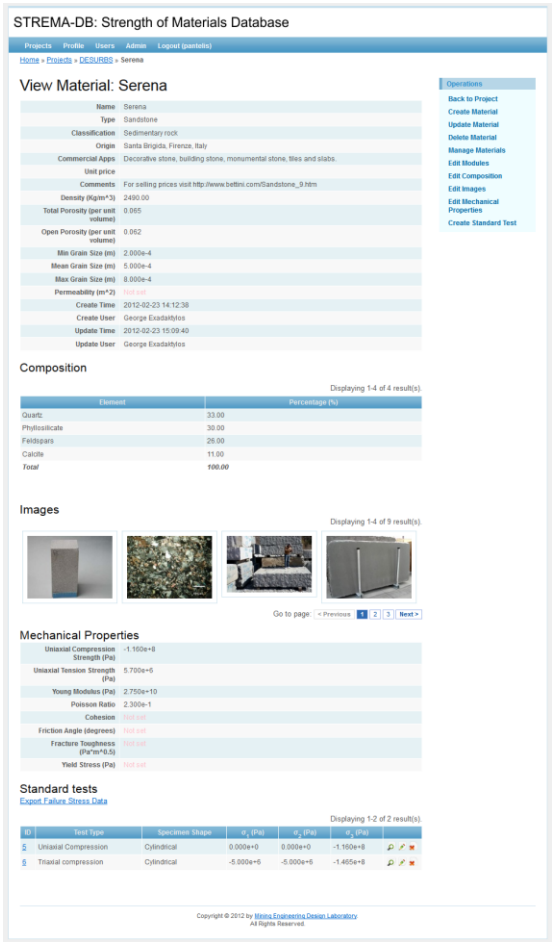

Figure 15: Example of material data in STREMA-DB.

16. FCMODEL:

To be used in combination with the STREMA-DB materials database, a MATLAB™ application known as FCMODEL has been developed that calibrates yield/damage/failure models based on STREMA-DB database data. With this software, a user can analyze/process test data and derive a yield/damage/failure model for a material of interest. This type of functionality is currently missing in other, commercially available databases.

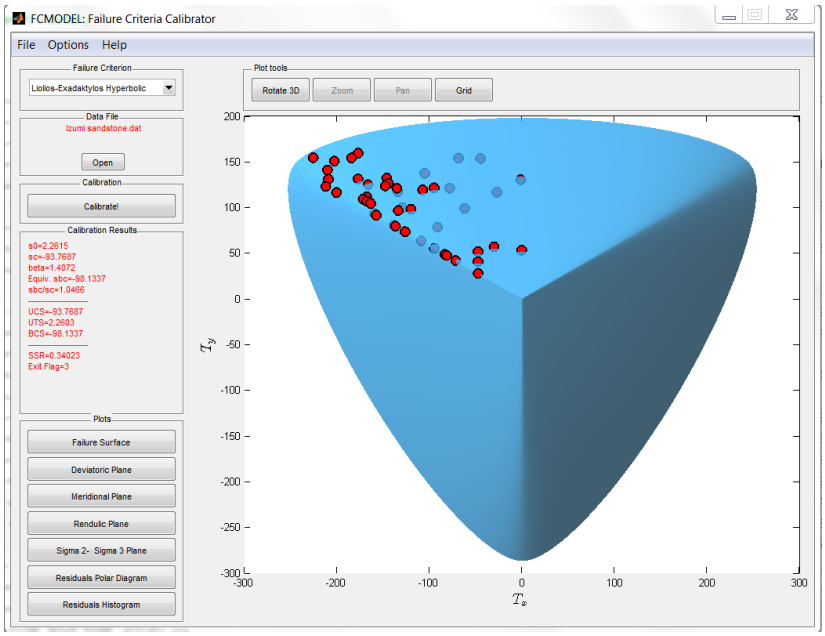

Figure 16: FCMODEL result from a dolomitic rock, shown in three dimensional stress space.

17. Vulnerability of structures database for blast and earthquake:

In DESURBS we have used advanced structural models based on finite elements and discrete elements together with numerical methods as tools for developing a database of vulnerability curves which describe graphically the damage of a structure as a function of a measure of the hazard size . Two main hazards have been considered within the DESURBS project: the seismic case and the case of open air explosions. Our simulations focus on urban structures subjected to these hazards in order to evaluate the structural damage and establish diferent damage scenarios. Significant work for the seismic case has been carried out on the 2011 Lorca earthquake as reference, while Barcelona has been used as the test case for the blast simulations.

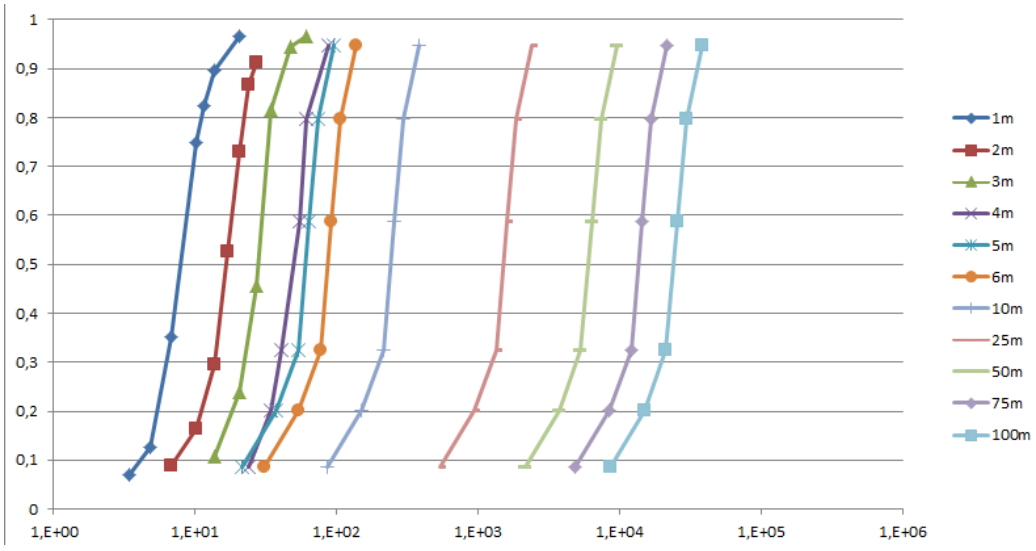

Figure 17: Typical vulnerability curves for an unreinforced masonry wall type in Barcelona.

18. Designing Safer Urban Spaces Decision Support System Portal (DSSP):

The aim of the DSSP is to bring the various tools and databases for achieving safer urban design under a common framework. The portal is housed on a remotely accessible server and the system can potentially support hundreds to thousands of concurrent users. The databases are scalable and able to handle a mix of structured and unstructured data. Entrance to the portal is based on a username/password authentication system. Without authentication a user can browse the site via a number of public demonstrators. The authentication mechanism limits specifically which features that a user can view.

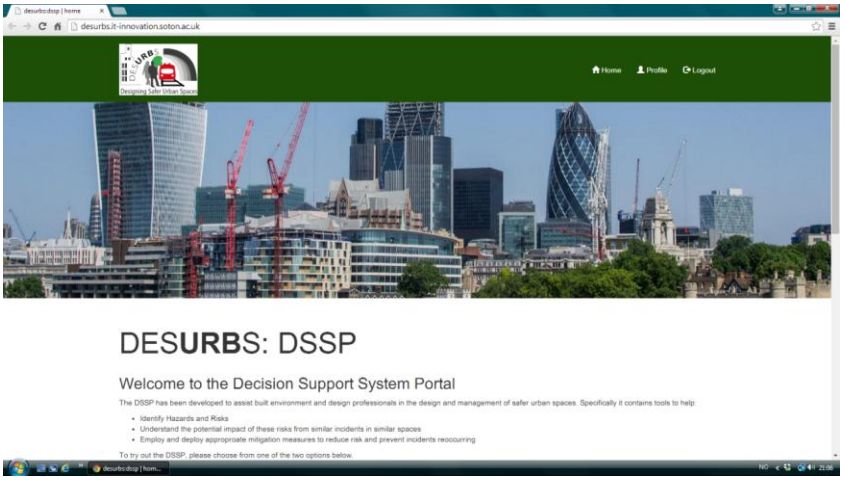

Figure 18: Start page of DESURBS DSSP.

19. Security incidents report list database and preventive cases database:

This is an incidents database and a preventive cases database incorporated into the DSSP security incidents reporting tools. They are completely separate from the ISR and are both directly accessible on the DSSP Internet site (after login to the DSSP). These two databases can easily be updated and modified externally by DSSP users with editor privileges. Both the security incidents report list and the preventive cases report list accept possible new incidents for submission by third parties with subsequent evaluation and approval by editors, as well as comments from third parties.

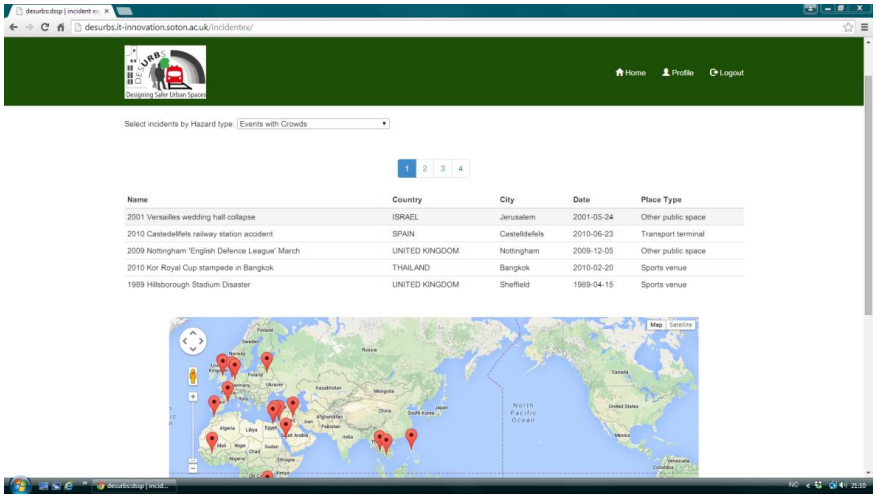

Figure 19: Report list explorer in DESURBS DSSP.

20. UK Crime Explorer:

This application downloads information from the UK police crime API and performs analyses upon it. From a high level it performs similarly to the security incidents report list database. The initial view of the system is a map in which the user can interact with via panning and zooming. At each additional zoom level, and thus region, different information is shown on the map. The different regions and resulting information are: cities: This shows a bounding polygon for the different cities; neighbourhoods: This shows the different administrative regions within a city; and postcodes.

Each of these regions can be colored with a heat map overlaying the frequency of a specific sort of crime and markers corresponding to the crimes that occurred. When a user selects a city, a series of data about the city are displayed. The user can also compare cities at any of the regional levels and between them.

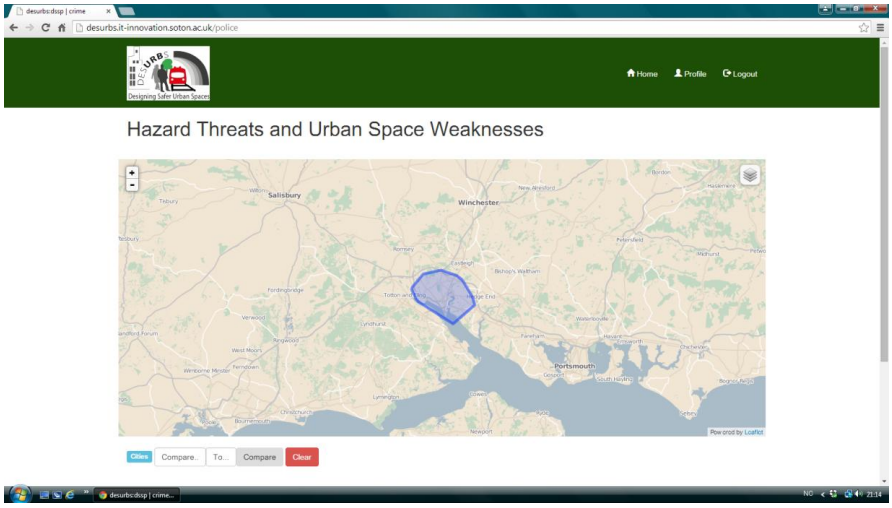

Figure 20 : UK Crime Explorer in DESURBS DSSP.

21. Security culture assessment methodology:

An important element in an analysis of weaknesses and possible measures for strengthening an urban space is the existing security culture of the people using that space. Weakness or vulnerability of a space is not just a function of physical parameters but also is highly dependent on peoples' perception of the safety and security there, as well as their feelings and opinions about what types of measures might be necessary or acceptable to effect a change for the better.

This methodology defines the urban users themselves as a complementary prism in security culture analysis. This employs user's experience (i.e. perceptions and actual experience) concerning security incidents, such as terrorism, as a viable component in shaping complex design strategies aimed at constructing safer urban spaces (user's experience -based research for user-based design). The analysis identifies and maps specific categories related to strengths, weakness, opportunities and threats concerning the effects of existing security factors in the typological-spatial distribution of an urban space.

Figure 21: The DESURBS security culture assessment methodology was developed with Jerusalem as a test bed.

22. Security incident Mapping and Prevention Opportunities (IMPO) methodology:

The DESURBS team analyzed 10 past security incidents, from the perspective of urban space vulnerability and resilience in a series of Incident Analyses Reports. During this time the Incident Mapping and Prevention Opportunities (IMPO) supporting tool was developed, allowing for identification of industrial design security products as a security factor or weakness in the design or use of an urban public space. The model is based on the Haddon Matrix used to analyze vehicle crashes and accident prevention models such as Generic Epidemiological models. The use of this tool also highlights the roles that existing security cultures play in affecting outcomes of identified security incidents, resulting from human interpersonal relationships and human relationships with

security products or systems. In the future, an extended database of incidents analyzed by IMPO would be valuable in decision and policy making, by allowing end users to easily highlight problems in past situations.

Figure 22: IMPO methodology involves looking at possible effects of interventions with security products before, during and after incidents, in a manner similar to the Haddon Matrix for injury prevention.

4. Potential impact (including the socio-economic impact and the wider societal implications of the project so far) and the main dissemination activities and the exploitation of results.

As final results of DESURBS, we have a diverse collection of tools and methodologies which can be exploited by themselves or as part of the integrative project decision support system portal (DSSP). The ultimate impact of the DESURBS results will be to a significant degree dependent upon further communication, dissemination, development and use of the individual DESURBS outputs by project beneficiaries, through further direct efforts to reach and engage the primary targeted stakeholder group of urban planners, urban designers and building and infrastructure engineers, as well as secondary end-users which include all people concerned with urban space security. The impact of the project will also be facilitated by the initiation and successful funding of new research and innovation projects which use the project advances as a jumping off point for addressing the still current and relevant societal need for widely applicable and generic tools to help make the design and redesign of safer urban spaces more economical, efficient and effective.

In terms of specific, high-breakthrough-potential impacts so far, the new industrial design security products from the Bezalel Academy team have been noticed by the United Nations Office for Disaster Risk Reduction (UNISDR). Evidence of this can be found in the invitation for a presentation of the HopeSpot tethered balloon signaling system as a featured IGNITE lecture at the UN World Conference on Disaster Risk Reduction at Sendai, Japan, in March 2015. Successful commercial production and use of this package in post-disaster response and recovery situations could be an important element in facilitating aid to disaster victims on site, and potentially saving lives.

To foster and increase the impact of the individual DESURBS outputs, the project website is being revamped for the post-project phase in which the focus of the site will shift from the aims and objectives of the work to a more directed promotion of the exploitable results and outreach activities for increasing DESURBS presence in the news and in society going forward.

SME impact and job growth potential

The DESURBS decision support system and associated tools and methodologies are not commercially viable at the end of the project. The economic impact of the project on Resman, the consortium SME (currently 1 FTE), is at present minimal. However, there is expected to be a significant growth potential if the DESURBS outputs can be collocated, consolidated and sufficiently improved. If this is done correctly and successfully, the result could potentially be 5 additional FTEs in 5 years (that is to say, in the year2020) and a total of 20 additional FTEs in 10 years (in 20205) at RESMAN.

This projection is made by virtue of the fact that disasters continue to have an inordinate negative effect on society. For example, in Europe, more than 1300 reported disasters have claimed close to 150,000 lives and caused approximately 375 billion USD in economic damages in the past 30 years. A system that would facilitate informed and responsible decisions about where the most vulnerable urban spaces are and how to make them more resilient would therefore set the stage for enormous economic, environmental and social impacts in Europe and beyond; certainly enough economic impact to create 20 jobs in a 10 year period, if successful.

Main dissemination activities

There have been two main end-user dissemination and training workshops in the project, one in Jerusalem in May 2014 and the other in Brussels in November 2014. In addition to dissemination, an additional purpose of these workshops was to highlight the potential utility of a number of the tools and products that have been under development in the DESURBS project to an audience of interested end-users and stakeholders.

Specifically:

-With regard to the ISR design framework, from the workshops some useful contacts were made with people interested in a) conducting further research related to the ISR process and b) embedding the ISR process into their risk management practices when planning and designing urban spaces.

-With regard to the DESURBS industrial design security products, the HopeSpot balloon and the CityZen app were showcased in a live demonstration, while CityTalk and the Urban Resilient Design Guidelines were explained through slide and video presentations to end-users attending the workshop during Jerusalem in May 2014. All four products were represented with large posters and promotional clips screened at the Brussels workshop in November.

Through the Jerusalem dissemination event close connections were made by Bezalel Academy with the UNISDR Global Resilient Cities Campaign, and work is ongoing to have the DESURBS Industrial design security products available through their extensive campaign in thousands of cities around the world.

-With regard to the security incident mapping tool, this was presented during the workshop held in May 2014 in Jerusalem, and has also has been shown to officials at the municipality of Barcelona.

Additionally, More than 16 DESURBS-related articles have already been published in refereed journals, and at least eight more are pending; 14 articles have been presented at conferences and subsequently published in conference publications; two book chapters, five Ph.D. theses and five Master's theses have also come out of the project .

Exploitation of results

Below is a summary of exploitation activities carried out so far and planned for a number of the DESURBS exploitable results

ISR design framework:

Future professional practice: It is anticipated that the ISR could form a useful risk management framework that can be utilized on forthcoming urban development projects by Loughborough, Warwick and perhaps other DESURBS partners. Accordingly, endeavors will be made to promote the benefits of the DSSP and supporting tools by giving brief talks to key stakeholders across Europe; such stakeholders so far have included the Metropolitan Police, Clarke Bond, Control Risks and Local Authorities in the UK.

Ongoing undergraduate training courses: The School of Civil and Building Engineering at Loughborough University provides a range of undergraduate courses (BEng, BSc, MEng and MSc) on

built environment topics, such as 'Civil Engineering', 'Construction Management' and 'Architectural Engineering and Design Management'. The ISR framework is now being embedded into the teaching of a number of optional modules on these courses with the aim that a significant proportion of future graduates will have incorporated urban risk and security as an important part of their training and ultimately their future professional practice.

Industrial design security products:

Work is ongoing to have the DESURBS industrial design security products available through the UNISDR Global Resilient Cities Campaign in thousands of cities around the world.

A. *Hope Spot:* The HopeSpot will be presented at the 3rd World Conference on Disaster Risk Reduction, 14-18 March 2015 in Sendai, Japan. The HopeSpot applied for the UNISDR RiskAt award for continued funding for development in order to bring the product to market, and a number of commercial companies have expressed interest in the HopeSpot balloon.

B. *CityZen:* At the beginning of December 2014, CityZen was invited to give a presentation to the chief security officer and the chief information officer of the Tel-Aviv municipality. Following the Jerusalem Marathon Pilot the project was also presented to security officials at the Jerusalem's municipality.

   To continue its promotion and exploitation, Bezalel Academy applied for a number of international prizes. CityZen was a local (Israel) finalist in the 2014 European Satellite Navigation Competition. CityZen was also a finalist for the GNSS Living Lab Prize, as a finalist GNSS Living Lab Prize, a connection was made with the Forum Virium Helsinki. An option to run a CityZen pilot with a user group from the local population was discussed with a representative from the forum. CityZen also created a mockup of the app for the Israel Nature and Parks Authority.

C. *CityTalk:* The core working group of TUD COST Action TU1203 'Crime Prevention through Urban Design and Planning' attended the Jerusalem workshop and expressed interest in running a CityTalk pilot in the Netherlands. The project is currently in the mockup stage and needs to go the through a programming phase at Bezalel Academy prior to running a pilot.

Urban Resilient Design Guidelines:

These guidelines database may be exploited going forward by Bezalel Academy through the UNISDR Global Resilient Cities Campaign, and perhaps also in conjunction with Warwick/Loughborough, as part of the ISR exploitation discussed above.

DySTUrbD - Agent-based model simulation package:

Exploitation of the agent based simulation model will take the following form:

Training Tool: the simulation model is useful for both estimated outputs it generates and the training and instruction opportunities it presents. In terms of the latter we envisage the model for training professional emergency responders. In conjunction with local and national government agencies, we intend to conduct training courses for emergency planners. These will use the tool to appreciate

some of the wider implications of severe shocks to the urban system. It will provide a framework for thinking about longer term impacts of urban disasters beyond the immediate response that they are generally called to provide.

Web-Based GIS site: to exploit the outputs of the model, the HUJI team has launched an accompanying website that demonstrates the array of visualized outputs produced and shows how these can be displayed as dynamic web maps and graphs. This can be accessed at:

http://ccg.huji.ac.il/AgentBasedUrbanDisaster/index.html

Academic Channels of Exploitation: The HUJI team has a publications and presentations agenda covering the period 2015/6. This includes pre-commissioned chapters for two academic books, presentation at international specialist meetings and NSF workshops and a string of papers dealing with the data, modeling and policy aspects of the tool, earmarked for international peer-reviewed journals.

Sensometer tracking tool:

General exploitation: The Sensometer is available for use for the wide public. Individuals and groups who wish to utilize the tool for various purposes such as monitoring crowd behavior, collecting reports about hazards and sense of security and tracking human behavior in general can do so using the Sensometer system. Links to the Sensometer can be found on the DSSP on: http://desurbs.it-innovation.soton.ac.uk/osense_index (login is required). The Android and iOS mobile apps are available on the application stores for free.

Research Activity: The Sensometer was already exploited in a PhD study and MA study that are expected to be submitted in the next few months at HUJI. Another academic study about the livability of cities is expected to take place in New Zealand in the beginning of 2015. Several other researchers from Israel, United State and Denmark showed interest in exploiting the Sensometer system in their studies.

Academic publications: The work on the Sensometer led to the submission of an article in a geographical journal. Two other articles are expected to be submitted during 2015. Moreover, we expect that future studies that will make use of the Sensometer will be published in highly ranked peer-review journal in the next years as well.

STREMA-DB and FCMODEL:

A one-day seminar on the materials database was delivered by G. Exakaktylos (of beneficiary TUC) at Ruhr Universitaet Bochum on 10th of July 2014. It was realized there after discussions that Strema-db alone or accompanied with the FC-MODEL subroutine could be indispensable tools for assisting decisions regarding selection of materials for a structural applications or assessing the remaining life of structures or back-analyzing disaster incidents (like the Sao Paulo underground station collapse presented in the frame of Eurotun2013 international workshop also at Bochum, Germany) or in deep geothermal applications to pre-assess the potential of a geothermal field to be productive among others. Such seminars may be continued after the end of the DESURBS project in order to attract the interest of potential future collaborators for continuously upgrading the database or modifying it by adding new modules to consider more engineering applications (for example resistance of structures to impacts or explosions etc). Further we shall consider both the STREAM-DB database and the

accompanying FC-model calibration tool in a next proposal funded partly by Greece and/or European Union aiming at promoting the link of Universities with Private Enterprises and the creation of start-up companies. For this purpose we have to conduct a feasibility study, a market analysis and then come up with a business plan.

RISK-AT vulnerability of structures database – blast and earthquake:
The simulation of complex events requires an intense process of calculation, the tool developed generalizes the numerical process and allows a priori calculation for a lot of possible scenarios; thereby displaying a specific event can be performed in real time and in a simple way. This is one of the great advantages of the program developed. On the one hand vulnerability curves of each structure to a specific risk are generated and on the other hand the visualization tool which uses the vulnerability curves associated to a specific structure, presented the damage depending on the magnitude of the event.

All design methodology, calculation and implementation, as well as the visualization has been entirely developed by CIMNE, thus allowing use of it freely without payment of royalties to third parties.

This tool has been presented during the workshop held in May 2014 in Jerusalem and also shown to the municipality of Barcelona and has been used to analyze the Lorca earthquake in 2011.

The interest shown by the city of Barcelona was enough to generate a demo version in order to assess its implementation within the Project SMART-CITY (http://smartcity.bcn.cat)

Similarly, the development of this tool has given rise to a variety of Bachelor's, Master's theses and scientific articles produced by CIMNE, as reflected in the final report of WP4.

The current status of this tool allows it to be used as a platform for decision-making by public agencies dedicated to safety and design plans. A great advantage is its implementation in any city, with a minimum of effort.

Moreover, CIMNE's short-term objective for exploitation includes spreading the benefits of this tool as well as the research and its application to the simulation of other risks, either by any public body, or as a starting point for a project set.

DSSP - Decision Support System Portal, web-based security incident mapping tools:

A key motivator of the DESURBS project from the start has been the realization that designing and redesigning urban spaces to make them more secure is often constrained by the limited local knowledge and experience of dealing with these different types of hazard and security threats, and the ability to share, analyse and understand past experiences of how these risks have impacted on urban spaces is therefore critical. We now have several platforms to facilitate this type of knowledge transfer in our web-based security incident list databases. The impact of these going forward will be dependent on our ability to generate third party interest in contributing viable and valuable content that has a multiplier effect on the number of users. By keeping the content free, focusing on best practice and providing name recognition to providers of 'best practice' content, the potential impact is considered to be significant and persistent. Both of the web-based security incident mapping tools are going to be continually updated, enhanced, disseminated and exploited going forward by

beneficiary RESMAN in conjunction with IT Innovation for the DSSP version, and with CIMNE for the CIMNE map-based version.

5. Website and contact details

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