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Realising European ReSIliencE for Critical INfraStructure

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D5.2 Initial CONOPS Framework

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1While the end user partners (BASt, CML, EMRA, EDPD, & IW) did not formally have time to contribute to this task, their involvement was crucial for the development of the case studies, and should be noted.

The research leading to these results has received funding from the European Union’s Horizon 2020 Research and Innovation Programme, under Grant Agreement no 653260
EXECUTIVE SUMMARY

Objectives

As part of the Harmonisation work package, the work towards this deliverable involved the analysis of the three CI organisations operational practices, as they are relevant to the working definition of resilience from WP1, along with the conceptual integration of the tools and guidelines being developed in WP2 and WP3. The objective of this report is to develop an initial concept of operations (CONOPS) framework. In doing so we reviewed current articulations of CONOPS, identifying a key limitation in its ability to capture and account for social, political and organisation issues. In response we propose an evolved CONOPS, which we term an ‘Activity Centred CONOPS’ (ACC). The initial framework developed is in support of using and developing an ACC.

This deliverable reports on our research processes and findings whereby we have endeavoured to situate the RESILENS solutions in the context of the CI operational and organisational contexts and anticipate the challenges for the future integration of these solutions. The development of an initial ACC framework provides the means to achieve two goals. The first is the development of an initial framework for ACC, which future developers can model from for use. The second is the application of the framework to the RESILENS outputs in order to provide feedback for their future development and progression.

Here, we present the findings from empirical study, including fieldwork observations and interviews with key personnel associated with achieving resilience in their organisations, along with an initial framework for further defining a RESILENS ACC for each of these throughout the remainder of the project. The development and application of the ACC framework was carried out in line with the wider objectives of the project, to develop practical and operationalisable tools and solutions to support the transition of CI organisations from Critical Infrastructure Protection (CIP) to Critical Infrastructure Resilience (CIR), in order to improve their resilience. The development of the initial ACC framework also contributes to the objectives of WP5, as the harmonisation WP. Through the application of the initial framework to end user cases studies we were able to provide feedback for the development of the EMRG, in relation to the role of social, political and organisational factors.

Description of the work

In order to carry out the work a range of activities were undertaken. This included extensive desk based research of extant literature in relation to the role of social, political and organisation factors in CI organisations, activity theory, current applications of CONOPS, and resilience and organisation studies. This work was added to with direct engagement with end users organisations; including a workshop, a number of follow up interviews, and correspondence. To ensure the accuracy of the case studies and descriptions developed and presented were sent for a final review and confirmation before publication of the report. A critical review of and reflection on existing project reports was also carried out. In addition, we participated in the scheduled calls and meetings of WP2 and WP3 with the contributing RESILENS partners, in order to elicit their perspective on the tools and solutions being developed, and ensure a continual consideration of the role social, political and organisational factors play and how best to incorporate these within the tools and solutions under development.
All data gathered was analysed in line with activity theory, and is presented within the scope of the proposed reporting template of the an ACC. Further work will be required to expand upon the findings of the case studies and account for the progress of the project, and will be captured throughout the different task of WP5.

Results and conclusions

Preliminary results from the development and application of the ACC framework to the RESILENS project and selected end user case studies support the position of the project to extend risk management to include social, political and organisational factors, as a means to transition from CIP to CIR. While social, political and organisational factors express themselves in different ways across the organisations, which was to be expected, their presence is consistent, highlighting the central role they play. Thus, confirming the need to develop tools and solutions that can capture and account for the role of these factors.

Findings from the case studies also confirmed that in order for successful uptake of the project outputs to occur, their added value will need to be clearly demonstrated to targeted end users. This is particularly relevant in relation to the aspects of the tools and solutions that deal with social, political and organisational issues, as many technical operators may not be familiar with these. To deepen our understanding on how best to address this issue, table top testing of the project outputs will need to be carried out (WP3) to develop solutions for buy-in from the perspective of end users.

This deliverable relates to the development of the initial draft of the EMRG (T3.3). The recommendations in Chapter 4 provide high level points of inquiry to guide consideration of social, political and organisational factors. To support this work, T5.2 will pick up the findings from the case studies and use these to guide their interactions with end users in workshops. These workshops will look at current uses of existing standards and guidelines in order to address their inability to account for social, political and organisational issues in a meaningful sense, so as to avoid this limitation in the development of the ERMG.
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Project Number: 653260
Project Acronym: RESILENS
D5.2 Initial CONOPS Framework
1.0 Introduction

1.1 Overview of the RESILENS project
Critical Infrastructure (CI) provides essential functions and services that support European societal, economic and environmental systems. As both natural and man-made threats, disaster and crisis situations become more commonplace, the need to ensure the resilience of CI so that it is capable of withstanding, adapting and recovering from adverse events, is paramount. Moving resilience from a conceptual realm to applied, operational measures that integrate best practice from the related realm of risk management and vulnerability assessment is the focus of the RESILENS project.

RESILENS will develop a European Resilience Management Guideline (ERMG) to support the practical application of resilience to all CI sectors. Accompanying the ERMG will be a Resilience Management Matrix and Audit Toolkit which will enable CI systems (encompassing assets and organisations) to quantitatively and qualitatively index their level of resilience. The proposed toolkit will also allow for the quantitative analysis of the resilience of the systems at different spatial scales (urban, regional, national and trans-boundary), which can then be iteratively used to direct users to aspects of their systems where resources could be concentrated in order to further improve their resilience levels. The ERMG and RESILENS resilience management methods will be tested and validated through stakeholder engagement, table-top exercises and three large scale pilots (transport CI, electricity CI and water CI). The ERMG and accompanying resilience methods will be hosted on an interactive web based platform - the RESILENS Decision Support Platform (RES-DSP). The RES-DSP will also host an e-learning hub that will provide further guidance and training on CI resilience.

Overall, RESILENS will aim to further advance the state of the art in CI resilience management and intends to increase and optimise the uptake of resilience measures by CI stakeholders.

1.2 Overview of Work Package 5
Work Package (WP) 5 is responsible for harmonisation across the project. Its role is to bring together key findings and outputs from the project, including the European Resilience Management Guidelines (ERMG), the Resilience Management Matrix and Audit Toolkit (ReMMAT), the e-learning hub and the RESILENS Decision Support Platform (RES-DSP), situating them within the context of the operating environment and practices of CI owners and operators, as the primary targeted end users of the RESILENS outputs. Harmonisation is not simply about summarising the work of the other WPs and reporting on them. Rather, its purpose is to take that work and put it in dialogue with the contextual realities of CI operating environments, focusing on the role social, political and organisational factors play in the resilience of CIs.

We aim to do this in a way that produces a greater understanding and awareness of how CI organisations manage resilience and how use of the RESILENS outputs can potentially contribute to this, in support of the project objectives and development of solutions. We view harmonisation as a collaborative practice amongst project partners, carried out through iterative critical engagement and reflection with the development process, asking what the project is trying achieve, why it is trying to achieve it, and how. Harmonisation activities support the aims and objectives of the project.
in two ways. On the one hand, it provides this space for ongoing internal project critical engagement and reflection, as we consider how the different parts of the project come together, providing feedback and recommendations for refinement. On the other hand, it provides a space to draw a line between the internal activities of the project (research environment) and the external realities of CI organisations (operating environment), drawing on the perspectives and opinions of targeted end users. Through this dual approach WP5 plays a key role in ensuring the development of high quality and meaningful, user-friendly, integrated outputs, centred around an embedded iterative design process.

The tasks of WP5 harmonise the outputs of the different WPs over the course of the project. Figure 1, below, maps out the relationship between the different tasks of WP5 and other WPs, graphically visualising the harmonisation process, which occurs at two levels. WP5 tasks draw on the outputs of the other WPs, reflecting upon and contextualising them, to provide recommendations for refinements in relation to social, political and organisational factors. This is demonstrated through the solid arrows, indicating a double feedback loop, over the lifecycle of the project. In addition, an internal harmonisation of WP5 outputs takes place. The later tasks (T5.5 and T5.6) draw on the outputs of the earlier tasks (T5.2, T5.3 & T5.4), as is demonstrated through the flow of broken arrows. Thus, the later tasks of WP5 carry out a harmonisation of the earlier WP5 tasks. These different levels of harmonisation and analysis have been designed into the structure of WP5, and are reflected in how the WP5 tasks are integrated, ensuring project wide harmonisation.
Figure 1. Harmonisation Double Feedback Loop
WP5 is made up of five research tasks and one management task. Task (T) 5.2, ‘Harmonisation of conceptual approaches: methodological adaptation of resilience management and assessment’, undertakes the development of a thematic framework which will help guide potential future users on how best to engage with the outputs being put forward in WP2 and WP3, developing a whole system and harmonised approach for resilience management. This task will also contribute to the refinement and development of the ERMG in WP3.

T5.3, ‘Development of Initial CONOPS Framework’, proposes an evolved CONOPS framework, which we describe as an Activity-Centered CONOPS(ACC) Framework. An ACC provides a means to capture and investigate desired changes to operating systems and situations. This generic framework is applied to the RESILENS project, providing a first point of investigation on how the RESILENS outputs can contribute to the resilience of three case study CI organisations. It places particular emphasis on understanding the goals of actors in the system/situation, the activities they undertake and the tools and technologies they use to achieve them. It looks at these activities and goals in relation to assigned roles and responsibilities within the organisation, along with the rules and relationships that shape their operating environment. This task provides a working example from which future ACC developers can learn, contributes to the development of project outputs, with a particular emphasis on the ERMG, and demonstrates the benefits of the project outputs to CI owners and operators.

T5.4, ‘Evaluation of Outcomes of Pilot Demonstrations’, will assess and evaluate the outcomes of the pilot demonstrations in WP4, which will be carried out with key stakeholders from various CI sectors. This task will ensure the outputs of the project are meaningfully tested and validated. This task is crucial as it is one of the final points of evaluation for the project outputs and will provide an analysis of the cumulated project research activities and outputs.

T5.5, ‘Final CONOPS framework for Guideline Updates specific to Core CI Sectors beyond the project’, will integrate findings from the previous tasks to create a comprehensive account of the RESILENS outputs, contextualised within enduser operating environments, reflecting on the progress of the project over time. In addition, it will support the potential future transfer of the RESILENS outputs beyond a research context through the development of a road map for the uptake of the ERMG.

And, finally, T5.6, ‘Guideline and Future Standard Development’ will support and further the work of T5.5 through the development of a roadmap for the adoption and implementation of the RES-DSP. It will also identify key elements to be included in future EU wide resilience management standards. This work will contribute to the activities of WP6, in relation to the dissemination and exploitation of project results.

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1 We should note that at the time of writing only T5.2 and T5.3 are active. The descriptions for T5.4 - T5.6 are based on how we foresee these tasks unfolding, however, aspects of these may change as the project progresses and develops. This will be accounted for in future WP5 deliverables.
In the following section we outline the rationale and structure of this report, its contribution to the harmonisation objectives of WP5, and the wider project objectives.

### 1.3 Overview of Deliverable 5.2

This report presents the outputs of T5.3, as they relate to the objectives of WP5 and RESILENS, through the development and application of an initial ACC framework.

Harmonisation occurs through a dual process of critical reflection on the rationale and development processes behind the project outputs, which are examined in relation to the operational and organisational factors in resilience. This aligns with RESILENS’ objective to develop operationalisable tools and solutions for the practical application of resilience to CI organisations.

Chapter 1 provides a description of the purpose and scope of this report, positioning the objectives and findings of T5.3 in relation to the objectives of WP5 and the RESILENS. As the first report to be submitted under WP5 it establishes the collaboration driven harmonisation process for RESILENS, focusing on the role of social, political and organisational factors in relation to understanding and improving resilience within CI organisations.

Chapter 2 outlines a proposed initial generic framework for an Activity Centered CONOPS (ACC), building on established principles of Concept of Operations (CONOPS), to address the challenge of meaningfully accounting for the perspective of the user and accounting for the role of social, political and organisational factors. The framework is developed across three related processes of representation, investigation and inquiry. This chapter concludes by outlining how the development of an ACC can contribute to resilience in CI organisations.

Chapter 3 provides a working example of how to develop an ACC, as we apply it to outputs of RESILENS, as they are available, in the context of three CI organisations. The application of the framework provides a basis for future actors to understand how an ACC is used, and to develop recommendations for the refinement and design of project outputs, in relation to the role of social, political and organisational factors.

Chapter 4 draws on the outputs of Chapter 3, to propose future actions for the project in line with the objectives of harmonisation. Drawing on examples of the role played by social, political and organisational factors in the current operating practices of the organisations described in Chapter 3 we identify key themes, relating to these factors, which can be used to guide the development of the ERMG. This work builds upon and extends current standards for organisational resilience, such as BSI 65000. This chapter also presents a summary of the ongoing harmonisation that took place over the lifecycle of the task in relation to the refinement of the ReMMA toolkit, along with future harmonisation steps to be undertaken in WP5.

Chapter 5 concludes the report, arguing, on the basis of the findings from the case studies, for the transition from CIP to CIR, as supported by the outputs of the project.
1.3.1 RESILENS and CONOPS

In line with the dual role of the harmonisations process, our use of CONOPS in RESILENS also operates at two levels. For the purposes of RESILENS, the value of a CONOPS lies in its ability to consider how the introduction of a change to a system/situation might impact that system/situation, as it relates to concrete objectives and goals. For example, if an organisation was to implement a new system for the reporting of accidents, what impact would this have; what new capabilities would it offer, would new policies and procedures need to be developed to support the new system, are additional resources required, etc. These are the kinds of questions a CONOPS can help to answer.

Within RESILENS we develop an Activity Centred CONOPS (ACC) to consider how the introduction of key project outputs to CI organisations would affect their practices of resilience management. This is done through a two step process. In this report we develop an initial ACC framework, which we apply to three cases studies. This allows us to identify social, political and organisational practices, through critical reflection and engagement with the project outputs and their contextualisation within operator environments, that need to be accounted for in their design and development. It also provides a space to demonstrate the development and application process of an ACC, as an initial basis for future replication. Thus the role of a CONOPS in RESILENS is two fold, providing internal feedback and recommendations for project outputs, and providing future ACC developers with the means to think through the affect of introducing a change to their organisation, in this case, the outputs of RESILENS.
2.0 A Concept of Operations (CONOPS)

This chapter outlines the current process for developing an ACC. Based in the identification of a limitation in current articulations of CONOPS, we seek to address this through our proposal for an evolved CONOPS, which we describe as an ‘Activity Centred CONOPS’ (ACC). We provide an initial framework for the development of an ACC, outlining associated principles and practices, which we believe will be illustrative for future developers. This framework is applied to the RESILENS project in Chapter 3, providing a working example of an ACC, and feedback for the development of the RESILENS outputs (Chapter 4).

2.1 Current Uses and Limitations of a CONOPS

The development and use of Concept of Operations (CONOPS) are well established in engineering, military and defence, and emergency management domains. Within these fields the objectives and purposes of a CONOPS have been described in a number of ways, as...

- a user oriented document that describes system characteristics of the to-be delivered system from the user’s point of view (IEEE, 1998)
- a verbal or graphical statement that clearly and concisely expresses what the joint force commander intends to accomplish and how it will be done using available resources (US DoD, 2010)
- a user-oriented document that describes the characteristics for a proposed asset or system from the viewpoint of any individual or organizational entity that will use it in their daily work activities or who will operate or interact directly with it (US Coastguard, 2012)
- both an analysis and a formal document that describes how an asset, system, or capability will be employed and supported...The CONOPS is a communication vehicle to inform...stakeholders of the intended uses and methods of support of assets, systems, or capabilities (US DHS, 2010)

These descriptions highlight a number of features that are at the core of what a CONOPS is about, and which we believe make it well suited to the study of resilience. In particular we are interested in the capacity of a CONOPS to provide a descriptive account of the potential impact of proposed changes on the current operating practices of an organisation, its emphasis on the perspective of the user, its ability to function as a vehicle for collaboration and communication, and finally, its recognition of the role of action.

A CONOPS provides a means to document and explore both the current operating environment of a system/situation, and the potential impacts of proposed desired changes to the system/situation, as they contribute to achieving the goals and objectives of the user(s) and the organisation. It provides a description of how organisations operate on a daily basis (in relation to the system/situation under exploration), and a basis for reviewing and understanding the impacts of proposed desired changes. While a CONOPS has the capacity to develop a ‘steady state’ description of how an organisation operates on a daily basis, our focus here is on the use of a CONOPS to capture the potential impact of an introduced change. The structure of a CONOPS report typically follows a clear line of
development from a current, or ‘as-is’, description of the system, to a description of the proposed or desired changes. Based on these descriptions a potential future state, or ‘to-be’, description is produced. This describes a projected operating environment, looking at what conditions are required to support the introduced changes.

These descriptions are the building blocks of a CONOPS. It is recommended that they be developed from the perspective of the system user(s). The development of a CONOPS from a user’s point of view allows them to identify what is important to them in terms of how they work. It acknowledges the expertise and experience of the user, and takes seriously their needs and objectives. Familiarity with the system is required in order to understand how it is put to use in day-to-day operations, which may differ from its original purpose, manufacturer and design specifications, and/or established standard operating procedures (SOP), as users regularly adapt systems to fulfill and achieve their goals. These descriptions should avoid the use of overly technical and academic jargon, to support and promote cross disciplinary and departmental communication and collaboration. The descriptive sections of a CONOPS are built by asking a series of who, what, how, why, when and where questions.

Despite the emphasis placed on the role of user’ perspectives, many CONOPS struggle to account for it in a meaningful sense. Mostashari et al. (2011) in a review of 22 CONOPS documents point out that the “CONOPS development process should require active stakeholder participation from the beginning of the process, not just after a static document has been written. While this notion is commonly understood, it is often overlooked in practice”. Their critique highlights an important issue that we seek to address through our proposed framework for an evolved CONOPS, based on the principles of activity theory, which we describe as an Activity Centred Concept of Operation’ (ACC). We argue that the challenge for current versions of CONOPS to meaningfully account for the perspective of the user is related to the lack of guidance on the role social, political and organisational factors play in complex sociotechnical systems, which we locate in the adaptive capacity of human actors as they deal with change as part of their day-to-day work.

This challenge is reflected in both the structure of current CONOPS reports and the development process behind a CONOPS. Current articulations of CONOPS are typically presented as reports, producing a linear narrative of change processes within organisations, moving neatly through an account of current, desired changes, and potential future states descriptions of the system/situation. This is reflected in the structure of CONOPS reports, as is illustrated in Figure 2, below, the IEEE’s (1998) recommended template for a CONOPS.
Figure 2. IEEE template of a CONOPS report (1998), emphasis in original
We believe this linear structure presents an inaccurate and misleading account of how change is dealt within organisations, failing to capture the dynamic, transitional and oftentimes extended and incomplete nature of change.

The challenge to account for the role of social, political and organisational factors in CONOPS is not only reflected in the sequential structure of the reporting template, but also in the topics it covers. Working backwards, we take the template structure of the CONOPS report as a reflection of the issues prioritised in the system or situation for investigation. In doing so, we argue that current articulations of CONOPS have primarily focused on developing physical and technical oriented descriptions of the impact of desired changes, with little to no attention being paid to social, political and organisational factors. While the IEEE template does recognise these factors, with the inclusion of a section on ‘user classes and other involved personnel’, sub-headings 3.5 and 5.5, respectively, under both the current system and proposed system headings, it provides no concrete guidance on how to account for them. Rather, they state, “each organization that uses this guide should develop a set of practices and procedures to provide detailed guidance for preparing and updating ConOps documents. These detailed practices and procedures should take into account the environmental, organizational, and political factors that influence application of the guide” (IEEE, 1998).

We find, that what is missing from current articulations of CONOPS is a mechanism to investigate and analyse these ‘environmental, organizational and political’ influences. As such, they fade into the background of both the CONOPS report and the development process underpinning it, resulting in an inability to meaningfully account for the perspectives of system users, which are intrinsically and explicitly shaped by social, political and organisational factors. We seek to address this issue through our development of a framework for an ACC, which aims to provide a systematic yet flexible means to account for the role of social, political and organisational factors, as organisations consider the impact of the desired change on their day-to-day operations.

2.2 An Activity Centred Concept of Operations (ACC)

Without understanding the vital role of human and organizational factors in technological systems and proactively addressing/facilitating their interactions during unexpected (‘beyond design basis’) events, recovery will be a sweet dream and resiliency will only be an unattainable mirage (Meshkati & Khashe, 2015).

An Activity Centred CONOPS (ACC) builds on the foundations of already established CONOPS principles. It retains a focus on trying to understand processes of change, and an emphasis on the users’ perspective. An ACC does not dismiss the role of technical and physical factor, such as tools and technologies. Rather it seeks to produce a more holistic picture, placing emphasis on understanding the relationship between tools, technologies, context and users. In doing so, it addresses a gap in previous CONOPS, as they lack robust means to account for the social, political,

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The term environment is defined as ‘the circumstances, objects, and conditions that surround a system to be built; includes technical, political, commercial, cultural, organizational, and physical influences as well as standards and policies that govern what a system must do or how it will do it’ (IEEE, 1998).
and organisational impacts of a desired change on an organisation. To make the shift from previous CONOPS approaches we present an initial framework for an ACC, modelled around three interrelated processes of inquiry, investigation, and representation.

The framework presented below is an initial draft, it is not complete, nor is it intended to be. An updated version of the framework will be presented in D5.4, and will expand on what is outlined here. Our focus in this iteration of the framework, and its application to the outputs of the RESILENS project, is on making explicit the role of social, political and organisational factors in understanding the impacts of change on an organisation, and its resilience. By highlighting these factors we wish to demonstrate the key role they play in organisations, that failure to account for them results in a partial understanding of how organisations operate, and, that in changing the issues and topics examined under an ACC, a different story of the organisation can be told. In order to provide the flexibility and scope required to apply an ACC to different organisational types we have kept our descriptions of the framework generic.

2.2.1 An ACC framework

Our initial ACC framework is composed of three interconnected and interdependent processes, each related to the functional capacities and objectives of an ACC, that is what an ACC can and aims to do. This framework outlines the means to guide inquiry into the social, political and organisational factors of a system/situation, in order to understand they role they play in relation to the impact of introducing a desired change, the research practices required to carry out this inquiry, and finally, a revised reporting structure to represent it. For the sake of clarity we present these elements of the framework processes individually, in reality however, they are bound together and cannot be understood in isolation from one another. As before we begin by working backwards, looking first at the reporting structure of an ACC, then the development process, and finally, the concepts and assumptions underpinning the development of an ACC.

2.2.1.1 An ACC as Representation

In our discussion of how current CONOPS reports are structured we argue that they fail to meaningfully account for and represent the perspectives of users involved in the system/situation. This limitation is present in both the structure of the CONOPS report and the process supporting its development. In this aspect of the framework we address the structural and representational issues of a CONOPS report.

The linear representational structure of a CONOPS report undermines the dynamic and iterative nature of the development process supporting it. This problem is two fold. On the one hand it misrepresents the nature of change within organisations, neatly packaging them into a three part sequence of current, proposed desired changes and future state descriptions of the system/situation. On the other hand, it fails to capture the role of human actors in relation to managing and dealing with changes process. To address these issues we suggest a restructuring of the reporting format, reordering the building blocks of current, change and future state descriptions. This shift is illustrated in Figures 3 and 4 below.
We propose to restructure and expand the current reporting structure of a CONOPS. To do this we move the description of desired changes to the beginning of the descriptive accounts in the report. In doing so we position the role of changes in the foreground, which we feel better reflects the role it plays in an ACC, as the introduction of a desired change is the driving purpose behind the development of an ACC.

To counteract the linear nature of reports we stress the iterative and cyclical aspects of an ACC within the reporting structure. ACC reports should be presented as a history of desired changes, current and proposed future state descriptions, documenting how the proposed future state, if the desired change is implemented and works, becomes the ‘current’ description for following ACC descriptions. This is represented in the ‘new current state’ and ‘repeat’ stages of the linked chain model, Figure 4 below.
Figure 4. Proposed ACC Reporting Structure
In addition, we have embedded an analytic component across the various sections of the report, in order to better capture the dynamic and fluid nature of change and the role of human actors in the process, stressing the role of social, political and organisational factors. This analysis takes place between the investigative process and writing up process of an ACC. Data gathered during the investigative process must be analysed on an iterative basis, as new findings emerge and may change how we interpret and understand earlier data.

In addition to this highlevel structure for an ACC report we also propose a number of subheadings. These will be expanded on in T5.5, but for now, we focus on developing headings that will support the ACC developer to report on issues relating social, political and organisational factors. These subheadings are outlined below, providing an initial template supporting the proposed ACC reporting structure.

**Desired changes**
- Justification and drivers of Change(s) – why the change(s) are required.
- Objectives of desired Change(s) – what the change(s) are supposed to do.
- Description of desired Change(s) – what the change(s) are.
- Assumptions and limitations of desired Change(s) – what the change(s) require for operationalisation, and what they cannot do.

**Current**
- Background – the organisation’s objectives.
- Operating environment – constraints, enablers, rules, community and division of labour.
- Roles and Responsibilities – objectives, goals and activities.
- Tools – tools, technologies and resources, which mediate the user’s goals.

**Proposed/Imagined Future State**
- Background – the organisation’s objectives.
- Operating environment – constraints, enablers, rules, community and division of labour.
- Roles and Responsibilities – objectives, goals and activities.
- Tools – tools, technologies and resources, which mediate the user’s goals.

**Refinement – case specific**
- Identify assumptions underpinning the use of the desired changes, and any associated limitations – availability of existing skills, resources, level of training required for use, etc.
- Identify points of contradiction – between the desired change and the needs of the system/situation user.
- Actions to resolve – adjustment in proposed change and/or adjustments in operating practices and/or environment.
Although we have repositioned the placement of the descriptive account of desired changes to the fore of the reporting template structure, it is unlikely it will be the first issue to be addressed in the investigative process (discussed below). Rather organisations will need at least a preliminary understanding of the current operating environment and practices to identify what changes they wish to introduce. The opening sections are addressed in our current application of an ACC to RESILENS, Chapter 3, reflecting the current status of the project. Initial testing of the project outputs will be carried out in WP3, through table top testing, and will be supported with further testing in WP4, through pilot demonstrations. The findings of which will be captured in later WP5 tasks (T5.4 & T5.5). As this is a research project, implementation and the realisation of a new current state will not be realised within the project’s research activities. However we have provided provisional subheading for these also, outlined below.

Testing

- Methodology – sets out the parameters of the testing, to determine the suitability of the desired change. This should include the role of the user, the operating environment, and any other relevant social, political and organisational factors. The means to measure the results of the testing should be addressed here also.
- Scenarios/Case studies – context specific use cases used to test how the desired change will operate in relation to the goals and activities of the system/situation user(s) and wider organisation.
- Evaluation – determines how close the current iteration of the desired changes is to the needs of the user, based on an understanding of their perspective, as captured in the description of current operating practices.
- Findings – feeds back into refinement process.

Implementation

- Participants – who in the new current system/situation will be affected, through the introduction of the desired change, and how.
- Resources – what resources will be required to support the new system/situation, and/or what resources will be freed up through the introduction of the desired change.
- Dependencies – what new dependencies will the new system/situation result in, and/or what dependencies will it remove (both intra- and inter- organisational).
- Disruption – what disruptions to service may occur during the implementation of the desired change.

New Current State

- Background – the organisation’s objectives.
- Operating environment – constraints, enablers, rules, community and division of labour.
- Roles and Responsibilities – objectives, goals and activities.
The change in subheadings (from the IEEE recommended template for a CONOPS to our template for an ACC) better reflects the position of social, political and organisations factors, drawing them into the foreground, demonstrating the role they have to play in understanding change in sociotechnical systems. Put simply, changing the headings of the report, as a reflection of the priorities of the report, and the development process behind it, allows the developer to tell a different story, one that might not have been captured otherwise, expanding the picture of how the organisation operates. In order for this shift to be meaningful it must be supported with methods for investigation that allow ACC developers to gather and analyse relevant data to examine the role of social, political and organisational factors.

2.2.1.2 An ACC as Investigation

To support the reporting structuring of an ACC we propose a qualitative investigative process that aims to capture the perspectives and experiences of the system/situation user under investigation, as shaped by the role of social, political and organisational factors.

Hogan, Dolan and Donnelly (2009) describe qualitative research as “a multifaceted approach that investigates culture, society and behaviour through an analysis and synthesis of people’s words and actions. Unlike quantitative approaches, it does not try to transform verbal symbols into numerical ones; the data remains at the level of words, either the research participants’ own words, the words written in documents, or the words used by the researcher herself / himself to describe the activities, images and environment observed. It tries to get to the heart of what exactly led to decisions, or choices, that were made, and how these choices came to take the form that they ultimately did”. Qualitative research examines the meanings and motivations attached to what people say and do; it “is pragmatic, interpretive and grounded in the lived experiences of people” (Marshall & Rossman, 1999). These characteristics and objectives of qualitative research align with our objective to evolve CONOPS to an ACC.

To operationalise an ACC, developers will need to carry out qualitative research methods, investigating the role of social, political and organisational factors. It should be noted that these factors are not solely attributes of human actors, but include technical and physical factors, as human actors imbue them with meaning and significance through their development and use. In relation to the development of an ACC we focus on the use of qualitative methods in two ways. The first relates to direct interaction and engagement with people, through participant observation, interviews and workshops. The second relates to document analysis, looking at written sources of information, such as reports, manuals, and policies, etc. The divide between these two uses of qualitative methods is artificial, and both sources of information should be used to support one another in building an indepth picture of the lived experiences of people in order to understand the role of social, political and organisational factors.

Participant observation (PO) requires spending an extended period of time observing the activities of the user of the system/situation, immersing yourself in their daily work practices in order to
understand how they do things and why. One to one interviews and workshops can be used to support the findings of PO to carry out more focused research, exploring the activities and practices noted during PO in greater detail. Document analysis looks at the content of written documents and reports as a reflection of the priorities of the organisation. The use of both document analysis should be supported with direct engagement with individuals and groups in the organisation, as what is outlined in formal documents is not always a true reflection of how people carry out their work.

To support the use of qualitative research methods we provide guiding questions below that will help orient the investigative process of an ACC. These questions providing a starting point to gather the information and data necessary to develop an ACC. The questions presented here are generic so that they may be applied to a wide range of organisations, they will need to be adjusted to the organisational context the system/situation under investigation belongs to.

We have grouped these questions under the four categories of the THEO framework; Technological; Human; Ethical and Legal; and Organisational. While these questions have been separated out for the sake of clarity, they are interrelated and a neat division between technical, human, ethical and legal and organisational issues cannot be made. This is made clear in the way that the responses to these questions will never be purely technical, human, ethical and legal and organisational.

**Technological**
- What capabilities does the system/situation provide?
- How does it provide them, what is the mode of operation?
- What inputs supports the system/situation?
- What tool/technologies/resources does the system/situation depend on?
- How will the introduction of the desired changes interact with legacy systems?

**Human**
- Who uses the system/situation?
- What are their roles and responsibilities?
- What skills do they rely on?
- Are the desired changes user friendly?
- Who has identified the need for the desired change?

**Ethical and Legal**
- What policies and legislation regulate the use of the system/situation?
- Will the introduction of the desired change require additional policies for operation?
- Will the introduction of the desired changes fall under additional legislation/regulation?
- Who will ensure and enforce compliance with legislation and regulation?

**Organisational**
• Who is responsible for the outputs of the system/situation?
• Which actors do the system/situation users work with? Will the introduction of the desired changes create new/ser existing inter and intra organisational relationships?
• Who do the system/situation users report to?
• What is the need/gap the desired change will address?
• How will the introduction of the desired change support the system/situation user to do their work?
• Who will be responsible for implementing and overseeing the new system? – Training, consistent use, proper reporting, etc.
• Will use of the new system require additional resources? If so, from where will these be secured?

The data to address these questions “will come from the process of participatory fieldwork and it is important that the details here reflect the reality of operations rather than unrealistic assumptions” (Cooke & Murphy, 2016). The value of qualitative research methods comes not only from the questions asked, but the quality of the engagement process between the researcher and the participants, and the analysis of the information gathered.

We anchor the engagement process between the researcher and participants around collaborative practices of active listening, establishing rapport and trust, recognising the role of contradiction in what people say and do, taking these seriously, and understanding that what people say and what people do often differs. These engagements can be recorded for ease of note taking purpose, with the consent of the participants. The data gathered should be written up for analysis, identifying the role of social, political and organisational factors. To carry out the investigative process of an ACC we recommend the developer be familiar with qualitative research methods, organisation studies, and the role of tools and technologies in sociotechnical systems.

The interpretation and analysis of the information gathered is dependent on what the developer of the ACC is trying to understand, that is, what is the research problem they have set out. While this will vary from developer to developer, we can outline key principles and concepts underpinning the investigative process, which we turn to next.

2.2.1.3 ACC as Inquiry

To guide the investigative process and write up of an ACC we use Activity Theory (Engestrom, 1987) as a conceptual foundation, outlining provisional boundaries for an ACC’s research problem space.

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DeWalt & DeWalt (2002) describe active listening as when “the researcher is more actively aware of the conversation than in conversations in nonresearch settings. The researcher is making mental notes about what is said, who said it, and what it might mean in the context of the project. … is “on,” with heightened awareness of the context and increased attentiveness to detail. S/he may be making mental notes of specific words and information, or may be talking (sic) jot notes during the conversation. The researcher is not only attending to verbal communication, but is also noting nonverbal cues as well. The researcher is also trying to communicate that s/he is interested in what the informant is saying and respects the ideas and opinions of the informant (whether or not the researcher agrees with them).
Put another way, activity theory provides the ACC developer with a mechanism to think about what it is they want to investigate, and how to interrupt the findings for analysis.

To understand the impact of introducing a desired change to an organisation CHAT models a set of relations between individuals/groups (subject), the wider organisation (community) and tools, as shaped by social norms and values (rules) and social hierarchies of power and access (division of labour). The different elements of the model are understood in relation to activities. Thus, activity theory provides a model for understanding interactions between individuals/groups and the world, as mediated by the use of tool. Figure 5 illustrates the relationship between actors, their environment, the tools they use and the outcomes they are oriented towards as proposed by activity theory.

![Activity System Model](image)

Figure 5. Engestrom’s Activity System Model (1987)

A summary of activity theory’s assumptions is as follows,

- The human actor in any system (subject) is goal oriented (object);
- The extent to which they are successful at achieving their goal results in a measurable outcome through the application of appropriate objectives;
The relationship between the subject and the object (and therefore the outcome), is mediated by technological and other artefacts (instruments or tools);

Change, addition or removal of any technological artefacts will have an impact on the outcome;

The actor is part of a larger organisational system with a division of labour;

Activities are governed by rules, including procedures, social norms, ethical and privacy regulations, etc.

These assumptions of how individuals and groups relate to one another and the world around them provide an initial line of inquiry for developing an ACC, as it allows the researcher to focus their efforts on identifying examples of these interactions. Activity theory emphasises the dynamic nature of mediation between subjects, tools, and outcomes. As individual and groups use tools in different ways, to achieve different outcomes, they mutually shape one another in order to achieve their outcomes. Activities are always looked at in relation to the wider organisational context they take place in. The use of activity theory brings a dynamic analytical capacity to an ACC, moving beyond flat descriptions of current operating practices, to consider what they mean within a situated web of relations between the different elements of the model.

The use of the proposed ACC framework extends the capability of current CONOPS processes to include social, political and organisational factors, allowing organisations to better understand the perspectives of system/situation users, and how the introduction of a proposed desired change may impact on how they carry out their work. This provides organisations with a mechanism to capture and engage with social, political and organisational factors, contributing, along with other RESILENS outputs, to the project’s objective to support CI organisations transition from CIP to CIR.
3.0 An Activity Centred CONOPS of RESILENS

Over the course of this chapter we apply the proposed ACC framework to RESILENS. We examine the potential impacts of introducing the outputs of RESILENS, as the desired changes, to three end user CI organisations, producing accounts of their current operating practices and the proposed future states the changes, if implemented, will result in.

In line with the framework we have structured the descriptions across the proposed ACC reporting template to highlight the role of social, political and organisational factors in CIR. It should be noted that the descriptions provided here are neither complete nor exhaustive, presenting an initial account of our findings based on interactions with the end users. This is evident in the descriptions of the proposed future states of each case study. Further details on how the different organisations will use the outputs of RESILENS are required to fill out these sections. As such they depart from the headings outlined in the ACC reporting template. Instead, they look at how well the current operating practices of the identified users are suited to implementing the RESILENS outputs, or not. These accounts were produced on the basis of interviews and workshops conducted with the different organisations, and analysis of supporting documentation, in order to capture their experiences and perspectives. Initial descriptions were drafted and then returned to the organisations to review for accuracy. The accounts presented here are a reflection of this collaborative engagement process, and are central to the development of an ACC. It should also be noted that although the proposed investigative process of an ACC calls for indepth study of the current operating practices of system/situation users, requiring a sustained level of access, this was not feasible within RESILENS. To address this limitation interviews and workshops were scheduled in conjunction with project meetings, making best use of time and access available to us, in addition to which project partners contributed effort where possible, through calls and emails. Future project activities such as table top testing (WP3) and pilot demonstrations (WP4) will also be exploited to deepen and augment the accounts produced here. We use this report to present our findings, such that they may be used to provide recommendations for the future development of the project outputs, with a particular focus on the ERMG, and to demonstrate the process of developing an ACC. In doing so it contributes to the process of developing tangible, user friendly outputs, with the intention to increase the uptake and sustainability of the project outcomes.

While Chapter 4 presents our recommendations for the future refinement and development of project outputs we have framed the accounts presented here with explanatory notes, embedding the educational component of developing an ACC within the chapter. This is primarily for illustrative purposes and it is not necessary for future ACC developers to include these sections in their own descriptions. These notes help to make explicit what is included in each section, how the data it was collected, and what role it plays in helping to understand the impact of the desired change.
3.1 Description of Desired RESILENS Changes

Previous deliverables in WP1, 2 and 3 have provided detailed technical descriptions of the project outputs, particularly in relation to the Resilience Management Matrix and Audit Toolkit (ReMMAT). In line with the objectives of the harmonisation process we aim to draw together and critically engage with these descriptions to produce a narrative account of RESILENS. We present this account under four headings; justification of desired changes; objectives of desired changes; description of desired changes; and, assumptions and limitations of desired changes. This allows us to reflect on the supporting rationale for project outputs, and the manner in which they come together, working at an integrated level, paying particular attention to the added capabilities they provide CI organisations in relation to transitioning to CIR.

3.1.1 Justification of Desired Changes

This section should provide an overview of why the desired changes are required; do they provide additional capability, address an identified gap, and/or improve operations? The reason for introducing and implementing the desired changes should be made clear here. While the justification for the desired change need not be directly related to a social, political or organisational factor, it should account for the role they play in the desired change. For example, replacing a manual clocking in/out system with a new biometric system is a technical change, however it potentially affects the organisational and social practices of employees, preventing timesheet fraud and employees impersonation (Egress Systems, 2014). It also affects political factors as the use and retention of biometric data is subject to privacy rules and data protection laws and regulations, which organisations must follow. From this simple example we can see how changes to technical and physical aspects of organisations are connected to social, political and organisational issues and factors.

Supporting data to justify the desired change can come for a variety of sources, depending on what need/gap the change addresses. It may come from a formal gap analysis, from user expertise and experience, and/or be driven by a change in external policy, regulation, or market changes. In the case of RESILENS state of the art research and a gap analysis were carried out in WP1, out of which a project position on how best to improve resilience in CI organisations was established and agreed upon.

Box 1 below outlines how the outputs of RESILENS, as the desired changes, are justified.

Box 1. Justification of Desired RESILENS Changes

The aim of RESILENS is to produce practical and operationalisable tools and solutions for use in the building of resilience among CI organisations. To do so the project is developing a number of key outputs, including a European Resilience Management Guideline (ERMG), a Resilience Management Matrix and Audit Toolkit (ReMMAT), and an e-learning hub, all of which will be hosted on the RESILENS Decision Support Platform (RES-DSP).

The need for these desired changes occurs at two levels. One the one hand, there is an increasing
sense that CI organisations face multiple complex threat and hazards for which traditional risk management and mitigation practices are no longer equip to deal with. As a result we have seen an increasing call to action in relation to researching and developing the preparedness and security of critical infrastructure, reflected in the priorities of research funding. On the other hand, this identified limitation in previous practices has opened the way to look beyond technical and physical risk assessments to consider social, political and organisational factors as a cornerstone of resilience.

At the outset of RESILENS state of the art research was carried out on current risk management and resilience practices of CI organisations, along with a gap analysis (WP1). The results of this work concluded that there is a lack of tools to provide CI organisations with support on understanding the role of social, political and organisational factors as they relate to building resilience. In response RESILENS has argued for a transition from Critical Infrastructure Protection (CIP) to Critical Infrastructure Resilience (CIR). This shift brings together traditional concerns relating to the technical and physical aspects of CI organisations and systems, with the ‘softer’ social, political and organisational aspects. To do this, the project views resilience as an extension of the principles and practices of risk management, this “transitionary perspective recognises the importance of risk management to CI operation, but proposes that these practices need to be extended to encompass resilience practice that integrates social and organisational factors, as well as building capacity to change” (D1.1, 2015).

By extending and merging risk management with a consideration of social, political and organisational aspects of CIs, the outputs of the project will support the building of more holistic and effective resilience practices, enabling CI organisations to better prepare for, withstand, and respond to threats and hazards, addressing a limitation in thinking that risk management equates to resilience, and providing tools and solutions to account for social, political and organisational factors.

This justification of the RESILENS tools provides the rationale supporting their development, and outlines the context of why they are required by CI organisations to make the transition from CIP to CIR. A clear description of why the desired change is required is important to justify and secure the support and resources needed to implement the change.

### 3.1.2 Objectives of Desired Changes

This section should outline the objectives of the desired changes, what is it they are expected to do, along with the capabilities they will provide the organisation. There should be a clear relationship between the justification of the desired changes and their objectives. Again, this description should look at the role of social, political and organisation factors. While the means to achieve the objectives of the desired change may come in the form of a physical or technical change, more often than not the objective of the desired change will be at a social, political and/or organisational level. For example, the introduction of physical security measures at CI facilities, such as security gates, bollards and entry/exit passes, are introduced in order to manage the flow and traffic of employees
and on site personnel. While the changes are physical and technical in nature, their objective is to produce a social and organisational order, determining who has access to what, when and where.

Supporting data for this description was gathered through a review of the formal project reports, and participation in the design and development process of the project outputs, as the developers explained the objectives behind the tools and solutions they were developing.

Box 2 below outlines the objectives and capabilities of the desired RESILENS changes.

**Box 2. Objectives of Desired RESILENS Changes**

The introduction of the RESILENS outputs should provide actors in different CI sectors across Europe with guidance on transitioning to and building CIR, and the means to achieve this. These are supported with educational and learning materials and resources that promote understanding and buy-in for the transition to CIR, demonstrating the added value it offers to organisations.

More specifically the outputs of the project are expected to provide,

- A guideline document on the principles of CIR (ERMG),
- A management process for CIR (Resilience management process),
- The means to assess and evaluate their level of CIR (ReMMAT),
- The means to define the scale of assessment (sub-system/entire CI system/local boundary/city/region) (ReMMAT),
- Self-provision of improvement strategies for CIR (ReMMAT),
- Education and learning materials on the role and use of CIR (GIS map, e-Learning hub, and ACC framework).

In doing so the project provides CI organisations with the capability to reflect upon and prioritise their use of resources in a manner that support the principles and practices of CIR, in response to identified areas of vulnerability. The management of resources is inevitably tied to social, political and organisational factors, and brings to the fore questions such as resilience for who, what, when and how.

A clear description of the expected capabilities to be provided by the desired changes is important as it provides the basis against which future refinements and redesign to the changes may have to be made.

### 3.1.3 Description of Desired Changes

This section should provide an overview of how the desired changes will achieve the objectives outlined in the previous section. This includes a description of the technical and operational aspects of the desired changes, which, as before, should account for the role of social, political and organisational factors. This would include, for example, who the expected user will be, what skills they require, the mode of operation and use of the desired change, etc.
Supporting data for this description was gathered through a review of the formal project reports, and participation in the design and development process of the project outputs, as the developers explained the operational process behind the tools and solutions they were developing.

Box 3 below outlines a description of the currently available outputs of RESILENS, as they relate to the objectives of the project.

**Box 3. Description of Desired RESILENS Changes**

The development of project outputs is driven by the objective to support the transition from CIP to CIR. To do this a number of descriptive qualities associated with CIR were first identified, outlining the aims, focus and approaches for CI organisations as they differ from CIP (WP1). These are summarised below.

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<th>Aim</th>
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<th>Transformational</th>
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<td>Existing normality</td>
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<td>Preserve</td>
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<td>Recovery</td>
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<td>Optimisation</td>
<td>Greater redundancy/diversity</td>
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<td>Single-sector focus</td>
<td>Dependencies</td>
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**WP1. Deliverable 1.1, Transition to CIR**

It must be noted here, as it is in the report, that the division is not a hard binary one, but a transition, and it is likely that organisations will display characteristics of both CIP and CIR simultaneously.

These descriptive qualities provide an aspirational set of criteria-based outcomes to be developed and achieved through practices of Critical Infrastructure Resilience Management (CIRM). Guideline management steps and sub steps have been developed to provide CI organisations with a conceptual model, illustrating the relationship between risk management and resilience.
management, as a basis for action. The resilience management steps and sub steps merge principles and practices of risk management (looking at technical and physical considerations) with considerations of social, political and organisations aspects to provide a framework for CIRM. This is illustrated below.

### WP2. Deliverable 2.1, Resilience Management Steps

This model for resilience management argues that as disruptions are infrequent events, organisations spend the majority of their time in the ‘before disruption’ time period, which is associated with the ‘prepare, prevent and protect’ phase of the resilience cycle. Within this phase three resilience management steps have been identified,

- Defining the system,
- Assessing Resilience,
- Enhancing Resilience.

These are linked in a feedback loop to the management step, ‘transforming’, and the resilience phase, ‘learn’.

As it is argued that many CI organisations spend the majority of time in the first resilience phase, ‘prepare, prevent, protect’, this is the targeted space of intervention the project has focused on, developing tools and solutions for CIR through improved strategies for preparedness. To do this, RESILENS has developed a suite of tools, the Resilience Management Matrix and Audit Toolkit (ReMMAT), illustrated below.
The toolkit will be available online, and access will be managed by the coordinating project partner. The targeted users of the toolkit are CI owners and operators. It is unlikely that the

WP5. Deliverable 5.2. HarmonisedReMMAToolkit

These tools function in concert to provide a holistic assessment and evaluation of the CIR status of a CI system. The toolkit will be available online, and access will be managed by the coordinating project partner. The targeted users of the toolkit are CI owners and operators. It is unlikely that the

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v The structure of the toolkit was adapted to better reflect the objectives of the project as part of the harmonisation activities of WP5. This is discussed further in Chapter 4.
The toolkit can be operated by a single user and will most likely require input from “a panel of relevant sectional CI managers or personnel in the CI system who have a good knowledge of the different organisational and operational aspects of the CI. Ideally the proposed panel will be made up of managers with organisational decision making capabilities as well as operational line managers with knowledge on particular department operations associated with the provision of the CI critical functions” (D2.3, 2016). Contributors will also require a working knowledge of the organisation’s risk management strategies and practices as they relate to their own areas of operation, in order to complete the management matrix tool of the toolkit. The management matrix tool presents users with a series of components to be assessed using a Likert scale. The results of the assessment allow them to identify potential areas of vulnerability in their CIR. Users will then be required to reflect on the results of the matrix score in relation to social, political and organisational factors, to answer the question of resilience for who, what and when, in order to justify the use and prioritisation of resources in order to build and improve CIR within their organisation, as part of the audit tool. This will require detailed knowledge of the operating practices of the different teams and departments of the organisations (developed through an ACC). The scores of the matrix tool are linked to the GIS mapping tool and provide a baseline snapshot of the organisation’s current CIR. Following the introduction of interventions on the basis of the results of the matrix tool and decisions of the audit tool, after a suitable period of time to allow for affect, the assessment process can be repeated. The scores from the second assessment are also linked to the mapping tool and a visual comparison can be made to illustrate any potential improvements.

The different steps of the toolkit mirror and reflect the resilience management steps of CIRM, with the GIS tool providing a connection to the learning phase of the resilience cycle, as is outlined in the flow of the management steps above.

The use of the management steps and toolkit is supported with introductory and instruction texts, the e-learning hub and the ACC framework. The management process, toolkit and e-learning hub will be hosted on the RES-DSP, which is yet to be developed. Framing the use of these outputs is the ERMG, which provides guidelines on the principles of CIR, providing instruction to organisations on the process of CIR and CIRM.

The use of the management process, toolkit and the to be developed ERMG provides an integrated solution for understanding, assessing and implementing CIR within CI organisations. The use of these tools provides practical tools for CI organisations, extending risk management to include social, political and organisational factors.

3.1.4 Assumptions and Limitations of Desired Changes

This section outlines the assumptions made in order for the desired changes to operate efficiently, including existing processes and practices in place in organisations, resources required for use and expected use of the outputs by future users. It also outlines the limitations of the outputs, and potential barriers to their uptake.
Supporting data for this description was gathered through a review of the formal project reports, and participation in the design and development process of the project outputs, as the developers explained the assumptions and limitations associated with the tools and solutions they were developing.

Box 4 below outlines the assumptions and limitations of the desired RESILENS changes.

**Box 4. Assumptions and Limitations of Desired RESILENS Changes**

In order for the outputs of RESILENS to be effective they rely on a number of assumptions. A number of which are outlined below.

The merging of risk management with resilience practices and the use of the CI definition tool assumes that organisations are already familiar with the risks of their organisations, and have in place an established process for managing them.

The use of the matrix tool assumes that there will be personnel available to commit the time and resources required to complete what is a lengthy process, which requires iteration.

Future ownership of the toolkit will need to be addressed, in term of hosting and password allocation and management, to address data sharing and security issues.

The use and development of an ACC requires familiarity and expertise with social scientific research methods and analysis. This may be found in existing skillsets within the organisation, or require outside consultation.

The transition from CIP to CIR will require buy in from CI organisations and owners, this will primarily involve an ability to demonstrate the value of accounting for social, political and organisational factors, which should be demonstrated through the development of an ACC, supporting education materials from the e-learning hub, and the use of the audit tool.

The assumptions and limitations associated with any solution are important to consider as “there is no quick fix, no single process, management system or software application that will create resilience” (Gibson and Tarrant, 2010), organisations must be conscious of this in relation to the introduction of any desired change, to understand the impact it will have, which should be made explicit in this section.

We turn now to look at the operating practices of three CI organisations in the water, electricity and transport sectors. Each of these case studies highlights the different ways in which social, political and organisational factors affects the way in which they carry out their work, manage their risks and build their resilience. As before, these descriptions have been structured across the proposed headings for the ACC template, outlined in Chapter 2. At the time of writing interactions with personnel from the different organisations were based on their perspectives of who would potentially use the RESILENS outputs, as they were available, in order to develop proposed future state descriptions. As such, these descriptions are based on their understanding of the ReMMA
toolkit. We use the findings from our case studies to guide the future development of the ERMG in Chapter 4.

3.2 Description of Energias de Portugal Distribuição: Current Operating Practices

3.2.1 Background

This section outlines the critical function and key objectives of Energias de Portugal Distribuição (EDPD). The data for this section was gathered through interviews with members of the business continuity team, in addition to a review of the EDP website, and verified through a review process.

Box 5 outlines EDPD’s objectives below.

**Box 5. Background**

Although there are additional energy suppliers in Portugal, Energias de Portugal, S.A. (EDP) is a vertically integrated utility company in the electricity sector value chain. EDP is the largest generator, distributor and supplier of electricity in Portugal and the third largest electricity generation company and largest gas distributor in Iberia Peninsula. EDP Distribuição – Energia, S.A. (EDPD) operates as the main Portuguese Distribution System Operator (DSO) supplying 99% of connections in the Portuguese mainland, through high, medium and low voltage grids. EDPD holds national binding licences for high and medium voltage distribution and municipality concessions for low voltage distribution, serving almost 6 million customers.

EDPD must fulfill regulatory requirements to plan, build and maintain the national grid, deliver, monitor and operate the supplied energy, and support the market. EDPD’s primary function is maintaining and operating the grids, ensuring a continuous flow of electricity to their customers. During the event of an outage they respond to ensure that power is returned as quickly as possible.

Within EDPD the business continuity team has self-identified as the primary user of the available RESILENS outputs, as such our descriptions focuses on the work they carry out.

This section provides contextual details of the CI organisation the RESILENS outputs will potentially be put to use in. The following sections build on these details to produce a more comprehensive account of how the business continuity team contributes to the resilience of EDPD.

3.2.2 Operating Environment

This section outlines the current operating practices of EDPD’s business continuity team. In line with the principles of activity theory, it provides a space to document the wider social and organisational factors that impact on how the business continuity team carries out their work. The data for this
section was gathered through a workshop and interviews with members of the business continuity team, and verified through a review process.

Box 6 outlines the operating environment of the business continuity team, looking at organisational and reporting structures, and the composition of the business continuity team.

<table>
<thead>
<tr>
<th>Box 6. Operating Environment</th>
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<tbody>
<tr>
<td>EDPD falls under the umbrella of EDP, a worldwide organisation with more than 10 million customers around the world and an overall installed capacity of close to 24,4 GW.</td>
</tr>
<tr>
<td>EDPD is structured across four units, operational, commercial, technology and management support, which include different departments. EDPD’s organisational structure is illustrated below.</td>
</tr>
<tr>
<td>The Business Continuity Department sits within Environment, Sustainability and Business Continuity Direction, which is located in the Management Support Units. While, the business continuity team has self-identified as the group most likely to use the outputs of RESILENS, it is important to note that the resilience of a system cannot come from one team or department alone, but is an organisation wide activity.</td>
</tr>
<tr>
<td>In 2015 EDPD was certified in the Business Continuity Management System standard, ISO22301: 2012. The business continuity team is made up of three members, including the manager of the business continuity system. The team members possess and use a range of skillsets. Their educational backgrounds include civil protection, electrical engineering, health and safety, and microeconomics, with experience in training for emergency management and response, and, health and safety, human resources, network planning, and risk management. The Business Continuity process involves and reports to two main committees, the business continuity sub-committee, which is presided by the Environment, Sustainability and Business Continuity Director, and the business continuity committee, whose president is the CEO of EDPD. This support comes not only from top level management within EDPD and EDP, but also from their external regulators, the Entidade Reguladora dos Serviços Energéticos (ERSE), and Direção Geral de Energia e Geologia (DGEG).</td>
</tr>
<tr>
<td>Through their role and assigned responsibilities (discussed below) the business continuity team works closely with the various units and departments within in EDPD, helping them to identify solutions for potential gaps and vulnerabilities.</td>
</tr>
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</table>
Organisational Structure of EDPD.
The involvement of the EDPD board in overseeing the work of the business continuity team signals a strong commitment from top level management in support of building and embedding resilience practices in EDPD. This moves resilience from a priority in policy to concrete practices and actions. In addition, the development of the business continuity department is relatively new, having been set up in May 2013, illustrating a proactive approach to resilience. The establishment of two committees and a business continuity team embeds resilience within the formal organisational structure of EDPD, building new norms around which practices of resilience can coalesce. A proactive approach to resilience and its positioning as a new normality for the company are key features of CIR as outlined in D1.1, WP1.

The operating environment of EDPD sets the conditions in which the business continuity team carries out their work, as they fulfil their role and responsibilities, which we turn to next.

### 3.2.3 Roles and Responsibilities

This section outlines the various roles and responsibilities of the business continuity team, looking at the different activities they undertake to achieve their goals. The data for this section was gathered through a workshop and interviews with members of the business continuity team, and verified through a review process.

Box 7 outlines the roles and responsibilities of the business continuity team below.

<table>
<thead>
<tr>
<th>Box 7. Roles and Responsibilities</th>
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<tbody>
<tr>
<td>The business continuity team is responsible for promoting the testing and improving of preparedness and resilience in EDPD. The main goals of the business continuity teams are risk assessment and impact management, to improve the preparedness of the company. To do this, the team identifies potential gaps or vulnerabilities within systems, maps company processes and elaborates procedures in order to address the needs of each department. This is achieved through three related activities,</td>
</tr>
<tr>
<td>• Testing of plans</td>
</tr>
<tr>
<td>• Education and training</td>
</tr>
<tr>
<td>• Managing relationships/ Interaction with all organization units</td>
</tr>
</tbody>
</table>

EDPD has several plans to manage and coordinate the work of the different departments and elements of the system. The departments are responsible for developing these plans internally. It is the business continuity team’s responsibility to promote the integration of these individual plans in a business continuity plan, and to develop an exercise programme to test them at an integrated level. This is being carried out on a phased basis; beginning with the operational plans, and will be expanded to include “each time more persons and also combining different emergency plans ... [which] makes the need to involve different areas of the company” (Interview with business continuity team, 2016).

The business continuity team works with a planning team and the different departments in EDPD.
during the testing process, identifying potential gaps based on the experiences of department personnel. Based on the results of the exercise they will “define and identify opportunities for improvement [and] identify the person who will be responsible to implement [these]” (Interview with business continuity team, 2016). The results of the exercises are then reported to the business continuity committees; where they review what solutions to implement. These solutions are co-developed by the different departments, as they participate throughout the process, and “the results of the exercises are spread across the company via the relevant departments responsible for implementing the changes, and the sub committees [for business continuity], which has sub directors from the majority of department on it” (Interview with business continuity team, 2016). The business continuity team is also responsible for going back and checking that the solutions have been implemented. If a solution has been identified as difficult or a problem they can take it to the business continuity committee, where top level management will make a strategic decision on what is the best solution to pursue. Through these activities the team demonstrates the value of business continuity and the purpose of their role. As the team explained,

... we talk with everyone, we are spreading business continuity ... in the last meeting we had with one department, they say I have a situation, I think the business continuity department should solve it. So the people are looking to us as someone who can resolve some issue or someone who can address another department, so we make the bridges between departments (Interview with BC team, 2016).

In this way the team also promotes relationships between different departments in the organisation. Similarly the involvement of different department sub directors in the business committee ensures that all departments across EDPD are aware of what is happening across the company in relation to preparedness and resilience.

The team is also involved in education and training both within EDPD and also with key external stakeholders. They have developed a small course on business continuity and implementing business continuity in the company, in line with ISO 22301, for use within EDPD. This is shown to the new company employees and all future ones. They are also developing an e-learning course that will be available for all company, in 2017. In addition they have held two workshops with their main suppliers in 2015, to educate/sensitize them on the purpose of business continuity and “what are the priorities they are looking at” (Interview with business continuity team, 2016). The team not only educates company personnel and key suppliers on the role of business continuity but also learns from the operational teams. They have held a workshop, based on work they have done with a university faculty of psychology, about how they can act and react in a crisis situation. The purpose of the workshop was to “provide the information that the workers need to identify improvements to do a better job. And, also, by the other side to help the first lines to identify what could provide more support to the operational teams” (Interview with business continuity team, 2016). The team is looking into developing solutions to address the gaps that were identified in this workshop, these are, as the team describes it, “the social part” (Interview business continuity team, 2016).
The activities of the business continuity team clearly demonstrate the role of social, political and organisational factors in the building of resilience. The provision of psychologically supportive training to operational teams indicates an understanding that the resilience of an organisation cannot come from physical and technical means alone, but needs to account for the people involved. In addition, the cultivation of supplier relationships in line with ISO 22301 demonstrates the role of inter-organisational relationships in building and maintaining resilience. And, finally, consistent and iterative testing of the system, at an integrated level, in order to identify any potential gaps/vulnerabilities supports a proactive and long-term approach to building resilience.

An account of the role and responsibilities of the business continuity team provides a means to describe the different activities they undertake. To better understand how the business continuity team carries out their work to achieve their goals we look at the different tools, technologies and resources they make use of.

3.2.4 Tools, Technologies and Resources

This section outlines the various tools, technologies and resources the business continuity team uses to achieve their goals. It is important to note that the category of tools is not limited to physical tools and technologies but also includes several concepts and models used by the team and the organisation. The data for this section was gathered through a workshop and interviews with members of the business continuity team, and verified through a review process.

Box 8 outlines the tools, technologies and resources used by the business continuity team below.

<table>
<thead>
<tr>
<th>Box 8. Tools, Technologies and Resources</th>
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<tbody>
<tr>
<td>To successfully carry out their work the company relies on a number of tools, technologies and resources. Here, we look at the three pillar model they use to manage business continuity, the policies and tools used to manage risk, and finally, the collaboration based model they use for testing and change processes.</td>
</tr>
<tr>
<td>Underpinning the activities of the business continuity team is a conceptual model, which looks at the interplay of three pillars: human resources, physical and technology infrastructures. These pillars represent the areas which team looks for, when checking for preparedness, asking, “if any of these are unavailable, what is required then?” (Interview with business continuity team, 2016).</td>
</tr>
<tr>
<td>To operationalise the model the team carries out a risk assessment and facilities analysis, looking at all the facilities they have, the systems that support these facilities and all the people that work in these facilities. This allows the team to identify if any of the three pillars may be missing/vulnerable and creating a gap in their resilience. This risk assessment is supported with a business impact analysis that identifies all the tasks that are considered a priority, “looking at all the company, and looking is this crucial for us, for our activity” (Interview with business continuity team, 2016).</td>
</tr>
</tbody>
</table>

As a subsidiary of EDP, EDPD operates in line with their policies relating to risk management. EDP
manages risk in a tri part manner involving actor’s accountability, mandated practices, and the use of risk reporting tools. To support risk assessment, EDP uses a Risk Portal, “an application that collects information related to risk identification, analysis, evaluation, mitigation measures and monitoring concerning significant risks” (EDP website, ‘Risk Management’). This tool allows users to benchmark risks and risk management, providing a space for sharing best practices across the different branches of EDP. The use of the risk portal is supported by an Enterprise Risk Management (ERM) process and policy. ERM “encompasses a set of practices in order to identify, analyze, evaluate, treat and report the corporation’s main risks”, in line with this, the ERM policy states that “all relevant risks should be assessed and managed, clearly identifying both the business unit and the chain of command responsible for its management”. The Risk Portal is updated by risk managers and can be accessed by authorised personnel, such as top managers, the practices of ERM are embedded in the management style EDP requests of its employees, and risk management is considered a responsibility of all employees throughout the organisation.

The POAC is the crisis management plan for EDPD. The POAC states that both the plan for crisis management must be reviewed each year, along with all the systems. This is done on a cyclic basis. When testing the different parts of the system for potential gaps and vulnerabilities and developing the required solutions the team relies on a collaborative model of engagement. Rather than simply taking the plans of the different departments, testing them and developing solutions to improve upon them, in isolation from the departments involved, the team works closely with them throughout the process to ensure that what is developed hasn’t “been imposed, we have talked with people, ... so it’s also their plans, so the implementation is theirs, not ours” (Interview, BC team, 2016). This model not only develops and supports a collaborative and trust based environment and relationship, it also includes space for learning and feedback between the business continuity team and the departments. Lessons learned are identified for each test carried out, and helps shape what solutions will be developed and direct the future direction the organisation will move regarding its resilience.

This description demonstrates the interdependent nature of social, political, organisational, physical and technical elements of an organisation, and that CI organisations needs to address all of these factors as part of understanding resilience practices

3.2.5 Proposed Future State

This section outlines a proposed future state in relation to the use of the RESILENS outputs by the business continuity team, Box 9, below. The data for this section was produced through reflection on the descriptions of the current operating practices of the business continuity team, and the desired changes presented under RESILENS.

Box 9. Proposed Future State

Based on the current operating practices of the business continuity team we believe they are well
suited to use and implement the RESILENS outputs.

Through their access to top level management and their regulators they are in a position to secure
the support and resources required to adapt the recommendations to build CIR within the
organisation.

Equally, the activities they undertake to improve the preparedness of EDPD through testing, risk
assessments and impact management there are already structures in place to mange the
implementation of these recommendations.

In addition, through their interdepartmental work they possess the relationships necessary to
identify the relevant actors required to complete the matrix tool, and to take ownership of the
outputs in order to determine where best to make changes on the basis of the results.

We would note that as part of their work EDPD has already developed a vision for how they wish
to develop their resilience and, how the priorities of that plan and the results of the toolkit merge
will need to be addressed.

The results of the table top testing in WP3 and the pilot demonstrations in WP4 will allow us to
develop a more detailed and nuanced understanding of how the introduction of the RESILENS
outputs will impact the current operating practices of the business continuity team, and EDPD
overall.

This proposed future state description allows us to identify the factors present in EDPD’s current
operating environment and practices, which we believe will support future use of the RESILENS
outputs. Further work is required in this area, and the results of the table top testing in WP3 will be
of particular importance to guide this.

3.3 Description of Irish Water Current Operating Practices

3.3.1 Background

This section outlines the critical function and key objectives of Irish Water. The data for this section
was gathered through interviews with members of the risk management team, in addition to a
review of the Irish Water website, and verified through a review process.

Box 10 outlines Irish Water’s key objectives below.
assets and systems, investment and planning, managing capital projects, and customer care and billing.\textsuperscript{vi} Irish Water is regulated by the Commission for Energy Regulation (CER), which manages economic regulation, and the Environmental Protection Agency (EPA), which manages environmental regulation.

Within Irish Water the risk management team has self-identified as the primary user of the available RESILENS outputs, as such our descriptions focuses on the work they carry out.

This section provides contextual details of the CI organisation the RESILENS outputs will potentially be put to use in. The following sections build on these details to produce a more comprehensive account of how the risk management team contributes to the resilience of Irish Water.

### 3.3.2 Operating Environment

This section outlines the current operating practices of Irish Water’s risk management team. In line with the principles of activity theory it provides a space to document the wider social and organisational factors that impact on how the risk management team carries out their work. The data for this section was gathered through a workshop and interviews with members of the risk management team, and verified through a review process.

Box 11 outlines the operating environment of the risk management team, looking at organisational and reporting structures, interdepartmental relationships and dependencies, and the role of policy and regulation.

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**Box 11. Operating Environment**

Irish Water is structured across nine units\textsuperscript{vii}, which are made up of a number of different departments. Irish Water’s organisational structure is illustrated below. The risk management team is housed in asset strategy and sustainability, under the asset management department. While, the risk management team has self-identified as one of the groups most likely to use the outputs of RESILENS, it is important to note that the management of risks is not carried out by a single team or department, rather the various departments and units are responsible for managing their own risks.

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\textsuperscript{vi} In 2016 the Water Services (Amendment) Bill was passed suspending domestic water charges to allow for a deliberation on the status of household water charges. An expert commission will be established to make recommendation on the matter to be decided by a special Oireachtas committee. The introduction of household water charges was a highly fraught social and political issue.

\textsuperscript{vii} The organisational structure of Irish Water is undergoing change; one of the units is to be merged with the remaining eight, it has not been fully decided what this will look like. The structure presented below is correct at the time of publishing, and any changes in structure will be noted in the updated CONOPS report, D5.4.
Organisational structure of Irish Water\textsuperscript{viii}

\textsuperscript{viii}Correction note, the Managing Director is now Jerry Grant, announced 16 June 2016.
Box 11 (continued). Operating Environment

The risk management team is made up of the three members with backgrounds and experience in contract administration and procurement, civil engineering, project management, risk management, asset management and decision analysis. The team reports to the Sustainability Policy and innovation lead and fortnightly meetings are held between the different teams to coordinate their efforts. Most discussions take place in formal meetings, and a large number of cross functional committees and forums for information sharing, project delivery, and policy review. As Irish Water is a relatively new company it is still in the process of developing formalised processes and policies, as a result they depend heavily on close interaction, communication and cooperation between the different teams and departments. In order to achieve their objectives the risk management team works closely with a number of other departments. Primarily, these are operations and maintenance, legal services, finance, technical advisor (which includes environmental and policy licencing, and HSQE), and communications and corporate services. This is supported by what the team describes as “a culture of openness and access to top level management”, as they explained that “the habits and practices being built by those in top level management will set a precedent for those who come after them, and that they will follow this approach” (Interview with risk management team, 2016).

Much of the operating environment the team works in is determined by regulations such as health and safety regulations, EU drinking water regulations and the EU urban wastewater treatment directive. Each branch of the organisation has their own set of polices to ensure compliance with the regulations that are relevant to their particular objectives and these shape the operating environments. The regulations are part of national and EU legislation, and Irish Water must be in line with them. In addition, the Eastern and Midland Regional Assembly (EMRA) plays a role in setting policy. These policies must be adhered to by local authorities, as the primary operators of the water and waste water systems, on behalf of Irish Water.

In the case of Irish Water their operating environment is particularly sensitive to public relations. The setting up of Irish Water took place on a public stage, and their role in introducing water charges was a highly debated issue, with a number of public protests taking place. The issue escalated to the point where it has created sufficient pressure on the political agenda to become a key discussion point during party campaigns for the 2016 General Elections were based, with parties running on the promise that if elected they will abolish both the utility and water charges. Voting results from the elections failed to meet the criteria required for a single party to form a government. Water became a significant issue post-election in negotiations to form a coalition government, particularly in relation to charges, and was heavily covered by the media.

From this description we can see the central role social, political and organisational factors play in the resilience of Irish Water. The role of top level management in creating a culture of openness and access, along with close inter department cooperation, are important aspects of CIR. In addition, the initial challenges relating to the issue of water charges demonstrates the affect social and political
issues can have on the strategic operating environment and practices of CI organisations. While many of these issues are of importance for top level management, the ways in which they affect the day-to-day work of the teams and departments are less obvious, and are seen to be disconnected from their work.

The operating environment of Irish Water sets the conditions in which the risk management team carries out their work, as they fulfil their role and responsibilities, which we turn to next.

### 3.3.3 Roles and Responsibilities

This section outlines the various roles and responsibilities of the risk management team, looking at the different activities they undertake to achieve their goals. The data for this section was gathered through a workshop and interviews with members of the risk management team, and verified through a review process.

Box 12 outlines the roles and responsibilities of the risk management team below.

<table>
<thead>
<tr>
<th>Box 12. Roles and Responsibilities</th>
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<tbody>
<tr>
<td>The risk management team is not responsible for managing all risks within the organisation. Rather, risk management is dispersed across the different departments, as they each look at risks in their own fields. The risk management team is focused on asset risks, “looking at anything that can go wrong with the physical infrastructure of the system” (Interview, risk management team, 2016). This involves identifying the potential risks of assets, the critically of the consequences of that risk should it occur, and the development of business cases to determine the level of investment requires to resolve and/or mitigate the risk, in order to prioritise and manage investment.</td>
</tr>
<tr>
<td>While the different departments of Irish Water are responsible for managing their own risks, this is not done in a siloed way, and involves close cooperation between all departments. The risk management team sits within asset strategy and sustainability (asset management unit) and whilst their primary area of responsibility is strategic risk, they are also involved in looking at operational risks and issues relating to procedures and capacities of the system (operations and maintenance). The different departments, and the infrastructure operators, will come together to decide an overall plan for managing the risk associated with an asset. An example of this process took place during the development of the investment plan. The asset strategy and sustainability teams met with the local authorities, operating the system on behalf of Irish Water, and workshopped the different assets, talking through all the potential issues (identified through expertise and local knowledge). Out of these workshops a business case was developed, outlining proposed plans for prioritised investment. These plans are developed by asset strategy, and then issued to asset investment and finally to the regulator, the CER. The validity and soundness of the business case is tested on a cost/benefit basis and put into a plan balancing tool. The business cases for different assets are completed using a template so they can compare like with like. This process is similar to</td>
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</table>
ones used in UK water utilities and Ervia.

In addition to identifying and managing the risk of the asset the team is also involved in determining the criticality of the consequences of an asset failure, should it occur. Through these assessments the team is developing a means to review "the consequences of a total failure of the asset. The criticality of an asset is then used in decision making processes involving the assets: how critical they are to the business plays a role in making investment decisions" (Personal communication with risk management team, 2016). This starts with determining a relative criticality of the assets, identifying the most vulnerable parts and the means to mitigate the risks by either reducing the probability of occurrence or the consequences of failure.

The risk management team carries out different levels of risk assessment, on the one hand they assess the potential for failure (risks to an asset), and on the other hand they assess the criticality of the consequences if it does fail (risk of an asset), the latter form of assessment is strategic rather than operational. The analysis of assets is carried out on the basis of proactive costing. It is five to eight times more cost efficient to take preventative measures rather than reactive ones. This process is based on three steps; local knowledge about knowing when something is due for replacement/maintenance; knowing what signs to look for; and following a replacement/repair schedule. This work involves both Irish Water and local authority personnel. Currently, the team is collecting the data required to carry out the risk assessments, the next step will be “to use the data to inform mathematical models related to risk management (reliability engineering, deterioration models, etc.); the last step is to analyse the output of these tools to identify and standardise maintenance and monitoring practices to minimise the risks” (Personal communication with risk management team, 2016). Once this data collection has been completed, it will allow them to carry out risk assessments on the water and waste water infrastructure on a national level, which never existed in Ireland before.

On a final point, it is interesting to note that the function/role of asset management is a relatively new addition to the running of utilities, developed only in the past thirty years.

An account of the role and responsibilities of the risk management team provides a means to describe the different activities they undertake, and how social, political and organisational factors affect and shape the wider contexts in which they set out and achieve their goals. The use of proactive costing illustrates investment in the long term resilience of the infrastructure, and a future looking perspective within the organisation. This description also demonstrates the key role risk management plays, and should continue to play, in resilience.

To better understand how the risk management team carries out their work to achieve their goals we look at the different tools, technologies and resources they make use of.

3.3.4 Tools, Technologies and Resources

This section outlines the various tools, technologies and resources the risk management team uses to achieve their goals. It is important to note that the category of tools is not limited to physical tools.
and technologies but also includes several concepts and models used by the team and the organisation. The data for this section was gathered through a workshop and interviews with members of the risk management team, and verified through a review process.

Box 13 outlines the tools, technologies and resources used by the risk management team below.

**Box 13. Tools, Technologies and Resources**

The risk management team have developed a toolbox in asset management that they use. This includes a set of decision making tools, which have been designed to be user friendly, although they require a level of expertise. In addition, high-level process maps are used to provide guidelines on how to manage different tasks. And, the team uses modelling software and systems, such as GIS and asset management tools. When assessing an asset for the consequences of a failure, should it occur, they use five criteria; Number of customers impacted, environment, reputational damage, cost, and ease of repair (how quickly can the system be up and running and again). Embedded across these criteria is a concern with health and safety. These criteria help them to identify the criticality of an asset (this links to the Critical Assets policy), and are part of the toolbox used by the team.

They are also involved in developing an asset management framework for Irish Water. This is new and still under development. It includes the different roles and responsibilities and support functions and how they interact with core functions. It sets out commitments and priorities, in line with the priorities set out by Irish Water in their business plan, which include; eliminating the risk of drinking water contamination for 940,000 people; lifting all current boil water notices; reducing leakage from 49% to 38% - saving 180 million litres every day; implementing a national lead strategy to reduce risk of contamination in up to 140,000 homes and an additional 40,000 homes on shared services; ending the discharge of untreated wastewater at 44 locations; and significantly increasing water and wastewater capacity to support social and economic development.

While they do not formally use the resilience cycle, it is implied in their work. They use the plan, do, check, act cycle. This process is also embedded in the HSQE Department’s plans and work. The HSQE manager is responsible for activities such as health and safety management, emergency response and co-ordination. At a high level, they also deal with preparedness, looking at the plans and processes, ensuring they can execute an appropriate response and that they are resilient against threats.

This description demonstrates the interdependent nature of social, political, organisational, physical and technical elements of an organisation, and that CI organisations needs to address all of these factors as part of understanding resilience practices.
3.3.5 Proposed Future State

This section outlines a proposed future state in relation to the use of the RESILENS outputs by the risk management team, Box 14, below. The data for this section was produced through reflection on the descriptions of the current operating practices of the risk management team, and the desired changes presented under RESILENS.

Box 14. Proposed Future State

Based on the current operating practices of the risk management team we believe there is a role for the RESILENS outputs to play in Irish Water.

The organisation is interested in investing in resilience practices and has demonstrated a desire to establish themselves as a resilience organisation.

They have also shown an understanding of the role of social and organisational factors play, although how these can be accounted for and used to improve resilience will need to be shown in way that brings benefit to the organisation to justify investment in them.

Existing strong interdepartmental relational and interactions will support the use of the matrix tool, as it will allow the user responsible to identify who has the expertise and experience necessary to complete the assessment.

It should be pointed out that the team have noted that depending on who uses the tool and for what reason it will be used in different ways. Future testing will need to address this issue in terms of how the outputs of the toolkit are actioned across departments, who will retain ownership and responsibility of the tool for updating and maintaining it.

This proposed future state description allows us to identify the factors present in Irish Water’s current operating environment and practices, which we believe will support future use of the RESILENS outputs. Further work is required in this area, and the results of the table top testing in WP3 will be of particular importance to guide this.

3.4 A Transport CI Organisation

3.4.1 Background

This section outlines the critical function and key objectives of BASt. The data for this section was gathered from a workshop and follow up interview with members of the Tunnel and Foundation Engineering, Tunnel Operation and Civil security sub-department of Department B, Bridges and Structural Technology, and a review of the BASt website, and public reports, and verified through a review process.

Box 15 outlines BASt’s key objectives below.
Box 15. Background

BASt is The Federal Highway Research Institute; it is a practice-oriented, technical-scientific research institute of the German Government in the field of road engineering. It is a public government body reporting to the Federal Ministry of Transport and Digital Infrastructure (BMVI) providing them with “scientifically-backed decision aids for technical and road-traffic related issues” (BASt website, Publications, ‘Research-Advice-Tests-Standards’, 2011). As a research institute BASt is involved in the improvement of the safety, environmental impact, efficiency and performance of road traffic and road use. BASt carries out research in five areas; highway construction technology; bridges and structural technology; traffic engineering; automotive engineering; and behaviour and safety. In addition it is the “central agency for road traffic research” (BASt Website, Publications, ‘About the BASt’), along with contributing to the “drafting and harmonization of standards and guidelines at a national, European and international level” (BASt Website, Publications, ‘About the BASt’, 2015).

Unlike the previous organisations BASt is not a primary user for the outputs of RESILENS, as it is not a CI owner or operator. However, its role in carrying out research and supporting the development of policy, standards and guidelines, positions it as representative of primary users, CI owners and operators. BASt has confirmed this, as they noted they are “representative of users, in the sense that it would be difficult to have an actual road operator involved in the research projects, BAS does the research for them and informs policy” (Interview with BASt, 2016).

Through their work BASt possesses experience on how the road network operates at a whole system level. The different position of BASt, both in relation to the use of the RESILENS outputs and its role in the wider actor network of the road network, is reflected in the how the descriptive accounts outlined below differ from those of the other case studies. However, we retain a focus on the role of social, political and organisational factors, examining them under the headings set out in the initial ACC reporting template, allowing for a measure of comparison between the different organisations.

This section provides contextual details of CI organisation involved in how the RESILENS outputs will potentially be put to use in. The following sections build on these details to produce a more comprehensive account of how BASt contributes to the resilience of the road network.

3.4.2 Operating Environment

This section provides a high level outline of the road management process, distributed across different actors in the road network. In line with the principles of activity theory it provides a space to document the wider social and organisational factors that impact on how the actors in the road network carry out their work. The data for this section was gathered through a workshop and interview with members of the Tunnel and Foundation Engineering, Tunnel Operation and Civil security sub-department of BASt, and verified through a review process.
Box 16 outlines the operating environment of the road network, looking at the interactions between federal, state and private actors.

**Box 16. Operating Environment**

The management of the road network is a complex system, involving multiple actors, distributed across different levels of authority and organisational type (public and private). Germany differentiates between federal, state and municipal roads and highways. “Federal highways consist of long-distance interstate highways (Autobahnen), major divided four-lane highways that connect to the interstate system, and some thoroughfares through local communities. Most other highways and roads belong to states, except for the road systems of major municipalities, for which these municipalities are responsible” (The Library of Congress, National Funding of Road Infrastructure: Germany).

Typically, the roads are operated and maintained by a road agency on behalf of a state, for example the Roads North Rhine-Westphalia agency acts on behalf of North Rhine-Westphalia, reporting their activities to the state ministry of transport, who, in turn reports to the federal ministry. While state responsibilities tend to focus on the operation and maintenance of the road network the funding to do so comes from the federal government. The federal government is more focused on financing, the design and drafting of road network development and improvement programs, and the drafting of standards, legal rules and regulations. It is the responsibility of BASt, a federal institution, to support the BMVI, providing expert advice and guidance. The management of the quality of the road network is also distributed across the two governance structure, whereby risk assessments for assets are carried out locally by states, but the standards which are set for these assessments are determined by the federal government. The federal government has access to the data developed in the risk assessments through its role in the approval process for large projects, those costing upwards of 2.5 million, such as the construction of new assets of major upgrades.

The different states are fully responsible for emergency management, and the police and fire services play a supportive role in managing roads during an event or incident. For example if a section of a road is knocked out, while road operators manage the traffic flow, only the police can close a road, unless it is a critical safety situation. In situations involving scheduled maintenance and construction road operators cannot close the road, but must liaise with the police.

Neither resilience nor risk are considered as separate issues from the maintenance and operation of the road network, as such there is no “department responsible for resilience ... if the issues were security [related] then the ministry for the interior would be directly involved but not for safety and operational resilience” (interview with BASt, 2016).

During discussions with the team from BASt they outlined the differing policy environment for different parts of the road network, comparing tunnels and bridges. They noted that “there is an EU directive on minimum requirements on road tunnel safety [2204/54/EC], which Member States have to implement. There is nothing yet for bridges. Tunnels are a priority for regulation due to a number of historical incidents involving fatalities”. (Interview with BASt, 2016).

BASt expects that the State Ministry of Transport, or possibly the road operator agency, will be the
It is clear from this account that BASt understands the role social, political and organisational factors have on the resilience of the road network. During our interaction with them they discussed the varying political climates and pressures that shape the development of policies and regulations (or not), which the road operators, states and federal government must comply with. The different levels of authority and responsibility distributed across multiple actor groups showcases the complex web of actors involved in maintain and building the resilience of the road network. But also demonstrates the complexities of co-ordinating goals and objectives, as they have different needs and constraints they must work with, i.e. requirements to share data, security concerns, defined areas of responsibility and competing work pressures. And, finally BASt’s targeted research on driver behaviour and safety indicates an acknowledgement of the social nature of not only management of the road network but also its use, in terms of learned behaviour, interactions, rule compliance etc.

The operating environment of actors in the road network sets the context in which they carry out their work, as they fulfil their role and responsibilities, which we turn to next.

### 3.4.3 Roles and Responsibilities

This section outlines the attitudes of various actors in the road network towards resilience, as it relates to their roles and responsibilities in maintaining and operating the road network. The data for this section was gathered through a workshop and interview with members of the Tunnel and Foundation Engineering, Tunnel Operation and Civil security sub-department of BASt, and verified through a review process.

Box 17 outlines the attitudes in relation to the role of resilience below.

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**Box 17. Roles and Responsibilities**

The role of resilience within the organisations’ and participants’ views on it were also discussed. The prioritization of resilience practices or not, was seen to play a key role in determining the uptake of new tools and techniques. Factors affecting this included, time pressures, lack of regulation and enforcement, increasing workloads, simplicity of the tools (but not overly so), competition for priorities and resources, and accessibility through the national language. Critically, the potential value, or lack of, attached to these developments in resilience practices was stressed, and a challenge identified was finding ways to make these new developments meaningful in relation to the work carried out within the organisation. A common attitude to new developments in resilience practices was described in the following way,

> the acceptance for these instruments is not so high, because they have other problems ... here is a little bit of research they think, and to accept this research for their daily work, it must be in a way that is easy and friendly so that acceptance will rise (Interview with BASt, 2015).
Attitudes towards the role of new resilience building tools and technologies within their everyday work often positioned them as being temporary and secondary. As such they are never fully embedded in the daily activities and routines of users, remaining on the periphery until a new tool or technology is introduced. This issue is further complicated by the fact that resilience was also described as being ‘too academic’. And, while operators may already be engaged in ‘doing’ resilience, as they have “a feeling for resilience without recognizing it ...communicating the concept will be a challenge” (interview with BASt, 2016). This means, as a first step the authorities must be made aware of resilience aspects and its advantages, and as a second step they need practical solutions for the implementation in a daily work.

BASt also noted that their concern with resilience in not simply on areas of vulnerability, but also criticality, to the know on effects on other facilities, for example the closure of a bridge may affect a route to a hospital. The main concern regarding resilience here is not object level, specific assets, but system level, the connectivity between assets, trying to understand “what is the impact of the loss of a specific object on the whole system”, which depends on its criticality – social, economic, health, etc. (BASt interview, 2016). This was noted as a challenge for road operators, as it’s not simply a case of diverting traffic, you must take into account the congestion of the other roads, changing it from a question of redundancy to capacity.

The above description requires further research on the different roles and responsibilities of the various actors in the road network, however it does demonstrate the way in which social, political and organisation factors impact how they carry out their work, and thus a need to account for these factors when assessing and evaluating the resilience of an CI system.

To better understand how actors in the road network carry out their work to achieve their goals we look at the different tools, technologies and resources they make use of.

3.4.4 Tools, Technologies and Resources

This section outlines the various tools, technologies and resources actors in the road network uses to achieve their goals. It is important to note that the category of tools is not limited to physical tools and technologies but also includes several concepts and models used by the team and the organisation. The data for this section was gathered through a workshop and interview with members of the Tunnel and Foundation Engineering, Tunnel Operation and Civil security sub-department of BASt, and verified through a review process.

Box 18 outlines the tools, technologies and resources used below.
including a consideration of different scenarios.

When beginning a project, risk assessments will be carried out at the beginning. Safety inspections will also be carried out. These are not a quantitative analysis, but are based on expert opinions. Engineers will carry out inspections of the assets and make an assessment based on visual inspections, if necessary they will take further actions, performing a more in depth study and perhaps close the tunnel or bridge, if necessary.

Contingency planning is also used. If a section of road or bridge/tunnel is knocked out, plans would be in place for traffic management at system level. Again, concern here is not with the specific object/asset but with the network at a system level. During this kind of event road operators will manage the traffic flow, but only the police can close a road. There are also road control centres and tunnel control centres, sometimes these are combined, and are operated at State level.

In Germany target safety levels for the road network are set by national standards. For tunnels there are approximately 1500 possible damages that could occur. These are rated on a scale of 1 - 4, with 4 being the most sever and requiring closure. This list is part of a diagnostic methodology, but it is “highly dependent on the engineer being able to recognize something not being right” (BASt interview, 2016).

Safety Inspections occur every 6 years. While there is no direct system for reporting anomalies (non-emergency), for anything dangerous or significantly disruptive, they would call the fire brigade. BASt noted that “sometimes people just look up the number of the state road authority and report but it’s not a dedicated number. If it’s a safety issue then people call the fire brigade” (BASt interview, 2016).

And, finally, the fire service is also involved in project planning. Their opinion is critical for approval. However, neither the police or fire service are involved in inspections. They do play a role in exercise and they may also be involved in upgrades to facilities. Exercises are carried out, but mainly on an object level, for safety issues such as fire.

This description demonstrates the interdependent nature of social, political, organisational, physical and technical elements of an organisation, and that CI organisations needs to address all of these factors as part of understanding resilience practices

3.4.5 Proposed Future State

This section outlines a proposed future state in relation to the use of the RESILENS outputs by BASt, Box 19, below. The data for this section was produced through reflection on the descriptions of the current operating practices among actors in the road network, and the desired changes presented under RESILENS.

Box 19. Proposed Future State
In the case of organisations that are representative of the targeted user groups, CI owners and operators, the role and benefits of the RESILENS project outputs needs to be further explored and clarified.

Based on the initial descriptions outlined above we believe that through their relationships and interactions with the multiple actors in the road network BASt occupies a central position is helping to ensure the results and recommendations developed out of the toolkit are considered for use.

Through the work they doing both in research and providing support to the federal government on policy development they are in an influential position to promote the use of RESILENS in a coordinated way, as they hold a whole system view of the road network and its operation and maintenance.

BASl has also highlighted key challenges that are faced in the uptake of new tools and solution and these must be considered in relation to the future development and use of the RESILENS outputs, particularly regarding the issue of acceptability, demonstrated value, and supporting regulation for use.

This proposed future state description allows us to identify the factors present in the current operating environment and practices of the German road network, which we believe will support future use of the RESILENS outputs. Further work is required in this area, and the results of the table top testing in WP3 will be of particular importance to guide this.

Over the course of this chapter we have explored the operating environment and practices of three CI organisations, operating across different CI sectors within different social and political climates. This initial ACC of the different organisations has allowed us to identify the role social, political and organisation factors play in CI organisations. While these factors may present themselves in different ways, there presence is consistent across the three case studies, and support the objective of the project to provide CI organisation with practical tools and solutions that help them transition from CIP to CIR.

In the following chapter we reflect on the findings of the case studies to draw recommendations for the future development of the ERMG. In addition to outlining how social, political and organisational factors have been accounted for in the ReMMA toolkit and its development process.
4.0 Harmonisation and Recommendations

Having outlined the desired changes to be introduced, in the form of selected RESILENS outputs, and current operating practices of three end user organisations, we now reflect on how the findings of the ACC can be used to refine the outputs of WP2 and provide recommendations to guide the future development of the ERMG. A summary of the activities taken over the lifecycle of this task to support the refinement of the ReMMAToolkit, in relation to the inclusion of social, political and organisational factors, are presented first. These are followed with our recommendations for the ERMG.

Over the course of T5.3 we maintained regular contact and participation in the development of the toolkit. Through participation in scheduled calls, a review of the tools under development, and asking questions on how social, political and organisational factors are being accounted for (who is the expected user, how will they use the toolkit, how will the results of the toolkit be managed and maintained, etc.) we supported and refined the development of the toolkit to ensure consistency with the objectives of the project as outlined in WP1, that is to develop practical solutions to support CI organisations transition from CIP to CIR. Participation in the calls presented an opportunity to embed a consideration of social, political and organisational factors across the development process of the toolkit. As the majority of partners involved in the development of the toolkit have technical backgrounds, this presented an opportunity to learn about how social, political and organisational factors play a role in resilience from different perspectives, and how to bring these perspective together to produce user friendly operationalisable outputs.

Recognition of the role of social, political and organisational factors was embedded across the design of the toolkit, and resulted in the discussion and inclusion of a range of features, including the following,

- A mandatory comment section justifying the chosen score on the Likert scale of the different matrix components. This will both ensure that users cannot score themselves higher than they can prove, and that there will be a documented justification for the score chosen for future users to understand, reflecting the priorities of the current user(s), and accounting for their subjective perspective;

- User interface was a key design component, to support the use(s) through the process, so that they will gain maximum value for the toolkit. This includes the use of supporting explanatory text, consistent formatting, and smooth integration between the different components of the toolkit. In light of competing time pressures and restraints on the user(s) it is important that the toolkit be user friendly if it is to achieve successful uptake beyond the project.

- A dedicated CI resilience assessment component was developed through the matrix tool addressing the role of social, political and organisation factors in resilience (Component 1.1).
• The audit tool was specifically designed to provide users with the space to reflect on the role of social, political and organisational factors. The use of concrete, practice related exercises provides both an opportunity to demonstrate the importance on considering these factors, thus encouraging buy in from users, and helps to develop skills to think about and take action in relation to these factors;

Discussion of social, political and organisation factors not only looked at the content of the toolkit, and the capabilities it offers CI organisations, but also its structure to ensure a logical progression. The sequence of the toolkit was developed to reflect and support the management process for CIR, as outlined in D2.1. It also guides users through a step-by-step process that reflects the transition from CIP to CIR (the early tools focus principally on risk assessment measures and the later tool extend this to include the social, political and organisational factors). Thus the toolkit is designed for use in a way that reflects the reality of CI organisations as being both CIP and CIR. The inclusion of social, political and organisational factors across the resilience management process, the ReMMA toolkit, and the ongoing development of the ERMG (to be discussed below), lends consistency and a harmonised approach to the outputs of the project.

Findings from the application of the initial ACC framework to the three end users organisations showcase the central role social, political and organisational factors play in risk management, supporting the project’s argument to transition from CIP to CIR by explicitly accounting for these factors as an extension of risk management. Below we summarise the role played by social, political and organisational factors identified in the practices of the organisations. These are combined with the recommended guidelines provided in BSI 65000, expanding upon them. We recommend these be used to guide the development of the ERMG, and reviewed in respect to the qualities of CIR originally outlined in D1.1.

BSI 65000 (2014) identifies governance and accountability, leadership and culture, common vision and purpose as the organisational foundations for resilience. Building upon these they list a set of practices and actions organisations should be taking to build resilience, these include being informed (situational awareness), setting direction, bringing coherence, developing adaptive capacity, strengthening the organization, and validating and reviewing. To support the use of the guidelines, a maturity model is provided to “assist in determining to what extent an organization is addressing good practice” (BSI 65000, 2014).

Findings from the case studies revealed the expression and role of social, political and organisational factors in the following way,

• The organisational structure and type play an important role, both within the organisation, but also in relation to the wider network of actors involved in the CI system. This includes the wider set of relations between CI organisations and suppliers, policy makers, emergency management, citizens, the media, regulators, weather forecasting, and national and international crisis management committees. Aligning goals and objectives between these
multiple actors and organisations is a crucial aspect of CIR and requires that good communication and collaboration practices be established.

- The role of top level management was identified as both a barrier and an enabler for resilience. Top level management plays a key role in setting priorities for the organisation and managing the distribution of resources. Support from top level management shapes the culture of an organisation and the operating environment in which CI organisations carry out their work. This is evident in the level of emphasis placed on resilience as either a core tenet of the organisation or a passing interest.

- Policy is also important in setting the operating environment for CI owners and operators. Policy plays a guiding role in ensuring that organisations are operating according to best practice. But it is also subject to social and political pressures, as certain issues make their way on to the political agenda while other do not. Organisations will need to look beyond policy to consider all the issue that are relevant to their CI system.

- The expression of social, political and organisational factors across the different case studies demonstrate the range of ways in which these factors play a role, either enabling or restricting, in building resilience. These factors should be included in the development of the ERMG to ensure that the guidelines developed promote the transition from CIP to CIR, in line with the objectives of the project. As the development of the ERMG is still under way, with follow up table top testing to be carried out we propose that the inclusion of social political and organisational factor are structurally embedded across the ERMG, with a paragraph explaining how the guidance on each of the components covered relates to the social, political and organisational aspects of CIR. This relationship can be measured against the qualities of CIR first outlined in WP1.

As what is proposed here and in D3.2 are both initial drafts, what is developed will need to be tested and validated with end users to ensure their usability and suitability. In WP5 this will be picked up in T5.2, as they engage with end user using existing standards and guidelines, examining how they account for social, political and organisational factors, which will contribute to further refining the development of the ERMG, and establishing its relationship to CIRM.
5.0 Conclusion

We have presented the initial results from the study of three distinct CI providers all with differing goals and objectives, organisational structures, cultures and processes. While our purpose was not to simply identify commonalities between them or point out how they are distinct, it was to gain a better understanding of the range of dynamics that are present when it comes to determining the resilience of the organisation’s operations and form the foundation for a CONOPS to support the embedding of the RESILENS tools in the future.

The Activity-Centred CONOPS represents a conceptual and practical development of existing standards for CONOPS by emphasising the dynamic nature of the relationships between human actors, tools, resources and socio-organisational contexts, and emphasising the non-static nature of these systems as they evolve over time in response to societal, economic, commercial, structural and technological changes.

As the project progresses we will continue to explore more deeply the processes by which resilience is achieved within these organisations and present, through the final CONOPS framework, a methodological model of how resilience is achieved and maintained through the linking of resilience as a measurable outcome with the day-to-day operational processes, tools and resources that go into achieving it.
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