



DESURBS Deliverable 2.3: Generic Integrated Security and Resilience decision support framework

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Table of Contents

1. Introduction.....	4
1.2 Purpose of the report.....	4
1.3 Structure of the report.....	4
2. ISR Framework.....	5
2.1 Methodology.....	5
2.2 Stages of the ISR framework.....	5
2.3 Rationale for basing the ISR framework upon ISO 31000.....	7
3. Overview of the ISR process in the DSSP.....	8
3.1 Stage 1: What are the hazards/ threats to the site.....	8
3.2 Stage 2: Assess the vulnerability of the site to the identified hazards/ threats.....	11
3.3 Stage 3: Determining risk.....	16
3.4 Stage 4: Identifying ways to reduce the identified risk.....	16
3.5 Stage 5: Prioritising risk reduction measures.....	17
3.6 Final DSSP report.....	17
4. Conclusions.....	19
5. References	20

1. Introduction

This report constitutes Deliverable 2.3 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 these case study cities (and countries), is chronologically the third deliverable of this work package. WP2 encompasses the development of an integrated security and resilience (ISR) design framework, specifically for identifying urban vulnerabilities and improving urban spaces with respect to security threats. It is 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 (WPs 2.3 and 2.4)

1.1 Purpose of the report

The purpose of Deliverable 2.3 is to report on the development of an Integrated Security and Resilience (ISR) framework.

1.2 Structure of the report

In order to provide consistency across all WP2 outputs, structures of all deliverables revolve around the structure of the ISR itself. Therefore, the report will detail the identification of hazards and threats, the assessment of vulnerability, the determination of risk, the identification of risk reduction measures, and the prioritisation of those measures.

2. ISR Framework

The purpose of WP 2.3 is to consolidate security and resilience approaches suitable for urban spaces, through the creation of a generic ISR decision-support framework. This work builds on both WP 2.1 and WP 2.2, where the relationships between key stakeholders, and the tools and approaches that have been used for security and resilience purposes have been investigated. The integral parts of WP2.3 are WP1.3 and WP1.5 that establish the initial, fully functional database that can be used as a resilient (re)design tool by the project's targeted end users (for instance urban planners, designers, engineers). It develops an objective rating scale for quantifying safety of different urban space designs and use it to show that DESURBS solutions result in urban spaces less prone to, and less affected by, security threats.

The ISR framework therefore guides users how 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 acts as the backbone of the Decision-Support System Portal (DSSP) developed on WP5 by IT Innovation, Southampton and that will be presented in Deliverable 2.4. 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).

2.1 Methodology

As with the other deliverables for WP2, this report has been 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 the work on Nottingham, UK-based publications and sources were predominantly used to provide the contextually specific insights that were required. Material that was more than 10 years old was not particularly prominent 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 roles and responsibilities of identified stakeholders. The literature review was supplemented by a number of key informant interviews with public and private sector stakeholders, in both the UK (by Loughborough University) and Israel (by Bezalel Design Academy). In total, 21 interviews were conducted with data collection in each case study city being co-ordinated by researchers at Loughborough University in accordance with UK, Israeli, and European Commission data collection and data protection rules and regulations.

2.2 Stages of the ISR Framework

The ISR framework stems from the literature reviews and data collection/analysis that have been undertaken over the duration of the project. 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 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 Bosher, 2014). The five key stages of the ISR framework are detailed in Table 1.

Table 1 Detailed contents of the ISR Framework (Bosher 2014 after Mansfield *et al.* 1996)

ISR Stage		Descriptor	
1	Identify, characterize, and assess hazards/threats	<p>Hazard/Threat identification – the process of finding, recognising and describing hazards/threats to which the space is exposed. Hazard/Threat identification involves the identification of:</p> <ul style="list-style-type: none"> • Type of hazard/threat • The events/circumstances when the hazard/threat is prevalent • Their causes • Their potential consequences <p>It involves:</p> <ul style="list-style-type: none"> • Assessing historical data, • theoretical analysis, • seeking informed and expert opinions, and • understanding stakeholders’ needs. 	
2	Assess the vulnerability of urban spaces to specific hazards/threats	<p>Vulnerability assessment is the process of assessing the susceptibility of the intrinsic properties (the structure, materials, construction and planning) to a hazard/threat that can lead to an event with a consequence</p>	
3	Determine the risk (i.e. the expected consequences of specific hazards/threats on specific assets)	<p>Identifying the level of risk - magnitude of a risk or combination of risks, expressed in terms of the combination of the likelihood (chance of something happening) and the impact (consequences) of an incident caused by that hazard/threat. It utilises a Risk Matrix as a tool for ranking and displaying risks by defining ranges for consequence and likelihood</p>	
4	Identify ways to reduce those risks	<ol style="list-style-type: none"> 1. Inherent safety – eliminate the possibility of hazards/threats occurring 2. Prevention – reduce the likelihood of hazards/threats 3. Detection – measures for early warning of hazards/threats 4. Control – limiting the size of the hazards/threats 5. Mitigation and adaptation – protection from the effects of hazards/threats 6. Emergency response – planning for evacuation and access for emergency services 	<p>Identifying (and prioritising) a course of action to address and treat the hazard/threat and its associated risks. Treatment can involve:</p> <ul style="list-style-type: none"> • avoiding the risk by deciding not to start or continue with the activity that gives rise to the risk; • removing the hazard/threat source; • changing the likelihood or magnitude; • changing the consequences; • protecting assets/spaces from the effects of the risk • preparedness planning for the impacts of risks (events) • sharing the risk with another party or parties [including contracts and risk financing]; and • retaining the risk by informed decision making
5	Prioritise risk reduction measures		

2.3 Rationale for basing the ISR framework upon ISO31000

By basing the ISR framework upon 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 ISO 31000 standard has been deemed to be of relevance for the scope of the DESURBS project because it is an established framework for risk management that can be applicable to a number of dimensions encompassed by the DESURBS project, namely:

- A range of urban contexts (i.e. city, building, organisation)
- Covering a range of countries (Pan-European and global)
- A broad range of professions (i.e. planners, architects, security consultants, engineers, local authorities)

3. Overview of the ISR process in the DSSP

This section will present a ‘walk-through’ process that informs the logic behind DSSP. The ISR framework has been designed to help users to design safer urban spaces, through a stage-by-stage process, and acts as the core of the DSSP tool. In order to incorporate the ISR into the DSSP, it is important to align the ISR with the Urban Space Design Safety Scale (USDSS) (Table 2) developed in WP 1.5 to provide a framework for the DSSP. The USDSS is described in more detail in the Deliverable 1.5.

Table 2 ISR incorporation in the USDSS

ISR stage			USDSS step
1	Identify, characterise, and assess hazards/ threats	Hazard/ threat identification	Hazard identification + Impact = Exposure
2	Assess the vulnerability of urban spaces to specific hazards threats	Vulnerability assessment	Site Vulnerability + Design Vulnerability = Likelihood
3	Determine the risk (i.e. expected consequences of specific hazard/ threat on specific assets)	Identifying level of risk – it utilises a Risk matrix as a tool for ranking and displaying risks by defining ranges for consequence and likelihood	Exposure + Likelihood = ISDSS Rating
4	Identify ways to reduce those risks	Identifying a course of action to address and treat the hazard/ threat and its associated risk	Indicator based on risk assessment
5	Prioritise risk reduction		

From the end-user point of view, the ISR should address the following:

- Help in decision making;
- Provide a structure in which to understand hazards, threats and risks;
- Illustrate why the suggested steps should be taken;
- Offer a method of understanding the threats, hazards and risks the end-user faces in the designed space;
- Provide examples of how to undertake each risk;
- Offer a paper trail that will provide a record of which steps could be/have been taken by the end user

3.1 Stage 1: What are the hazards/ threats to this site

The aim of this stage is to help the end-user begin recognising the threats and hazards to which the chosen project space is exposed. This may sound like a straightforward requirement but research has found that this critical stage is too often overlooked by key decision makers (see Boshier *et al.* 2007; Fisher *et al.* 2012; Chmutina *et al.*, 2014) This is achieved through the description and identification of the hazards and threats provided by the end user. This stage involves two steps (steps 1 and 2 of the USDSS):

1. Supported by the series of statements, the end-user will be able to identify the hazards and threats.

2. Based on the impact table, a range of possible and likely impacts of X are identified. The impact rating developed in this step will then be used in Stage 3.

The questions for the hazard identification are presented in Table 3. If the response to any of the questions is 'yes', this hazard/ threat¹ is identified as a potential risk to be dealt with.

Table 3 Hazard identification questions

HAZARDS	INDICATIVE QUESTIONS
Terrorism and Crime	<p><i>"Is the proposed development located near an area that might be a potential target of a terrorist attack, e.g. government building, military base, TA Office, transport hub or tourist attraction?"</i></p> <p><i>"Is there intelligence or statistics of targeting where the development is located?"</i></p>
Events with Crowds	<p><i>"Will the proposed development be used to host large-scale public events or gatherings?"</i></p> <p><i>"Will there be facilities close to the development, which will potentially generate crowds, e.g. sports stadia, entertainment facilities or transport hubs?"</i></p>
Earthquakes	<p><i>"Is the development located in an area where earthquakes have occurred in the past, or are predicted in the future?"</i></p>
Floods and Storms	<p><i>"Is the development site located on a flood plain or close to the sea?"</i></p> <p><i>"Have there been any floods or serious storm events within the vicinity of the development in recent years?"</i></p>

Once the identification of potential hazards/ threats is complete, the end-user is required to identify a range of possible impacts based on a Table 4. The impact rating shown in is based on an overall 'score'² (from 1 ('very low') to 5 ('very high')) and is discussed in more detail in Deliverable 1.5. End-users have to identify which level of impact is relevant under each heading.

¹ It is important to notice that more than one hazard/ threat can be identified and worked on simultaneously.

² The score used in the calculations of the impact in stage 1 is based on the highest score given in any one category.

Table 4 Impact of a hazard/ threat and Impact assessment scoring system

Impact	Social disruption and harm to life	Physical damage	Economic harm and business disruption
Very High	Massive loss of life (>1000) and attendant casualty level Significant disruption for a prolonged period nationwide (5)	Significant and long-term damage to buildings and infrastructure (5)	Long-term damage to the financial well-being of similar businesses nationwide leading to bankruptcy/ closure (5)
High	Severe loss of life (101-1000) and attendant casualty level Significant disruption for a limited period of time nationwide (4)	Widespread long-term public concern (4)	Long-term damage to the financial well-being of similar businesses throughout the region potentially leading to bankruptcy/ closure (4)
Medium	Substantial loss of life (51-100) and attendant casualty level Significant disruption on a regional level for a prolonged period on time (3)	Public concern raised on a national basis for a limited period (3)	Significant loss over a prolonged period and / or impacting on the financial well-being of similar businesses in the immediate geographical area (3)
Low	Significant loss of life (10-50) and attendant casualty level Significant disruption on a local level for a prolonged period of time (2)	Public concern raised on a regional basis for a prolonged period (2)	Significant financial loss confined to the site potentially leading to bankruptcy/ closure (2)
Very Low	Limited loss of life (<10) and attendant casualty levels Local disruption for a limited period (1)	Public concern raised on a local basis for a limited period (1)	Limited financial loss confined to the site (1)

The user is also provided with the breakdown showing the scores under each category (an example is shown in Figure 1). The impact rating developed in this step then informs Stage 3, described in section 3.3 of this document.



Figure 1 Example breakdown of the impact assessment scores

After completing this (and each following stages), the end-user is presented with a set of outputs for each hazard/ threat identified. The outputs include hazard/ threat impact rating; the exemplar case studies illustrating good (i.e. where the hazard has been identified and the benefits of this) and bad (i.e. where a hazard was not identified) practice; the list of documents that illustrate how to identify potential threats and hazards; and a list of tools useful at this stage, presented in detail in the Deliverable 2.2

3.2 Stage 2: Assess the vulnerability of the space to the identified threats/ hazards

At this stage the end-users identify how vulnerable their project site is based on its location and design. This will be done in two following steps (steps 3 and 4 of USDSS):

1. Identification of site vulnerabilities
2. Identification of design vulnerabilities.

The identification of both groups of vulnerabilities is based on the WP1 Design Weaknesses described in detail in Deliverable 1.5. The general idea behind the assessment of the site and design vulnerabilities is similar to the impact assessment: it will be based on the overall 'scores' (1 to 5), and the breakdown of the scores will also be provided. The categories against which the vulnerabilities will be scored and their descriptors are provided in Table 5.

Table 5 Vulnerabilities' categories and rating scale

Vulnerability/ Score	1	2	3	4	5
Planning	Full implementation of planning policy and procedures, with due consideration for potential risks at a land-use, individual site or strategic planning level.	Substantial implementation of planning policy and procedures, with due consideration for potential risks at a land-use, individual site or strategic planning level.	Some implementation of planning policy and procedures, with due consideration for potential risks at a land-use, individual site or strategic planning level.	Little consideration of planning policies and procedures, or potential risks.	No consideration of planning policies and procedures, or potential risks.
Design	Comprehensive built environment design with full consideration of the processes taking place within the resultant spaces, including how the built elements could potentially impede the effectiveness of safety and security functions	Substantial consideration within the built environment design of the processes taking place within the resultant spaces or how the built elements could potentially impede the effectiveness of safety and security functions.	Some consideration within the built environment design of the processes taking place within the resultant spaces or how the built elements could potentially impede the effectiveness of safety and security functions.	Little consideration within the built environment design of the processes taking place within the resultant spaces or how the built elements could potentially impede the effectiveness of safety and security functions.	No consideration within the built environment design of the processes taking place within the resultant spaces or how the built elements could potentially impede the effectiveness of safety and security functions.

DESURBS Deliverable 2.3: Generic ISR decision support framework

Management	Comprehensive site management and monitoring programme, particularly around safety procedures and considerations of the developments ongoing processes and functions.	Reasonable site management and monitoring programme, including safety procedures and considerations of the developments ongoing processes and functions.	Basic site management and monitoring programme, with some consideration of the areas of safety procedures and the developments ongoing processes and functions	Little site management and monitoring programme, particularly in the areas of safety procedures and the developments ongoing processes and functions.	No programme of site management and monitoring.
Structural	Comprehensive structural design which considers integrity to a range of factors; proposed solution promotes robustness over considerations, such as cost.	Substantial consideration of structural designs integrity or robustness to a range of factors.	Some consideration of structural designs integrity or robustness to a range of factors.	Little consideration of structural designs integrity or robustness to a range of factors.	No consideration of structural designs integrity or robustness.
Material	Comprehensive consideration of materials performance and appropriateness for given design, with solution promoting maximum function over other considerations, such as cost.	Substantial consideration of materials performance and appropriateness for given design.	Some consideration of materials performance and appropriateness for given design.	Little consideration of materials performance and appropriateness for given design.	No consideration of materials performance and appropriateness for given design.
Maintenance	Comprehensive maintenance of built environment assets and processes, with proactive programme to replace and repair equipment vital to site function.	Substantial maintenance of built environment assets and processes, with programme of monitoring for defects to repair.	Basic maintenance of built environment assets and processes, with reactive repair of defects.	Little maintenance of built environment assets and processes, or defects repair.	No maintenance of built environment assets and processes.

DESURBS Deliverable 2.3: Generic ISR decision support framework

Mitigation	Comprehensive hazard mitigation or risk assessment procedures, integrated into all levels of governance, design, construction and management.	Substantial hazard mitigation or risk assessment procedures.	Basic hazard mitigation or risk assessment procedures.	Little in the way of hazard mitigation or risk assessment procedures.	No hazard mitigation or risk assessment procedures.
Emergency response	Comprehensive emergency response design, co-produced by local emergency services providers.	Substantial consideration of emergency response in built environment design, including consultation and feedback from local emergency services providers.	Some consideration of emergency response in built environment design, with limited input by local emergency services providers.	Little consideration of emergency response in built environment design, or input by local emergency services providers.	No consideration of emergency response.
Stakeholders	Full engagement with all significant stakeholders, at the optimum stage in the design process.	Substantial engagement with all significant stakeholders, at different stages throughout the design process	Some engagement with critical stakeholders at some point in the design process.	Little engagement with critical stakeholders.	No engagement with critical stakeholders

Overall vulnerability will be determined as a combination of a highest design vulnerability score and the highest site vulnerability score, as Figure 2 demonstrates.

Site Vulnerability	V. High	Red	Red	Red	Red	Red
	High	Orange	Orange	Orange	Orange	Red
	Medium	Yellow	Yellow	Yellow	Orange	Red
	Low	Green	Green	Yellow	Orange	Red
	V. Low	White	Green	Yellow	Orange	Red
		V. Low	Low	Medium	High	V. High
Design Vulnerability						

Figure 2 Overall vulnerability of the space

The breakdown of vulnerabilities will be presented to an end user using a radar chart, example of which is given in Figure 3.

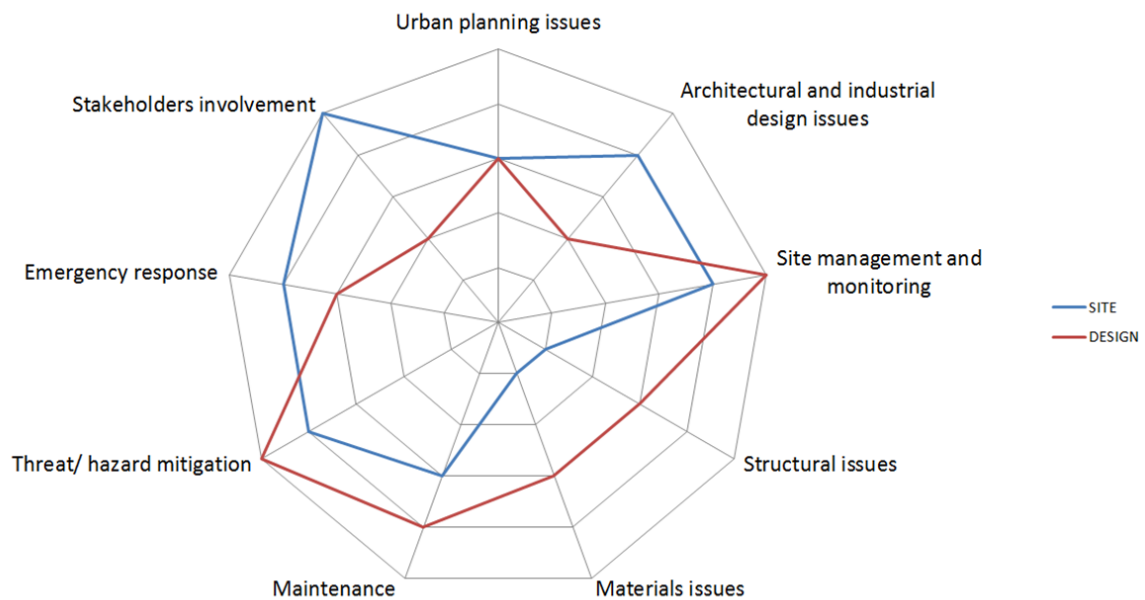


Figure 3 Example breakdown of the vulnerability assessment scores

Once Stage 2 is complete, the end user is provided with a set of outputs that include the vulnerability rating that demonstrates the overall score and focuses on the weaknesses that need further addressing; two case examples illustrating the cases where vulnerabilities have been identified and why it was beneficial for the project, and where vulnerabilities were not identified and their consequences; and the list of relevant documents and tools. The format of the output is similar to the ones in Stage 1.

3.3 Stage 3: Determining risk

The objective of this stage is to demonstrate the overall magnitude of risk per hazard/ threat type. This stage is based on the information drawn from Stages 1 and 2: 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 the matrix (Figure 4) based on the USDSS risk rating, described in detail in Deliverable 1.5.

Likelihood (Stage 2)	V. High					
	High					
	Medium					
	Low					
	V. Low					
		V. Low	Low	Medium	High	V. High
Exposure (Stage 1)						

Figure 4 Risk rating matrix

As in the previous stages, once the overall magnitude of the risk is identified, the end user will be presented with a set of outputs, including risk rating, case examples, and lists of relevant tools and documents.

3.4 Stage 4: Identifying ways to reduce the identified risks

The aim of this stage is to identify a course of action to address and treat the hazards/ threats and risks associated with them. Table 6 provides information on possible mitigation measures; based on the information in Table 6, suggestions of mitigation options appropriate for the identified hazard/

threat are provided to the end-user. It is however important to bear in mind that the best options will invariably be context specific.

Table 6 Mitigation measures possible for each hazard/threat

<i>Risk reduction option/ Hazard</i>	Earthquake	Crowded event	Flood and storm	Terrorism
Inherent safety	N	#	#	#
Prevention of hazard	N	#	#	#
Detection of hazard	N	#	Y	#
Control of hazard	N	#	#	#
Mitigation of hazard	Y	#	Y	#
Emergency response	Y	#	Y	#
'Y' –there are possibly a range of useful risk options available '#' – some risk reduction options can be used but they are likely to be of only limited effectiveness 'N' –other than relocating the built asset there is little that can be done to reduce this hazard/ threat				

3.5 Stage 5: Prioritising risk reduction measures

Once the potential course of action has been identified, it is important to prioritise the most suitable options. Thus the objective of this stage is to assist in identifying the most appropriate intervention(s) for a given project. The prioritisation will depend on a number of factors individual to each project; these include (but are not limited to):

- Cost vs. benefit of identified interventions
- Corporate social responsibility
- Business continuity
- Legal and statutory requirements
- Technical and social feasibility
- Proportionality of identifies interventions
- Complementarity with measures introduced to mitigate other hazards.

At the end of this stage the end users is provided with the 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.

3.6 Final DSSP report

Once all the stages are completed, the end-user will receive a report, which incorporates the results of all the stages including the following:

- Relevant bad and good practice case examples (from the case study incident data base developed in WP 1.1);
- Scores of the impact assessment and vulnerability assessment ;
- Likelihood and exposure to risks;
- List of documents relevant for this particular case (including overview of both structural and non-structural risk reduction measures); and

DESURBS Deliverable 2.3: Generic ISR decision support framework

- List of tools relevant for this particular case with the emphasis on the tools developed by the project partners.

It has to be emphasised that the report will not provide the answers but rather help in decision making by illustrating various examples and signposting to most suitable tools and documents that can assist the decision-making process.

4. Conclusion

In this deliverable we have given an overview of the ISR framework that has been developed to consolidate security and resilience approaches suitable for urban spaces, through the creation of a generic, decision-support framework. The ISR framework comprises five key stages that are primarily derived from an international standard for risk management (British Standards Institution, 2011; 2009). The ISR framework, which has feedback/review options at every stage, has gone through several iterations to this point.

This deliverable presented a detailed walk-through process of all the stages of the ISR, incorporated with the USDSS, which together will act as a backbone of the DSSP, as Figure 5 demonstrates.

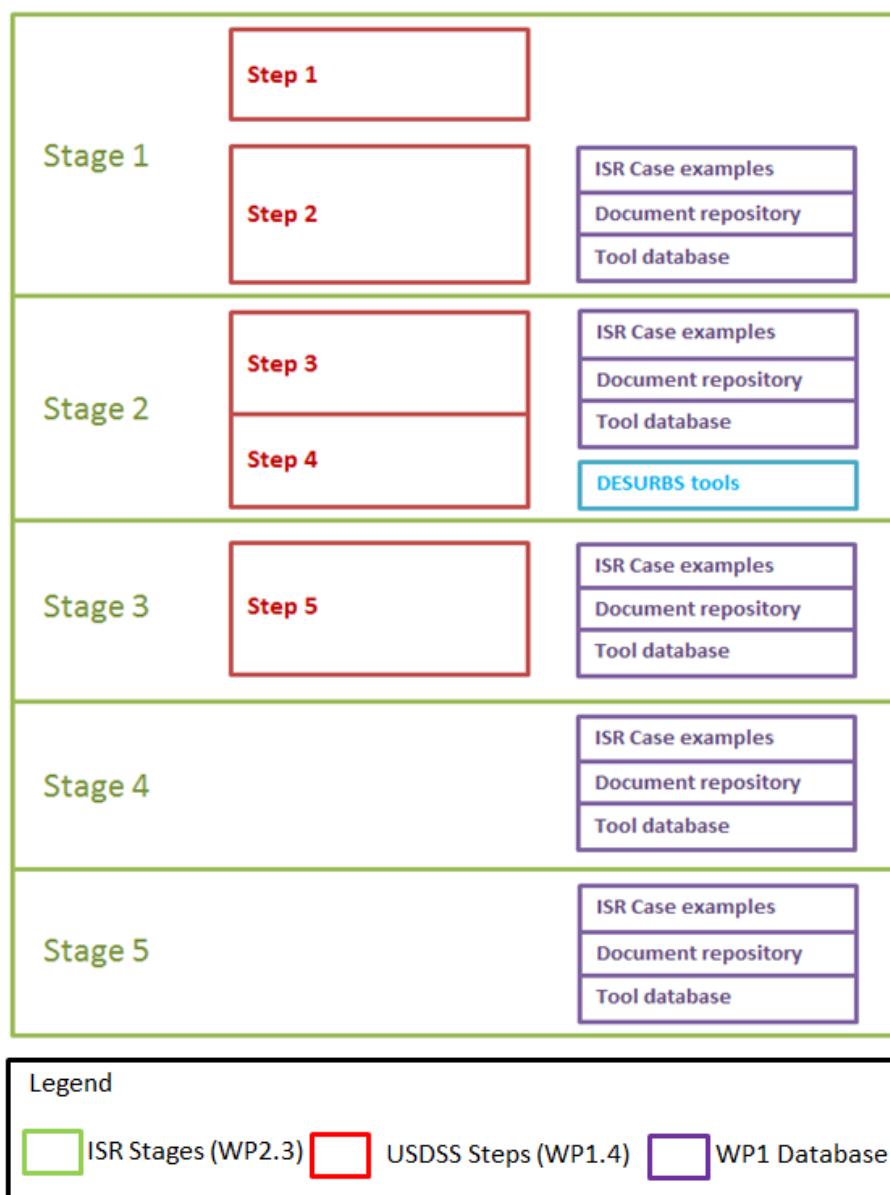


Figure 5 The ISR and USDSS fit into ISR

Further improvements and embedding of the ISR within the online decision-support systems portal (WP5, Southampton University) will be presented in the Deliverable 2.4.

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