EU-CIRCLE

A pan-European framework for strengthening Critical Infrastructure resilience to climate change

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Statement
The EU-CIRCLE project advances the state-of-the art through a proposed methodological framework for assessing risk and resilience of climate extreme conditions, climate hazards and climate change scenarios to critical infrastructures and support relative adaptation decisions based on consequences and cost-benefit analysis. The project adopts a holistic management approach, which means that all climate-related hazards are considered by the proposed solution and furthermore tools for supporting decisions on the impacts due to eventual disruptions of the critical infrastructures and the essential services that they provide to modern society are developed.

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Executive Summary

The EU-CIRCLE project advances the state-of-the art through a proposed methodological framework for assessing risk and resilience of climate extreme conditions, climate hazards and climate change scenarios to critical infrastructures and support relative adaptation decisions based on consequences and cost-benefit analysis. The project adopts a holistic management approach, which means that all climate-related hazards are considered by the proposed solution and furthermore tools for supporting decisions on the impacts due to eventual disruptions of the critical infrastructures and the essential services that they provide to modern society are developed. A validation methodology and a relevant protocol, based on key evaluation questions (KEQs), end-of session questionnaires, interviews and debriefing guidelines has been defined in order to be followed by all the organizers of the (5) case studies of the EU-CIRCLE project. D6.1 describes the approach, the methodology and the protocol for validating the main outcome of the project, which includes the risk management and resilience framework and the related IT tools developed for operationalizing the relevant concepts and approaches delivered by EU-CIRCLE.

Contents

List of domain specific, frequently used abbrevCIRPions

List of Abbreviations	
AAL	Average Annual Loss
CC	Climate Change
CI	Critical Infrastructure
CI/KR	Critical Infrastructure / Key Resource
CIP	Critical Infrastructure Protection
ECI	European Critical Infrastructure
GIS	Geographic Information Systems
LP-HC	Low Probability-High Consequence
NRA	National Risk Assessment
PML	Probable Maximum Loss
RA	Risk Assessment
RVA	Risk and Vulnerability Analysis

1 Introduction

The EU-CIRCLE Reference Case studies and EU-CIRCLE assessment (Deliverable 6.1) aims to define a methodological approach that can be applied for the testing and evaluation of the core results of the EU-CIRCLE project. More specifically this deliverable sets the context for evaluating the Climate Infrastructure Resilience Platform (CIRP) and the SIMICI IT tools[1], being the Information Management infrastructure, developed along with the underlying risk assessment and resilience framework of EU-CIRCLE that represent the overall outcome of the project. The capability of the project overall to assess:

- the potential impacts to interconnected critical infrastructures due to climate hazards and climate change pressures;

- the efficiency of the resilience indicators to monitoring the impacts, disruptions and capacity of the CI to adapt and;

- the contribution to decision support on cost-efficient adaptation measures,

shall be tested and evaluated, according to the framework described in this document.

As such, WP6 (Case studies and EU-CIRCLE assessment) is closely linked to all other WPs of the project since it will put their outcomes to the a thorough evaluation (especially the proposed frameworks in WP1 – Methodological Framework, WP3 – Critical Infrastructure Risk Model for Climate Hazards and WP4 – CI Resilience and Adaptation to Climate Change, the data sets delivered by WP2 – Climatic data capture and processing and the technical development of WP5 – Development of EU-CIRCLE (CIRP) framework and WP7 – SIMICI: Reference Simulation Network of ICI). Furthermore, WP6 will use the opportunity of organizing the project case studies in cooperation with a variety of stakeholders in different EU countries to disseminate the project results in properly organized sessions of the relative planned events, contributing thus to WP8 (Dissemination and Exploitation).

Task WP6.1 is related to the **establishment of a reference validation framework** for the EU-CIRCLE project which will be used to evaluate the proposed case studies and could be further employed as an exploitation material from the project for similar situations. The validation framework will include two main components, accounting the exercise as a CI resilience to climate hazards, and also the response to case study scenario from the participants:

• Qualitative assessment, based upon a dedicated questionnaire where all aspects of the proposed resilience framework, web-based application, results obtained, future exploitation will be analysed and introduced
• Quantitative assessment using a series of Key Performance Indicators to evaluate (a) EU-CIRCLE functionality and user-friendliness, (b) introduced web-based tools to assess climate hazards resilience of CI, (c) added value of the results, (d) future exploitation.

1.1 Scope and Objectives
In context of WP6, the consortium aims to validate the EU-CIRCLE methodological approach, its overall functionality and results produced by both the CIRP and the SIMICI developed tools as well as the Risk and Resilience Assessment Framework upon which they are based.

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[1] A ubiquitous collaborative environment, allowing CI stakeholders to use different and diverse modeling solutions and services in a standardized and homogenized fashion with the aim to improve their understanding on the climate-change impact to the CIs and perceive relative system interdependencies (DoA).

The envisaged validation framework that is adopted to perform the aforementioned assessment shall include two main components, accounting the exercise as a CI resilience to climate hazards, and also the response to case study scenario from the participants:
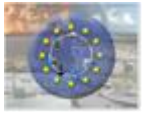
• Qualitative assessment, based upon a dedicated questionnaire where all aspects of the proposed resilience framework, web-based application, results obtained, future exploitation will be included, seeking feedback from participants

• Quantitative assessment, using a series of Key Performance Indicators to evaluate (a) EU-CIRCLE functionality and user-friendliness, (b) introduced web-based tools to assess climate hazards resilience of CI, (c) added value of the results, (d) future exploitation.

The goals set in order to achieve a quality assessment of the EU-CIRCLE approach comprise the following:

- **Risk assessment framework review**: Consider evaluation frameworks for risk assessment, as defined in WP3, and define the way (methodology and procedures) an appropriate such framework can be used in context of the case studies of EU-CIRCLE. This will support the selection of components for the proposed methodology, illustrate the thought-process behind it and further ensures that no aspect of the evaluation objective will be neglected, given existing capacity.

- **Resilience framework review**: The resilience metrics and indicators defined in WP4 will be validated during the trial and according to the variety of scenarios across the different case studies. The methodology and procedures to perform this task, in context of the project case studies, will be based in observations against expected results and mainly against users' acceptance of the system capability, usefulness and correctness of its output compared with experts' opinion. Thus, the adequacy of the metrics and the associated countermeasures will be assessed in cooperation with the end users.

- **CIRP/SIMICI review**: Metrics and tests to validate and verify system output, based on case study data and end user originated scenarios have to be defined. User appreciation of the usefulness and usability of the platform shall also be considered as part of the validation process.

- **Setting up of comprehensive test scenarios**: It is very important to define the test scenarios in cooperation with the end users (CIP authorities and CI operators and managers) in order to gather the respective requirements against which the system will be validated. The scenarios shall feature high plausibility for the end users in order to allow them to assess the quality and the usefulness of the results. The test scenarios have to be comprehensively described in order to challenge the EU-CIRCLE tool's ability to model as many aspects as possible of a given situation.

- **Definition of a roadmap for testing**: D6.1 shall provide a roadmap for testing the EU-CIRCLE developments and more specifically the Risk assessment and the Resilience framework as well as the EU-CIRCLE toolbox (CIRP and SIMICI). The output produced by these developments will be validated both in terms of compliance with the EU-CIRCLE conceptual and methodological framework as well as the intuitiveness of the results themselves as they will be evaluated by the end-users.

- **Organizing the WP6 case studies execution timeline**: Within D6.1 the timeline for executing the case studies is indicated. In addition, intermediate steps and relevant guidelines should be issued, by the organizers of the case studies, in order to break down the overall assessment process into smaller more easily managed tasks.

1.2 Basic definitions of relative concepts

A first step for establishing the validation and evaluation framework of EU-CIRCLE is to provide the definitions of the basic concepts used, in context of the project, for the relative tasks.
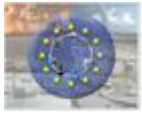
Validation is defined the process of determining whether or not the design of EU-CIRCLE tools (CIRP, SIMICI) and methodology fulfils the purpose for which it was intended, meets all constraints and perform as expected (yes/no decision) in context of the case studies included in the project tests. Validation will establish scientific evidence that the EU-CIRCLE methodology and tools are capable of consistently delivering operationally appreciated and quality products to the relevant stakeholders.

Validation with mathematical rigor is called (formally) **verification** and concerns the task of determining that the system is built according to its specifications.

Respectively, **evaluation** reflects the acceptance of the system by the end users and the collection of qualitative information concerning some key characteristics of the project design, which define its performance in the field/operations.

Normally validation, verification and evaluation are performed in a row allowing to estimate the completeness and consistency of the system and examining for its technical correctness. Briefly the VV&E tasks of the EU-CIRCLE development, spread in WP5 and WP6, are designed to:

a) Verify that the (IT) system is built in the right way (WP5);

b) Validate EU-CIRCLE is the right system for the purpose it was built (WP6) and;

c) Evaluate the usefulness of the system (WP6).

The above items b and c will be performed against the approach defined in Deliverable D1.5 (methodological framework), D3.3 (risk assessment) and D4.1 (resilience framework).

In the context of this document, the purpose of validation and evaluation is closely related and therefore the terms can be used interchangeably. The technical aspects of validating EU-CIRCLE IT tools will be addressed mostly in WP5. However, the design of the case studies' implementation and the feedback that will be analysed from the stakeholders will be analyzed against both validation and evaluation elements. Therefore, the questions addressed to the participants will point to this direction.

1.3   Evaluation, Validation and Verification in context of the EU-CIRCLE

The EU-CIRCLE framework shall undergo a quality assessment process as shown in Figure 1. This process will run along the entire duration of WP6 and will include iterative cycles of verification and validation of the project development. The term system in the figure represent all the constructs of the project, which means that both validation and verification shall refer to the Risk assessment framework, the Resilience framework and the EU-CIRCLE online tools (CIRP and SIMICI). Briefly verification shall consider whether the system works properly, while validation shall focus to assess whether the developed system is aligned with the user requirements. Thus, the validation process covers not only the pilot demonstrations but also earlier meetings and discussions in which the requirements are refined. It is very important then and a high priority to define for each case study the user requirements against which the EU-CIRCLE will be validated within WP6 tasks.

As already mentioned, verification of an information system is the task of determining that the system is built according to its specifications. Validation is the process of determining that the system actually fulfils the purpose for which it was intended. Evaluation reflects the value and the acceptance of the system by the end users and its performance.
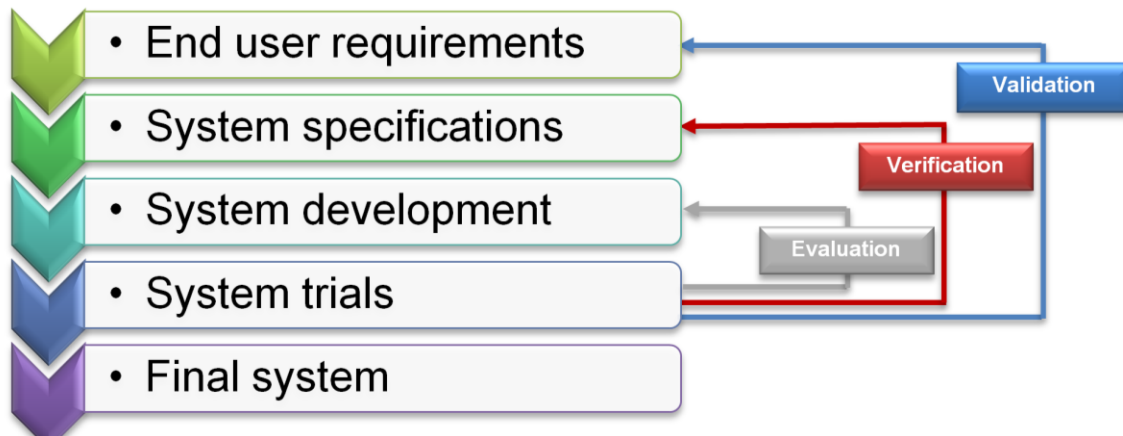
Figure 1 Quality assurance framework of EU-CIRCLE

Further to what has been mentioned before, the concept of validation, verification and evaluation of the EU-CIRCLE project results in context of defining the Reference Validation Framework are presented here next.

Validation

A basic definition of validation is that it is the process of checking whether or not a certain (possibly partial) design is appropriate for its purpose, meets all constraints and will perform as expected (yes/no decision). Validation with mathematical rigor is called (formal) verification[2].

Since EU-CIRCLE will deliver an originally designed system, validation during the design process is considered quite important. Hardly such a system would work as expected, had it not been validated during the design. As a consequence, the system's design, representing the methodological approach of EU-CIRCLE, has to be validated. Validation will be performed as a follow up of WPs1-4 and run in parallel with the development tasks (WP8).

In particular concerning the EU-CIRCLE platform, validation involves answering the key question: "**Does the EU-CIRCLE platform do what the end users want?**". In addition to performing thorough testing in-house (alpha testing) in context of WP5, validation will involve regular trials of the system during the case studies in collaboration with the end users and stakeholders, to ensure that any missing or misunderstood requirements are revealed and incorporated (beta test). It has to be noticed that it is perfectly possible for an IT system to pass a series of tests, and still not do what the end user wants; this usually happens because the IT end users do not properly communicate all their requirements to the RTD actors.

Evaluation

Validation and verification are part of an IT system evaluation. Therefore, evaluation is broader in scope than validation and verification. An information system, which doesn't work properly in doing what the end user wants is unlikely, unless by accident, to be of value. Thus, the CIRP and SIMICI tools have to be evaluated by end users to confirm if they are satisfied concerning the way the EU-CIRCLE platform works and if it covers what they wanted from such a platform.

Evaluation typically involves running experiments with the system, in real or simulated operational conditions. Sometimes, formal experiments are run, where one test group of users carries out tasks using the system under evaluation, and a control group carries out the same tasks using a pre-existing method (perhaps manually, or using a rival system). The software is seen to be of value where the test group out-performs the control group. Often, formal experiments are not conducted, but users are given the system

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[2] http://link.springer.com/chapter/10.1007%2F978-94-007-0257-8_5
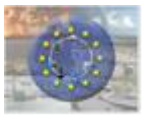
to "try-out'" for a period of time, and report back. EU-CIRCLE would examine implementing this aspect in context of the open call for external analysis components to be integrated in the platform.

Typically, evaluation entails demonstrating that a system has benefit to the end users, allowing them to do something they couldn't do before, or allowing them to do something better or faster than they could before. Thus, it is imperative to ensure the willingness of the end users to have a system doing something they are interested for. Even in case a system works correctly, and do what the end users want, it may still not be of value to users.

Summarizing, regarding the CI resilience platform of EU-CIRCLE, evaluation involves answering the key question: "**Does the EU-CIRCLE platform provide something of sufficient value to the relevant end users?**"

Verification

Verification is the act of reviewing, inspecting, testing, checking, auditing or otherwise establishing and documenting whether or not items, processes, services or documents conform to specified requirements. The technical testing of system verification is part of WP5 and isn't addressed in D6.1. Thus, regarding the project case studies, verification involves answering the key question: "**Does the EU-CIRCLE platform work properly?**".

Most commonly, verification is performed by testing the software on a range of test cases. A test case consists of two parts: the input to the IT system, and the desired correct output. When the test cases are run on the system, if the actual output matches the desired output in every case, the software passes the verification test. In the case of EU-CIRCLE, there is no such thing as a correct output; instead, there may be outputs with different degrees of user acceptability. Many application domains have this feature and they often use human judgement and rules-of-thumb are factors in reaching a conclusion. Therefore, there is some "fuzziness" in deciding if the system passes the verification test or not and thus EU-CIRCLE quality assurance, in context of the case studies, won't focus particularly to verification.

1.4   Design – Implement – Validate Case studies framework

According to the DoA, the organization of the EU-CIRCLE case studies (CS) will be implemented in a generic way. Each CS will be organised by local partner(s) who will have the overall responsibility to collect data and feedback and perform the evaluation task during the implementation of the individual case study. Depending on the scenario of the case study, the envisaged CIs and the climate hazard considered, different competent partners will be involved and relevant tools, systems and components of the web-based platform will be used. The approach can be modified to comply to the particularities of each case study and with relative local conditions and specificities.

The sequence, which is indicative and may be subject to spatio-temporal adaptation related to the envisaged case studies include:

A. A **preparatory phase** of the case study

i. Setup – scenario specification design. This task will result in an initial scenario specification which will guide the initial stages of the case study in the quest for the most suitable models and fitting local climate / weather data and CI asset definition;

This phase also involves: 1/ a thorough literature review, historic overview of similar cases either in the region of interest or of similar climatic characteristics and 2/ an examination of the local or national risk assessment to identify the credibility of the derived scenario.

ii. Model implementation and customization. This will result in a very specific elaboration of the web-based tools using CI models, systems and climate / extreme event data required to perform system validation tests (WP5) and EU-CIRCLE evaluation (WP6) for each individual case study;

iii. Case Study Description and preparation, where a specific scenario will be derived, with discrete events and their timeline, CI description, targets and envisaged application of the EU-CICLE framework. During the

course of the actual demonstration different variations of the case study may be tested, for example different climate hazards, timescales introduced, adaptation measures and their comparison and validation etc. Within EU-CIRCLE the utilization of tools such as mindmap, UML business process are suggested to provide a timeline analysis of the scenario.

iv. Data collection. This task involves the collection and processing according to the EU-CIRCLE defined format of the needed data in order to conduct the case study. This task will involve particularly CI assets / networks and auxiliary data (e.g. population, land use / land cover, socio-economic, adaptation technologies costs) which are required in order to feed the Risk and Resilience framework and to smoothly execute the envisaged scenario of each case study and;

B. An **implementation phase** of the case study

i. Organize a (National/Regional/Local or CI operators) training course the day before running the case study scenario (D-1). Participants and local stakeholders will be having the opportunity to familiarize with the EU-CRICLE methodological framework, the web-based tools and the holistic risk/resilience/adaptation framework;

ii. Execute the exercise (as table top) according to the pre-defined scenario (Ai) the next day of the training (D) at the local organization premises, with active participation of local End Users and CI stakeholders

iii. Evaluate EU-CIRCLE by End Users. In the last part of the case study day (D), the participants will provide an independent evaluation of the EU-CIRCLE, according to the framework defined in Task 6.1 and described in this deliverable.

iv. Summarize and Report the results of the case study tests, including all the activities and external experts' responses. The period for collecting feedback and recommendations concerning EU-CIRCLE assessment in context of the case study execution may continue up to one month following the day of the system trial (Day D+30).

Based on the above approach, a sequential scheme will be used to ensure and assess the quality of response of the EU-CIRCLE framework to the case study scenarios, following a stepwise procedure, as shown in Figure 2. The procedure aims to provide a generic approach for the evaluation of EU-CIRCLE, across all five case studies of the project.

The first step of the procedure is to set the context of the validation. This includes the identification of end users that will be involved and related requirements, and the definition of the validation objectives and the relevant criteria that can be used. The second step is to plan each exercise, determining the scenarios, analysing the previous step criteria, and defining the appropriate methods for evaluation. In the third step, the plans will be implemented and the quality of data used, produced and gathered, will be assessed. Finally, the last step includes the analysis of the tests and the reporting of the validation results.

Figure 2 EU-CIRCLE evaluation methodology

The deliverable D6.1 aims to:

- determine the context for running the pilot scenarios that will be used for assessing the EU-CIRCLE framework.

- set up the trial environment, considering the special needs of the scenario and the participating partners.

- provide properly prepared questionnaires, which will be used to validate the reliability, technical feasibility and users' acceptability of the EU-CIRCLE framework and tools and also collect feedback on eventual modifications or improvements that may be required in the future.

More specifically, the document at hand include ways and means that can be used to set up, run and evaluate the EU-CIRCLE framework and the supporting IT tools in context of the project case studies. In particular, regarding the CIRP and SIMICI tools, which are considered the output that integrates all the project's developments, the validation and quality assessment process associated to the case studies shall be comprised of the following elements:

- installation of CIRP components in the demonstration sites;

- feed CIRP with the data of the specific case study;

- training the end users of the system (D-1 day);

- run system with scenario data (D day)

- monitoring of CIRP operation throughout the pilot phase in order to ensure system robustness, usability and operability and;

- evaluation of the CIRP's efficiency, performance, capabilities and usage (D+).

Within the scope of EU-CIRCLE five case studies (pilots) will be conducted:

- Case study 1: Extreme drought and very large forest fires in South France, FR

- Case study 2: Storm and Sea Surge in the Baltic Sea Port of Gdynia, PL

- Case study 3: Coastal flooding across Torbay, UK

- Case study 4: International Event, Bangladesh

- Case 5: Rapid winter ice melting and river floods around Dresden, GER

The quality assurance and validation framework will be applied to the above case studies 1-5.

2   EU-CIRCLE evaluation framework

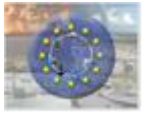### 2.1   Review of "evaluation framework" methodological approach

There are several validation and evaluation techniques, which can vary across the different domains of application as well as according to the technology readiness (TRL) or maturity level (ML) of the envisaged system. When these techniques are analyzed into individual elements and components relevant parameters and taxonomies may emerge. Such elements are based on criteria regarding timing, the way of conducting the validation and its relative purpose. The five basic evaluation criteria that should be considered in a framework are related to relevance, effectiveness, efficiency, impact and sustainability.

In terms of timing, the evaluation can be classified as described here next:

- Ex-ante evaluation (Bourguignon et al, 2002) is a technique, which is applied before the finalization of the development of a specific system and thus it needs to be planned and defined at the first stage of implementation with some degree of detail. The advantage of the ex-ante evaluation is that it allows pre-assessing the relevance and coherence of the envisaged system and its findings are taken into account in the final solution delivered. Therefore, it allows anticipating problems during the development phase, assessing the relevance between strategy and objectives or identifying any inconsistency among them and finally foresee whether the desired impact is realistic. This technique is adequate for conducting baseline development or establishing indicators.

- Mid-term evaluation covers the core period of implementing a specific solution, and since it takes place during the monitoring of outputs and outcomes, it is often confused with that activity, even though they are distinct. This evaluation consists of a series of detailed studies, since it includes further analysis on valuation issues arising during implementation. It allows a consistent and effective collaboration between the evaluator and the person who manages and carries out the intervention, and therefore it generates better and more appropriate conclusions and recommendations.

- Terminal evaluations (JICA, 2004) are usually conducted at the end of cooperative projects. This approach examines on a comprehensive level whether the project objectives were achieved. Consequently, relevance, efficiency, and effectiveness are examined based on the actual situation and performance. Impact and sustainability are examined as well, based on the performance and status of activities up to that point, and with regards to future trends and feasibility.

- Ex-post evaluation (Bourguignon et al, 2002) is carried out not before the intervention is terminated and after a reasonable period of time. It seeks to estimate the efficiency and effectiveness of an intervention, to identify factors of success or failure, to assess the sustainability of results and impacts and to draw conclusions that can be generalized to other interventions. For this reason, the ex post evaluation must be conducted with a delay relative to the end of the implementation and is directed more to future similar solutions rather than the evaluated one.

According to the way the evaluation is conducted we can distinguish the following types (Volkov and Baron, 2011):

- Internal evaluation, can be carried out by organizations, groups or stakeholders directly involved in the implementation of the project solution. This approach is often used in combination with other forms of external evaluation and it is useful to allow those who participate in the implementation to improve their performance and adjust their running programs.

- External evaluation is carried out by specialists outside the development team, who are not employed within the organization responsible for the project under evaluation and who have no personal, financial or direct interest in the project. External evaluations guarantee this way neutrality and they keep the required distance from the object of the evaluation compared to the

case of internal evaluation. However, the advantage of internal evaluations is that they allow to have faster access to information, more in depth knowledge of the system and a wider awareness of it.

Finally, based on the purpose the evaluation can be classified (Benjamin, 1971) as:

- Formative evaluation, which is the case when used to support the involved actors, such as end users, managers and persons directly interested and involved in the development of a system and helps them improving their assessment and decisions in general. Formative evaluation is mainly applied during the project implementation and aims to assess its effectiveness and its relevance.

- The Summative evaluation aims also to determine the effectiveness of a project. It is carried out for the benefit of external stakeholders or decision makers (who are not directly involved in the development of the project). This kind of evaluation is performed, for instance, to assess accountability, reporting on research results or justifying expenses.

For the scope of EU-CIRCLE, the evaluation of the system in context of the case studies' trials will be:

- ex-post, in terms of timing since it takes place after the development stage of the project

- external, since it will be performed in context of demonstration of different cases studies by representatives of CIP practitioners (operators, managers, security experts, public service employees etc.) not related to the consortium

- summative, in terms of purpose taking into account the aim of the evaluation which is to facilitate the members of the consortium, who are directly involved in the project development, to assess its overall functionality.

Having defined the concept and the approach for the validation and evaluation of the EU-CIRCLE solution, we need to proceed selecting the appropriate tools for the evaluation taking into account the existing limitations and resources available. The most commonly used tools and techniques for evaluation purposes (Morra-Imas and Rist 2009) can include observation, SWOT analysis, survey questionnaires, case studies, analytical models, expert panels consultation, cost-benefit analysis (CBA), multi-criteria analysis (MCA) etc.

Based on the particular design and nature of the EU-CIRCLE evaluation, which is based heavily on expert opinion and end-user input, the most appropriate tools that are used for the evaluation needs include the survey questionnaires and the case studies (scenario-based evaluation).

Consultation techniques will play a significant role in the evaluation of the EU-CIRCLE solution, since the feedback from users and system testers through the use of questionnaires will be the cornerstone of the project evaluation methodology. To that end, we present here next the most widely used consultation techniques, which can be used by the consortium to achieve high quality feedback from the cooperating stakeholders of the project and in particular from the participants of the case studies:

- *Interview (or face to face):* Usually the interviews are based on a thorough face-to-face discussion with an individual, in order to gather specific information on individual issues. The interview technique is used to gather qualitative information and opinions of the people involved in a particular program or project, in its context or the outcome or impact. Various forms of talk can be distinguished, each of which carries a different purpose: the informal interview, the semi-structured interview guide-based and structured interview (the stricter approach).

- *Focus groups:* these are interviews/debates aimed at a homogenous group of subjects composed of a number of people (usually from 6 to 12) whose attention is focused on a specific topic that is explored in depth. A moderator directs and leads the discussion among participants and facilitates the interaction. The technique is often applied with a soft qualitative evaluation approach, which is when it is appropriate to use assessments, judgments, opinions expressed by professionals, experts and users/customers to gather the different points of view on a subject, a process, a result, a product etc. For the EU-CIRCLE the focus groups are represented by the stakeholders from the case

study areas.

- *Brainstorming:* brainstorming is one of several non-group techniques developed for the assessment, with the special devotion to facilitate creativity and production of new ideas. The traditional version of brainstorming involves a group of people, better if led by a moderator. The group is asked to produce new ideas rather than comments on old ones, regardless of their value.

As expected the above techniques have a variety of limitations and drawbacks. However, common problems that crop up during evaluation regardless of technique are missing data, simple or subjective classification of data, insignificant or not generalizable information gathering, biased or unreliable answers, arbitrary selection of information, ambiguity of results etc. That is why specific problems derived from a single kind of evaluations could be mitigated by the use of a composite analysis. Therefore, the most indicative combination of consultation techniques for the EU-CIRCLE evaluation during the case study trials comprises of semi-structured, guide-based interviews along with questionnaire-based feedback provided by focus groups. The overall strategy and design for evaluating the software components of the proposed solution is based upon examining 3 main characteristics of the EU-CIRCLE IT tools. They are:

- intuitiveness: how the estimations produced by the EU-CIRCLE tools match those of the end-users or seem expected/reasonable to them;

- usability: ease of use, GUI functionality, output usefulness and;

- ultimately, it's marketability: usefulness to the end-user, willingness to buy.

Since the final tangible output of the EU-CIRCLE platform are the IT tools, namely the CIRP and SIMICI components that the project will deliver, reviewing the usability of such tools is a matter thoroughly researched and largely documented. The same principles that are applied for evaluating usability may also be implemented in the evaluation of the intuitiveness, which is much more difficult to assess. Here next, a reference to the most prominent evaluation methodologies is provided. The most common models are briefly presented and commented:

- The Technology Acceptance Model (TAM) was initially proposed by Davis (1986) as an extension of the Theory of Reasoned Action (TRA), presented by Fishbein and Ajzen in 1975. This theory deals with issues associated to the way users accept and use a new technology. There are major elements in TAM that influence user's decision on how and whether the technology will be used. These two elements are "perceived usefulness" and "perceived ease of use", as depicted in Figure 3. Davis et al. (1989), define "perceived usefulness" as the degree to which a user believes that using a particular system would enhance his or her job performance while "perceived ease of use" corresponds to the degree to which a user believes that using a particular system would be free from effort.
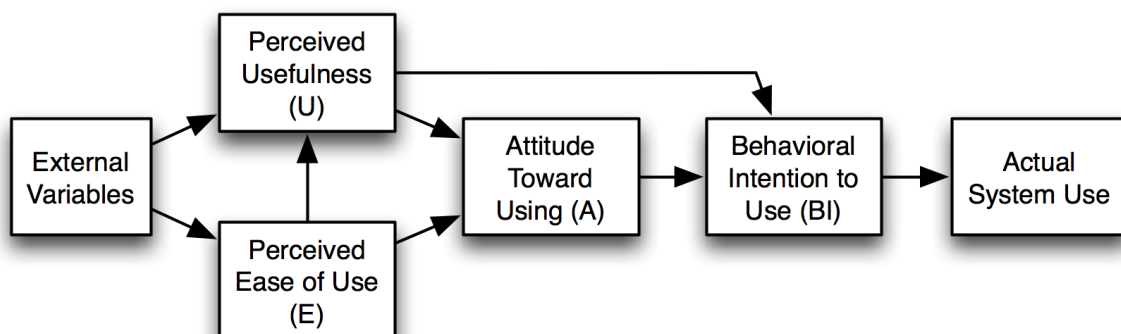

Figure 3 Technology Acceptance Model (Davis, Bagozzi & Warshaw 1989)

- The Diffusion of Innovation (DOI), proposed by Rogers (1962) is a theory based in sociology and it has been used to study a variety of innovation, ranging from agricultural tools to organizational innovation. Within information systems, Moore and Benbasat (1991) adapted the characteristics of innovation presented by Rogers and refined a set of constructs that could be used to study the acceptance of individual innovative systems and technology. These constructs are: Relative Advantage, Ease of Use, Image, Visibility, Compatibility, Results Demonstrability, and Voluntariness of Use. The acceptance of the EU-CIRCLE methodological framework, being an innovative RTD output, could be modelled, based on feedback collected during the project case studies.

- From the software engineering standpoint, in his quality model, McCall (1977) attempted to bridge the gap between users and developers by focusing on a number of software quality factors that reflect both the users' views and the developers' priorities. The so-called McCall's Quality Model has three major perspectives for defining and identifying the quality of an IT system, as shown in Figure 4. They are Product Revision (its ability to undergo changes), Product Transition (its adaptability to new platforms) and Product Operations (its operational characteristics). In context of the EU-CIRCLE use case only the Product Operations can be assessed. Product Revision and Product Transition perspectives could be validated in WP5.
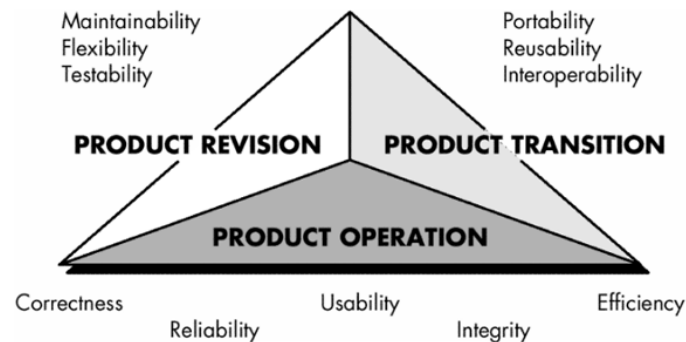

Figure 4 McCall's Quality Model

- Another important evaluation model on software engineering aspects is provided by the Standard ISO/IEC 9126. This standard defines quality by identifying a set of features and attributes that a generic software needs to have. In this respect, software quality is defined as "the set of characteristics that affect the ability of the product to meet explicit or implied requirements". The standard sets out three "points of view" to determine the overall software quality that any development project must take into account and satisfy: External quality, Perceived quality (in use) and Internal quality (intrinsic). Out of these three viewpoints, only the Perceived quality could be partially assessed, during the case studies, as regards the EU-CIRCLE IT tools. As shown in Figure 5, the three points of view on quality influence one another. In fact, software quality, as perceived by the user, is determined gradually through a logical sequence of actions along the development cycle. For the three previously identified views there is a set of basic criteria that define the quality of the products: Functionality, Reliability, Usability, Efficiency, Maintainability and Portability.

Figure 5 ISO/IEC 9126's approach

2.2 Methodology for Risk Evaluation Framework

An effective evaluation, in context of the case study trials, needs to seek as clear as possible answers to the following issues:

1. **What has to be evaluated?**

Although the focus will be to the functionality of the project's IT tools (being the front end of the EU-CIRCLE solution), the intuitiveness of the underlying risk and resilience assessment framework as well as the overall exploitation and operationalization potential of the end-product of EU-CIRCLE will be evaluated.

2. **Who is interested in the evaluation?**

The primary beneficiary of the evaluation will be the consortium in its entirety. All partners will receive valuable feedback regarding the results and findings of the project at various levels, including the technical development, theoretical approach adopted and implemented, etc. Furthermore, the evaluation is important for the stakeholders of EU-CIRCLE since it will document and provide the proof of concept as regards the acceptance of the project approach to support resilience planning of critical infrastructures against potential climate hazards and climate change.

3. **What critical issues have to be tackled?**

The evaluation will be considered to provide positive feedback based on the end-users through physical interaction during the case studies (planning, organization, execution) replying to questions posed by adequate questionnaires, express opinions in the focus groups and end-session interviews, indicating that the EU-CIRCLE solution is:

- performing well and provides useful information

- easy to use

- easy to understand, learn to operate and ultimately facilitates decision making

- reliable, works flawlessly and without a hitch

- equipped with an easy-to-follow interface and features an ergonomic GUI

- providing added value to the end-users and increases the efficiency of their day-to-day activities

4. **What has to be measured?**

Based on the background provided in the previous chapters, the main indices that will be measured through the EU-CIRCLE questionnaire include:

- performance versus expectation

- ease-of-use
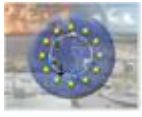
- understandability (intuitiveness)

- reliability of operations

- completeness and reliability of output

- functionality

- man-machine interface

- efficiency

5. How evaluation has to be performed?

The EU-CIRCLE evaluation will be conducted in the following steps:

Preparation (D-)

    i. A test scenario (depending on the area of application) will presented to the end-users and its details will be discussed with the EU-CIRCLE project through the local partner(s) of the consortium

    ii. The consortium will provide a demonstration of the system to the stakeholders of each case study to familiarize them with the EU-CIRCLE methodological framework and the relative approach for assessing risk and resilience. The case study participants should be also provided with information on adaptation options they may test using the EU-CIRCLE solution

    i. After made sure that the end-users have understood the core scenario and following the class demo and training to the system capabilities they are given specific instructions on how to use the EU-CIRCLE platform (input of real or simulated data) in order to model and analyze alternative scenarios (climate, hazards and CI data) and receive the relative risk, resilience and adaptation outputs of the EU-CIRCLE.

    ii. After the training and demonstration, the end-users are allowed to test the software freely, trying out custom scenarios and experiencing the overall performance. The consortium overlooks and support the case study actors to use the system and make them familiar with the approach and tools of EU-CIRCLE.

Implementation (D, D+)

    iii. The EU-CIRCLE equipment is prepared with the required spatial data (of the envisaged case study) and CI information in order to be ready to run the predefined scenario(s)

    iv. Following a specific scenario storyline, the users should be guided through the capabilities of the EU-CIRCLE platform to assess climate risk and CI resilience levels, according to variations of the scenario. The results will be elaborated to identify adequate adaptation measures to reduce risk and enhance resilience.

    v. After the trials have been conducted, the participants are asked to fill a specifically designed questionnaire and individual feedback is collected this way.

    vi. Personal interviews with selected users are organized by representatives of the Technical Committee of the project supported by relevant partners. The purpose is to collect direct feedback concerning the experience of the participants (at the organization or focus group level) in technical and operational issues of the demonstrated system.

vii. At the final stage of the case study execution, all the participants gather together to evaluate collectively the different aspects of the trial and the demonstrated solution. This is where end-users' views are put in perspective within the group and additional conclusions are drawn.

It should be clear that during the case study trials as well as in all the interaction with the stakeholders of the EU-CIRCLE particular attention should be paid to the ethical, legal and societal implications could be created. For this purpose, all involved stakeholders and participants should be informed as regards the purpose and use of personal and operational data that will be used during the trials and the validation work. This means that relative announcements should be made during the case studies, video surveyed/recorded areas should be properly marked, consent forms should be signed when necessary etc.
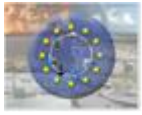
6. Who is involved in the evaluation?

The end-users and stakeholders of the EU-CIRCLE case studies have been identified by the case study owners (local partners). A quite long cooperation has been established with these groups providing input and recommendations concerning the project development and potential scenarios. The stakeholders may vary among the different case studies however they will belong to one of the following groups:

- Stakeholders of the case studies

- CI operators, managers and administrators

- Regional administration and Authorities

- Security service providers

- Security professionals and practitioners

- Meteorological services and meteo-service providers

- Telecommunication providers

- Law Enforcement Agencies (LEAs)

- Homeland security authorities

- Civil Protection Organizations

- Policy makers

- Emergency organisations and First Responders

- Consulting companies (Security and Risk)

- Insurance Companies

In the frame of the evaluation, the participants to the case study trials will be sorted into three main groups as follows:

- R&D providers from relevant research and academic organisations and industry. They mostly belong to the EU-CIRCLE consortium and will be responsible for the organization, preparation and implementation of the trials.

- Decision makers/supervisors from relevant organisations, public services and authorities. This category of end-users will facilitate the collection of information concerning the potential exploitation and use of the EU-CIRCLE solution and they will give feedback as regards the conditions and prerequisites of their organization for expressing willingness to use and adopt the system.

- CI operators, administrators and managers who can provide input based on an operational point of view. They can evaluate the overall risk and resilience assessment framework given

their experience as well as the functionality/output of the EU-CIRCLE solution, in comparison to the solutions they currently use.

Within each of the above stakeholders' categories the consortium additionally set some minimum requirements for selecting participants for the case study trials:

- Participant selected should represent the full range of project stakeholders and in particular they ensure a good degree of "representativeness" of the stakeholders related to the scenario and the local institutional context. To that end, at least one representative of the critical infrastructures involved in the scenario should participate to the trials plus one representative of the Regional or National authority formally in charge of CIP issues.

- Participants should be experienced in their respective field of expertise and should be unbiased and neutrally predisposed towards the system operation and the success of the trials per se.

- The participants should ideally have previous involvement in similar projects and have a good understanding of the purpose they are called to fulfil during the EU-CIRCLE case study trials.

7. How results will be reported?

The results will be presented in suitable style and form, according to the reporting target audience. All the reporting activities have to be planned accordingly, paying attention to the most suitable communication means for the specific audience, in terms of content presentation, type of language, level of details and so on.

The case study organizers will be in charge of identifying and involve the participants of the trials. They are also appointed to distribute and collect the appropriate questionnaires during the case studies. The local organizers will be responsible to identify the representatives of the involved organizations (focus group) that will be interviewed at the end of the trials for gathering feedback on EU-CIRCLE potential and acceptance. The elaboration of the questionnaires, the feedback from the interviews of the focus groups and the conclusions of the debriefing sessions (hot and cold wash) of each case study will be summarized in a proper internal report that will be prepared by the partner leading the WP6 and the respective case study owner within one month from the end of the trial. A consolidated document summarizing the evaluation findings and the feedback and comments of the participants of the trials will be produced then by the WP6 leader and will be further analyzed in context of the D6.7 as outcome of the WP6.4.

3   Organization of the EU-CIRCLE Evaluation through the case study trials

The arrangements for the evaluation trials include the following steps: Firstly, the stakeholders will be contacted by local organizers via e-mail, post mail or telephone and be presented with the overall idea of the case study and its purpose. After receiving a declaration of interest and willingness to participate, the stakeholders will be sent the agenda of the case study trial with an overview of the meeting objective and structure to allow them to be prepared for the trial. The agenda shall include the session program (training and trial implementation), which will describe all the activities to be carried out along with their timing and purpose, the list of participants, information on the place of the meeting and instruction on when be presented and how to reach it. At the beginning of the workshop, selected end-users will be assigned specific roles and respective work positions (computer with relevant CIRP modules and capabilities).

As mentioned in other parts of this document (and the DoA) the case study trials will be performed during two consecutive days. The first day (D-1) will be devoted to training and familiarization of the end users while the second day (D) will be devoted to trials and validation of the EU-CIRCLE outputs. Preparation of the trial will require some of the partners to collaborate the days before the training for setting up and adapt the EU-CIRCLE solution to the individual case study.

All the trials will be filmed by the consortium and the relative material will be used by the WP leader to develop a promo movie concerning the events and the validation output of the trials of the EU-CIRCLE case studies.

3.1   Scenario Presentation

Prior to the distribution of the questionnaire (D day) the end-users will be introduced to the project and be given a demonstration of the capabilities and functionality of the EU-CIRCLE tools (D-1 day). This will be achieved through the use of relevant (to the case study) scenarios prepared by the partner responsible for the organisation of the case study. The following scenarios have been drafted for each test case:

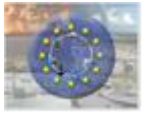### 1)   Case study 1: Extreme Dryness and forest fires on electricity and transport networks

Case Study 1 involves a scenario on dryness and forest fires that impacts transport and electrical networks. The case study area covers around 31,000 km² in south France, and has a population of five million. Inhabitants. The case study occurs during the summer, when the population highly increases due to the presence of tourists, leading to an overloaded flux of people on the railways and highways networks.

The main identified risks in the area are forest fires, floods and snow, while the type of infrastructure that may be impacted are those of Energy, Transport, Health Sector and Emergency Management Services.

The policy objective is to maintain the infrastructure activity during the event. A focus will be on prevention processes such as clearing along highway and railways networks or high voltage line to limit the power of the fire front. Another important aspect are protocols to restore to normal operations in a safe way for public and rescue services.

2)   Case Study 2: Storm and Sea Surge at a Baltic Sea Port, Gdynia Poland

Case Study 2 involves a scenario on oil transport piping transportation system in Baltic sea and a chemical spill due to extreme sea surges. In the first case, increasing stress of weather influence on the operation conditions in the form of maritime storm and/or other hard sea conditions. In the second case, bad weather and hard sea conditions may lead the transported goods to be swept overboard, that will threat the crew and any ship in the area.

In these test cases, infrastructures that may be impacted are those of Energy, Transport, Chemical, Water, ICT, Health and EMS sector. The main climatological related risks identified in the area, are sea level rise, big waves and extreme wind speed.

3) Case Study 3: Coastal Flooding (surface water, highway, sewer and watercourse flooding) across Torbay, UK

Case Study 3 involves a scenario of coastal flooding in the South West of England which covers an area of approximately 62 km^2. Coastal areas of Torbay suffer coastal flooding due to overtopping of sea defences during high tides that coincide with easterly winds. All sources of flooding in the low lying areas of Torbay are exacerbated during high tides and heavy rainfall when capacity of outfalls discharging to coastal waters are reduced.

In these test cases, infrastructures that may be impacted are those of Transport network (roads, rail, buses), Residential properties, Businesses, Commercial properties (shops), Sewer system (pumping stations, infiltration), Electric supply (premises, other critical infrastructure), Tourism (EU designated bathing waters, amenity, attractions), Health (Emergency services disruption, nursing homes).

4) Case Study 4: International Event

Bangladesh is the studied area within the fourth case study, which is highly vulnerable to climate induced hazards and disasters and its coastal part are mostly threatened for the impacts of climate change in case of cyclone, storm surges, flood, salinity and tsunami disaster.

The main focus of the critical infrastructure impacts will be concentrated within the Khulna district on the effect on roads and water infrastructure (most parts of the district do not have electricity, hence will not be a sector that will be considered under infrastructure), which are key to the survival and sustainability of the community.

5) Case Study 5: Rapid Winter Flooding (melting ice, narrow mountain streams, flooding) around Dresden, German

The city of Dresden is the area studied within the 5th case study, using a scenario of river flooding. The main infrastructures that are affected under this circumstance, includes transportation, telecommunications and electricity.

As risk, flooding caused by intense and long rain which led to floods of the Elbe, is identified. However, there is another threat which is happening more often and hence causing more damage because of the currently ongoing climate changes. In cases of heavy rains small streams in the surrounding mountains rapidly grow quite large, especially compared to their normal size, enhancing the flooding.

Each of the above scenarios will be finalised and presented in each test case, and subsequently the end-users will be asked to use the EU-CIRCLE platform in order to assess the risk involved and quantify the CI's resilience within the frame set by the scenario. Step-by-step instructions on how to use each available menu, option and feature of the project's IT tools will be given so that the end-users will be allowed to test the EU-CIRCLE solution in a controlled environment and learn the basics.

3.2 Questionnaire design

There will be two kinds of questionnaire used during the case study trials, which address the audience of the case study trials (1) and the focus groups (2) of each case study. Questionnaire 1 will be distributed the day before the trial (D-1) and it will be filled by all participants and collected at the end of the next day (D).

Questionnaire 2 will be filled collectively by the local partners, selected participants of the trial (focus group) and the leader of WP6.

3.3 The Questionnaire 1

The Questionnaire 1 will be addressed to all participants of the trials and is based on the System Usability Scale (SUS), developed by John Brooke in 1986, which provides a "quick and dirty", though reliable tool for measuring the usability of tested systems. SUS consists of a 10-item questionnaire with five response options for respondents; from Strongly agree to Strongly disagree. It allows to gather evaluation feedback concerning a wide variety of products, systems and services, including hardware, software, mobile devices, websites and applications. SUS has become an industry standard, with references in several articles and publications. The noted benefits of using SUS include that it:

- Is a very easy scale to administer to participants
- Can be used on small sample sizes with reliable results
- Is valid – it can effectively differentiate between usable and unusable systems

When using SUS we need to keep in mind the following issues:

- The scoring system is somewhat complex
- There is a temptation, when we look at the scores, since they are on a scale of 0-100, to interpret them as percentages, while they are not
- The best way to interpret results involves "normalizing" the scores to produce a percentile ranking
- SUS is not diagnostic - its use is in classifying the ease of use of the site, application or environment being tested

The Questionnaire 1 (SUS Questionnaire) invite respondents (the trials participants) to score the following ten items in a scale 1-5 corresponding to the range from Strongly Agree to Strongly disagree. These questions adapted to the EU-CIRCLE needs are the following:

1. I think that I would like to use the EU-CIRCLE platform for operational (planning) purpose
2. I found the EU-CIRCLE solution unnecessarily complex
3. I thought the EU-CIRCLE platform was relatively easy to use
4. I think that I would need the support of significant technical personnel to be able to operate and use the EU-CIRCLE solution
5. I found the various functions in the EU-CIRCLE platform were well integrated
6. I thought there was too much inconsistency in the EU-CIRCLE approach (methodology)
7. I would imagine that most of the interested people would learn to use the platform very quickly
8. I found the EU-CIRCLE platform very cumbersome to use
9. I felt very confident using the EU-CIRCLE platform
10. I needed to learn a lot of things before I could get going with the EU-CIRCLE platform

3.4 The Questionnaire 2 (Focus Groups)

As previously mentioned, the EU-CIRCLE validation questionnaire aims to extract user assessed indicators on the basis of intuitiveness, usability and potential exploitation of the EU-CIRCLE results. For this reason, a specific detailed questionnaire is prepared which will be used to gather comprehensive information from selected users and testers of the EU-CIRCLE platform after they have experienced the capabilities and the use of the system during the case study trials. This will be done with the Questionnaire 2. The main body of this questionnaire is split in four sections corresponding to the above indicators and it is analysed here next. Initially, we considered designing multiple questionnaires specifically intended for each one of our main end-user categories. However, this approach would create confusion and burdening among the

consortium and the stakeholders while it would also be limiting to the conclusion extraction process without any real benefit other than having several somewhat smaller questionnaires instead of a single larger unified one. A unified questionnaire, instead, would render the evaluation process more open-ended, which is the EU-CIRCLE request in interacting with the stakeholders' groups, enabling all categories of end-users to speak their mind on any subject they might have something to say on. This would additionally assist in introducing the focus groups into the deeper aspects of the EU-CIRCLE solution and paint a more complete picture on what the evaluation task that they participate in is all about. Moreover, end-users with an "intermediate" role (e.g. decision makers with risk assessment or IT expertise) can evaluate the tool holistically using a unified questionnaire.

Taking everything above into consideration, the questionnaire that emerged is split into four main sections each aimed at examining a different aspect of the end-users' view on the CIRP. They will additionally facilitate the reporting of the feedback collected as they set the pillars upon which the evaluation is based. These sections are:

General Information

This is the introductory part of the questionnaire where the end-user identifies themselves and provides information about his role/expertise along with some contact information. This is done to facilitate data analysis and help draw useful conclusions regarding the point of view of each end-user and how that affects their answers.

Intuitiveness

In this section the end-user evaluates the overall framework of EU-CIRCLE on its efficiency, speed and accuracy based on their expertise and experience using similar tools wherever applicable. Several indicators are used to estimate overall satisfaction and credibility of produced output as well as identify suggestions for improvements and use cases which the tool facilitates. If the end-users appear to be positively disposed towards the EU-CIRCLE intuitiveness answers like "Strongly agree" or "Agree" are expected to arise since all questions are "positively expressed". This would be a clear indication of a favourable evaluation of the soundness of the EU-CIRCLE risk assessment framework and additionally it would indicate that the EU-CIRCLE results offer significant advantages over existing needs, requirements, procedures and currently available tools.
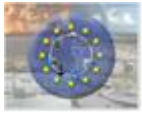
Usability

This section is used for the evaluation of the tool on a more technical/user-experience basis. Indicators of ease of use and convenience are used along with questions regarding potential problems with actual use, speed and user interface. Throughout this section an assessment of how favourable is the opinion of the end-user on the following matters:

- performance expectation
- ease-of-use
- understandability
- reliability
- functionality
- man-machine interface
- efficiency

Exploitation of results

This section of the questionnaire is particularly designed to aid in the understanding of the tool's market and provide added value to WP5 of the Project. The end-user is asked questions pertaining to the perceived value of the tool. Furthermore, indicators relating to the willingness to procure relevant tools or its related services are also considered along with an evaluation of the tool's innovation aspect and utility. In addition,

data concerning the organization the end-user represents are gathered in an effort to formulate a more precise image of the EU-CIRCLE potential market.

The Questionnaire 2, which will be filled in a semi-structured interview context by the EU-CIRCLE consortium and selected end-users (focus groups) after the end of each case study trial is attached at the end of this deliverable (Annex). The answers provided by the focus group will be developed in a specific validation report for each case study.
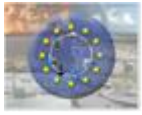
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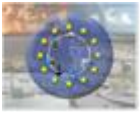
Annex I - System Usability Scale Questionnaire (Questionnaire 1) – All participants

	Strongly disagree				Strongly agree

1. I think that I would like to use this system frequently

1	2	3	4	5

2. I found the system unnecessarily complex

1	2	3	4	5

3. I thought the system was easy to use

1	2	3	4	5

4. I think that I would need the support of a technical person to be able to use this system

1	2	3	4	5

5. I found the various functions in this system were well integrated

1	2	3	4	5

6. I thought there was too much inconsistency in this system

1	2	3	4	5

7. I would imagine that most people would learn to use this system very quickly

1	2	3	4	5

8. I found the system very cumbersome to use

1	2	3	4	5

9. I felt very confident using the system

1	2	3	4	5

10. I needed to learn a lot of things before I could get going with this system

1	2	3	4	5

Annex II - Questionnaire2 (Focus Groups)

EU-CIRCLE End-User Test Trial Questionnaire

General Information

1. Name

_____

2. Contact details

Address:	
Telephone:	
E-mail:	
Website:	

3. Name of your company/organisation

_____

4. Function/Post within company or organisation

_____

EU-CIRCLE Framework Validation - Intuitiveness

5. Using the EU-CIRCLE platform would enable me to assess risks and define resilience more quickly than with my current methods.

    (Risk)   ☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

    (Resilience)   ☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

6. If you (strongly) agree, which tasks do you think it would be completed in a better or faster way?

_____

_____

7. **Using the EU-CIRCLE platform would enable to assess unexpected likelihood/consequences of eventual climate/climate change incidents more accurately than with your current methods?**

☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

8. **Using the EU-CIRCLE solution would enable you to take into account multiple risk scenarios and more threats than currently existing tools/methods allow.**

☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

9. **Using the EU-CIRCLE solution would help you to understand impacts originating from secondary effects (propagated consequences).**

☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

10. **Using the EU-CIRCLE solution would enable you to manage risks/strengthen resilience more effectively than you can now.**

(Risk)   ☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

(Resilience)   ☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

11. **Please elaborate (e.g. More accurate time management, better resource planning).**

12. **I find the EU-CIRCLE risk/resilience estimations to be very close to what I would expect from my experience.**
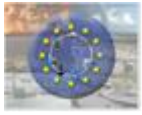
(Risk)   ☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

(Resilience)   ☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

13. **In my opinion the overall Risk Assessment/Resilience Framework as showcased by the EU-CIRCLE appears to be appropriate and correct.**

(Risk)   ☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

(Resilience)   ☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

Product Assessment – Usability

14. The EU-CIRCLE works the way I want it to work.

☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

15. If you (strongly) disagree which components do you find problematic and why?

_____

_____

16. Working with the EU-CIRCLE platform it was a nice experience

☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

17. Does your organisation have records of the assets and is interested in continuing using EU-CIRCLE?

☐Yes   ☐No

18. If yes, in what format is the data available (also consider available conversion tools)?

☐GIS   ☐Google Earth ☐ASCII ☐XML ☐Other (specify):_____

19. The EU-CIRCLE platform is generally easy to learn how to use

☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

20. If you (strongly) disagree, which component(s) did you find difficult to use and why?

_____

_____

21. Did you encounter problems while using the EU-CIRCLE platform?

☐Yes   ☐No

22. If yes, were you able to recover from these errors easily and quickly?

☐Yes   ☐No

23. In case you would be a formal user, which kind of support do you prefer?

☐FAQ   ☐E-Mail ☐Telephone-Hotline   ☐Internet

24. I find the information provided by EU-CIRCLE platform to be:

☐Very Clear   ☐Clear enough ☐A bit confusing ☐Incomprehensible

25. I find the terminology used in EU-CIRCLE to be (please tick all that apply):

☐Consistent   ☐Understandable/Clear ☐Compliant to standard terms   ☐Inconsistent

26. **I find the error/help messages of the platform to be:**

☐Helpful   ☐Quite complex ☐Not really useful   ☐Incomprehensible

27. **I think the platform's user interface is (please tick all that apply):**

☐Well-designed/Ergonomic   ☐Polished   ☐Simple   ☐Intuitive

28. **I find the responsiveness of the EU-CIRCLE platform to be:**

☐Very fast   ☐Reasonably fast   ☐Underwhelming   ☐Too slow

29. **Overall, I find the EU-CIRCLE solution to be:**

☐Very reliable   ☐Reliable enough   ☐Not very reliable   ☐Unreliable

30. **The EU-CIRCLE solution can cover all levels of end-users (both technically and operationally oriented users)**

☐Strongly agree ☐Agree   ☐Disagree   ☐Strongly disagree

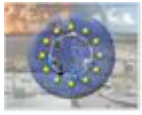31. **What other information or functionality would you like to see in the EU-CIRCLE platform?**

_____

_____

32. **Do you have any further comments about the risk/resilience assessment method or the CIRP?**

Risk: _____

  _____

Resilience: _____

  _____

Business Model - Marketability

33. Type of end-user's entity

    ☐Private   ☐Public   ☐Other (Specify: _____)

34. Entity form of business

    ☐Profit   ☐Non-profit

35. Entity level of operation

    ☐Local   ☐Regional   ☐National   ☐International

36. Entity annual turnover: _____€

37. How innovative do you find the EU-CIRCLE solution to be?

☐It's something completely new and exciting for me
☐I am aware of other tools with similar functionality but this is the first time I get to use one
☐I think the EU-CIRCLE is better in comparison to similar products
☐I think the EU--CIRCLE is lacking compared to similar products

38. How often do you "risk-assess" or "estimate resilience" in your infrastructure?

Risk

☐Weekly   ☐Monthly   ☐At a 6-month interval
☐Yearly   ☐Less than once per year

Resilience

☐Weekly   ☐Monthly   ☐At a 6-month interval
☐Yearly   ☐Less than once per year

39. Are you willing to share your data with other entities that may use EU-CIRCLE?
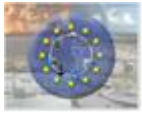
    ☐Yes   ☐No   ☐Partially

Please elaborate:

_____

_____

40. Would you be interested to use the EU-CIRCLE solution (once commercialized) and fine-tune it to your specific needs?

    ☐Yes   ☐No

41. If yes, which one of the following services would you be interested in (please tick all that apply):

☐Online access to EU-CIRCLE services
☐Local Installation
☐Incorporation of the functionality into your network/back-office systems
☐Technical support (customer model development, client networks data-entry)
☐Software maintenance
☐Content analysis
☐Staff training

42. Which form of payment would you find convenient for the EU-CIRCLE services (please number in order or convenience – from 1 "most convenient" to 4 "least convenient")?

☐One-off   ☐Yearly/Monthly fee   ☐Per use fee   ☐Per license/user fee

43. How much would you be willing to pay to gain access to the EU-CIRCLE functionality?

Price Range

Service provision			
One-off	☐Less than 2,000€	☐2,000€ - 4,000€	☐More than 4,000€
Yearly fee	☐Less than 2,000€	☐2,000€ - 4,000€	☐More than 4,000€
Per use fee	☐Less than 100€	☐100€ - 1,000€	☐More than 1,000€
Per license/user fee	☐Less than 500€	☐500€ - 2,000€	☐More than 2,000€

44. Would you recommend the EU-CIRCLE solution?

☐Yes   ☐No   ☐With modifications

Please elaborate:

_____

_____