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Capability Project

RECONASS' User Requirements

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ABBREVIATIONS AND ACRONYMS

ABBREVIATION	DESCRIPTION
DBA	D. Bairaktaris & Associates Structural Design Office LTD
DEC	Disasters Emergency Committee
EC	European Commission
FEMA	Federal Emergency Management Agency (US)
FOI	Swedish Defense Research Agency
GDACS	Global Disaster Alert and Coordination System
GIS	Geographic Information Systems
GS	GeoSIG AG Switzerland
GSM	Global System for Mobile Communications
HAZUS	FEMA's Methodology for Estimating Potential Losses from Disasters
IASC	Inter-agency Standing Committee (UN)
ICCS	Institute of Communications and Computer Systems,
ITC	University of Twente, Department of Earth Systems Analysis, Faculty of Geo-Information Science and Earth Observation
IRP	International Recovery Platform
NATF	Needs Assessment Task Force
NGO	Non-governmental organisation
OCHA	Office for the Coordination of Humanitarian Affairs (UN)
PDNA	Post Disaster Needs Assessment
RISA	RISA Sicherheitsanalysen GmbH/RISA Safety Analysis Ltd
TECNIC	Techniche e Consulenze Nell' Ingegneria Civile SPA - Consulting Engineers S.p.A
THW	Federal Agency for Technical Relief
TUD	Technical University of Dresden
UAV	Unmanned Aerial Vehicle
UNDAC	United Nations Disaster Assessment and Coordination team
UNDP	United Nations Development Programme
UNOSAT	United Nations Operational SATellite (UNITAR)
WB	World Bank
WLAN	Wireless Local Area Network

GLOSSARY OF TERMS

Term	Definition
ATC-58 Project	The Applied Technology Council (ATC) – US -has entered into a contract with the Federal Emergency Management Agency (FEMA) –US- to develop a next generation performance-based seismic design guideline for buildings (project ATC-58). The work includes a building taxonomy and damage states for several structural and non-structural components.
Business Requirement (BR)	A BR is a statement of the functions needed in order to accomplish the business objectives. It is the highest level of requirement, developed through the dictation of policy and process by the business owner.
Business Rule (RU)	An RU is a statement that defines or constrains some aspect of the business. It is intended to assert business structure, or to control or influence the behaviour of the business. The RUs that concern the project are atomic in that they cannot be further decomposed and they are not process-dependent, so that they apply at all times. Business rules typically fall into one of five categories: terms, facts, derivations, assertions or action enablers.
Damage or Limit State	For a particular component, or the building as a whole, a range of damage conditions associated with unique consequences.
Floor Acceleration	At a floor level, the acceleration of the centre of mass relative to a fixed point in space.
Functional Requirement (FR)	An FR is a statement of an action or expectation of what the system will take or do. It is measured by concrete means like data values, decision making logic and algorithms.
GEM (Global Earthquake Model)	In the GEM project researchers from different countries are developing a physical earthquake risk estimation model of global use. In it a common terminology or taxonomy is critical to document variations in building design and construction practices around the world
In-Plane Behaviour	Behaviour that occurs in the direction parallel to the orientation of the element, which is typically a wall. The term is often used to describe failure, where for instance door and window openings in a wall may no longer have right angle corners.
Interstory Drift	The relative horizontal displacement of two adjacent floors in a building. Inter-story drift can also be expressed as a percentage of the story height separating the adjacent floors.
Non-functional Requirement (NR)	An NR is a low-level requirement that focuses on the specific characteristics that must be addressed in order to be acceptable as an end product. NRs have a focus on messaging, security, and system interaction.
Non-structural Components	In this work these are components that are a permanent part of the building and are not part of the structural system.
Out-of-Plane Behaviour	Behaviour that occurs in the direction perpendicular to the orientation of the structural element, which is typically a wall. The term is often used to describe failure, where for instance a wall may deform outwards or completely collapse into the adjacent street or valley.
Scenario	A scenario is a sequence of steps taken to complete a user requirement, similar to a use case.
Structural Components	Building components that are part of the intended gravity, seismic, blast/impact or fire forces resisting system, or that provide measurable resistance to these forces.

Term	Definition
Taxonomy	A hierarchical classification system
Unreinforced Masonry Wall	Clay brick, concrete or natural stone units bound together using lime or cement mortar to form o wall, without any reinforcing elements such as steel reinforcing bars.
Use Case	A use case is a description of a system's behaviour as it responds to a request that originates from outside of that system. The use case is made up of a set of possible sequences of interactions between systems and users in a particular environment and related to a particular goal. The use case should contain all system activities that have significance to the users. Use cases typically avoid technical jargon, preferring instead the language of the subject matter expert.
User Requirement (UR)	A UR is a statement of what users need to accomplish. It is a mid-level requirement describing specific operations for a user (e.g., a business user, system administrator, or the system itself). They are usually written in the user's language and define what the user expects from the end product.

EXECUTIVE SUMMARY

The present third deliverable of work package 1 "User Requirements and System Architecture" contains the final user requirements as basis for the system specification process. The previous deliverable D1.1 "State-of-the-Art of Assessment Tools and preliminary user requirements" was the initial step to define user requirements for the RECONASS system. It was followed by the end user meeting resulting in deliverable D1.2 "Proceedings of the first workshop". With the help of scenarios, the preliminary user requirements were discussed and additional user requirements were gathered.

In order to be able to classify the different user requirements, the framework behind is initially introduced. This framework covers the definition of the RECONASS sub systems and modules, the types of RECONASS users, the distinction between functional and non-functional user requirements and the description of the prioritization system.

Then the process to collect and specify the user requirements is described, from preliminary user requirements through creation and use of questionnaires to the end user workshop and the final analysis.

Building on this, general results are presented to better understand the meanings and prioritisations of the final user requirements. Then the non-functional user requirements and the functional user requirements are listed and explained in order of non-functional requirement type and respective RECONASS sub system.

The presented finalised user requirements are prerequisites to specify the RECONASS system, which will be the aim of deliverable D1.4. The system requirements in D1.4 will give a more detailed description of the RECONASS system that is necessary to fulfil the user requirements.

Many ideas were collected among possible users of the RECONASS system and some user requirements are prioritised as "musts" but technical, legal or financial reasons may lead to the decision, that some user requirements cannot be translated into specifications. But the described process helped the developers to better understand the user needs. The end user participation will be continued in work package 7, the evaluation of the RECONASS system during its development process.

1. INTRODUCTION

This third deliverable of Work package 1 presents the user requirements for the RECONASS system based on the preliminary user requirements (Deliverable 1.1) and the results of the end user workshop (Deliverable 1.2).

The RECONASS system aims to develop a monitoring system for buildings and comparable constructed facilities. The monitoring data will be fed to the RECONASS Structural, Economic Loss and Needs Assessment Module. This software module will provide a near real-time assessment of the structural and non-structural damages and the structural condition of the monitored facility.

This damage assessment will be completed by oblique airborne observations providing a 3D geometric reconstruction of the building exterior and its damages. These three RECONASS sub systems and its modules are assembled in section 2.1.

In chapter 2, further parameters describing the user requirements are specified, such as user types, user requirement types and the prioritisation system. Based on this, chapter 3 describes the user requirements specification process.3.

The resulting user requirements are covered with general remarks in chapter 4. Chapter 5 lists and explains the non-functional requirements and chapter 6 follows up with the functional requirements. Conclusions are given in chapter 7.

1.1. Objectives

In order to create a system that is needed and accepted by the users, **the first step is to collect, analyse and document user requirements**. As there are many different possible users, such as building operators or emergency managers, and as the RECONASS system will include different sub systems and modules, there will be a large variety of different user requirements.

These different requirements must be organised to enable tracking during the next steps, the translation into system specifications and the system evaluation. Consequently the user requirements are needed for these further system development steps.

The user requirements state the services, which the system is expected provide to system users and the constraints, under which it must operate. The user requirements are not the system requirements, which give more detailed descriptions of the system and will be part of the RECONASS specification document deliverable D1.4.

The overall goal is to ensure that the RECONASS system complies with the user requirements. This will lead to a system, which will be user friendly and does, what the user expects from such a system.

1.2. Methodology and Related Work

The present document is the result of the work described in document "D1.1: State-of-the-Art of Assessment Tools and preliminary user requirements" [1] and "D1.2: Proceedings of the first workshop" [2] that can be retrieved at www.RECONASS.eu .

In the first deliverable, the state of the art of assessment tools and of the fields related to RECONASS research activities was described. Subsequently, lessons learnt from further events with damaged and collapsed buildings were presented.

With the aid of a **specialised user group**, **preliminary user requirements** as prerequisites for the first RECONASS end user workshop (deliverable 1.2) and **the final RECONASS user requirements** were gathered.

This was initially performed using the **RECONASS end-user questionnaire** that was adapted to the different background of different user types.

At the end user workshop, see D1.2 [2], members of the RECONASS end user group worked with the questionnaire results and the preliminary user requirements with reference to different scenarios to formulate user requirements for the RECONASS tool.

In deliverable "D1.4: Full specification set for the RECONASS system" the user requirements and further technical requirements will be used to to specify the RECONASS system as basis for its development.

The resulting system will be evaluated throughout the whole development process to ensure the usability of the system ant that it is conform with the user requirements. Part of the evaluation process will be a preliminary demonstration and table top exercise followed by component testing leading to deliverable "D7.1 Results of component testig". Deliverable "D7.2 Structural and non-structural damage evaluation of software modules including image based monitoring" and Deliverable "D7.3 Evaluation f the RECONASS System" will conclude the evaluation process.

2. FRAMEWORK FOR THE USER REQUIREMENTS

Introduction

This chapter provides background information to understand the user requirements and its relations to the RECONASS system. The RECONASS system and the modules are described and the different user types. The user requirements are divided into functional and non-functional requirements and prioritised.

2.1. The RECONASS System

The RECONASS system can be divided into the main sub systems "**RECONASS Monitoring System**", "**RECONASS Structural, Economic Loss and Needs Assessment Module**" and "**UAV Damage Mapping System**". These three sub systems consist of further modules that are compiled in the following Table 1 with the responsible RECONASS partners.

Table 1: The RECONASS system and its sub systems with responsible partners

1.	**RECONASS Monitoring System**
1.1.	Overall Monitoring System and interfaces
1.2.	Acceleration Sensors(GS)
1.3.	Strain Sensors (GS)
1.4.	Temperature Sensors (GS)
1.5.	Local Positioning System (TUD)
1.6.	Data Hub (GS)
1.7.	Communication Gateway Module (ICCS)
2.	**RECONASS Structural, Economic Loss and Needs Assessment Module**
2.1.	Assessment Module and interfaces (DBA, TECNIC AND RISA)
2.2.	Structural Assessment Module (DBA)
2.3.	Economic Loss and Needs Assessment Module (TECNIC)
2.4.	PCCDN Software Tool (RISA)
3.	**UAV Damage Mapping System**
3.1.	UAV System and Interfaces(ITC)
3.2.	UAV Damage Mapping (ITC)

The enumeration system is used to classify the user requirements in chapter 4 and is used to classify the sub systems in the following deliverbale "D1.4: Full specification set for the RECONASS system".

2.2. RECONASS user types

As the RECONASS system consists of such different sub systems and will be used during the regular usage of the building as well as during the response and recovery phase after damaging events diverse users will be confronted with the RECONASS system. Consequently the following user types were defined:

A. Governmental Emergency / Disaster Response Organisations

B. Non-Governmental Emergency / Disaster Response Organisations

C. Public Operators of Critical Buildings

D. Private Operators of Critical Buildings

E. Organisations involved in the development of remote sensing based damage maps

F. Organisations involved in synoptic damage prediction based on acceleration measurements, insurance companies, etc.

With the help of these user types, the relevant (or respective) user requirements (see section 4) and the user group members (see [2]) are classified. But still the users assigned to one user group differ in training and their fields of activity. For instance the user belonging to user type A – "Governmental Emergency / Disaster Response Organisations" may be an engineer who is trained to assess the building damage state or an emergency shelter specialist.

2.3. User requirements types

The user requirements are distinguished between **functional (FR)** and **non-functional (NFR)** after [3]:

1. Functional requirements (FR): These are statements of services the system should provide, how the system should react to particular inputs and how the system should behave in particular situations. In some cases, the functional requirements may also explicitly state what the system should not do.

2. Non-functional requirements (NFR): These are constraints on the services or functions offered by the system. They include timing constraints, constraints on the development process and standards. Non-functional requirements often apply to the system as a whole. They do not usually just apply to individual system features or services.

In reality, the distinction between different types of requirement is not as clear-cut as these simple definitions suggest. A user requirement concerned with security, such as a statement limiting access to authorized users, may appear to be a non-functional requirement. However, when developed in more detail, this requirement may generate other requirements that are clearly functional, such as the need to include user authentication facilities in the system (Sommerville 2011). Especially the interface requirements – both user interfaces and interfaces with other systems - are here defined as non-functional requirements because the interfaces describe how the system behaves.

The ISO/IEC 25010 standard classifies software quality and is used to classify non-functional requirements. It includes sub-types such as "interoperability", "usability", performance and "availability" and it is used for a more detailed classification of the final user requirements in chapter 5

2.4. User requirements prioritisation

The prioritization of the user requirements uses the MoSCow attempt [4] using the following four cathegories:

M - MUST: Describes a requirement that must be satisfied in the final solution for the solution to be considered a success.

S - SHOULD: Represents a high-priority item that should be included in the solution if it is possible. This is often a critical requirement but one which can be satisfied in other ways if strictly necessary.

C - COULD: Describes a requirement which is considered desirable but not necessary. This will be included if time and resources permit.

W - WONT: Represents a requirement that stakeholders have agreed will not be implemented in a given release, but may be considered for the future. (Note: occasionally the word "Would" is substituted for "Won't" to give a clearer understanding of this choice)

The prioritisation is a result of the user questionnaires and user workshop. However the main goals of the RECONASS system were described in the project's Description of Work. The consortium will have to decide, which additionally requested functions of the system can be realized within the scope of the already defined research project.

3. USER REQUIREMENTS SPECIFICATION PROCESS

Introduction

This chapter describes the specification process of the user requirements, which were specified in four consecutive steps. **At first, preliminary user requirements were collected**. Based on the first results, a **questionnaire was created**. Preliminary user requirements and the questionnaire results **were evaluated and accomplished during the first end user workshop**. The analysis of this input led **to the finalised user requirements**. The results will be presented in the following chapters.

3.1. Preliminary user requirements

The preliminary user requirements presented in Deliverable D1.1 [1] base on the state of the art analysis and the analysis of the disaster events, both presented in D1.1. Further input from the RECONASS partners and from experienced THW members led to the questionnaire to accomplish, specify and consolidate the user requirements.

The preliminary user requirements table comprises of 102 user requirements. These preliminary user requirements were the basis of the following workshop on user requirements and the document on final user requirements. The classification system of the preliminary user requirements was extended for the classification of the final user requirements.

3.2. Questionnaires

In order to generate first user requirements and to prepare the following end user workshop, a questionnaire was created in cooperation with all RECONASS consortium members and sent out to the first organisations that were invited to join the user group, see D1.1 [1]. Two versions of the questionnaire for the different user types were developed, one for the user group A and B -emergency and disaster responders- and one for the user group C and D –building operators-. The members of group E and F answered the questionnaires with the most relevance to their activities.

The questionnaire document was realised as adobe pdf document with the functionality to collect user entries and export it to other applications, see D1.1 [1]. Actually 20 questionnaires were sent back with many remarks that have been translated to user requirements.

The completed questionnaires can be taken from the Annex.

3.3. End user workshop

With the help of the end user workshop it was explored how potential end users proceed with damage and needs assessment. Additionally the preliminary user requirements were evaluated. The central objective was to obtain as much input as possible from potential end users. The workshop took place in Berlin, Germany, 24th & 25th of March 2014. Within the workshop, end users were divided into two mixed groups in order to discuss, evaluate and consolidate the preliminary user requirements. The results are documented within deliverable D1.2 [2]. Participants from 18 organisations attended the workshop.

The two groups covered different scenarios, and even though each group presented quite specific findings, the main outcome is characterised by a significant level of congruity. End users wish to receive the data and the information in a simple and robust way, easy to handle. Furthermore the RECONASS system should be open for a broader detection of hazards such as gas or aftershocks, temperatures (fires, etc.), flooding, and allow interoperability with other monitoring systems as well. General findings of both working groups confirm the

findings of the RECONASS end user requirement questionnaire, e.g. the importance of a monitoring and alarm function of the RECONASS system.

3.4. Finalisation of the user requirements

The finalised end user requirements result from the prior steps including end user participation through questionnaires and during the first end user workshop (compare Figure 1). The questionnaire results were used to prepare the end user workshop and after review within the consortium were included into the finalised user requirements list.

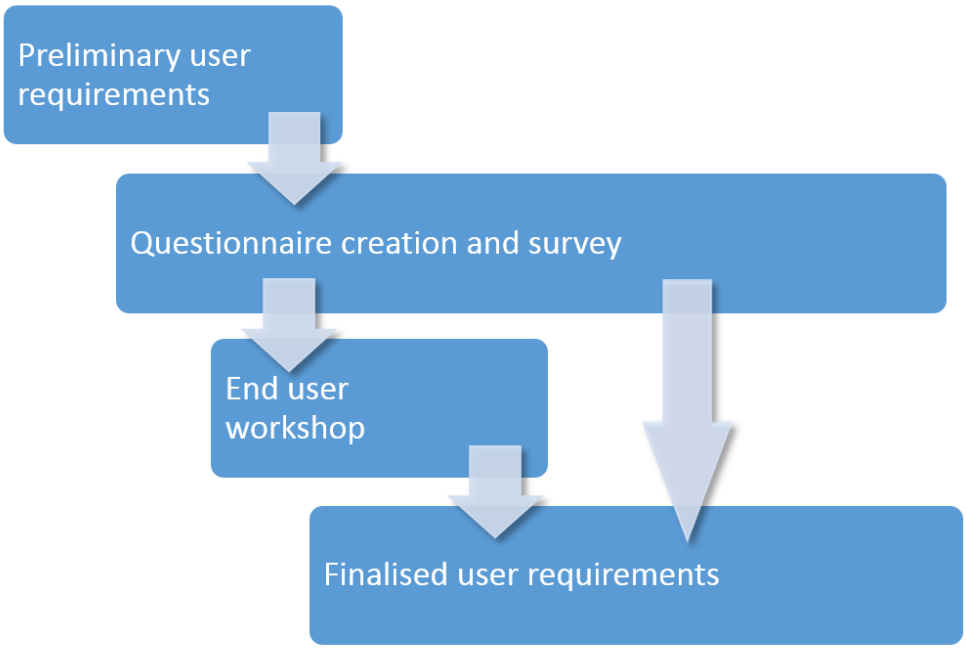

Figure 1: The user requirements specification process

The preliminary user requirements and the results from the workshop were also reviewed to assess the conformity with the RECONASS description of work document and feasibility of each user requirement (see section 6.4).

But even when the user requirements passed this first assessment, it may still be possible that some user requirements will not be possible to be implemented into system specifications in the following system specification steps. The main goals of the RECONASS system were described in the project's Description of Work. The consortium will have to decide, which additionally requested functions of the system can be realized within the scope of the already defined research project.

4. USER REQUIREMENTS OVERVIEW

Introduction

The user requirements, which are resulting from the specification process, are classified as functional and non-functional requirements. The following chapters 5 and 6 list the requirements. This chapter contains general findings to better understand the meanings and prioritisations of resulting user requirements.

4.1. Comparison of the questionnaire results from different user categories

In addition to the 14 questionnaires from user groups A and B (governmental and non-governmental response teams) that were evaluated in Deliverable D1.2 [2], six questionnaires have been submitted from representatives of the user groups C and D (public and private operators of critical buildings). As many of the questions in both questionnaires are identical, it is possible to directly compare the answers of both user types.

Figure 2, on the left, shows the results for the question: "Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?", answered by user groups A and B. Figure 2, on the right shows the results for the same question, answered by the user groups C and D.

The results clearly point out, that a simple and easy understandable presentation of an aggregated building status is not only essential to response teams approaching a damaged or collapsed building. It is also important for the building operators, allowing them to get a first approximate classification of the buildings condition before going more into details. The related user requirement is FR-025 (see page 36).

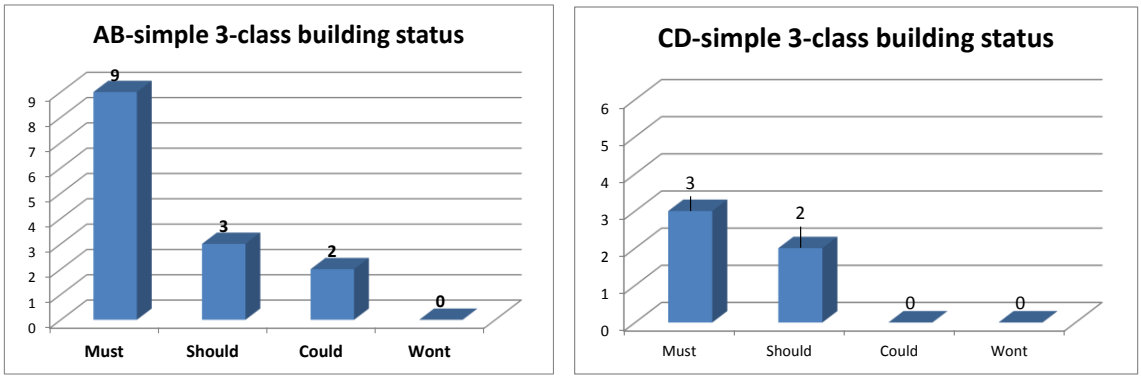

Figure 2: Disaster response organisations (AB, left): required building status classification and operators of critical buildings (CD, right)

In contrast the question "**Do you need:** the actual **measured data** such as stresses and plastic deformations?" shows that the opinions differ widely among the user group A and B, but is answered distinctively with "yes" from the user groups C and D (see Figure 3). This indicates a clear demand for the data, measured by the sensor networks in the building. The related user requirement is NFR-026 (see page 28) FR-114 (see page 35) and FR-130 (see page 35).

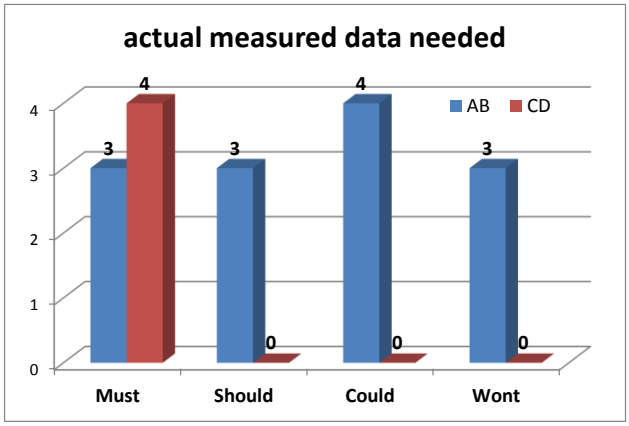

Figure 3: Answers to "Do you need: the actual measured data such as stresses and plastic deformations?" by disaster response organisations (AB, blue) and operators of critical buildings (CD, red)

Further detailed information needed by the two groups differ as well. This can be seen in Figure 4 and Figure 5. Responders would prefer aerial photos whereas operators of critical buildings are more interested in data about the building state such as "remaining load capacity". Responders need to get as much information as possible when deciding about significant and far reaching actions such as putting team members at risk by entering damaged buildings. Due to this reason they tend to interpret the delivered data and information by themselves because the lives of their response team members depend on this decision. (Related user requirements are: NFR-040, see page 29, NFR-094 and NFR-095, page 29)

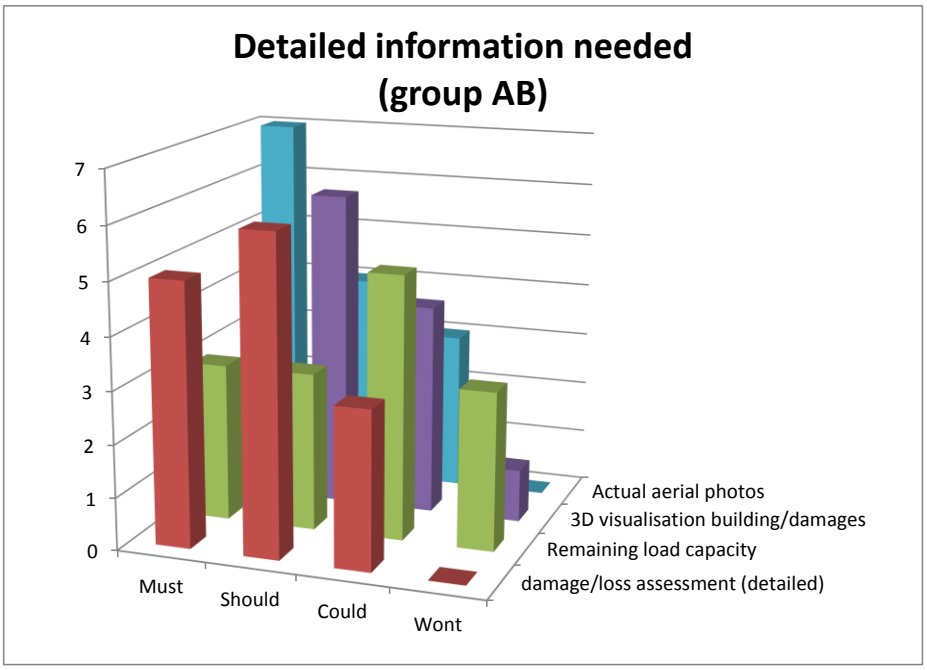

Figure 4: Areas, where detailed information is needed by user group AB - disaster response organisations

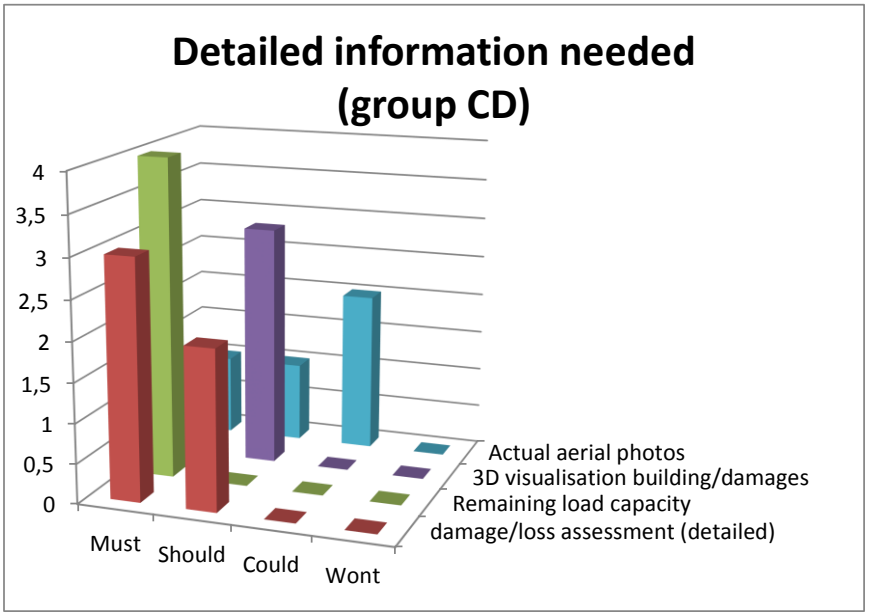

Figure 5: Areas, where detailed information is needed by user group CD – operators of critical buildings

The question "What would be the specific losses and needs to be identified by the PCCDN?" (see Figure 6) shows that the user groups A and B (disaster responders) clearly are focussed on the damage assessment and the needs for shoring and shelter, which are all three typical problems to be solved by first responders during the first phases of an incident involving damaged or collapsed buildings. (FR-043 – FR-050, see page 29).

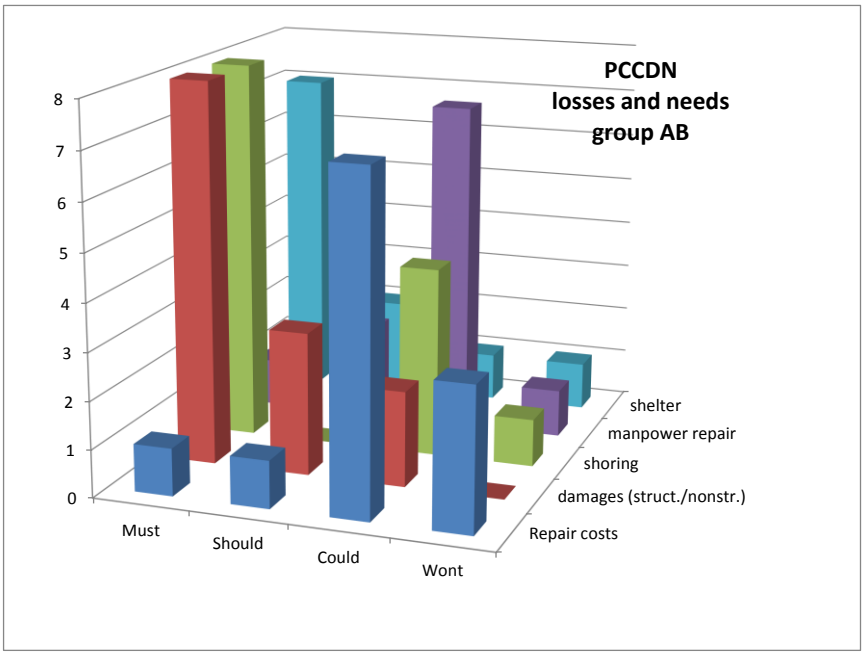

Figure 6: Disaster response organisations: results for question 3.2 "What would be the specific losses and needs to be identified" by the PCCDN tool?

Representatives from the user groups C and D (building operators) have a completely different point of view. As their work will begin when the first responders operations are over, their focus is clearly on the structural and non-structural damages (see Figure 7). Their answers also indicate a strong demand for the estimated repair costs,

needs for shoring or demolition and the manpower for reconstruction, as their main motivation is to get the damaged building to be repaired or replaced as soon as possible.

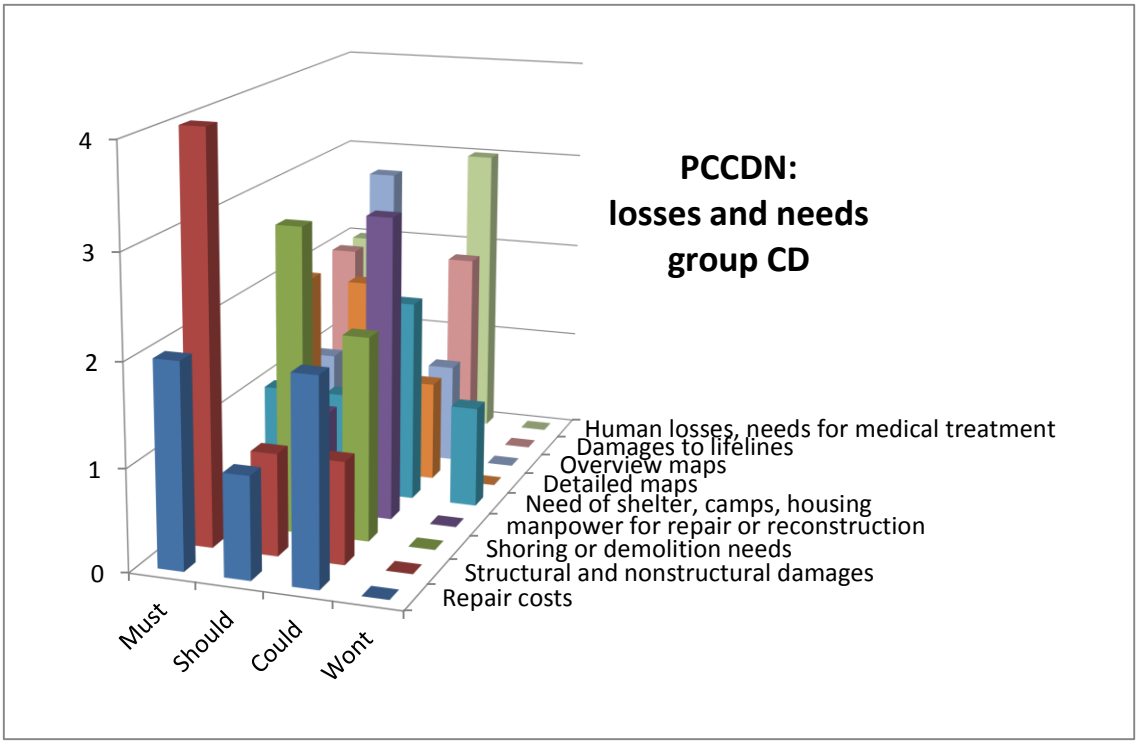

Figure 7: Building operators: results for question 3.2 "What would be the specific losses and needs to be identified" by the PCCDN tool?

The user groups A and B (disaster responders) answered the question "How do you want to receive the data?" related to the sensor network and monitoring system that the data transfer via the internet is commonly preferred (see Figure 8. Public and non-public building operators also insist on getting the data via an internet connection, but have a far stronger need for raw sensor data compared to the user group AB (disaster responders), probably to further analyse it in more specialised software analysis tools. There is also a notable demand for GIS ready data among the building operators. (FR-043 – FR-050, see page 29) (see Figure 9).

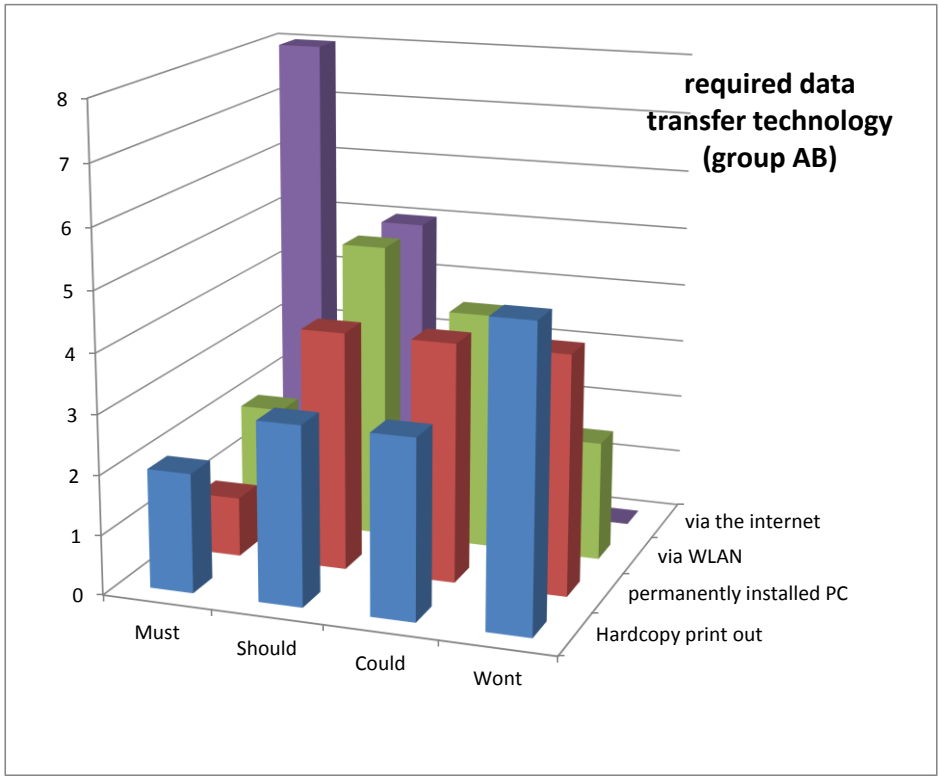

Figure 8: Disaster response organisations: required data transfer technology

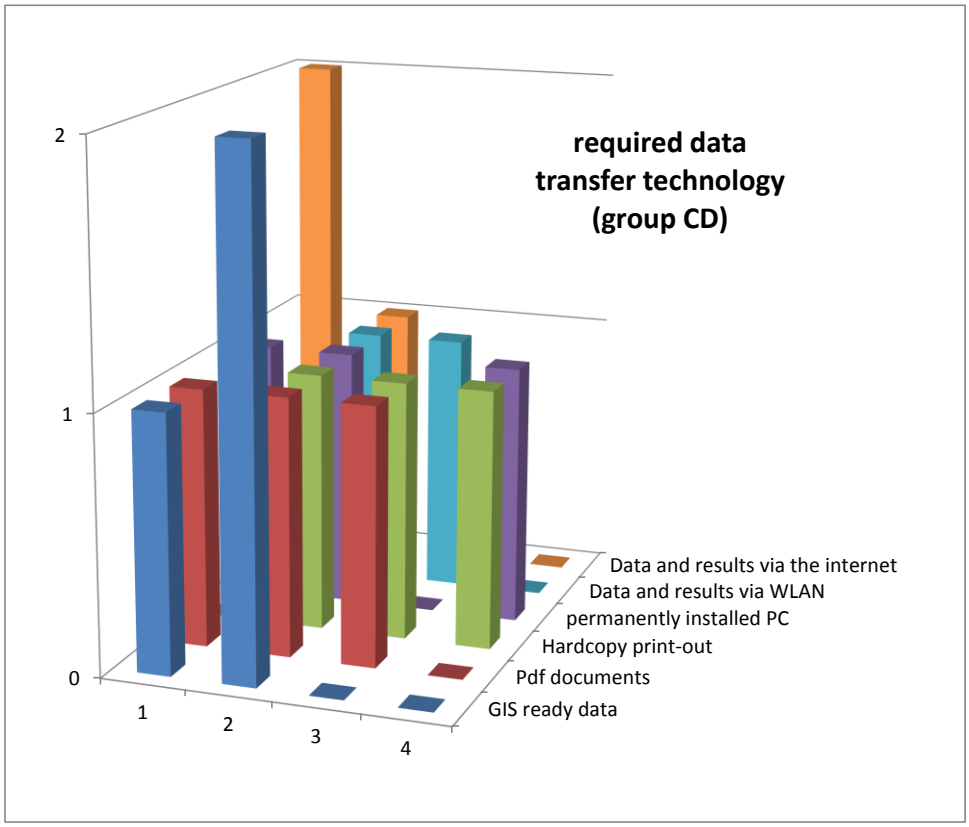

Figure 9: Building Operators (group CD): required data transfer technology

5. NON-FUNCTIONAL REQUIREMENTS

Introduction

Non-functional requirements describe how the system shall behave. The standard for quality dimensions of a system or software product with the title "*Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - System and software quality models*" [5] comprises relevant non-functional requirement types and describes two models to specify, measure and evaluate system and software product quality. These are the models "Quality in Use" and "Product Quality" (see Table 2) whereas the product quality model with its eight characteristics relates to static properties of software and dynamic properties of the computer system. The model is applicable to both computer systems and software products and is used in this deliverable.

Table 2: Non-functional requirement types after [5]

Product Quality	**Quality in Use**
Functional Suitability	Effectiveness
Performance Efficiency	Efficiency
Compatibility	Satisfaction
Usability	Freedom from Risk
Reliability	Context Coverage
Security	
Maintainability	
Portability	

The characteristics include further sub-characteristics which will be incorporated in the following sections.

5.1. Functional Suitability

This characteristic indicates to which degree the system fulfils the stated and implied user needs. The sub-characteristics are:

- Functional completeness. Degree to which the system covers all the specified tasks and user objectives.
- Functional correctness. Degree to which the system provides the correct results with the needed degree of precision.
- Functional appropriateness. Degree to which the functions facilitate the accomplishment of specified tasks and objectives.

Functional suitability will be measured during the evaluation process.

The following tables refer to the classification system described in chapter 2. The numbers of the user requirements were not changed during the preceding steps to avoid inconsistencies, the NFR means non-functional requirements. The RECONASS sub system numeration is described in chapter 2.1, the user types in 2.2 and the MSCW prioritisation system in 2.4

Table 3: Non-functional requirements: Functional suitability

Nr.	User requirement	Value	Description/comments	Sub system	User type	MSCW
NFR-005	The sensor network/monitoring system shall provide different goals or types for the instrumentation e.g. expected maximum losses, necessary precision of the damage estimation			1.1	CD	S
NFR-016	The system shall be designed for reinforced concrete buildings			1.1, 2.1, 3.1	ABCDEF	M
NFR-083	Structural damage assessment must consider the structures of specific buildings		Assessment of structural damages	2.2	ABCD	M
NFR-087	The non-structural elements must include unreinforced non-load bearing masonry walls		Assessment of non-structural damages	2.3	ABCD	M
NFR-096	Low flying UAVs can provide high resolution imagery that is necessary for search and rescue organisations		Support for response teams	3.1	ABCD	M

5.2. Performance Efficiency

The quantity of resources needed to achieve the requested performance relative to the amount of resources used under stated conditions. The sub-characteristics:

- Time behaviour. Degree to which the response and processing times of a system meet requirements.
- Resource utilization. Degree to which the amounts and types of resources used by a system meet requirements.
- Capacity. Degree to which the maximum limits of a system parameter meet requirements.

Table 4: Non-functional requirements: Performance Efficiency

Nr.	User requirement	Value	Description/comments	Sub system	User type	MSCW
NFR-011	The damage assessment sub-system shall assess information in near real time	<30 min	Depending on the user such as local fire brigades, international teams. Firefighting officers need this information for crucial intervention planning and tactical decisions.	2.2	ABCDF	M
NFR-052	The PCCDN overview maps shall be available after:	8h-24h	depending on the level of detail	2.1, 2.4	ABCDEF	S
NFR-053	The PCCDN detailed maps shall be available after:	24h - 72h	depending on the level of detail	2.1, 2.4	ABCDEF	S
NFR-077	Sensor data acquirement and data transmission must be fast enough to allow near real time damage assessment		Positioning and distance measurement secure communication	1.1	ABCD	M
NFR-088	The assessment of the damages must be calculated within minutes after the event		Damage simulation and assessment	2.1, 2.2	ABCD	M
NFR-089	The assessment of building functionality, repair needs and generated debris must be calculated within a few hours		Damage and needs assessment	2.1	ABCD	M

Nr.	User requirement	Value	Description/comments	Sub system	User type	MSCW
NFR-092	UAV Operators need time to reach the affected area		UAV used to generate oblique airborne imagery - first responders need the imagery, possibly bring their own simple UAVs (See additional information)	3.1	ABE	M
NFR-093	Actual satellite data is available after hours or days		Air and space born remote sensing	3.2	ABCDEF	M
NFR-100	Volumes of debris, blocked roads and collapsed buildings must be measured within	72h	Damage detection (roads and buildings), needs assessment,	3.1	ABCDEF	M
NFR-109	Level of accuracy varies with time required for assessment - different accuracy levels needed for different time frames			2.1	ABCDEF	M
NFR-113	For rescue activities, the monitoring system allows to survey relevant, measured information with a delay of less than	5 sec	such as accelerations and movements	2.1, 1.5, 1.2	AB	S
NFR-122	System costs: new buildings: percentage of the total construction costs		a smoke detection sensor network costs 3% of the total construction raw costs; existing buildings: to be included in the maintenance and running costs		CD	M

5.3. Compatibility

Degree to which a product, system or component can exchange information with other products, systems or components, and/or can perform its required functions, while sharing the same hardware or software environment. This characteristic is composed of the following sub-characteristics:

- Co-existence. Degree to which a product can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product.
- Interoperability. Degree to which two or more systems, products or components can exchange information and use the information that has been exchanged.

Table 5: Non-functional requirements: Compatibility

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
NFR-034	The system shall provide GIS-ready data			2.1, 3.1	ABC DEF	S
NFR-035	The system shall generate pdf reports		"To be discussed, AB-users: Pdf: too many documents, you need a specialist to read this, need somebody to interpret the data real time information needed, no time for print out	2.1, 3.1	ABC DEF	C

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
			and sort and put into binders"			
NFR-036	The system shall provide hard copy print-outs		To be discussed; AB-users: NO!	2.1	ABC D	C
NFR-037	The system shall include a permanently installed PC / monitor at the building to view data and calculation results		Not necessary	2.1	ABC D	W
NFR-038	The system shall deliver data and results via WLAN		Mini Version for PCCDN	2.1	ABC D	S
NFR-054	The system shall be able to exchange data with:	open source interface	PCCDN, other gateway=ICCS	2.1, 1.7	ABC DEF	M
NFR-055	Building damages shall be categorised additionally after EMS98 scale			2.1, 2.2	ABC DEF	S
NFR-061	The sensor network/monitoring system shall be connected with other monitoring systems. Which:	Fire detecting installation	User requirement out of the scope?	2.1	ABC D	S
NFR-073	Communication gateway must be interoperable to bridge between different types of sensor networks		Secure communication	1.7	ABC D	M
NFR-075	Interoperability: the gateway should be capable to operate different wireless access technologies		Secure communication	1.7	ABC D	M
NFR-078	Interoperability with GDACS must be ensured.		Post-earthquake response and recovery	2.1	ABC DEF	M
NFR-079	Standardized interfaces for communication and data exchange with actual common data exchange platforms such as GDACS and VirtualOSOCC		Post-earthquake response and recovery	2.1	ABC DEF	M
NFR-080	Results of comparable research projects must be monitored to ensure standardized interoperability		Post-earthquake response and recovery, all RECONASS research areas	1-3	ABC DEF	M
NFR-082	Standardized interfaces for communication and data exchange with local damage assessment systems such as HAZUS		Damage simulation and assessment	2.1, 1.7?	ABC DEF	M
NFR-101	Imagery must be used to improve the damage assessment based on sensors in buildings		Sensor networks, and assessment of structural and non-structural damages	1-3	ABC DEF	M
NFR-102	Building sensors must be located in the images generated by UAVs		Multi sensor assessment	1-3	ABC D	M
NFR-103	Correlation between building sensor network position data and the 3D model derived from airborne imagery		Multi sensor assessment	1-3	ABC D	M
NFR-104	The possibility to extend the building sensor network with disaster/emergency relevant chemical and biological sensors has to be investigated		Sensor network extension	1.1	ABC DEF	M
NFR-105	damage history and detoriation and actual loads must be used for the assessment calculation			2.2	ABC D	M
NFR-	The system shall deliver data and results via		for command posts and the	2.1	ABC	M

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
127	the internet		crisis centre		DEF	

5.4. Usability

Degree to which a product or system can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. This characteristic is composed of the following sub-characteristics:

- Appropriateness recognisability. Degree to which users can recognize whether a product or system is appropriate for their needs.
- Learnability. degree to which a product or system can be used by specified users to achieve specified goals of learning how to use the product or system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use.
- Operability. Degree to which a product or system has attributes making it easy to operate and control.
- User error protection. Degree to which a system protects users against making errors.
- User interface aesthetics. Degree to which a user interface allows for pleasing and satisfying interaction .
- Accessibility. Degree to which a product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.

Table 6: Non-functional requirements: Usability

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
NFR-001	The sensor network/monitoring system shall be easy to use by architects and engineers with a training of max:	1 week	after completing	1.1	CDF	M
NFR-002	The sensor network shall be easily switched on with one button			1.1	CD	S
NFR-006	The sensor network/monitoring system shall support the user (engineer and untrained personnel) to assess the damages			2.1	ABC D	M
NFR-007	The monitoring system shall have a GUI for the planning of the building instrumentation		Requirement out of scope?	1.1	CD	S
NFR-019	Sensor units are small enough to be integrated into the building structure during construction			1.1	CD	M
NFR-020	Maximum sensor unit size shall be	"(25x50 x100 mm)"	for integrated sensors: possible to integrate into concrete with limited weakening of the structure; for attached tags: flat enough due to aesthetic reasons attached at the middle of the columns and beams, others: must be relatively small but will be installed in determined places	1.1	CD	M
NFR-	The system shall provide a maintenance			2.1, 2.2	ABC	S

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
026	interface to read out actual measured data and calculation results				D	
NFR-040	The system must be designed for different operators		building operator, fast response personnel, architects and engineers, maintenance personnel	1-3	ABC D	M
NFR-062	The GUI shall be user friendly and easy to understand			2.1	ABC DEF	M
NFR-063	The training for the different sub systems and users shall not exceed:		different numbers for different users and sub systems must be defined, 1 week may be realistic for persons using many of the RECONASS system functions such as assessment team engineers, maintenance teams	2.1, 3.1	ABC DEF	M
NFR-094	Oblique imagery is necessary to detect damages below roof level		Damage detection	3.1	ABC DEF	M
NFR-095	3D point clouds from the multi-perspective, oblique and high overlapping images are necessary for detailed damage assessment		Damage detection	3.1	ABC DEF	M
NFR-118	"Different damage scales must be used. structural, functional, additional"		structural: (collapsed, partly collapsed, structural/non-structural damage,..); functional: (usable, partially usable, unusable), further damage grades (e.g. % of collapse probability)	2.1	ABC DEF	M
NFR-119	output must be aggregated on building level and for each structural/functional part of the building			2.1	ABC DEF	M
NFR-126	"The user interface must be simple, robust: has to be fire fighter proof, simple robust, easy to handle			2.1	AB	M
NFR-131	Imagery of collapsed buildings / area before damage event is needed		when on scene (after 24 hours) and on the way (after 6 hours)	3.1	ABC DEF	S

5.5. Reliability

Degree to which a system, product or component performs specified functions under specified conditions for a specified period of time. This characteristic is composed of the following sub characteristics:

- Maturity. Degree to which a system, product or component meets needs for reliability under normal operation.
- Availability. Degree to which a system, product or component is operational and accessible when required for use.
- Fault tolerance. Degree to which a system, product or component operates as intended despite the presence of hardware or software faults.

- Recoverability. Degree to which, in the event of an interruption or a failure, a product or system can recover the data directly affected and re-establish the desired state of the system.

Table 7: Non-functional requirements: Reliability

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
NFR-003	The system shall tolerate power break down for some hours Pass/Fail Statement: At least:	72h-1 week	For immediate response. If more than 48 hours are necessary, the installation must include an emergency backup generator	1.1, 2.1	ABC D	M
NFR-010	The damage assessment sub-system is reliable because human life depend on it		"Central processing unit (required to run the model) could be outside the building (RECONASS centre), and then serve the information to the end-users. But a smaller processing unit could be installed in each monitored building for performance reasons (federated approach).	2.2	ABC DF	M
NFR-017	The life expectancy of the sensor network/monitoring system shall be	>25 years	Calibration is needed on a yearly basis (ARU) (but remotely)->maintenance	1.1	CD	M
NFR-021	Parts of the sensor network/monitoring system shall be allowed to be connected by cables for power supply and communication			1.1	CD	M
NFR-022	If cables are used, cable damages shall be detected and reported		Include in alerting systems, but not the exact position, cannot distinguish between cable and sensor failure	1.1	CD	M
NFR-023	If cables are used, the units are functional (measurement and communication) for:	>72 h	all backup	1.1, 2.1, 3.1	CD	M
NFR-041	The monitoring system for response personnel must be reliable because otherwise human losses will occur			1.1, 2.1	AB	M
NFR-042	The result of the damage assessment sub system in regarding further usability of the building must be reliable because otherwise human losses may occur			2.2	CDF	M
NFR-064	The assessment results. probability must be indicated (error bars)		first structural assessments	2.2	ABC D	M
NFR-066	Accuracy of non line of sight measurement		Positioning and distance measurement	1.5	ABC D	M
NFR-067	Resilience in multi-path environments		Positioning and distance measurement and secure communication	1.5, 1.6, 1.7	ABC D	M
NFR-068	Enhanced accuracy by comparison of pre- and post-event measurements		Positioning and distance measurement	1.5	ABC D	M
NFR-070	Low power consumption to enhance battery life		Positioning and distance measurement and secure communication	1.1	ABC D	M
NFR-071	Enhanced range in reinforced concrete buildings		Positioning and distance measurement secure communication	1.5, 1.6, 1.7	ABC D	M

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
NFR-074	fault tolerance: if sensor nodes fail, the communication system must reroute the data paths –		Secure communication	1.5, 1.6, 1.7	ABC D	M
NFR-084	Vibration based damage assessment and strain monitoring must be combined to achieve reliable and precise results		Assessment of structural damages	2.1	ABC D	M
NFR-086	Structural damage assessment based on sensor measurements enhances credibility and assessment quality		Assessment of structural damages	2.1	ABC D	M
NFR-098	Further development in terms of accuracy, reliability and use of radiometric and optic sensors is necessary		Airborne sensor technology	3.1	ABC DEF	M
NFR-099	Satellite and airborne information gathering must be combined to reach a high level of information quality and reliability		Damage detection	3.1	ABC DEF	M
NFR-116	UAV imagery shall be at daylight and at night and under rainy and windy conditions			3.2	AB	S

5.6. Security

Degree to which a product or system protects information and data so that persons, other products or systems have the degree of data access appropriate to their types and levels of authorization. This characteristic is composed of the following sub characteristics:

- Confidentiality. Degree to which a product or system ensures that data are accessible only to those authorized.
- Integrity. Degree to which a system, product or component prevents unauthorized access to, or modification of, computer programs or data.
- Non-repudiation. Degree to which actions or events can be proven to have taken place, so that the events or actions cannot be repudiated later.
- Accountability. Degree to which the actions of an entity can be traced uniquely to the entity.
- Authenticity. Degree to which the identity of a subject or resource can be proven to be the one claimed.

Table 8: Non-functional requirements: Security

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
NFR-057	The data exchange shall not be accessed by others		between PCCDN and gateway	1.7, 2.1	ABC DEF	S
NFR-058	The data to be exchanged must be classified in different security levels		Take into account cyber-security as well as privacy issues especially for critical infrastructures, Probably depends on the manager of the critical infrastructure as well as the intended use	1.7, 2.1	ABC DEF	M
NFR-072	Common framework of communication for sensor networks		Secure communication	1.6, 1.7	ABC D	M
NFR-076	Measurement data must be transported secure and not be manipulated.		Secure communication	1.1, 1.7	ABC D	M
NFR-	UAVs do not put pilots at risk		UAV used to generate	3.1	ABC	M

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
097			oblique airborne imagery		D	

5.7. Maintainability

This characteristic represents the degree of effectiveness and efficiency with which a product or system can be modified to improve, correct or adapt it to changes in the environment, and/or requirements. This characteristic is composed of the following sub characteristics:

- Modularity. Degree to which a system or computer program is composed of discrete components such that a change to one component has minimal impact on other components.
- Reusability. Degree to which an asset can be used in more than one system, or in building other assets.
- Analysability. Degree of effectiveness and efficiency with which it is possible to assess the impact on a product or system of an intended change to one or more of its parts, or to diagnose a product for deficiencies, causes of failures, or to identify parts to be modified.
- Modifiability. Degree to which a product or system can be effectively and efficiently modified without introducing defects or degrading existing product quality.
- Testability. Degree of effectiveness and efficiency with which test criteria can be established for a system, product or component and tests can be performed to determine whether those criteria have been met.

Table 9: Non-functional requirements: Maintainability

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
NFR-009	The system shall send failure messages and maintenance information to a central unit		Alerting functions (different depending on sub system) PCCDN tool provides visualisation. All partners must provide such messages. Failure mode or self test is necessary	1.1	CD	S
NFR-018	Battery powered sensor and communication units shall have battery change intervals of	>2 years	strain sensors and tags and backup batteries	1.1	CD	M
FR-059	The system shall support building maintenance describing the necessary type of maintenance			1.1, 2.1	CD	C
NFR-069	Integration into the building structure and antenna design		Positioning and distance measurement and secure communication	1.5, 1.6, 1.7	ABC D	M

5.8. Portability

Degree of effectiveness and efficiency with which a system, product or component can be transferred from one hardware, software or other operational or usage environment to another. This characteristic is composed of the following sub characteristics:

- Adaptability. Degree to which a product or system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments.

- Installability. Degree of effectiveness and efficiency with which a product or system can be successfully installed and/or uninstalled in a specified environment.
- Replaceability. Degree to which a product can replace another specified software product for the same purpose in the same environment.

Table 10: Non-functional requirements: Portability

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
NFR-081	VEBE damage assessment tool to be used for the damage simulation		Damage simulation and assessment	2.1	AB CD EF	M
NFR-085	Sensor networks and damage assessment must be applicable to already existing buildings (after the construction phase)		Sensor networks, and assessment of structural damages	1.1	AB CD	M

Table 11: Non-functional requirements: Additional

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
NFR-024	Conformity with the relevant regulations shall be reached and declared (EC)			1.1, 2.1, 3.1	AB CD EF	M
NFR-090	Legal conditions for flying the drone must be fulfilled			3.1	AB E	M
NFR-091	Public opinion must tolerate the use of "drones"		UAV used to generate oblique airborne imagery	3.1	AB E	M
NFR-106	Legal aspects of the assessments must be considered		Reliability of the system, different users (if accessible by all citizens may be dangerous), possible claims due to wrong assessment results	2.1	AB CD	M

6. FUNCTIONAL REQUIREMENTS

Introduction

As defined in chapter 2.3, functional requirements (FR are statements of services the system should provide, how the system should react to particular inputs and how the system should behave in particular situations. In some cases, the functional requirements may also explicitly state what the system should not do.

The following functional requirements are assorted for the main RECONASS sub systems 1) Monitoring System, 2) Structural, Economic Loss and Needs Assessment Module and 3) UAV damage mapping system. Functional requirements that are valid for multiple sub systems will be added to each relevant table. Some of the user requirements were discussed with the conclusion that the RECONASS description of work document did not foresee such applications and the additional effort to realize such solutions would be out of scope. These are collected in chapter 6.4.

The following tables refer to the classification system described in chapter 2. User types are described in 2.2 and the MSCW prioritisation system is described in 2.4

6.1. Monitoring System: functional requirements

The monitoring subsystem consist of the following modules (see Table 12)

Table 12: The subsystem monitoring system and its modules

1.	**RECONASS Monitoring System**
1.1.	Overall Monitoring System and interfaces
1.2.	Acceleration Sensors
1.3.	Strain Sensors
1.4.	Temperature Sensors
1.5.	Local Positioning System
1.6.	Data Hub
1.7.	Communication Gateway Module

Table 13 summarises functional requirements that the monitoring system shall meet. FR-060 highlights the need to detect and assess pre-existing damages, if the system will be installed in a building after years of use with possible deteriorations or damages. FR-130 derives from input given by fire fighter officers during the user workshop. When temperatures are measured, the temperatures within the structure can be used to assess the deterioration of the structure, especially of steel reinforcements. Whereas temperatures on the surface or in the room can only be used to assess the temperatures within the structure with the knowledge of time-temperature curves, covering materials on structural elements and many other factors. This leads to a high level of inaccuracy compared to direct measurement. FR-117, use of transponders for first responder teams is discussed in section 6.4.2. and was proposed at the end user workshop.

FR-129, the needed measurement accuracy of structural movements was proposed during the user workshop. Existing monitoring systems for damaged buildings proved that this accuracy is possible and necessary in order to detect collapse hazards within damaged building structures allowing warning responders during rescue activities.

Table 13: functional requirements: Monitoring system

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
FR-004	The system shall start automatically after power outage			1,2,3		M
FR-056	The monitoring system shall provide a local alarming capability (sirens, flash light…) function			1.1, 2.1	AB CD	S
FR-060	If installed after construction: Prior damages or deterioration shall be determined by the system			1.1, 2.2	CD	C
FR-130	Temperatures shall be measured within the structure to detect fires, damages due to fire		see additional information/heat	1.4	AB CD	M
FR-117	The possibility to install additional position tags for first responder-teams		team members (Localisation/Position of first responders Bio sensors: physical and psychological behaviour Connection to PSE : BA, sensors integrated in FF-clothes) and points of interest	1.5	AB	S
FR-129	Accuracy of movement measurements needed for first responders	+/- 5-10 mm		1.5	AB CD	S
FR-114	The measured data and/or the calculation results shall be stored in a kind of black box or accessible place to be available, even when the building collapsed or the data transfer was interrupted		data such as accelerations during the earthquake	1.6, 1.7, 2.1	AB CD EF	S

6.2. Structural, Economic Loss and Needs Assessment Module: functional requirements

The subsystem includes the module post-crisis needs assessment tool in regards to construction damage and related needs (PCCDN) and the following modules (see Table 14).

Table 14: The subsystem monitoring system and its modules

2.	**RECONASS Structural, Economic Loss and Needs Assessment Module**
2.1.	Assessment Module and interfaces
2.2.	Structural Assessment Module
2.3.	Economic Loss and Needs Assessment Module
2.4.	PCCDN Software Tool

FR-114 was an input from the user workshop concerning a kind of black box storing the collected data near to the building for the case of internet failure. FR-107 ("The 3D user interface must show the user classification of the

building areas") means that the 3D user interface displays similar information to floor maps of the building (such as room number, function of rooms and section) in order to simplify orientation with the 3D user interface for untrained staff. FR-123 adds to FR-107 that the commonly used intervention plan information for buildings at risk should be integrated as well.

Rescue activities could be significantly supported with the assessment of collapse types (FR-115) and possible areas in damaged buildings, where victims could survive (FR-120). All above mentioned requirements in this section derived from discussions at the end user workshop.

Table 15: functional requirements: Structural, Economic Loss and Needs Assessment Module

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
FR-004	The system shall start automatically after power break down			1,2,3		M
FR-114	The measured data and/or the calculation results shall be stored in a kind of black box or accessible place to be available, even when the building collapsed or the data transfer was interrupted		data such as accelerations during the earthquake	1.6, 1.7, 2.1	AB CD EF	S
FR-008	The system shall have a GUI that shows the place of damaged sensors and the maintenance measures necessary to ensure functionality			2.1	CD	S
FR-014	The damage assessment sub-system shall assess generated debris		position, amount, type	2.1	AB CD F	M
FR-025	The system shall deliver a simple post-event building status of the monitored building with the status usable, partially usable and unusable			2.1	AB CD EF	M
FR-027	The system shall show the position of the sensors and the measured events in a 3D model		ITC can provide a 3D modelling (of the exterior) This is used to show more detailed data on request, collapse structure, damaged areas, collapse hazard must be shown	2.1	AB CD	S
FR-107	The 3D user interface must show the user classification of the building areas		e.g. hospital: name of ward, operating room…	2.1	AB CD	S
FR-108	Non-structural damages and environmental risks must be covered in the system output for the instrumented building		environmental risks: e.g. gas, explosion, fire, water, CBRN	2.1	AB CD EF	S
FR-110	The system shall provide photos from inside the structure			2.1	AB CD	S
FR-111	Social media data should be provided		images and text information	2.1	AB CD EF	S
FR-120	Specific areas within the collapsed structures with high probabilities of survival shall be indicated			2.1	AB	S

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
FR-121	Allow the integration with existing building management systems (security cameras, information on the elevators, ...)			2.1	AB CD EF	S or C
FR-123	The system shall provide information with the content of standard intervention plans		-basic building information: way in, way out, evacuation areas, evacuation routes, detection systems, automatic fire extinguishing installations, … -Occupant's information: how many, how old? What's their mobility (physical, psychological, asleep/awake)? What is the spread of the occupants in the building? Do they know the building? Are they trained? -Specific hazards: dangerous goods, gas installations, electrical installations -Affected areas in the building? -Detection systems? Automatic Fire Extinguishing Installations? (Sprinkler) -> time of activation, (intervention plans are already in use (paper or digital), but not for all buildings see BSAHF model (additional information) +construction type stable areas like staircases	2.1	AB CD	S
FR-124	The 3D user interface must show the intervention plan information			2.1	AB CD	S
FR-112	The RECONASS system should identify priority areas to be mapped (UAV)			2.1,2.2, 3.1	AB CD EF	S
FR-012	The damage assessment sub-system shall assess structural damages		position, extent and damaged members, the type of damages	2.2	AB CD F	M
FR-065	The possible further collapse of the damaged building must be indicated			2.2	AB CD	M

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
FR-039	The system shall continuously update damage assessments and the probability of further collapse after the initial damaging event and during and after following damaging events			2.2, 2.4	AB	S
FR-013	The damage assessment sub-system shall assess repair needs			2.3	CD F	M
FR-015	The damage assessment sub-system shall assess building functionality			2.4	AB CD F	M
FR-043	The Post Crisis Needs Assessment Tool (PCCDN) shall assess repair costs for affected areas		need for repair: (yes, no, repair options for structural components)	2.4	AB CD EF	S
FR-044	The Post Crisis Needs Assessment Tool (PCCDN) shall assess structural damages for affected areas			2.4	AB CD EF	S
FR-045	The Post Crisis Needs Assessment Tool (PCCDN) shall assess non-structural damages for affected areas			2.4	AB CD EF	S
FR-046	The Post Crisis Needs Assessment Tool (PCCDN) shall assess shoring and demolition needs for affected areas		not necessary for single buildings (opinion of first responders)	2.4	ABC DEF	S
FR-047	The Post Crisis Needs Assessment Tool (PCCDN) shall assess needed manpower for repair and reconstruction for affected areas		not necessary for single buildings (opinion of first responders)	2.4	AB CD EF	S
FR-048	The Post Crisis Needs Assessment Tool (PCCDN) shall assess needs of shelter, camps and housing for affected areas			2.4	AB CD EF	S
FR-049	The Post Crisis Needs Assessment Tool (PCCDN) shall provide detailed maps with information for single buildings for affected areas		should be a WebGIS Application (dynamic map) Satellite / aerial pictures -> Optional Height information _> No Assessed damages -> Yes Hazardous areas (landslides, flooding, …) -> Yes Different standard maps -> update maps with new/more reliable information (highlighting the differences to the previous version) GIS ready data - Pdf export capability	2.4	AB CD EF	S
FR-050	The Post Crisis Needs Assessment Tool (PCCDN) shall provide overview maps for affected areas, information	100x 100m		2.4	AB CD EF	S

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
	summarized for:					
FR-115	The system shall provide measures for partially and totally collapsed buildings to prioritize the first responders interventions		Depending on collapse type, assessed survivors in the buildings and possibility to rescue the victims	2.4	AB	S

6.3. UAV Damage Mapping System: functional requirements

Only few functional user requirements where collected for the UAV system additional to the system description, which seemed to be sufficient to the users. With the aid of the post-crisis needs assessment tool in regards to construction damage and related needs (PCCDN), areas could be pre-defined, where UAV systems start with mapping activities after reaching the affected area.

Table 16: functional requirements: UAV Damage Mapping System

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
FR-004	The system shall start automatically after power outage			1,2,3		M
FR-112	The RECONASS system should identify priority areas to be mapped (UAV)			2.1,2.2, 3.1	AB CD EF	S
FR-027	The system shall show the position of the sensors and the measured events in a 3D model		ITC can provide a 3D modelling (of the exterior) This is used to show more detailed data on request, collapse structure, damaged areas, collapse hazard must be shown	2.1	AB CD	S
FR-028	The system shall provide aerial photos of the undamaged structure			3.1	AB CD EF	S
FR-029	The system shall provide aerial vertical imagery of the damaged structure	Geo-referenced	interface to PCCDN may be investigated	3.1	AB CD EF	S
FR-030	The system shall provide oblique imagery of the damaged structure		georeferenced, angle of view, Req 28-31 useful for first responders to enter the area, see hazards..	3.1	AB CD EF	S
FR-031	The system shall provide detailed imagery of details of the damaged structure	1 cm resolution	detailed photos of collapsed and damaged areas, and of specific areas on user request	3.1	AB CD	S
FR-032	The system shall provide thermal imagery to detect persons and fire/heat		To be discussed	3.1	AB	S
FR-033	The system shall provide damage maps with a higher accuracy than the actual standard	0.5 m resolution	What should damage maps contain? Before and after the earthquake; Temperatures (fires),Hazards (gas,..) (floods), Occupancy, building types, storeys, Pre event satellite images ++, 3D model of the area +	3.2	AB CD EF	M
FR-125	Imagery shall make visible the fire spread and the progress of the fire		Especially when not reachable with turntable	3.1	AB CD	S

Nr.	User requirement	Value	Description/comments	Sub system	User type	MS CW
			ladders		EF	

6.4. User Requirements for future developments

THW as an end user as well as the partners of the user group were very inspired by the RECONASS concept and presented many ideas to further expand the RECONASS system. However, some of the ideas went far beyond the promised functionality of the system. Some other ideas are still to be discussed, such as how to integrate them into the RECONASS system. In this section, some of the possible ideas that will be out of scope of the actual proposed features of the RECONASS system are collected. These ideas should be used for further developments.

6.4.1. Detection of victims

FR-128	The sensor network/monitoring system shall detect victim sounds in collapsed buildings

The possibility to detect victims within the monitored structures was requested by the users that participated in the user workshop in Berlin and the questionnaires. This could be possible using noise, vibration or temperature sensors within the structure and with the help of UAVs. These ideas however, are out of the approved RECONASS project's scope. Nevertheless, the sensors' victim detection capabilities will be tested by THW during the evaluation phase.

6.4.2. Positioning of first responder personnel

The local positioning system will have an infrastructure to measure positions of tags placed on structural elements of the instrumented building. During the user workshop in Berlin the idea to provide additional tags for rescue personnel at entrances was discussed. In emergency situations first responders could pick up those tags allowing monitoring their position within the building. Such a system would help to detect trapped or injured responders e.g. in case of a fire with great smoke emission or subsequent collapses caused by an aftershock

FR-117	The possibility to install additional position tags for first responder-teams

This additional functionality seems to be technically possible but needs extension of the sensor system, the PCCDN and its user interfaces. The functionality should be considered in future projects following up on the RECONASS findings..

6.4.3. Damages to lifelines

FR-051	The Post Crisis Needs Assessment Tool (PCCDN) shall assess damages to lifelines	roads, water supply, electricity

The RECONASS system deals with buildings and its damages. The only possibility within the scope of the RECONASS system is to determine the amount of debris around the footprint of a collapsed building to assess the position of blocked roads. Further damages to lifelines cannot be considered.

7. CONCLUSIONS

In this deliverable D1.3, the end user requirements are presented as the result of a coherent process, beginning with deliverable D1.1 "Preliminary User Requirements" and deliverable D1.2 "End User Workshop" where developers, RECONASS partners and end users have been working closely together from the beginning on. Having in mind that end-users will not always have the same understanding as technical developers and researchers and that, on principal, they are not able to specify a complex technical system on their own, this process of a common approach lead to a mutual understanding and by the end to a consolidated view of end users needs and what the RECONAS system is supposed to perform.

Therefore, this document gives a detailed explanation of the classification system of the RECONASS system and of the user requirements classification system. The RECONASS system can be divided into three main sub systems "RECONASS Monitoring System", "RECONASS Structural, Economic Loss and Needs Assessment Module" and "UAV Damage Mapping System". These sub systems consist of further modules.

Different user types from governmental and non-governmental emergency and disaster responders through public and private operators of typical buildings to organisations involved in in the development of remote sensing based damage map and further end users in the field of damage prediction, insurances etc. are classified. The user requirements are distinguished between functional (FR) and non-functional (NFR) and prioritised after the MoSCow attempt.

To sum up, it can be said that even within one user group different types of functions and activities lead to different requirements. This could already be shown by the results of the RECONASS user requirement questionnaire addressing the above mentioned different user categories.

E.g. first responders may need initial damage assessments, but when they come to put their team members at risk when they enter a damaged building, they want to decide on a basis of collected data and information for themselves. On the other hand responders involved in disaster management for large areas will rely on computer generated assessments for single buildings.

On the one hand, all users prefer to receive the results generated by the RECONASS system via the internet. But the preferred assessments such as repair costs, damages, need for shoring or shelter differ greatly between user groups.

The non-functional user requirements describing the product quality are distinguished by functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability and portability. Altogether 88 non-functional requirements are listed and described.

The functional requirements are assorted for the three main RECONASS sub systems (see above). 43 functional requirements could be identified. Especially the requirements related to user interfaces are defined as non-functional requirements because the interfaces describe how the system behaves.

THW as an end user as well as the partners of the user group were very inspired by the RECONASS concept and presented many ideas to further expand the RECONASS system. Especially the detection of victims and positioning of responders inside the damaged buildings was demanded but is out of scope of the RECONASS system. However, some of the ideas went far beyond the promised functionality of the system. Nevertheless these ideas are collected and may be useful for further developments in the future..

In conclusion, these final user requirements of D1.3 will be one of the sources for the RECONASS system specification process: The basic concept and initial planning of the system of the RECONASS system originates from the RECONASS description of work (DOW). The final consolidated end user requirements resulting from deliverable D1.3 will be supplemented by further technical requirements deriving from international technical standards and the state of the art, both described in deliverable D1.1.

All these sources lead to a comprehensive system specification that will be summarised in deliverable D1.4. "Full specification set for the RECONASS system".

Ultimately however, despite the fact that end user requirements are prioritised as "musts", technical, legal or financial reasons may lead to the final decision, that some user requirements cannot be "translated" into technical specifications.

The declared aim of WP1 including deliverable D1.3 is to improve and increase a constant support by end users needed for the development of the RECONASS system during the lifetime of the project.

To this end, new aspects and issues will probably be collected, taken into account and possibly integrated into the RECONASS system.

8. REFERENCES

[1] Katrin Vierhuß-Schloms and Michael Markus, "D1.1: State-of-the-Art of Assessment Tools and preliminary user requirements, FP7-SEC-2012.4.3-1: Next Generation Damage and Post-Crisis Needs Assessment Tool for Reconstruction and Recovery Planning," Athens, 2014a.

[2] Katrin Vierhuß-Schloms and Michael Markus, "D1.2: Proceedings of the first workshop, FP7-SEC-2012.4.3-1: Next Generation Damage and Post-Crisis Needs Assessment Tool for Reconstruction and Recovery Planning," Athens, 2014b.

[3] Ian Sommerville, "Software engineering (9th ed.)," , New York, 2011.

[4] Dai Clegg and Richard Barker, *Case method fast-track: a RAD approach*.: Addison-Wesley Longman Publishing Co., Inc., 1994.

[5] ISO/IEC 25010:2011-03, "Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - System and software quality models," 2011.

ANNEXES

Annex A: Consolidated List of User Requirements

Colour Code of Requirements
Non-functional requirements: Functional suitability
Non-functional requirements: Performance Efficiency
Non-functional requirements: Compatibility
Non-functional requirements: Usability
Non-functional requirements: Reliability
Non-functional requirements: Security
Non-functional requirements: Maintainability
Non-functional requirements: Portability
Non-functional requirements: Additional
Functional requirements: Monitoring system
Functional requirements: Structural, Economic Loss and Needs Assessment Module
Functional requirements: UAV Damage Mapping System
Requirements for future developments

Nr.	User requirement	Value	Description/comments/links	Sub system	User type	MS CW
NFR-001	The sensor network/monitoring system shall be easy to use by architects and engineers with a training of max:	1 week	after completing	1.1	CDF	M
NFR-002	The sensor network shall be easily switched on with one button		function of RISA	1.1	CD	S
NFR-003	The system shall tolerate power break down for some hours Pass/Fail Statement: At least:	72h-1 week	For immediate response. If more than 48 hours are necessary, the installation must include an emergency backup generator	1.1, 2.1	ABCD	M
~~FR-004~~	~~The system shall start automatically after poweroutage~~			~~1,2,3~~		~~M~~
NFR-005	The sensor network/monitoring system shall provide different goals or types for the instrumentation e.g. expected maximum losses, necessary precision of the damage estimation			1.1	CD	S
NFR-006	The sensor network/monitoring system shall support the user (engineer and untrained personnel) to assess the damages			2.1	ABCD	M
NFR-007	The monitoring system shall have a GUI for the planning of the building instrumentation		User requirement out of scope?	1.1	CD	S
FR-008	The system shall have a GUI that shows the place of damaged sensors and the maintenance measures necessary to ensure functionality			2.1	CD	S
NFR-009	The system shall send failure messages and maintenance information to a central		Alerting functions (different depending on sub system) PCCDN	1.1	CD	S

Nr.	User requirement	Value	Description/comments/links	Sub system	User type	MS CW
	unit		tool provides visualisation. All partners must provide such messages. Failure mode or self test is necessary			
NFR-010	The damage assessment sub-system is reliable because human life depend on it		"Central processing unit (required to run the model) could be outside the building (RECONASS centre), and then serve the information to the end-users. But a smaller processing unit could be installed in each monitored building for performance reasons (federated approach).	2.2	ABCDF	M
NFR-011	The damage assessment sub-system shall assess information in near real time	<30 min	Depending on the user such as local fire brigades, international teams. Firefighting officers need this information for crucial intervention planning and tactical decisions.	2.2	ABCDF	M
FR-012	The damage assessment sub-system shall assess structural damages		position, extent and damaged members, the type of damages	2.2	ABCDF	M
FR-013	The damage assessment sub-system shall assess repair needs			2.3	CDF	M
FR-014	The damage assessment sub-system shall assess generated debris		position, amount, type	2.1	ABCDF	M
FR-015	The damage assessment sub-system shall assess building functionality			2.4	ABCDF	M
NFR-016	The system shall be designed for reinforced concrete buildings			1.1, 2.1, 3.1	ABCDEF	M
NFR-017	The life expectancy of the sensor network/monitoring system shall be	>25 years	Calibration is needed on a yearly basis (ARU) (but remotely)->maintenance	1.1	CD	M
NFR-018	Battery powered sensor and communication units shall have battery change intervals of	>2 years	strain sensors and tags and backup batteries	1.1	CD	M
NFR-019	Sensor units are small enough to be integrated into the building structure during construction			1.1	CD	M
NFR-020	Maximum sensor unit size shall be	(25x50x100 mm)	for integrated sensors: possible to integrate into concrete with limited weakening of the structure; for attached tags: flat enough due to aesthetic reasons attached at the middle of the columns and beams, others: must be relatively small but will be installed in determined places	1.1	CD	M
NFR-021	Parts of the sensor network/monitoring system shall be allowed to be connected by cables for power supply and communication			1.1	CD	M
NFR-022	If cables are used, cable damages shall be detected and reported		Include in alerting systems, but not the exact position, cannot distinguish between cable and sensor failure	1.1	CD	M
NFR-	If cables are used, the units are functional	>72 h	all backup	1.1, 2.1,	CD	M

Nr.	User requirement	Value	Description/comments/links	Sub system	User type	MS CW
023	(measurement and communication) for:			3.1		
NFR-024	Conformity with the relevant regulations shall be reached and declared (EC)			1.1, 2.1, 3.1	ABCD EF	M
FR-025	The system shall deliver a simple post-event building status of the monitored building with the status usable, partially usable and unusable			2.1	ABCD EF	M
NFR-026	The system shall provide a maintenance interface to read out actual measured data and calculation results		(rephrase, not raw data/Maintenance interface can provide this). Okay now?	2.1, 2.2	ABCD	S
FR-027	The system shall show the position of the sensors and the measured events in a 3D model		ITC can provide a 3D modelling (of the exterior) This is used to show more detailed data on request, collapse structure, amaged areas, collapse hazard must be shown	2.1	ABCD	S
FR-028	The system shall provide aerial photos of the undamaged structure			3.1	ABCD EF	S
FR-029	The system shall provide aerial vertical imagery of the damaged structure	georeferenced	interface to PCCDN may be investigated	3.1	ABCD EF	S
FR-030	The system shall provide oblique imagery of the damaged structure		georeferenced, angle of view, Req 28-31 useful for first responders to enter the area, see hazards..	3.1	ABCD EF	S
FR-031	The system shall provide detailed imagery of details of the damaged structure	1 cm resolution	detailed photos of collapsed and damaged areas, and of specific areas on user request	3.1	ABCD	S
FR-032	The system shall provide thermal imagery to detect persons and fire/heat		To be discussed	3.1	AB	S
FR-033	The system shall provide damage maps with a higher accuracy than the actual standard	0.5 m resolution ?	What should damage maps contain? Before and after the earthquake Temperatures (fires) Hazards (gas,..) (floods) Occupancy, building types, storeys, Pre event satellite images ++ 3D model of the area +	3.2	ABCD EF	M
NFR-034	The system shall provide GIS-ready data			2.1, 3.1	ABCD EF	S
NFR-035	The system shall generate pdf reports		"To be discussed, AB-users: Pdf : too many documents, you need a specialist to read this, need somebody to interpret the data real time information needed, no time for print out and sort and put into binders""	2.1, 3.1	ABCD EF	C
NFR-036	The system shall provide hard copy print-outs		To be discussed; AB-users: NO!	2.1	ABCD	C
NFR-037	The system shall include a permanently installed PC / monitor at the building to view data and calculation results		Not necessary	2.1	ABCD	W
NFR-038	The system shall deliver data and results via WLAN		Mini Version for PCCDN	2.1	ABCD	S
FR-039	The system shall continuously update damage assessments and the probability of further collapse after the initial damaging event and during and after following			2.2, 2.4	AB	S

Nr.	User requirement	Value	Description/comments/links	Sub system	User type	MS CW
	damaging events					
NFR-040	The system must be designed for different operators		building operator, fast response personnel, architects and engineers, maintenance personnel	1-3	ABCD	M
NFR-041	The monitoring system for response personnel must be reliable because otherwise human losses will occur			1.1, 2.1	AB	M
NFR-042	The result of the damage assessment sub system in regarding the further usability of the building must be reliable because otherwise human losses may occur			2.2	CDF	M
FR-043	The Post Crisis Needs Assessment Tool (PCCDN) shall assess repair costs for affected areas		need for repair: (yes, no, repair options for structural components)	2.4	ABCD EF	S
FR-044	The Post Crisis Needs Assessment Tool (PCCDN) shall assess structural damages for affected areas			2.4	ABCD EF	S
FR-045	The Post Crisis Needs Assessment Tool (PCCDN) shall assess non-structural damages for affected areas			2.4	ABCD EF	S
FR-046	The Post Crisis Needs Assessment Tool (PCCDN) shall assess shoring and demolition needs for affected areas		not necessary for single buildings (opinion of first responders)	2.4	ABCD EF	S
FR-047	The Post Crisis Needs Assessment Tool (PCCDN) shall assess needed manpower for repair and reconstruction for affected areas		not necessary for single buildings (opinion of first responders)	2.4	ABCD EF	S
FR-048	The Post Crisis Needs Assessment Tool (PCCDN) shall assess needs of shelter, camps and housing for affected areas			2.4	ABCD EF	S
FR-049	The Post Crisis Needs Assessment Tool (PCCDN) shall provide detailed maps with information for single buildings for affected areas		"should be a WebGIS Application (dynamic map) Satellite / aerial pictures -> Optional Height information _> No Assessed damages -> Yes Hazardous areas (landslides, flooding, …) -> Yes Different standard maps -> update maps with new/more reliable information (highlighting the differences to the previous version) GIS ready data - Pdf export capability"	2.4	ABCD EF	S
FR-050	The Post Crisis Needs Assessment Tool (PCCDN) shall provide overview maps for affected areas, information summarized for:	100x100 m		2.4	ABCD EF	S
FR-051	The Post Crisis Needs Assessment Tool (PCCDN) shall assess damages to lifelines	roads, water supply, electricity		2.4	ABCD EF	C
NFR-052	The PCCDN overview maps shall be available after:	8h-24h	depending on the level of detail	2.1, 2.4	ABCD EF	S
NFR-053	The PCCDN detailed maps shall be available after:	24h - 72h	depending on the level of detail	2.1, 2.4	ABCD EF	S
NFR-054	The system shall be able to exchange data with:	open source	PCCDN, other gateway=ICCS	2.1, 1.7	ABCD EF	M

Nr.	User requirement	Value	Description/comments/links	Sub system	User type	MS CW
		interface				
NFR-055	Building damages shall be categorised additionally after EMS98 scale			2.1, 2.2	ABCD EF	S
FR-056	The monitoring system shall provide a local alarming capability (sirens, flash light…) function		rephrase	1.1, 2.1	ABCD	S
NFR-057	The data exchange shall not be accessed by others		between PCCDN and gateway	1.7, 2.1	ABCD EF	S
NFR-058	The data to be exchanged must be classified in different security levels		Take into account cyber-security as well as privacy issues especially for critical infrastructures, Probably depends on the manager of the critical infrastructure as well as the intended use	1.7, 2.1	ABCD EF	M
FR-059	The system shall support building maintenance describing the necessary type of maintenance			1.1, 2.1	CD	C
FR-060	If installed after construction: Prior damages or deterioration shall be determined by the system			1.1, 2.2	CD	C
NFR-061	The sensor network/monitoring system shall be connected with other monitoring systems. Which:	Fire detecting installation	User requirement out of the scope?	2.1	ABCD	S
NFR-062	The GUI shall be user friendly and easy to understand			2.1	ABCD EF	M
NFR-063	The trainig for the different sub systems and users shall not exceed:		different numbers for different users and sub systems must be defined, 1 week may be realistic for persons using many of the RECONASS system functions such as assessment team engineers, maintenance teams	2.1, 3.1	ABCD EF	M
NFR-064	The assessment results: probability must be indicated (error bars)		first structural assessments	2.2	ABCD	M
FR-065	The possible further collapse of the damaged building must be indicated			2.2	ABCD	M
NFR-066	Accuracy of non line of sight measurement		Positioning and distance measurement	1.5	ABCD	M
NFR-067	Resilience in multi-path environments		Positioning and distance measurement and secure communication	1.5, 1.6, 1.7	ABCD	M
NFR-068	Enhanced accuracy by comparison of pre- and post-event measurements		Positioning and distance measurement	1.5	ABCD	M
NFR-069	Integration into the building structure and antenna design		Positioning and distance measurement and secure communication	1.5, 1.6, 1.7	ABCD	M
NFR-070	Low power consumption to enhance battery life		Positioning and distance measurement and secure communication	1.1	ABCD	M
NFR-071	Enhanced range in reinforced concrete buildings		Positioning and distance measurement secure communication	1.5, 1.6, 1.7	ABCD	M
NFR-072	Common framework of communication for sensor networks		Secure communication	1.6, 1.7	ABCD	M
NFR-	Communication gateway must be		Secure communication	1.7	ABCD	M

Nr.	User requirement	Value	Description/comments/links	Sub system	User type	MS CW
073	interoperable to bridge between different types of sensor networks					
NFR-074	fault tolerance: if sensor nodes fail, the communication system must reroute the data paths –		Secure communication	1.5, 1.6, 1.7	ABCD	M
NFR-075	Interoperability: the gateway should be capable to operate different wireless access technologies		Secure communication	1.7	ABCD	M
NFR-076	Measurement data must be transported secure and not be manipulated.		Secure communication	1.1, 1.7	ABCD	M
NFR-077	Sensor data acquirement and data transmission must be fast enough to allow near real time damage assessment		Positioning and distance measurement secure communication	1.1	ABCD	M
NFR-078	Interoperability with GDACS must be ensured.		Post-earthquake response and recovery	2.1	ABCD EF	M
NFR-079	Standardized interfaces for communication and data exchange with actual common data exchange platforms such as GDACS and VirtualOSOCC		Post-earthquake response and recovery	2.1	ABCD EF	M
NFR-080	Results of comparable research projects must be monitored to ensure standardized interoperability		Post-earthquake response and recovery, all RECONASS research areas	1-3	ABCD EF	M
NFR-081	VEBE damage assessment tool to be used for the damage simulation		Damage simulation and assessment	2.1	ABCD EF	M
NFR-082	Standardized interfaces for communication and data exchange with local damage assessment systems such as HAZUS		Damage simulation and assessment	2.1, 1.7?	ABCD EF	M
NFR-083	Structural damage assessment must consider the structures of specific buildings		Assessment of structural damages	2.2	ABCD	M
NFR-084	Vibration based damage assessment and strain monitoring must be combined to achieve reliable and precise results		Assessment of structural damages	2.1	ABCD	M
NFR-085	Sensor networks and damage assessment must be applicable to already existing buildings (after the construction phase)		Sensor networks, and assessment of structural damages	1.1	ABCD	M
NFR-086	Structural damage assessment based on sensor measurements enhances credibility and assessment quality		Assessment of structural damages	2.1	ABCD	M
NFR-087	The nonstructural elements must include unreinforced non-load bearing masonry walls		Assessment of nonstructural damages	2.3	ABCD	M
NFR-088	The assessment of the damages must be calculated within minutes after the event		Damage simulation and assessment	2.1, 2.2	ABCD	M
NFR-089	The assessment of building functionality, repair needs and generated debris must be calculated within a few hours		Damage and needs assessment	2.1	ABCD	M
NFR-090	Legal conditions for flying the drone must be fulfilled.			3.1	ABE	M
NFR-091	Public opinion must tolerate the use of "drones"		UAV used to generate oblique airborne imagery	3.1	ABE	M
NFR-092	UAV Operators need time to reach the affected area		UAV used to generate oblique airborne imagery - first responders need the imagery, possibly bring their own simple UAVs (See additional information)	3.1	ABE	M
NFR-	Actual satellite data is available after hours		Air and space born remote sensing	3.2	ABCD	M

Nr.	User requirement	Value	Description/comments/links	Sub system	User type	MS CW
093	or days				EF	
NFR-094	Oblique imagery is necessary to detect damages below roof level		Damage detection	3.1	ABCD EF	M
NFR-095	3D point clouds from the multi-perspective, oblique and high overlapping images are necessary for detailed damage assessment		Damage detection	3.1	ABCD EF	M
NFR-096	Low flying UAVs can provide high resolution imagery that is necessary for search and rescue organisations		Support for response teams	3.1	ABCD	M
NFR-097	UAVs do not put pilots at risk		UAV used to generate oblique airborne imagery	3.1	ABCD	M
NFR-098	Further development in terms of accuracy, reliability and use of radiometric and optic sensors is necessary		Airborne sensor technology	3.1	ABCD EF	M
NFR-099	Satellite and airborne information gathering must be combined to reach a high level of information quality and reliability		Damage detection	3.1	ABCD EF	M
NFR-100	Volumes of debris, blocked roads and collapsed buildings must be measured within	72h	Damage detection (roads and buildings), needs assessment,	3.1	ABCD EF	M
NFR-101	Imagery must be used to improve the damage assessment based on sensors in buildings		Sensor networks, and assessment of structural and nonstructural damages	1-3	ABCD EF	M
NFR-102	Building sensors must be located in the images generated by UAVs		Multi sensor assessment	1-3	ABCD	M
NFR-103	Correlation between building sensor network position data and the 3D model derived from airborne imagery		Multi sensor assessment	1-3	ABCD	M
NFR-104	The possibility to extend the building sensor network with disaster/emergency relevant chemical and biological sensors has to be investigated		Sensor network extension	1.1	ABCD EF	M
NFR-105	damage history and detoriation and actual loads must be used for the assessment calculation			2.2	ABCD	M
NFR-106	Legal aspects of the assessments must be considered		Reliability of the system, different users (if accessible by all citizens may be dangerous), possible claims due to wrong assessment results	2.1	ABCD	M
FR-107	the 3D user interface must show the user classification of the building areas		e.g. hospital: name of ward, operating room…	2.1	ABCD	S
FR-108	non-structural damages and environmental risks must be covered in the system output for the instrumented building		environmental risks: e.g. gas, explosion, fire, water, CBRN	2.1	ABCD EF	S
NFR-109	Level of accuracy varies with time required for assessment - different accuracy levels needed for different time frames			2.1	ABCD EF	M
FR-110	The system shall provide photos from inside the structure			2.1	ABCD	S
FR-111	Social media data should be provided		images and text information	2.1	ABCD EF	S
FR-112	The RECONASS system should identify priority areas to be mapped (UAV)			2.1,2.2, 3.1	ABCD EF	S
NFR-	For rescue activities, the monitoring system	5 sec	such as accelerations and	2.1, 1.5,	AB	S

Nr.	User requirement	Value	Description/comments/links	Sub system	User type	MS CW
113	allows to survey relevant, measured information with a delay of less than		movements	1.2		
FR-114	The measured data and/or the calculation results shall be stored in a kind of black box or accessible place to be available, even when the building collapsed or the data transfer was interrupted		data such as accelerations during the earthquake	1.6, 1.7, 2.1	ABCD EF	S
FR-115	The system shall provide measures for partially and totally collapsed buildings to prioritize the first responders interventions		Depending on collapse type, assessed survivors in the buildings and possibility to rescue the victims	2.4	AB	S
NFR-116	UAV imagery shall be at daylight and at night and under rainy and windy conditions			3.2	AB	S
FR-117	The possibility to install additional position tags for first responder-teams		team members (Localisation/Position of first responders Bio sensors: physical and psychological behaviour Connection to PSE : BA, sensors integrated in FF-clothes) and points of interest"	1.5	AB	S
NFR-118	Different damage scales must be used	structural, functional, additional	structural: (collapsed, partly collapsed, structural/nonstructural damage,..); functional: (usable, partially usable, unusable), further damage grades (e.g. % of collapse probability)	2.1	ABCD EF	M
NFR-119	output must be aggregated on building level and for each structural/functional part of the building			2.1	ABCD EF	M
FR-120	specific areas within the collapsed structures with high probabilities of survival shall be indicated			2.1	AB	S
FR-121	Allow the integration with existing building management systems (security cameras, information on the elevators, ...)			2.1	ABCD EF	S or C
NFR-122	System costs	new buildings: percentage of the total construction costs exixting buildings	a smoke detection sensor network costs 3% of the total construction raw costs; exixting buildings: to be included in the maintenance and running costs		CD	M
FR-123	The system shall provide informationwith the content of standard intervention plans		-basic building information: way in, way out, evacuation areas, evacuation routes, detection systems, automatic fire extinguishing installations, … -Occupant's information: how many, how old? What's their mobility (physical, psychological, asleep/awake)? What is the spread of the occupants in the building? Do they know the building? Are they trained?	2.1	ABCD	S

Nr.	User requirement	Value	Description/comments/links	Sub system	User type	MS CW
			-Specific hazards: dangerous goods, gas installations, electrical installations -Affected areas in the building? -Detection systems? Automatic Fire Extinguishing Installations? (Sprinkler) -> time of activation, (intervention plans are already in use (paper or digital), but not for all buildings see BSAHF model (additional information) +construction type stable areas like staircases			
FR-124	The 3D user interface must show the intervention plan information			2.1	ABCD	S
FR-125	imagery shall make visible the fire spread and the progress of the fire		especially when not reachable with turntable ladders	3.1	ABCD EF	S
NFR-126	The user interface must be simple, robust: has to be fire fighter proof, simple robust, easy to handle			2.1	AB	M
NFR-127	The system shall deliver data and results via the internet		for command posts and the crisis centre	2.1	ABCD EF	M
FR-128	The sensor network/monitoring system shall detect victim sounds in collapsed buildings			1.2	ABCD	S
FR-129	accuracy of movement measurements needed for first responders	+/- 5-10 mm		1.5	ABCD	S
FR-130	temperatures shall be measured within the structure to detect fires, damages due to fire		see additional information/heat	1.4	ABCD	M
NFR-131	Imagery of collapsed buildings / area before damage event is needed	when on scene (after 24 hours) and on the way (after 6 hours)		3.1	ABCD EF	S

Annex B: Completed questionnaires

Altogether **14 completed questionnaires of type AB** and **6 completed questionnaires of type CD** (compare section 4.1) are attached.

User Requirements

Questionnaire

RECONASS

Reconstruction and REcovery Planning:

Rapid and Continuously Updated COnstruction Damage and Related Needs ASSessment

WP1: User Requirements and System Architecture

Questionnaire

Governmental and Non-Governmental Emergency / Disaster Response Organizations

A. Introduction

RECONASS is a project co-funded by the European Commission under FP7 (No 312718) that started in December 2013 with duration of 42 months. Further details can be found at http://www.reconass.eu.

In order to support the development of the RECONASS system during the project term, three user meetings will be organized.

Completing the questionnaire will take approximately **15 minutes** of your time.

Please press "**submit**" after completion **or if not possible** please send the questionnaire until **February 27th**, 2014.

by email (markus@baufb.de), fax (Fax: +49 228 940 1520) or mail to: Technisches Hilfswerk, Referat E1 "RECONASS", Provinzialstr. 93, D- 53127 Bonn, Germany

THANK YOU for supporting RECONASS!

User Requirements
Questionnaire

B. The RECONASS System

The RECONASS System is mainly designed for earthquake events, explosions and fires and consists of

1: A **sensor network** to be integrated in **critical buildings of** such as hospitals, fire stations or important transportation hubs. It includes an evaluation unit to assess the structural damages (with and without collapse), direct economic loss and needs of repair. Sensor measurements and damage assessments will reach the base station at real time, so, e.g. the Department of Health will know almost immediately after an earthquake if monitored hospitals are safe.

2. **Calibration of damage and needs assessment maps** derived e.g. from satellite or aerial images using the detailed assessments of monitored buildings and additional **multi view oblique airborne imagery acquired by an unmanned aerial vehicle (UAV)**, provided with a likely time delay of 1-2 days due to equipment deployment to the incident site.

3. A **post-crisis needs assessment tool** in regards to construction damage and related needs (PCCDN) that will enable fusion of external information and provide **interoperability** between the involved units for reconstruction and recovery planning to support their **cooperation** based on reliable data.

User types of the RECONASS system will be:

A. **Governmental** Emergency / **Disaster Response** Organizations
B. **Non-Governmental** Emergency / **Disaster Response** Organizations
C. **Public Operators** of Critical **Buildings**
D. **Private Operators** of Critical **Buildings**
E. **Organizations** involved in the **development** of remote sensing based **damage maps**
F. Organizations involved in synoptic **damage prediction** based on acceleration measurements, **insurance companies**, **etc.**

C. Instructions

You can fill in the pdf document on your computer and send it back using the submit button. You can also use the printout and send it back, preferably by email. If you want to add comments, please use the comment field at the end of the document or an additional email/ sheet of paper.

Some questions use the MoSCoW requirements attempt:

M - MUST: Describes a requirement that must be satisfied in the final solution for the solution to be considered a success.

S - SHOULD: Represents a high-priority item that should be included in the solution if it is possible. This is often a critical requirement but one which can be satisfied in other ways if strictly necessary.

C - COULD: Describes a requirement which is considered desirable but not necessary. This will be included if time and resources permit.

User Requirements
Questionnaire

W - WONT: Represents a requirement that stakeholders have agreed will not be implemented in a given release, but may be considered for the future. (note: occasionally the word "Would" is substituted for "Won't" to give a clearer understanding of this choice)

If you are not sure with your answer you can skip it and go ahead to the next question.

User Requirements
Questionnaire AB01

2	Sensors in buildings: Information about single buildings				
		Must	Should	Could	Wont
2.1	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☑	☐	☐	☐
2.2 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☐	☑	☐	☐
b	**detailed results** of the **damage and loss assessment**?	☐	☑	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☐	☑	☐	☐
d	a **3D building illustration** visualizing the damage data?	☐	☑	☐	☐
e	actual **aerial photos** of the damages taken by the UAV?	☑	☐	☐	☐
2.3	**How do you want to receive the data (2.2)?**	Must	Should	Could	Wont
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☑	☐	☐
b	**3D model** data	☐	☑	☐	☐
c	**GIS** ready data	☐	☑	☐	☐
d	**Pdf** documents	☑	☐	☐	☐
e	Hardcopy **print-out**	☑	☐	☐	☐
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☑	☐	☐
g	Data and results via **WLAN**	☐	☑	☐	☐
h	Data and results via the **internet**	☑	☐	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.4	Do you need a **specific monitoring function** about the building state **during your intervention**?	☐	☑	☐	☐
2.5	Do you need an **alarm** (acoustic, light,..)?	☐	☑	☐	☐
*	**... minutes after the event:**	5'	20'	60'	later
2.6	**When** do you need this information (2.1 -3)?	☐	☐	☑	☐
	... hours after the event:	6 h	12 h	24 h	48 h
2.7	I accept **receiving aerial photos** later:	☑	☐	☐	☐
		1 h	1 day	1 week	more
2.8	How much time could you or your staff invest in **training** to use the system?	☐	☐	☑	☐
2.9	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?	Building owner			
2.10	**Comments** about sensors in buildings, Information about single buildings:				

User Requirements
Questionnaire AB01

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	**Must**	**Should**	**Could**	**Wont**
a	.. in **single buildings**.	☐	☐	☑	☐
b	.. in several **buildings equipped with sensors.**	☐	☑	☐	☐
c	.. an **affected area.**	☐	☑	☐	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	**Must**	**Should**	**Could**	**Wont**
a	**Repair costs**	☐	☐	☑	☐
b	**Structural and nonstructural** damages	☑	☐	☐	☐
c	**Shoring** or demolition needs	☑	☐	☐	☐
d	Needed **manpower** for repair or reconstruction	☐	☑	☐	☐
	Need of **shelter**, camps, housing	☐	☑	☐	☐
e	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☑	☐	☐	☐
f	**Overview maps**, information summarized for blocks of 100m x 100m	☐	☑	☐	☐
d	Damages to **lifelines** like roads, water supply, electricity, and needs	☑	☐	☐	☐
d	Human losses, needs for **medical** treatment	☑	☐	☐	☐
h	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☑	☐	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☐	☑	☐	☐
	after the event:	☐	☐	☐	☐
		12 h	**24 h**	**48 h**	**later**
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☐	**1 week** ☑	**more** ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):				
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				

User Requirements
Questionnaire AB01

4	General Requirements				
		Must	Should	Could	Wont
4.1	Is it necessary, that the system can **exchange data** with other systems?	☐	☐	☑	☐
4.2	What would be the systems you would intend to exchange data with?				
		Must	Should	Could	Wont
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☐	☐	☑	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☑	☐
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☑	☐	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☐	☐	☑	☐
4.6	after the event:	30'	2 h	8 h	24 h
	How long must the system work after **power breakdown**?	☐	☐	☐	☑
	after the event:	3 days ☐	7 days ☐	3 weeks ☐	more ☐
5	**Additional requirements from your point of view**				
		Must	Should	Could	Wont
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				

THANK YOU!

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User Requirements
Questionnaire AB02

2	Sensors in buildings: Information about single buildings				
		Must	Should	Could	Wont
2.1	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☐	☑	☐	☐
2.2 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☐	☑	☐	☐
b	**detailed results** of the **damage and loss assessment**?	☑	☐	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☐	☑	☐	☐
d	a **3D building illustration** visualizing the damage data?	☑	☐	☐	☐
e	actual **aerial photos** of the damages taken by the UAV?	☑	☐	☐	☐
2.3	**How do you want to receive the data (2.2)?**	Must	Should	Could	Wont
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☑	☐	☐
b	**3D model** data	☐	☑	☐	☐
c	**GIS** ready data	☑	☐	☐	☐
d	**Pdf** documents	☑	☐	☐	☐
e	Hardcopy **print-out**	☐	☐	☑	☐
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☑	☐	☐
g	Data and results via **WLAN**	☐	☑	☐	☐
h	Data and results via the **internet**	☐	☑	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.4	Do you need a **specific monitoring function** about the building state **during your intervention**?	☐	☐	☐	☐
2.5	Do you need an **alarm** (acoustic, light,..)?	☐	☐	☐	☐
*	**... minutes after the event:**	5'	20'	60'	later
2.6	**When** do you need this information (2.1 -3)?	☐	☐	☐	☐
	... hours after the event:	6 h	12 h	24 h	48 h
2.7	I accept **receiving aerial photos** later:	☑	☐	☐	☐
2.8	How much time could you or your staff invest in **training** to use the system?	1 h ☐	1 day ☑	1 week ☐	more ☐
2.9	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?	Governmental Organisation			
2.10	**Comments** about sensors in buildings, Information about single buildings:				

User Requirements
Questionnaire AB02

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	Must	Should	Could	Wont
a	.. in **single buildings**.	☑	☐	☐	☐
b	.. in several **buildings equipped with sensors.**	☑	☐	☐	☐
c	.. an **affected area.**	☑	☐	☐	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	Must	Should	Could	Wont
a	**Repair costs**	☑	☐	☐	☐
b	**Structural and nonstructural** damages	☑	☐	☐	☐
c	**Shoring** or demolition needs	☑	☐	☐	☐
d	Needed **manpower** for repair or reconstruction	☑	☐	☐	☐
	Need of **shelter**, camps, housing	☑	☐	☐	☐
e	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☑	☐	☐	☐
f	**Overview maps**, information summarized for blocks of 100m x 100m	☑	☐	☐	☐
d	Damages to **lifelines** like roads, water supply, electricity, and needs	☑	☐	☐	☐
d	Human losses, needs for **medical** treatment	☑	☐	☐	☐
h	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☑	☑	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings**?**	☐	☐	☐	☐
		☑	☐	☐	☐
	after the event:	**12 h**	**24 h**	**48 h**	**later**
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☑	**1 week** ☐	**more** ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):	GOVERNEMENTAL ORGANISATION			
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				

User Requirements
Questionnaire AB02

4	**General Requirements**				
		Must	**Should**	**Could**	**Wont**
4.1	Is it necessary, that the system can **exchange data** with other systems?	☑	☐	☐	☐
4.2	What would be the systems you would intend to exchange data with?				
		Must	**Should**	**Could**	**Wont**
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☑	☐	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☑	☐	☐	☐
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☐	☑	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☑	☐	☐	☐
4.6	after the event:	**30'**	**2 h**	**8 h**	**24 h**
	How long must the system work after **power breakdown**?	☑	☐	☐	☐
	after the event:	☐ **3 days**	☐ **7 days**	☐ **3 weeks**	☐ **more**
5	**Additional requirements from your point of view**				
		Must	**Should**	**Could**	**Wont**
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				

THANK YOU!

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RECONASS questionnaire2014-1-AB
page 7

User Requirements
Questionnaire AB03

2	**Sensors in buildings: Information about single buildings**				
		Must	**Should**	**Could**	**Wont**
2.1	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☑	☐	☐	☐
2.2 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☐	☐	☐	☐
b	**detailed results** of the **damage and loss assessment**?	☑	☐	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☐	☐	☑	☐
d	a **3D building illustration** visualizing the damage data?	☐	☐	☐	☐
e	actual **aerial photos** of the damages taken by the UAV?	☑	☐	☐	☐
2.3	**How do you want to receive the data (2.2)?**	**Must**	**Should**	**Could**	**Wont**
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☐	☐	☐
b	**3D model** data	☐	☐	☐	☐
c	**GIS** ready data	☐	☐	☐	☐
d	**Pdf** documents	☐	☐	☐	☐
e	Hardcopy **print-out**	☐	☐	☐	☐
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☐	☐	☐
g	Data and results via **WLAN**	☐	☐	☐	☐
h	Data and results via the **internet**	☑	☐	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.4	Do you need a **specific monitoring function** about the building state **during your intervention**?	☑	☐	☐	☐
2.5	Do you need an **alarm** (acoustic, light,..)?	☑	☐	☐	☐
*	**... minutes after the event:**	**5'**	**20'**	**60'**	**later**
2.6	**When** do you need this information (2.1 -3)?	☑	☐	☐	☐
	... hours after the event:	**6 h**	**12 h**	**24 h**	**48 h**
2.7	I accept **receiving aerial photos** later:	☐	☐	☐	☐
2.8	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☐	**1 week** ☑	**more** ☐
2.9	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?				
2.10	**Comments** about sensors in buildings, Information about single buildings:				

Technisches Hilfswerk

User Requirements
Questionnaire AB03

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	**Must**	**Should**	**Could**	**Wont**
a	.. in **single buildings**.	☑	☐	☐	☐
b	.. in several **buildings equipped with sensors.**	☐	☐	☐	☐
c	.. an **affected area.**	☑	☐	☐	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	**Must**	**Should**	**Could**	**Wont**
a	**Repair costs**	☐	☐	☐	☐
b	**Structural and nonstructural** damages	☑	☐	☐	☐
c	**Shoring** or demolition needs	☑	☐	☐	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☐	☐
	Need of **shelter**, camps, housing	☐	☐	☐	☐
e	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☑	☐	☐	☐
f	**Overview maps**, information summarized for blocks of 100m x 100m	☑	☐	☐	☐
d	Damages to **lifelines** like roads, water supply, electricity, and needs	☑	☐	☐	☐
d	Human losses, needs for **medical** treatment	☐	☐	☐	☐
h	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☑	☐	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☑ / ☐	☐	☐	☐
	after the event:	**12 h**	**24 h**	**48 h**	**later**
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☐	**1 week** ☑	**more** ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):				
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				

User Requirements
Questionnaire AB03

4	**General Requirements**				
		Must	**Should**	**Could**	**Wont**
4.1	Is it necessary, that the system can **exchange data** with other systems?	☐	☐	☐	☐
4.2	What would be the systems you would intend to exchange data with?				
		Must	**Should**	**Could**	**Wont**
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☑	☐	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☐	☑
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☐	☑	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☐	☐	☑	☐
4.6	after the event:	**30'**	**2 h**	**8 h**	**24 h**
	How long must the system work after **power breakdown**?	☐	☐	☐	☑
	after the event:	☐ **3 days**	☐ **7 days**	☐ **3 weeks**	☐ **more**
5	**Additional requirements from your point of view**				
		Must	**Should**	**Could**	**Wont**
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				

THANK YOU!

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User Requirements
Questionnaire AB04

2	Sensors in buildings: Information about single buildings				
		Must	Should	Could	Wont
2.1	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☑	☐	☐	☐
2.2 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☐	☑	☐	☐
b	**detailed results** of the **damage and loss assessment**?	☐	☑	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☑	☐	☐	☐
d	a **3D building illustration** visualizing the damage data?	☑	☐	☐	☐
e	actual **aerial photos** of the damages taken by the UAV?	☑	☐	☐	☐
2.3	**How do you want to receive the data (2.2)?**	Must	Should	Could	Wont
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☑	☐	☐
b	**3D model** data	☑	☐	☐	☐
c	**GIS** ready data	☑	☐	☐	☐
d	**Pdf** documents	☑	☐	☐	☐
e	Hardcopy **print-out**	☑	☐	☐	☐
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☑	☐	☐
g	Data and results via **WLAN**	☑	☐	☐	☐
h	Data and results via the **internet**	☑	☐	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.4	Do you need a **specific monitoring function** about the building state **during your intervention**?	☑	☐	☐	☐
2.5	Do you need an **alarm** (acoustic, light,..)?	☑	☐	☐	☐
*	**... minutes after the event:**	5'	20'	60'	later
2.6	**When** do you need this information (2.1 -3)?	☑	☐	☐	☐
	... hours after the event:	6 h	12 h	24 h	48 h
2.7	I accept **receiving aerial photos** later:	☑	☐	☐	☐
2.8	How much time could you or your staff invest in **training** to use the system?	1 h ☐	1 day ☐	1 week ☑	more ☐
2.9	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?	NGO			
2.10	**Comments** about sensors in buildings, Information about single buildings:				
	We should have a sensor that can measure the volume of the rooms\spaces after explosions or collapses. This will allow to compare the total volume of the seperate rooms and inform the rescuers about any life triangles and\or type of deformation without going deep in the debris.				

User Requirements
Questionnaire AB04

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	Must	Should	Could	Wont
a	.. in **single buildings**.	☑	☐	☐	☐
b	.. in several **buildings equipped with sensors.**	☑	☐	☐	☐
c	.. an **affected area.**	☑	☐	☐	☐
d	Other: ESPECIALLY PUBLIC BUILDINGS WHICH HAS A SCORE OF PEOPLE	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	Must	Should	Could	Wont
a	**Repair costs**	☐	☐	☐	☑
b	**Structural and nonstructural** damages	☐	☑	☐	☐
c	**Shoring** or demolition needs	☑	☐	☐	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☐	☐
	Need of **shelter**, camps, housing	☐	☑	☐	☐
e	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☑	☐	☐	☐
f	**Overview maps**, information summarized for blocks of 100m x 100m	☑	☐	☐	☐
d	Damages to **lifelines** like roads, water supply, electricity, and needs	☑	☐	☐	☐
d	Human losses, needs for **medical** treatment	☑	☐	☐	☐
h	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☑	☐	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☑	☐	☐	☐
	after the event:	**12 h**	**24 h**	**48 h**	**later**
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☐	**1 week** ☑	**more** ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):	NGO			
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				
	SAR team sepecially need soe specific informations on damaged and or collapsed buildings, such as; -original construction systems and additions (if) -number of floors -elevation difference -height -function of the building -app. number of users				

User Requirements

Questionnaire AB04

4	General Requirements				
		Must	Should	Could	Wont
4.1	Is it necessary, that the system can **exchange data** with other systems?	☑	☐	☐	☐
4.2	What would be the systems you would intend to exchange data with?	social info. topographic info. infrastrucure etc.			
		Must	Should	Could	Wont
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☑	☐	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☑	☐
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☑	☐	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☑	☐	☐	☐
4.6	after the event:	**30'**	**2 h**	**8 h**	**24 h**
	How long must the system work after **power breakdown**?	☑	☐	☐	☐
	after the event:	☑ **3 days**	☐ **7 days**	☐ **3 weeks**	☐ **more**
5	**Additional requirements from your point of view**				
		Must	Should	Could	Wont
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				
	To determine the strategy of search and rescue, all kinds of information about disaster area should be submitted to Search and Rescue group.(Like THW, Red Cross, NGO's....) Especially, before moving to disaster area the transmitted information will be invaluable in the preparation phase.				

THANK YOU!

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User Requirements
Questionnaire AB05

2	Sensors in buildings: Information about single buildings				
		Must	Should	Could	Wont
2.1	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☑	☐	☐	☐
2.2 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☐	☐	☐	☑
b	**detailed results** of the **damage and loss assessment**?	☑	☐	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☐	☐	☐	☑
d	a **3D building illustration** visualizing the damage data?	☐	☐	☑	☐
e	actual **aerial photos** of the damages taken by the UAV?	☐	☑	☐	☐
2.3	**How do you want to receive the data (2.2)?**	Must	Should	Could	Wont
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☐	☐	☑
b	**3D model** data	☐	☑	☐	☐
c	**GIS** ready data	☑	☐	☐	☐
d	**Pdf** documents	☑	☐	☐	☐
e	Hardcopy **print-out**	☐	☑	☐	☐
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☐	☑	☐
g	Data and results via **WLAN**	☑	☐	☐	☐
h	Data and results via the **internet**	☑	☐	☐	☐
i	**Other** data transfer: Social Media	☐	☐	☐	☐
2.4	Do you need a **specific monitoring function** about the building state **during your intervention**?	☑	☐	☐	☐
2.5	Do you need an **alarm** (acoustic, light,..)?	☑	☐	☐	☐
*	**... minutes after the event:**	5'	20'	60'	later
2.6	**When** do you need this information (2.1 -3)?	☑	☐	☑	☐
	... hours after the event:	6 h	12 h	24 h	48 h
2.7	I accept **receiving aerial photos** later:	☐	☑	☐	☐
		1 h	1 day	1 week	more
2.8	How much time could you or your staff invest in **training** to use the system?	☑	☐	☐	☐
2.9	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?	building owner - red cross			
2.10	**Comments** about sensors in buildings, Information about single buildings:				
	1. buildings suffer damage which are not structural but make it unusable (as broken pipes and "local flooding"). this should be considered in the "usability assessment". 2. For critical infrastructure there are 2 dimensions - the damage sustained and the decision of it's management on the operational status (functional or not)				

User Requirements
Questionnaire AB05

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	Must	Should	Could	Wont
a	.. in **single buildings**.	☑	☐	☐	☐
b	.. in several **buildings equipped with sensors.**	☑	☐	☐	☐
c	.. an **affected area.**	☑	☐	☐	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	Must	Should	Could	Wont
a	**Repair costs**	☐	☐	☐	☑
b	**Structural and nonstructural** damages	☑	☐	☐	☐
c	**Shoring** or demolition needs	☐	☐	☑	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☑	☐
	Need of **shelter**, camps, housing	☑	☐	☐	☐
e	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☑	☐	☐	☐
f	**Overview maps**, information summarized for blocks of 100m x 100m	☑	☐	☐	☐
d	Damages to **lifelines** like roads, water supply, electricity, and needs	☑	☐	☐	☐
d	Human losses, needs for **medical** treatment	☑	☐	☐	☐
h	Other: status of critical infrastructure _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☑	☐	☐	☐
3.4	after the event:	20'	60'	3h	6 h
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☐ ☑	☑ ☑	☑ ☑	☑ ☐
	after the event:	12 h	24 h	48 h	later
3.5	How much time could you or your staff invest in **training** to use the system?	1 h ☑	1 day ☐	1 week ☐	more ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):	The building owner and response organization			
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**	1. information is evolving, thus it should be sent periodically. 2. So far what has been presented is damage assessment and not needs assessment			

User Requirements

Questionnaire AB05

4	General Requirements				
		Must	Should	Could	Wont
4.1	Is it necessary, that the system can **exchange data** with other systems?	☐	☑	☐	☐
4.2	What would be the systems you would intend to exchange data with?	MDA C4I system			
		Must	Should	Could	Wont
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☐	☐	☑	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☐	☑
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☑	☐	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☑	☐	☐	☐
4.6	after the event:	30'	2 h	8 h	24 h
	How long must the system work after **power breakdown**?	☐	☐	☑	☐
		☑	☐	☐	☐
	after the event:	3 days	7 days	3 weeks	more
5	**Additional requirements from your point of view**				
		Must	Should	Could	Wont
5.1	Humanitarian needs assessment	☑	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				

1. An organization what the status of it's assets in details.
2. Responders want to have the usability of critical infrastructure (regardless of the damage they sustained). the question would be who will provide the "functional" situation of a critical asset (road, hospital, water plant)
3. The tool is about damage assessment not about needs assessment
4.As information in disasters is evolving, the system needs to provide periodic updates.
5. sometimes you want details and sometimes overview. The system must support both.

THANK YOU!

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User Requirements
Questionnaire AB06

2	Sensors in buildings: Information about single buildings				
		Must	Should	Could	Wont
2.1	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☐	☐	☑	☐
2.2 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☐	☐	☐	☑
b	**detailed results** of the **damage and loss assessment**?	☐	☐	☑	☐
c	information about the **remaining load capacity** of the building and its elements?	☐	☐	☑	☐
d	a **3D building illustration** visualizing the damage data?	☐	☐	☐	☑
e	actual **aerial photos** of the damages taken by the UAV?	☐	☐	☑	☐
2.3	**How do you want to receive the data (2.2)?**	Must	Should	Could	Wont
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☐	☑	☐
b	**3D model** data	☐	☐	☑	☐
c	**GIS** ready data	☐	☐	☑	☐
d	**Pdf** documents	☐	☐	☑	☐
e	Hardcopy **print-out**	☐	☐	☑	☐
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☐	☑	☐
g	Data and results via **WLAN**	☐	☑	☐	☐
h	Data and results via the **internet**	☐	☑	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☑
2.4	Do you need a **specific monitoring function** about the building state **during your intervention**?	☐	☐	☑	☐
2.5	Do you need an **alarm** (acoustic, light,..)?	☐	☐	☑	☐
*	**... minutes after the event:**	5'	20'	60'	later
2.6	**When** do you need this information (2.1 -3)?	☐	☐	☐	☑
	... hours after the event:	6 h	12 h	24 h	48 h
2.7	I accept **receiving aerial photos** later:	☐	☐	☑	☐
		1 h	1 day	1 week	more
2.8	How much time could you or your staff invest in **training** to use the system?	☐	☐	☑	☐
2.9	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?	governm. org. or npo			
2.10	**Comments** about sensors in buildings, Information about single buildings:				

User Requirements
Questionnaire AB06

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	**Must**	**Should**	**Could**	**Wont**
a	.. in **single buildings**.	☐	☐	☑	☐
b	.. in several **buildings equipped with sensors.**	☐	☐	☑	☐
c	.. an **affected area.**	☐	☑	☐	☐
d	Other: _____	☐	☐	☐	☑
3.2	**What would be the specific losses and needs to be identified?**	**Must**	**Should**	**Could**	**Wont**
a	**Repair costs**	☐	☐	☑	☐
b	**Structural and nonstructural** damages	☐	☐	☑	☐
c	**Shoring** or demolition needs	☐	☐	☑	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☑	☐
	Need of **shelter**, camps, housing	☑	☐	☐	☐
e	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☐	☐	☑	☐
f	**Overview maps**, information summarized for blocks of 100m x 100m	☐	☐	☑	☐
d	Damages to **lifelines** like roads, water supply, electricity, and needs	☐	☑	☐	☐
d	Human losses, needs for **medical** treatment	☑	☐	☐	☐
h	Other: _____	☐	☐	☐	☑
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☑	☐	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings**?**	☐ ☑	☐ ☑	☐ ☐	☐ ☐
	after the event:	**12 h**	**24 h**	**48 h**	**later**
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☑	**1 week** ☐	**more** ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):	gov. org. or npo			
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				

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User Requirements

Questionnaire AB06

4	General Requirements				
		Must	Should	Could	Wont
4.1	Is it necessary, that the system can **exchange data** with other systems?	☐	☑	☐	☐
4.2	What would be the systems you would intend to exchange data with?	we'd prefer in general open source solutions with pre-defined interfaces			
		Must	Should	Could	Wont
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☐	☐	☑	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☐	☑
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☐	☑	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☐	☐	☑	☐
4.6	after the event:	**30'**	**2 h**	**8 h**	**24 h**
	How long must the system work after **power breakdown**?	☐	☐	☐	☐
	after the event:	☐ **3 days**	☐ **7 days**	☑ **3 weeks**	☐ **more**
5	**Additional requirements from your point of view**				
		Must	Should	Could	Wont
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				

THANK YOU!

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User Requirements
Questionnaire AB07

2	**Sensors in buildings: Information about single buildings**				
		Must	**Should**	**Could**	**Wont**
2.1	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☑	☐	☐	☐
2.2 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☐	☐	☐	☑
b	**detailed results** of the **damage and loss assessment**?	☐	☑	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☐	☐	☐	☑
d	a **3D building illustration** visualizing the damage data?	☐	☐	☑	☐
e	actual **aerial photos** of the damages taken by the UAV?	☑	☐	☐	☐
2.3	**How do you want to receive the data (2.2)?**	**Must**	**Should**	**Could**	**Wont**
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☐	☐	☑
b	**3D model** data	☐	☐	☑	☐
c	**GIS** ready data	☑	☐	☐	☐
d	**Pdf** documents	☐	☐	☑	☐
e	Hardcopy **print-out**	☐	☐	☐	☑
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☐	☐	☑
g	Data and results via **WLAN**	☐	☐	☐	☑
h	Data and results via the **internet**	☑	☐	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.4	Do you need a **specific monitoring function** about the building state **during your intervention**?	☐	☐	☐	☑
2.5	Do you need an **alarm** (acoustic, light,..)?	☐	☐	☐	☑
*	**... minutes after the event:**	**5'**	**20'**	**60'**	**later**
2.6	**When** do you need this information (2.1 -3)?	☐	☐	☐	☐
	... hours after the event:	**6 h**	**12 h**	**24 h**	**48 h**
2.7	I accept **receiving aerial photos** later:	☑	☑	☑	☑
		1 h	**1 day**	**1 week**	**more**
2.8	How much time could you or your staff invest in **training** to use the system?	☐	☑	☐	☐
2.9	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?				
2.10	**Comments** about sensors in buildings, Information about single buildings:				
	The answers have been provided from the emergency mapping perspective, i.e. with the goal to produce damage assessment maps based on remotely sensed (aerial/satellite) post-event imagery				

User Requirements
Questionnaire AB07

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	Must	Should	Could	Wont
a	.. in **single buildings**.	☐	☐	☑	☐
b	.. in several **buildings equipped with sensors.**	☐	☐	☑	☐
c	.. an **affected area.**	☑	☐	☐	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	Must	Should	Could	Wont
a	**Repair costs**	☐	☐	☐	☑
b	**Structural and nonstructural** damages	☑	☐	☐	☐
c	**Shoring** or demolition needs	☐	☐	☐	☑
d	Needed **manpower** for repair or reconstruction	☐	☐	☐	☑
	Need of **shelter**, camps, housing	☐	☐	☐	☑
e	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☑	☐	☐	☐
f	**Overview maps**, information summarized for blocks of 100m x 100m	☑	☐	☐	☐
d	Damages to **lifelines** like roads, water supply, electricity, and needs	☑	☐	☐	☐
d	Human losses, needs for **medical** treatment	☐	☐	☐	☑
h	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☑	☐	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings**?**	☐ ☑	☐ ☑	☐ ☑	☐ ☐
	after the event:	**12 h**	**24 h**	**48 h**	**later**
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☑	**1 week** ☐	**more** ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):				
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				
	The answers have been provided from the emergency mapping perspective, i.e. with the goal to produce damage assessment maps based on remotely sensed (aerial/satellite) post-event imagery				

User Requirements
Questionnaire AB07

4	**General Requirements**				
		Must	**Should**	**Could**	**Wont**
4.1	Is it necessary, that the system can **exchange data** with other systems?	☐	☐	☐	☑
4.2	What would be the systems you would intend to exchange data with?				
		Must	**Should**	**Could**	**Wont**
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☑	☐	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☐	☑
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☐	☐	☑	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☐	☐	☐	☑
4.6	after the event:	**30'**	**2 h**	**8 h**	**24 h**
	How long must the system work after **power breakdown**?	☐	☐	☐	☐
	after the event:	**3 days** ☐	**7 days** ☐	**3 weeks** ☐	**more** ☐
5	**Additional requirements from your point of view**				
		Must	**Should**	**Could**	**Wont**
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				
	The answers have been provided from the emergency mapping perspective, i.e. with the goal to produce damage assessment maps based on remotely sensed (aerial/satellite) post-event imagery.				

THANK YOU!

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User Requirements
Questionnaire AB08

2	**Sensors in buildings: Information about single buildings**				
		Must	**Should**	**Could**	**Wont**
2.1	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☑	☐	☐	☐
2.2 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☐	☐	☑	☐
b	**detailed results** of the **damage and loss assessment**?	☐	☑	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☑	☐	☐	☐
d	a **3D building illustration** visualizing the damage data?	☐	☑	☐	☐
e	actual **aerial photos** of the damages taken by the UAV?	☑	☐	☐	☐
2.3	**How do you want to receive the data (2.2)?**	**Must**	**Should**	**Could**	**Wont**
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☑	☐	☐	☐
b	**3D model** data	☐	☑	☐	☐
c	**GIS** ready data	☑	☐	☐	☐
d	**Pdf** documents	☑	☐	☐	☐
e	Hardcopy **print-out**	☐	☐	☐	☑
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☐	☑	☐
g	Data and results via **WLAN**	☐	☐	☑	☐
h	Data and results via the **internet**	☑	☐	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.4	Do you need a **specific monitoring function** about the building state **during your intervention**?	☐	☑	☐	☐
2.5	Do you need an **alarm** (acoustic, light,..)?	☐	☐	☑	☐
*	**... minutes after the event:**	5'	20'	60'	later
2.6	**When** do you need this information (2.1 -3)?	☐	☑	☐	☐
	... hours after the event:	6 h	12 h	24 h	48 h
2.7	I accept **receiving aerial photos** later:	☑	☐	☐	☐
		1 h	1 day	1 week	more
2.8	How much time could you or your staff invest in **training** to use the system?	☐	☑	☐	☐
2.9	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?	It much depends on the number of systems implemented			
2.10	**Comments** about sensors in buildings, Information about single buildings:				

User Requirements
Questionnaire AB08

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	Must	Should	Could	Wont
a	.. in **single buildings**.	☑	☐	☐	☐
b	.. in several **buildings equipped with sensors.**	☑	☐	☐	☐
c	.. an **affected area.**	☑	☐	☐	☐
d	Other: Comment: There are different needs, dending on the type and use of concerned buildings	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	Must	Should	Could	Wont
a	**Repair costs**	☐	☑	☐	☐
b	**Structural and nonstructural** damages	☐	☑	☐	☐
c	**Shoring** or demolition needs	☑	☐	☐	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☑	☐
	Need of **shelter**, camps, housing	☑	☐	☐	☐
e	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☑	☐	☐	☐
f	**Overview maps**, information summarized for blocks of 100m x 100m	☐	☑	☐	☐
d	Damages to **lifelines** like roads, water supply, electricity, and needs	☑	☐	☐	☐
d	Human losses, needs for **medical** treatment	☑	☐	☐	☐
h	Other:	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☑	☐	☐	☐
3.4	after the event:	20'	60'	3h	6 h
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☑	☐	☐	☐
	after the event:	☐	☐	☐	☐
		12 h	24 h	48 h	later
3.5	How much time could you or your staff invest in **training** to use the system?	1 h ☐	1 day ☑	1 week ☐	more ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):	it much depends on the number of systems implemented and the types of buildings that are monitored.			
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				

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User Requirements

Questionnaire AB08

4	**General Requirements**				
		Must	**Should**	**Could**	**Wont**
4.1	Is it necessary, that the system can **exchange data** with other systems?	☐	☐	☑	☐
4.2	What would be the systems you would intend to exchange data with?	Systems used of the emergency management (building usability, assistance to the population, etc.).			
		Must	**Should**	**Could**	**Wont**
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☑	☐	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☑	☐
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☑	☐	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☑	☐	☐	☐
4.6	after the event:	**30'**	**2 h**	**8 h**	**24 h**
	How long must the system work after **power breakdown**?	☐	☑	☐	☐
	after the event:	**3 days**	**7 days**	**3 weeks**	**more**
5	**Additional requirements from your point of view**				
		Must	**Should**	**Could**	**Wont**
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				
	It is difficult to choose the answer to the above questions, since some				

THANK YOU!

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User Requirements
Questionnaire AB09

2	Sensors in buildings: Information about single buildings				
		Must	Should	Could	Wont
2.1	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☐	☑	☐	☐
2.2 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☐	☐	☑	☐
b	**detailed results** of the **damage and loss assessment**?	☐	☑	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☐	☐	☑	☐
d	a **3D building illustration** visualizing the damage data?	☐	☑	☐	☐
e	actual **aerial photos** of the damages taken by the UAV?	☐	☑	☐	☐
2.3	**How do you want to receive the data (2.2)?**	Must	Should	Could	Wont
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☑	☐	☐
b	**3D model** data	☐	☑	☐	☐
c	**GIS** ready data	☐	☑	☐	☐
d	**Pdf** documents	☐	☐	☑	☐
e	Hardcopy **print-out**	☐	☐	☐	☑
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☐	☐	☑
g	Data and results via **WLAN**	☐	☐	☑	☐
h	Data and results via the **internet**	☐	☑	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.4	Do you need a **specific monitoring function** about the building state **during your intervention**?	☐	☐	☐	☐
2.5	Do you need an **alarm** (acoustic, light,..)?	☐	☐	☐	☐
*	**... minutes after the event:**	5'	20'	60'	later
2.6	**When** do you need this information (2.1 -3)?	☐	☐	☐	☐
	... hours after the event:	6 h	12 h	24 h	48 h
2.7	I accept **receiving aerial photos** later:	☐	☐	☐	☐
2.8	How much time could you or your staff invest in **training** to use the system?	1 h ☐	1 day ☐	1 week ☐	more ☐
2.9	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?				
2.10	**Comments** about sensors in buildings, Information about single buildings:				

User Requirements
Questionnaire AB09

4	General Requirements				
		Must	Should	Could	Wont
4.1	Is it necessary, that the system can **exchange data** with other systems?	☑	☐	☐	☐
4.2	What would be the systems you would intend to exchange data with?				
		Must	Should	Could	Wont
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☐	☑	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☐	☑
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☐	☐	☑	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☐	☐	☑	☐
4.6	after the event:	**30'**	**2 h**	**8 h**	**24 h**
	How long must the system work after **power breakdown**?	☐	☐	☐	☐
	after the event:	☐ **3 days**	☐ **7 days**	☐ **3 weeks**	☐ **more**
5	**Additional requirements from your point of view**				
		Must	Should	Could	Wont
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				

THANK YOU!

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User Requirements
Questionnaire AB10

2	Sensors in buildings: Information about single buildings				
		Must	Should	Could	Wont
2.1	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☑	☐	☐	☐
2.2 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☑	☐	☐	☐
b	**detailed results** of the **damage and loss assessment**?	☑	☐	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☐	☑	☐	☐
d	a **3D building illustration** visualizing the damage data?	☐	☑	☐	☐
e	actual **aerial photos** of the damages taken by the UAV?	☑	☐	☐	☐
2.3	**How do you want to receive the data (2.2)?**	Must	Should	Could	Wont
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☐	☑	☐
b	**3D model** data	☐	☑	☐	☐
c	**GIS** ready data	☑	☐	☐	☐
d	**Pdf** documents	☑	☐	☐	☐
e	Hardcopy **print-out**	☐	☑	☐	☐
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☐	☐	☑
g	Data and results via **WLAN**	☐	☐	☑	☐
h	Data and results via the **internet**	☑	☐	☐	☐
i	**Other** data transfer: Smart phone / SMS warning	☐	☑	☐	☐
2.4	Do you need a **specific monitoring function** about the building state **during your intervention**?	☑	☐	☐	☐
2.5	Do you need an **alarm** (acoustic, light,..)?	☐	☑	☐	☐
*	**... minutes after the event:**	5'	20'	60'	later
2.6	**When** do you need this information (2.1 -3)?	☐	☑	☐	☐
	... hours after the event:	6 h	12 h	24 h	48 h
2.7	I accept **receiving aerial photos** later:	☑	☐	☐	☐
		1 h	1 day	1 week	more
2.8	How much time could you or your staff invest in **training** to use the system?	☐	☑	☑	☐
2.9	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?	Building owner controlled by Governmental Organisation			
2.10	**Comments** about sensors in buildings, Information about single buildings:				
	Periodic test-system				

User Requirements
Questionnaire AB10

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	**Must**	**Should**	**Could**	**Wont**
a	.. in **single buildings**.	☑	☐	☐	☐
b	.. in several **buildings equipped with sensors.**	☐	☑	☐	☐
c	.. an **affected area.**	☐	☐	☑	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	**Must**	**Should**	**Could**	**Wont**
a	**Repair costs**	☐	☐	☑	☐
b	**Structural and nonstructural** damages	☑	☐	☐	☐
c	**Shoring** or demolition needs	☑	☐	☐	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☑	☐
	Need of **shelter**, camps, housing	☑	☐	☐	☐
e	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☐	☑	☐	☐
f	**Overview maps**, information summarized for blocks of 100m x 100m	☐	☑	☐	☐
d	Damages to **lifelines** like roads, water supply, electricity, and needs	☑	☐	☐	☐
d	Human losses, needs for **medical** treatment	☐	☐	☑	☐
h	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☑	☐	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☐	☐	☑	☐
	after the event:	**12 h**	**24 h**	**48 h**	**later**
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☑	**1 week** ☑	**more** ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):	Building owners - controlled by governmental organisation			
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				
	Periodic test-system				

User Requirements

Questionnaire AB10

4	General Requirements				
		Must	Should	Could	Wont
4.1	Is it necessary, that the system can **exchange data** with other systems?	☐	☑	☐	☐
4.2	What would be the systems you would intend to exchange data with?	Compatible with apple (no exe files)			
		Must	Should	Could	Wont
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☐	☑	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☐	☑
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☐	☑	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☑	☐	☐	☐
4.6	after the event:	30'	2 h	8 h	24 h
	How long must the system work after **power breakdown**?	☐	☑	☐	☐
	after the event:	3 days	7 days	3 weeks	more
5	**Additional requirements from your point of view**				
		Must	Should	Could	Wont
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	General comments:				

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User Requirements
Questionnaire AB11

2	Sensors in buildings: Information about single buildings				
		Must	Should	Could	Wont
2.1	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☐	☑	☐	☐
2.2 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☐	☐	☑	☐
b	**detailed results** of the **damage and loss assessment**?	☐	☐	☑	☐
c	information about the **remaining load capacity** of the building and its elements?	☐	☐	☐	☑
d	a **3D building illustration** visualizing the damage data?	☐	☐	☑	☐
e	actual **aerial photos** of the damages taken by the UAV?	☐	☐	☑	☐
2.3	**How do you want to receive the data (2.2)?**	Must	Should	Could	Wont
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☐	☐	☐
b	**3D model** data	☐	☑	☐	☐
c	**GIS** ready data	☑	☐	☐	☐
d	**Pdf** documents	☐	☐	☐	☑
e	Hardcopy **print-out**	☐	☐	☐	☑
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☐	☑	☐
g	Data and results via **WLAN**	☐	☑	☐	☐
h	Data and results via the **internet**	☐	☑	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.4	Do you need a **specific monitoring function** about the building state **during your intervention**?	☐	☐	☐	☐
2.5	Do you need an **alarm** (acoustic, light,..)?	☐	☐	☐	☐
*	**... minutes after the event:**	5'	20'	60'	later
2.6	**When** do you need this information (2.1 -3)?	☐	☐	☐	☐
	... hours after the event:	6 h	12 h	24 h	48 h
2.7	I accept **receiving aerial photos** later:	☐	☐	☐	☐
2.8	How much time could you or your staff invest in **training** to use the system?	1 h ☐	1 day ☐	1 week ☑	more ☐
2.9	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?				
2.10	**Comments** about sensors in buildings, Information about single buildings:				

User Requirements
Questionnaire AB11

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	Must	Should	Could	Wont
a	.. in **single buildings**.	☐	☐	☑	☐
b	.. in several **buildings equipped with sensors.**	☐	☑	☐	☐
c	.. an **affected area.**	☐	☐	☑	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	Must	Should	Could	Wont
a	**Repair costs**	☐	☐	☐	☐
b	**Structural and nonstructural** damages	☐	☐	☐	☐
c	**Shoring** or demolition needs	☐	☐	☐	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☐	☐
	Need of **shelter**, camps, housing	☐	☐	☐	☐
e	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☑	☐	☐	☐
f	**Overview maps**, information summarized for blocks of 100m x 100m	☐	☐	☐	☐
d	Damages to **lifelines** like roads, water supply, electricity, and needs	☐	☐	☑	☐
d	Human losses, needs for **medical** treatment	☐	☐	☐	☐
h	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☐	☐	☐	☐
3.4	after the event:	20'	60'	3h	6 h
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☐	☐	☐	☐
	after the event:	12 h	24 h	48 h	later
3.5	How much time could you or your staff invest in **training** to use the system?	1 h ☐	1 day ☐	1 week ☑	more ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):				
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				

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User Requirements

Questionnaire AB11

4	**General Requirements**				
		Must	**Should**	**Could**	**Wont**
4.1	Is it necessary, that the system can **exchange data** with other systems?	☐	☐	☐	☐
4.2	What would be the systems you would intend to exchange data with?				
		Must	**Should**	**Could**	**Wont**
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☐	☑	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☑	☐
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☐	☐	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☐	☐	☐	☐
4.6	after the event:	**30'**	**2 h**	**8 h**	**24 h**
	How long must the system work after **power breakdown**?	☐	☐	☐	☐
	after the event:	**3 days**	**7 days**	**3 weeks**	**more**
5	**Additional requirements from your point of view**				
		Must	**Should**	**Could**	**Wont**
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				

THANK YOU!

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User Requirements
Questionnaire AB12

2	Sensors in buildings: Information about single buildings				
		Must	Should	Could	Wont
2.1	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☑	☐	☐	☐
2.2 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☑	☐	☐	☐
b	**detailed results** of the **damage and loss assessment**?	☐	☑	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☐	☐	☑	☐
d	a **3D building illustration** visualizing the damage data?	☐	☑	☐	☐
e	actual **aerial photos** of the damages taken by the UAV?	☐	☑	☐	☐
2.3	**How do you want to receive the data (2.2)?**	Must	Should	Could	Wont
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☐	☑	☐
b	**3D model** data	☐	☐	☑	☐
c	**GIS** ready data	☐	☐	☑	☐
d	**Pdf** documents	☐	☐	☑	☐
e	Hardcopy **print-out**	☐	☐	☐	☑
f	Data and results on a **permanently installed PC** / monitor at the building	☑	☐	☐	☐
g	Data and results via **WLAN**	☐	☐	☐	☑
h	Data and results via the **internet**	☑	☐	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☑
2.4	Do you need a **specific monitoring function** about the building state **during your intervention**?	☑	☐	☐	☐
2.5	Do you need an **alarm** (acoustic, light,..)?	☑	☐	☐	☐
*	**... minutes after the event:**	5'	20'	60'	later
2.6	**When** do you need this information (2.1 -3)?	☑	☐	☐	☐
	... hours after the event:	6 h	12 h	24 h	48 h
2.7	I accept **receiving aerial photos** later:	☑	☐	☐	☐
		1 h	1 day	1 week	more
2.8	How much time could you or your staff invest in **training** to use the system?	☐	☑	☐	☐
2.9	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?	Building owner			
2.10	**Comments** about sensors in buildings, Information about single buildings:				
	Financial aspects to be discussed during user meeting				

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User Requirements
Questionnaire AB12

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	Must	Should	Could	Wont
a	.. in **single buildings**.	☐	☐	☐	☑
b	.. in several **buildings equipped with sensors.**	☑	☐	☐	☐
c	.. an **affected area.**	☐	☑	☐	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	Must	Should	Could	Wont
a	**Repair costs**	☐	☐	☑	☐
b	**Structural and nonstructural** damages	☑	☐	☐	☐
c	**Shoring** or demolition needs	☑	☐	☐	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☑	☐
	Need of **shelter**, camps, housing	☑	☐	☐	☐
e	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☐	☑	☐	☐
f	**Overview maps**, information summarized for blocks of 100m x 100m	☐	☑	☐	☐
d	Damages to **lifelines** like roads, water supply, electricity, and needs	☑	☐	☐	☐
d	Human losses, needs for **medical** treatment	☑	☐	☐	☐
h	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☑	☐	☐	☐
3.4	after the event:	20'	60'	3h	6 h
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☐	☐	☑	☐
	after the event:	☐	☐	☐	☐
		12 h	24 h	48 h	later
3.5	How much time could you or your staff invest in **training** to use the system?	1 h ☐	1 day ☑	1 week ☐	more ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):	Building owner			
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				
	Financial aspects to be discussed during user meeting				

User Requirements

Questionnaire AB12

4	**General Requirements**				
		Must	**Should**	**Could**	**Wont**
4.1	Is it necessary, that the system can **exchange data** with other systems?	☐	☐	☑	☐
4.2	What would be the systems you would intend to exchange data with?	TBD			
		Must	**Should**	**Could**	**Wont**
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☑	☐	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☑	☐
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☐	☑	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☐	☑	☐	☐
4.6	after the event:	**30'**	**2 h**	**8 h**	**24 h**
	How long must the system work after **power breakdown**?	☐	☐	☑	☐
	after the event:	☐ **3 days**	☐ **7 days**	☐ **3 weeks**	☐ **more**
5	**Additional requirements from your point of view**				
		Must	**Should**	**Could**	**Wont**
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				

THANK YOU!

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User Requirements
Questionnaire AB13

2	Sensors in buildings: Information about single buildings				
		Must	Should	Could	Wont
2.1	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☑	☐	☐	☐
2.2 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☑	☐	☐	☐
b	**detailed results** of the **damage and loss assessment**?	☑	☐	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☑	☐	☐	☐
d	a **3D building illustration** visualizing the damage data?	☐	☑	☐	☐
e	actual **aerial photos** of the damages taken by the UAV?	☐	☑	☐	☐
2.3	**How do you want to receive the data (2.2)?**	Must	Should	Could	Wont
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☑	☐	☐
b	**3D model** data	☐	☐	☑	☐
c	**GIS** ready data	☐	☑	☐	☐
d	**Pdf** documents	☐	☑	☐	☐
e	Hardcopy **print-out**	☐	☑	☐	☐
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☑	☐	☐
g	Data and results via **WLAN**	☐	☑	☐	☐
h	Data and results via the **internet**	☐	☑	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.4	Do you need a **specific monitoring function** about the building state **during your intervention**?	☐	☐	☐	☐
2.5	Do you need an **alarm** (acoustic, light,..)?	☑	☐	☐	☐
*	**... minutes after the event:**	5'	20'	60'	later
2.6	**When** do you need this information (2.1 -3)?	☑	☐	☐	☐
	... hours after the event:	6 h	12 h	24 h	48 h
2.7	I accept **receiving aerial photos** later:	☑	☐	☐	☐
		1 h	1 day	1 week	more
2.8	How much time could you or your staff invest in **training** to use the system?	☐	☐	☑	☐
2.9	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?	building owner			
2.10	**Comments** about sensors in buildings, Information about single buildings:				

User Requirements
Questionnaire AB13

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	**Must**	**Should**	**Could**	**Wont**
a	.. in **single buildings**.	☐	☐	☑	☐
b	.. in several **buildings equipped with sensors.**	☐	☐	☑	☐
c	.. an **affected area.**	☐	☑	☐	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	**Must**	**Should**	**Could**	**Wont**
a	**Repair costs**	☐	☐	☑	☐
b	**Structural and nonstructural** damages	☑	☐	☐	☐
c	**Shoring** or demolition needs	☑	☐	☐	☐
d	Needed **manpower** for repair or reconstruction	☐	☑	☐	☐
	Need of **shelter**, camps, housing	☑	☐	☐	☐
e	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☑	☐	☐	☐
f	**Overview maps**, information summarized for blocks of 100m x 100m	☑	☐	☐	☐
d	Damages to **lifelines** like roads, water supply, electricity, and needs	☑	☐	☐	☐
d	Human losses, needs for **medical** treatment	☑	☐	☐	☐
h	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☐	☑	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☑ ☐	☐ ☐	☐ ☐	☐ ☐
	after the event:	**12 h**	**24 h**	**48 h**	**later**
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☐	**1 week** ☑	**more** ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):				
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				

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User Requirements
Questionnaire AB13

4	**General Requirements**				
		Must	**Should**	**Could**	**Wont**
4.1	Is it necessary, that the system can **exchange data** with other systems?	☐	☑	☐	☐
4.2	What would be the systems you would intend to exchange data with?				
		Must	**Should**	**Could**	**Wont**
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☑	☐	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☑	☐	☐	☐
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☑	☐	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☐	☑	☐	☐
4.6	after the event:	**30'**	**2 h**	**8 h**	**24 h**
	How long must the system work after **power breakdown**?	☑	☐	☐	☐
		☐	☐	☐	☐
	after the event:	**3 days**	**7 days**	**3 weeks**	**more**
5	**Additional requirements from your point of view**				
		Must	**Should**	**Could**	**Wont**
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				

THANK YOU!

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User Requirements

Questionnaire CD01

2	Sensors in buildings: Information about single buildings				
		Yes	No	N/A	
2.1	Do **you administer** at least one **building with sensors** to identify its damage state?	☐	☑	☐	
2.2	Do **you intend to build in** such sensors **in the future?**	☑	☐	☐	
2.3	**When** would you prefer to **install** such a system?	☑ **During construction**	☐ **Post construction**	☐ **N/A**	
2.4	How would you **install the sensors? Embedded** (difficult for existing buildings), **attached** or **mixed.**	embedded → attached			
		☐	☑	☐	☐
2.5	For **attached** sensors, please mark the **maximum permissible sensor size.** Length; width; thickness **[cm]**	**2.5; 2; 1.5** ☐	**5; 4; 2.5** ☑	**12, 6; 4** ☐	**18; 8; 6** ☐
2.6	For embedded sensors, please mark the **maximum permissible drill hole diameter** **[cm]**	**2** ☐	**4** ☑	**8** ☐	**12** ☐
2.7	Would it be **allowed, to …**	**Must**	**Should**	**Could**	**Wont**
a	..use **wireless technology within** the structure?	☑	☐	☐	☐
b	..use **cables to interconnect sensors**?	☐	☐	☐	☑
2.8 a	**Where** would you **install the central processing** and monitoring **unit**?	Building foyer, similar to fire alarm systems, or even outside the building.			
2.9	What are/would be the **reasons to use** such a **sensor network in your building?**	**Must**	**Should**	**Could**	**Wont**
a	To identify the **need for maintenance.**	☐	☐	☐	☑
b	To identify the **need for repair.**	☐	☐	☑	☐
c	To identify damages with **collapse** or **partial collapse.**	☑	☐	☐	☐
d	To estimate **material losses** (Building and content).	☐	☐	☑	☐
e	To estimate **human losses.**	☐	☐	☑	☐
f	Other: Use sensors for early warning system	☑	☐	☐	☐
		Must	**Should**	**Could**	**Wont**
2.10	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☑	☐	☐	☐
2.11 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☑	☐	☐	☐
b	**detailed** results of the **damage** and **loss** assessment?	☐	☑	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☑	☐	☐	☐
d	**3D building illustration** visualizing the damage data?	☐	☑	☐	☐
e	actual **aerial photos** of the damages taken by an UAV?	☑	☐	☐	☐

User Requirements

Questionnaire CD01

2.12	**How do you want to receive the data (2.2)?**	**Must**	**Should**	**Could**	**Wont**
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☑	☐	☐	☐
b	**3D model** data	☐	☑	☐	☐
c	**GIS** ready data	☐	☑	☐	☐
d	**Pdf** documents	☐	☑	☐	☐
e	Hardcopy **print-out**	☐	☑	☐	☐
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☑	☐	☐
g	Data and results via **WLAN**	☐	☑	☐	☐
h	Data and results via the **internet**	☑	☐	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.13	Do you need a **specific monitoring function** about the building state **after the event** if it was damaged?	☑	☐	☐	☐
2.14	Do you need an **alarm** (acoustic, light, sms, email..)?	☑	☐	☐	☐
2.15	**... minutes after the event:** / **When** do you need this information (2.1 -3)?	**5'** ☑	**20'** ☐	**60'** ☐	**later** ☐
2.16	**... hours after the event:** / I accept **receiving aerial photos** later:	**6 h** ☑	**12 h** ☐	**24 h** ☐	**48 h** ☐
2.17	**months** / What is the minimum technical **maintenance interval** (change of batteries, cables, sensors)	**6** ☐	**12** ☑	**24** ☐	**____** ☐
2.18 a	How much **funds** would you be willing **to invest** to have such a system? **Maximum €**	€ 5.000 to 20.000 €			
b	**Percentage** of the total investments in the building	max. 2 to 3 %			
2.19	How much time could you or your staff invest in **training** to use the system?	**1 day** ☐	**1 week** ☑	**1 month** ☐	**more** ☐
2.20	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?	occupant and/or owner			
2.21	**Comments** about sensors in buildings, Information about single buildings:				

2.4: We would prefer embedded sensors, but they must be accessible for maintenance.
2.9a: Maintenace intervals according to DIN VDI 6200 (every 5 years).
2.13: General building informations (construction method, materials, year of construction, building history) in addition to sensor data required.
2.17: Sensors should send their health status at least once per hour.

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User Requirements
Questionnaire CD01

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	**Must**	**Should**	**Could**	**Wont**
a	.. in **single buildings**.	☑	☐	☐	☐
b	.. in several **buildings equipped with sensors.**	☑	☐	☐	☐
c	.. an **affected area.**	☐	☑	☐	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	**Must**	**Should**	**Could**	**Wont**
a	**Repair costs**	☐	☐	☑	☐
b	**Structural and nonstructural** damages	☑	☐	☐	☐
c	**Shoring** or demolition needs	☐	☐	☑	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☑	☐
e	Need of **shelter**, camps, housing	☐	☐	☑	☐
f	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☐	☑	☐	☐
g	**Overview maps**, information summarized for blocks of 100m x 100m	☐	☑	☐	☐
h	Damages to **lifelines** like roads, water supply, electricity, and needs	☑	☐	☐	☐
i	Human losses, needs for **medical** treatment	☐	☐	☑	☐
j	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☑	☐	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings**?**	☐	☑	☐	☐
	after the event:	**12 h**	**24 h**	**48 h**	**later**
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☑	**1 week** ☐	**more** ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):	Owner			
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				

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User Requirements

Questionnaire CD01

4	General Requirements				
		Must	Should	Could	Wont
4.1	Is it necessary, that the system can **exchange data** with other systems?	☑	☐	☐	☐
4.2	What would be the systems you would intend to exchange data with?	Inpro (database for building approvals, decisions), tools for static calculations			
		Must	Should	Could	Wont
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☑	☐	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☑	☐	☐	☐
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☑	☐	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☑	☐	☐	☐
	Security: Is a **classification system** (public, restricted, ...) necessary?	☑	☐	☐	☐
4.6	after the event:	30'	2 h	8 h	24 h
	How long must the system work after **power breakdown**?	☐	☐	☐	☐
	after the event:	☑ 3 days	☑ 7 days	☐ 3 weeks	☐ more
5	**Additional requirements from your point of view**				
		Must	Should	Could	Wont
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				

THANK YOU!

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User Requirements

Questionnaire CD02

2	Sensors in buildings: Information about single buildings				
		Yes	No	N/A	
2.1	Do **you administer** at least one **building with sensors** to identify its damage state?	☐	☐	☐	
2.2	Do **you intend to build in** such sensors **in the future?**	☑	☐	☐	
2.3	**When** would you prefer to **install** such a system?	☐ **During construction**	☑ **Post construction**	☐ **N/A**	
2.4	How would you **install the sensors? Embedded** (difficult for existing buildings), **attached** or **mixed.**	embedded → attached			
		☐	☐	☑	☐
2.5	For **attached** sensors, please mark the **maximum permissible sensor size.** Length; width; thickness **[cm]**	**2.5; 2; 1.5** ☐	**5; 4; 2.5** ☐	**12, 6; 4** ☐	**18; 8; 6** ☑
2.6	For embedded sensors, please mark the **maximum permissible drill hole diameter** **[cm]**	**2** ☑	**4** ☐	**8** ☐	**12** ☐
2.7	Would it be **allowed, to …**	**Must**	**Should**	**Could**	**Wont**
a	..use **wireless technology within** the structure?	☑	☐	☐	☐
b	..use **cables to interconnect sensors**?	☐	☐	☐	☑
2.8 a	**Where** would you **install the central processing** and monitoring **unit**?	GROUND OR UNDERGROUND FLOOR			
2.9	What are/would be the **reasons to use** such a **sensor network in your building?**	**Must**	**Should**	**Could**	**Wont**
a	To identify the **need for maintenance.**	☑	☐	☐	☐
b	To identify the **need for repair.**	☑	☐	☐	☐
c	To identify damages with **collapse** or **partial collapse.**	☑	☐	☐	☐
d	To estimate **material losses** (Building and content).	☐	☑	☐	☐
e	To estimate **human losses.**	☑	☐	☐	☐
f	Other: To ameliorate and validate the intervention Code	☑	☐	☐	☐
		Must	**Should**	**Could**	**Wont**
2.10	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☑	☐	☐	☐
2.11 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☑	☐	☐	☐
b	**detailed** results of the **damage** and **loss** assessment?	☑	☐	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☑	☐	☐	☐
d	**3D building illustration** visualizing the damage data?	☐	☑	☐	☐
e	actual **aerial photos** of the damages taken by an UAV?	☐	☐	☑	☐

User Requirements

Questionnaire CD02

		Must	Should	Could	Wont
2.12	**How do you want to receive the data (2.2)?**				
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☑	☐	☐	☐
b	**3D model** data	☑	☐	☐	☐
c	**GIS** ready data	☑	☐	☐	☐
d	**Pdf** documents	☑	☐	☐	☐
e	Hardcopy **print-out**	☐	☐	☑	☐
f	Data and results on a **permanently installed PC** / monitor at the building	☑	☐	☐	☐
g	Data and results via **WLAN**	☐	☐	☑	☐
h	Data and results via the **internet**	☑	☐	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☑
2.13	Do you need a **specific monitoring function** about the building state **after the event** if it was damaged?	☑	☐	☐	☐
2.14	Do you need an **alarm** (acoustic, light, sms, email..)?	☑	☐	☐	☐
*	**... minutes after the event:**	5'	20'	60'	later
2.15	**When** do you need this information (2.1 -3)?	☑	☐	☐	☐
	... hours after the event:	6 h	12 h	24 h	48 h
2.16	I accept **receiving aerial photos** later:	☑	☐	☐	☐
	months	6	12	24	_____
2.17	What is the minimum technical **maintenance interval** (change of batteries, cables, sensors)	☑	☐	☐	☐

2.18 a	How much **funds** would you be willing **to invest** to have such a system? **Maximum €**	€
b	**Percentage** of the total investments in the building	

		1 day	1 week	1 month	more
2.19	How much time could you or your staff invest in **training** to use the system?	☐	☐	☐	☑
2.20	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?	Govern			

2.21 **Comments** about sensors in buildings, Information about single buildings:

The system could be implemented also in Monumental Buildings of Historical Center. A similar activity will be carried out during 2014-2015 in the framework of biennial Activities of the European Center of Prevention and Forecasting of earthquakes (E.C.P.F.E.) and especially the activity: " Vulnerability Assessment of Historical City Centers"

User Requirements

Questionnaire CD02

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	**Must**	**Should**	**Could**	**Wont**
a	.. in **single buildings**.	☑	☐	☐	☐
b	.. in several **buildings equipped with sensors.**	☑	☐	☐	☐
c	.. an **affected area.**	☑	☐	☐	☐
d	Other: _____	☐	☐	☐	☑
3.2	**What would be the specific losses and needs to be identified?**	**Must**	**Should**	**Could**	**Wont**
a	**Repair costs**	☑	☐	☐	☐
b	**Structural and nonstructural** damages	☑	☐	☐	☐
c	**Shoring** or demolition needs	☐	☑	☐	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☑	☐
e	Need of **shelter**, camps, housing	☐	☑	☐	☐
f	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☑	☐	☐	☐
g	**Overview maps**, information summarized for blocks of 100m x 100m	☐	☑	☐	☐
h	Damages to **lifelines** like roads, water supply, electricity, and needs	☑	☐	☐	☐
i	Human losses, needs for **medical** treatment	☑	☐	☐	☐
j	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☑	☐	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☑ / ☐	☐ / ☑	☐	☐
	after the event:	**12 h**	**24 h**	**48 h**	**later**
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☐	**1 week** ☐	**more** ☑
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):	Governmental Organization			
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				
	It is a very valuable and useful system, especially for Greece, which is at an area highly vulnerable to earthquake action. Also it is useful for testing the implementation of post earthquake Methodologies and Intervention Codes.				

User Requirements

Questionnaire CD02

4	General Requirements				
		Must	Should	Could	Wont
4.1	Is it necessary, that the system can **exchange data** with other systems?	☐	☐	☑	☐
4.2	What would be the systems you would intend to exchange data with?	For example in the case of hospitals with a Base Station placed in the Department of Health			
		Must	Should	Could	Wont
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☑	☐	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☑	☐
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☑	☐	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☑	☐	☐	☐
	Security: Is a **classification system** (public, restricted, ...) necessary?	☐	☐	☐	☑
4.6	after the event:	30'	2 h	8 h	24 h
	How long must the system work after **power breakdown**?	☐	☐	☑	☐
		☐	☑	☐	☐
	after the event:	3 days	7 days	3 weeks	more
5	**Additional requirements from your point of view**				
		Must	Should	Could	Wont
5.1	The system to be implemented in statues, monuments and museums	☑	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				
	*1.6 g 1. FEMA: Federal Emergency Management Agent - USA 2. Europa :Major Hazards Agreement - Council of Europe - European Center on Prevention and Forecasting of Earthquakes (ECPFE) under the aegis of EPPO 3. Hyogo Framework for Action - UNISDR (The United Nations office for Disaster Risk Reduction) 4. JHET-SDRU : Join Hellenic Turkish - Stand by Response Unit				

THANK YOU!

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User Requirements

Questionnaire CD03

2	**Sensors in buildings: Information about single buildings**				
		Yes	**No**	**N/A**	
2.1	Do **you administer** at least one **building with sensors** to identify its damage state?	☐	☐	☑	
2.2	Do **you intend to build in** such sensors **in the future?**	☐	☐	☑	
2.3	**When** would you prefer to **install** such a system?	☐ **During construction**	☐ **Post construction**	☐ **N/A**	
2.4	How would you **install the sensors? Embedded** (difficult for existing buildings), **attached** or **mixed.**	embedded ◣ **attached**			
		☐	☐	☐	☐
2.5	For **attached** sensors, please mark the **maximum permissible sensor size.** Length; width; thickness **[cm]**	**2.5; 2; 1.5** ☐	**5; 4; 2.5** ☐	**12, 6; 4** ☐	**18; 8; 6** ☐
2.6	For embedded sensors, please mark the **maximum permissible drill hole diameter** **[cm]**	**2** ☐	**4** ☐	**8** ☐	**12** ☐
2.7	Would it be **allowed, to …**	**Must**	**Should**	**Could**	**Wont**
a	..use **wireless technology within** the structure?	☐	☐	☐	☐
b	..use **cables to interconnect sensors**?	☐	☐	☐	☐
2.8 a	**Where** would you **install the central processing** and monitoring **unit**?				
2.9	What are/would be the **reasons to use** such a **sensor network in your building?**	**Must**	**Should**	**Could**	**Wont**
a	To identify the **need for maintenance.**	☐	☐	☐	☐
b	To identify the **need for repair.**	☐	☐	☐	☐
c	To identify damages with **collapse** or **partial collapse.**	☐	☐	☐	☐
d	To estimate **material losses** (Building and content).	☐	☐	☐	☐
e	To estimate **human losses.**	☐	☐	☐	☐
f	Other: _____	☐	☐	☐	☐
		Must	**Should**	**Could**	**Wont**
2.10	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☐	☑	☐	☐
2.11 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☑	☐	☐	☐
b	**detailed** results of the **damage** and **loss** assessment?	☑	☐	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☑	☐	☐	☐
d	**3D building illustration** visualizing the damage data?	☐	☐	☐	☐
e	actual **aerial photos** of the damages taken by an UAV?	☐	☐	☐	☐

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User Requirements

Questionnaire CD03

2.12	**How do you want to receive the data (2.2)?**	**Must**	**Should**	**Could**	**Wont**
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☑	☐	☐	☐
b	**3D model** data	☐	☐	☐	☐
c	**GIS** ready data	☐	☐	☐	☐
d	**Pdf** documents	☐	☐	☐	☐
e	Hardcopy **print-out**	☐	☐	☐	☐
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☐	☐	☐
g	Data and results via **WLAN**	☐	☐	☐	☐
h	Data and results via the **internet**	☐	☐	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.13	Do you need a **specific monitoring function** about the building state **after the event** if it was damaged?	☐	☐	☐	☐
2.14	Do you need an **alarm** (acoustic, light, sms, email..)?	☐	☐	☐	☐
2.15	**... minutes after the event:** **When** do you need this information (2.1 -3)?	**5'** ☐	**20'** ☐	**60'** ☐	**later** ☐
2.16	**... hours after the event:** I accept **receiving aerial photos** later:	**6 h** ☐	**12 h** ☐	**24 h** ☐	**48 h** ☐
2.17	**months** What is the minimum technical **maintenance interval** (change of batteries, cables, sensors)	**6** ☐	**12** ☐	**24** ☐	_____ ☐
2.18 a	How much **funds** would you be willing **to invest** to have such a system? **Maximum €**	€			
b	**Percentage** of the total investments in the building				
2.19	How much time could you or your staff invest in **training** to use the system?	**1 day** ☐	**1 week** ☐	**1 month** ☐	**more** ☐
2.20	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?				
2.21	**Comments** about sensors in buildings, Information about single buildings:				

Wir haben die Unterlagen des Forschungsvorhabens geprüft und uns entschieden hieran nicht mitzuarbeiten. Als Grund sehen wir die im Schadenfall immer anzustellende individuelle statische Prüfung des beschädigten Gebäudes, die auch durch das geplante Sensorsystem nicht obsolet wird. Bei der Fragestellung, ob und in welchem Umfang Gebäudeschäden infolge von Erdbeben die Standfestigkeit von Bauwerken beeinflussen können lässt sich durch ein Sensorsystem nicht ausrechend verlässlich genug beantworten. Auch müssten Sensoren neben einer regelmäßigen Wartung auch den Einsatzfall „überstehen" und es müsste gesichert sein, dass die Messergebnisse valide sind. Hier sehen wir eine hohe Hürde in der Entwicklungsarbeit.

User Requirements
Questionnaire CD03

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	**Must**	**Should**	**Could**	**Wont**
a	.. in **single buildings**.	☑	☐	☐	☐
b	.. in several **buildings equipped with sensors.**	☐	☐	☐	☐
c	.. an **affected area.**	☐	☐	☐	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	**Must**	**Should**	**Could**	**Wont**
a	**Repair costs**	☑	☐	☐	☐
b	**Structural and nonstructural** damages	☑	☐	☐	☐
c	**Shoring** or demolition needs	☐	☐	☐	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☐	☐
e	Need of **shelter**, camps, housing	☐	☐	☐	☐
f	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☐	☐	☐	☐
g	**Overview maps**, information summarized for blocks of 100m x 100m	☐	☐	☐	☐
h	Damages to **lifelines** like roads, water supply, electricity, and needs	☐	☐	☐	☐
i	Human losses, needs for **medical** treatment	☐	☐	☐	☐
j	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☐	☐	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings**?**	☐	☐	☐	☑
	after the event:	**12 h**	**24 h**	**48 h**	**later**
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☐	**1 week** ☐	**more** ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):				
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				

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User Requirements

Questionnaire CD03

4	General Requirements				
		Must	Should	Could	Wont
4.1	Is it necessary, that the system can **exchange data** with other systems?	☑	☐	☐	☐
4.2	What would be the systems you would intend to exchange data with?				
		Must	Should	Could	Wont
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☐	☐	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☐	☐
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☐	☐	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☐	☐	☐	☐
	Security: Is a **classification system** (public, restricted, ...) necessary?	☐	☐	☐	☐
4.6	after the event:	**30'**	**2 h**	**8 h**	**24 h**
	How long must the system work after **power breakdown**?	☐	☐	☐	☐
	after the event:	**3 days**	**7 days**	**3 weeks**	**more**
5	**Additional requirements from your point of view**				
		Must	Should	Could	Wont
5.1	Individual structural analysis performed by engineers for each affected building.	☑	☐	☐	☐
5.2	Sensors must "survive" damages to the building.	☑	☐	☐	☐
5.3	Results of the damage assessment must be complete (for the whole building) and 100% reliable.	☑	☐	☐	☐
5.4	Sensor system must work reliably over decades.	☑	☐	☐	☐
5.5	**General comments:**				

THANK YOU!

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User Requirements
Questionnaire CD04

2	Sensors in buildings: Information about single buildings				
		Yes	No	N/A	
2.1	Do **you administer** at least one **building with sensors** to identify its damage state?	☐	☑	☐	
2.2	Do **you intend to build in** such sensors **in the future?**	☐	☐	☑	
2.3	**When** would you prefer to **install** such a system?	☐ **During construction**	☐ **Post construction**	☑ **N/A**	
2.4	How would you **install the sensors? Embedded** (difficult for existing buildings), **attached** or **mixed.**	embedded ☐	☐	☐	attached ☐
2.5	For **attached** sensors, please mark the **maximum permissible sensor size.** Length; width; thickness **[cm]**	**2.5; 2; 1.5** ☐	**5; 4; 2.5** ☐	**12, 6; 4** ☐	**18; 8; 6** ☐
2.6	For embedded sensors, please mark the **maximum permissible drill hole diameter** **[cm]**	**2** ☐	**4** ☐	**8** ☐	**12** ☐
2.7	Would it be **allowed, to …**	**Must**	**Should**	**Could**	**Wont**
a	..use **wireless technology within** the structure?	☐	☐	☐	☐
b	..use **cables to interconnect sensors**?	☐	☐	☐	☐
2.8 a	**Where** would you **install the central processing** and monitoring **unit**?				
2.9	What are/would be the **reasons to use** such a **sensor network in your building?**	**Must**	**Should**	**Could**	**Wont**
a	To identify the **need for maintenance.**	☐	☑	☐	☐
b	To identify the **need for repair.**	☑	☐	☐	☐
c	To identify damages with **collapse** or **partial collapse.**	☑	☐	☐	☐
d	To estimate **material losses** (Building and content).	☐	☑	☐	☐
e	To estimate **human losses.**	☑	☐	☐	☐
f	Other: _____	☐	☐	☐	☐
		Must	**Should**	**Could**	**Wont**
2.10	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☑	☐	☐	☐
2.11 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☑	☐	☐	☐
b	**detailed** results of the **damage** and **loss** assessment?	☑	☐	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☑	☐	☐	☐
d	**3D building illustration** visualizing the damage data?	☐	☑	☐	☐
e	actual **aerial photos** of the damages taken by an UAV?	☐	☐	☑	☐

User Requirements

Questionnaire CD04

2.12	**How do you want to receive the data (2.2)?**	**Must**	**Should**	**Could**	**Wont**
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☐	☐	☐
b	**3D model** data	☐	☐	☐	☐
c	**GIS** ready data	☐	☐	☐	☐
d	**Pdf** documents	☐	☐	☐	☐
e	Hardcopy **print-out**	☐	☐	☐	☐
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☐	☐	☐
g	Data and results via **WLAN**	☐	☐	☐	☐
h	Data and results via the **internet**	☐	☐	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.13	Do you need a **specific monitoring function** about the building state **after the event** if it was damaged?	☐	☐	☐	☐
2.14	Do you need an **alarm** (acoustic, light, sms, email..)?	☐	☐	☐	☐
*	**... minutes after the event:**	**5'**	**20'**	**60'**	**later**
2.15	**When** do you need this information (2.1 -3)?	☐	☐	☐	☐
	... hours after the event:	**6 h**	**12 h**	**24 h**	**48 h**
2.16	I accept **receiving aerial photos** later:	☐	☐	☐	☐
	months	**6**	**12**	**24**	**____**
2.17	What is the minimum technical **maintenance interval** (change of batteries, cables, sensors)	☐	☐	☐	☐
2.18 a	How much **funds** would you be willing **to invest** to have such a system? **Maximum €**	€			
b	**Percentage** of the total investments in the building				
2.19	How much time could you or your staff invest in **training** to use the system?	**1 day** ☐	**1 week** ☐	**1 month** ☐	**more** ☐
2.20	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?				
2.21	**Comments** about sensors in buildings, Information about single buildings:				

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User Requirements

Questionnaire CD04

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	**Must**	**Should**	**Could**	**Wont**
a	.. in **single buildings**.	☑	☐	☐	☐
b	.. in several **buildings equipped with sensors.**	☑	☐	☐	☐
c	.. an **affected area.**	☑	☐	☐	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	**Must**	**Should**	**Could**	**Wont**
a	**Repair costs**	☐	☑	☐	☐
b	**Structural and nonstructural** damages	☑	☐	☐	☐
c	**Shoring** or demolition needs	☐	☑	☐	☐
d	Needed **manpower** for repair or reconstruction	☐	☑	☐	☐
e	Need of **shelter**, camps, housing	☑	☐	☐	☐
f	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☑	☐	☐	☐
g	**Overview maps**, information summarized for blocks of 100m x 100m	☐	☑	☐	☐
h	Damages to **lifelines** like roads, water supply, electricity, and needs	☐	☐	☑	☐
i	Human losses, needs for **medical** treatment	☑	☐	☐	☐
j	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☐	☐	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☐	☐	☐	☐
	after the event:	**12 h**	**24 h**	**48 h**	**later**
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☐	**1 week** ☐	**more** ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):				
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				

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User Requirements

Questionnaire CD04

4	General Requirements				
		Must	Should	Could	Wont
4.1	Is it necessary, that the system can **exchange data** with other systems?	☐	☐	☐	☐
4.2	What would be the systems you would intend to exchange data with?				
		Must	Should	Could	Wont
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☐	☐	☐	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☐	☐
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☐	☐	☐	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☐	☐	☐	☐
	Security: Is a **classification system** (public, restricted, ...) necessary?	☐	☐	☐	☐
4.6	after the event:	**30'**	**2 h**	**8 h**	**24 h**
	How long must the system work after **power breakdown**?	☐	☐	☐	☐
	after the event:	**3 days**	**7 days**	**3 weeks**	**more**
5	**Additional requirements from your point of view**				
		Must	Should	Could	Wont
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				

Our Agency act as the "landlord" for our primary tenant (*** Armed Forces) regarding protected and military installations mostly in underground facilities, but also concering ordinary buildings.

We also support the civil society with competence in the area of protection technology with the purpose to strengthen its robustness and crises preparedness and therefore we have an interest in this area, which will be handled in RECONASS. Many of the questions above are therefore hard so answer.

THANK YOU!

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User Requirements
Questionnaire CD05

2	Sensors in buildings: Information about single buildings				
		Yes	No	N/A	
2.1	Do **you administer** at least one **building with sensors** to identify its damage state?	☐	☑	☐	
2.2	Do **you intend to build in** such sensors **in the future?**	☐	☐	☑	
2.3	**When** would you prefer to **install** such a system?	☐ **During construction**	☐ **Post construction**	☑ **N/A**	
2.4	How would you **install the sensors? Embedded** (difficult for existing buildings), **attached** or **mixed.**	embedded ☐	☐	☐	attached ☐
2.5	For **attached** sensors, please mark the **maximum permissible sensor size.** Length; width; thickness **[cm]**	**2.5; 2; 1.5** ☐	**5; 4; 2.5** ☐	**12, 6; 4** ☐	**18; 8; 6** ☐
2.6	For embedded sensors, please mark the **maximum permissible drill hole diameter** **[cm]**	**2** ☐	**4** ☐	**8** ☐	**12** ☐
2.7	Would it be **allowed, to …**	**Must**	**Should**	**Could**	**Wont**
a	..use **wireless technology within** the structure?	☐	☐	☐	☐
b	..use **cables to interconnect sensors**?	☐	☐	☐	☐
2.8 a	**Where** would you **install the central processing** and monitoring **unit**?				
2.9	What are/would be the **reasons to use** such a **sensor network in your building?**	**Must**	**Should**	**Could**	**Wont**
a	To identify the **need for maintenance.**	☐	☐	☐	☐
b	To identify the **need for repair.**	☐	☐	☐	☐
c	To identify damages with **collapse** or **partial collapse.**	☐	☐	☐	☐
d	To estimate **material losses** (Building and content).	☐	☐	☐	☐
e	To estimate **human losses.**	☐	☐	☐	☐
f	Other: _____	☐	☐	☐	☐
		Must	**Should**	**Could**	**Wont**
2.10	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☐	☑	☐	☐
2.11 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☐	☐	☐	☐
b	**detailed** results of the **damage** and **loss** assessment?	☐	☑	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☐	☐	☐	☐
d	**3D building illustration** visualizing the damage data?	☐	☐	☐	☐
e	actual **aerial photos** of the damages taken by an UAV?	☐	☑	☐	☐

User Requirements
Questionnaire CD05

		Must	Should	Could	Wont
2.12	**How do you want to receive the data (2.2)?**				
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☐	☑	☐
b	**3D model** data	☐	☐	✓	☐
c	**GIS** ready data	☐	✓	☐	☐
d	**Pdf** documents	☐	☐	✓	☐
e	Hardcopy **print-out**	☐	☐	☐	✓
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☐	☐	✓
g	Data and results via **WLAN**	☐	☐	☐	☐
h	Data and results via the **internet**	☐	✓	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.13	Do you need a **specific monitoring function** about the building state **after the event** if it was damaged?	☐	☐	☐	☐
2.14	Do you need an **alarm** (acoustic, light, sms, email..)?	☐	☐	☐	✓**
*	**... minutes after the event:**	**5'**	**20'**	**60'**	**later**
2.15	**When** do you need this information (2.1 -3)?	☐	☐	☐	☐
	... hours after the event:	**6 h**	**12 h**	**24 h**	**48 h**
2.16	I accept **receiving aerial photos** later:	☐	☐	☐	☐
	months	**6**	**12**	**24**	**_____**
2.17	What is the minimum technical **maintenance interval** (change of batteries, cables, sensors)	☐	☐	☐	☐

2.18 a	How much **funds** would you be willing **to invest** to have such a system? **Maximum €**	€
b	**Percentage** of the total investments in the building	

		1 day	1 week	1 month	more
2.19	How much time could you or your staff invest in **training** to use the system?	☐	☐	☐	☐
2.20	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?				

2.21 **Comments** about sensors in buildings, Information about single buildings:

***would be a typical provider of damage assessments from space or airborne imagery. We would be very interested to use ground based data/information to integrate those into our damage assessment models and procedures. They could also be cross compared for validation purposes.

User Requirements
Questionnaire CD05

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	**Must**	**Should**	**Could**	**Wont**
a	.. in **single buildings**.	☐	☐	☑	☐
b	.. in several **buildings equipped with sensors.**	☐	☐	☑	☐
c	.. an **affected area.**	☐	☑	☐	☐
d	Other: Calibration of sat/uav based damage assessments	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	**Must**	**Should**	**Could**	**Wont**
a	**Repair costs**	☐	☐	☐	☐
b	**Structural and nonstructural** damages	☐	☐	☑	☐
c	**Shoring** or demolition needs	☐	☐	☑	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☐	☐
e	Need of **shelter**, camps, housing	☐	☐	☑	☐
f	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☐	☐	☑	☐
g	**Overview maps**, information summarized for blocks of 100m x 100m	☐	☐	☑	☐
h	Damages to **lifelines** like roads, water supply, electricity, and needs	☐	☐	☑	☐
i	Human losses, needs for **medical** treatment	☐	☐	☑	☐
j	Other:	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☐	☑	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☐	☐	☐	☑
	after the event:	**12 h**	**24 h**	**48 h**	**later**
		☐	☐	☐	☐
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☑	**1 week** ☐	**more** ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):				
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				

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User Requirements

Questionnaire CD05

4	General Requirements				
		Must	Should	Could	Wont
4.1	Is it necessary, that the system can **exchange data** with other systems?	☐	☐	☑	☐
4.2	What would be the systems you would intend to exchange data with?	Send data to other systems (broadcast)			
		Must	Should	Could	Wont
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☐	☐	☑	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☐	☑
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☐	☐	☑	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☐	☐	☐	☑
	Security: Is a **classification system** (public, restricted, ...) necessary?	☐	☐	☐	☑
4.6	after the event:	30'	2 h	8 h	24 h
	How long must the system work after **power breakdown**?	☐	☐	☐	☐
	after the event:	3 days	7 days	3 weeks	more
5	**Additional requirements from your point of view**				
		Must	Should	Could	Wont
5.1	Procedures to extrapolate results from buildings equipped with the sensors to those not equipped could be helpful	☐	☐	☑***	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				
	***is a typical "E. Organizations involved in the development of remote sensing based damage maps" user - thus the questionnaire could only be answered partially				

THANK YOU!

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User Requirements

Questionnaire CD06

2	**Sensors in buildings: Information about single buildings**				
		Yes	**No**	**N/A**	
2.1	Do **you administer** at least one **building with sensors** to identify its damage state?	☐	☑	☐	
2.2	Do **you intend to build in** such sensors **in the future?**	☐	☐	☑	
2.3	**When** would you prefer to **install** such a system?	☐ **During construction**	☐ **Post construction**	☐ **N/A**	
2.4	How would you **install the sensors? Embedded** (difficult for existing buildings), **attached** or **mixed.**	embedded → **attached**			
		☐	☐	☐	☐
2.5	For **attached** sensors, please mark the **maximum permissible sensor size.** Length; width; thickness **[cm]**	**2.5; 2; 1.5** ☐	**5; 4; 2.5** ☐	**12, 6; 4** ☐	**18; 8; 6** ☐
2.6	For embedded sensors, please mark the **maximum permissible drill hole diameter** **[cm]**	**2** ☐	**4** ☐	**8** ☐	**12** ☐
2.7	Would it be **allowed, to …**	**Must**	**Should**	**Could**	**Wont**
a	..use **wireless technology within** the structure?	☐	☐	☐	☐
b	..use **cables to interconnect sensors**?	☐	☐	☐	☐
2.8 a	**Where** would you **install the central processing** and monitoring **unit**?				
2.9	What are/would be the **reasons to use** such a **sensor network in your building?**	**Must**	**Should**	**Could**	**Wont**
a	To identify the **need for maintenance.**	☐	☐	☐	☐
b	To identify the **need for repair.**	☐	☐	☐	☐
c	To identify damages with **collapse** or **partial collapse.**	☐	☐	☐	☐
d	To estimate **material losses** (Building and content).	☐	☐	☐	☐
e	To estimate **human losses.**	☐	☐	☐	☐
f	Other: _____	☐	☐	☐	☐
		Must	**Should**	**Could**	**Wont**
2.10	Do you need a **simple post-event building status** of the monitored building such as usable, partially usable and unusable?	☐	☐	☐	☐
2.11 a	**Do you need:** the actual **measured data** such as stresses and plastic deformations?	☐	☐	☐	☐
b	**detailed** results of the **damage** and **loss** assessment?	☐	☐	☐	☐
c	information about the **remaining load capacity** of the building and its elements?	☐	☐	☐	☐
d	**3D building illustration** visualizing the damage data?	☐	☐	☐	☐
e	actual **aerial photos** of the damages taken by an UAV?	☐	☐	☐	☐

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User Requirements

Questionnaire CD06

2.12	**How do you want to receive the data (2.2)?**	**Must**	**Should**	**Could**	**Wont**
a	**Raw sensor data** (e.g. temperatures , peak accelerations, strains for your own software)	☐	☐	☐	☐
b	**3D model** data	☐	☐	☐	☐
c	**GIS** ready data	☐	☐	☐	☐
d	**Pdf** documents	☐	☐	☐	☐
e	Hardcopy **print-out**	☐	☐	☐	☐
f	Data and results on a **permanently installed PC** / monitor at the building	☐	☐	☐	☐
g	Data and results via **WLAN**	☐	☐	☐	☐
h	Data and results via the **internet**	☐	☐	☐	☐
i	**Other** data transfer: _____	☐	☐	☐	☐
2.13	Do you need a **specific monitoring function** about the building state **after the event** if it was damaged?	☐	☐	☐	☐
2.14	Do you need an **alarm** (acoustic, light, sms, email..)?	☐	☐	☐	☐
*	**... minutes after the event:**	**5'**	**20'**	**60'**	**later**
2.15	**When** do you need this information (2.1 -3)?	☐	☐	☐	☐
	... hours after the event:	**6 h**	**12 h**	**24 h**	**48 h**
2.16	I accept **receiving aerial photos** later:	☐	☐	☐	☐
	months	**6**	**12**	**24**	**____**
2.17	What is the minimum technical **maintenance interval** (change of batteries, cables, sensors)	☐	☐	☐	☐
2.18 a	How much **funds** would you be willing **to invest** to have such a system? **Maximum €**	€			
b	**Percentage** of the total investments in the building				
2.19	How much time could you or your staff invest in **training** to use the system?	**1 day** ☐	**1 week** ☐	**1 month** ☐	**more** ☐
2.20	**Who** should **operate the system** (e.g. building owner, governm. organization (which?), non-profit association)?				
2.21	**Comments** about sensors in buildings, Information about single buildings:				

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User Requirements

Questionnaire CD06

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	**Must**	**Should**	**Could**	**Wont**
a	.. in **single buildings**.	☐	☐	☑	☐
b	.. in several **buildings equipped with sensors.**	☑	☐	☐	☐
c	.. an **affected area.**	☑	☐	☐	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	**Must**	**Should**	**Could**	**Wont**
a	**Repair costs**	☐	☐	☑	☐
b	**Structural and nonstructural** damages	☐	☑	☐	☐
c	**Shoring** or demolition needs	☐	☑	☐	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☑	☐
e	Need of **shelter**, camps, housing	☐	☐	☐	☑
f	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☐	☑	☐	☐
g	**Overview maps**, information summarized for blocks of 100m x 100m	☑	☐	☐	☐
h	Damages to **lifelines** like roads, water supply, electricity, and needs	☐	☑	☐	☐
i	Human losses, needs for **medical** treatment	☐	☐	☑	☐
j	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☑	☐	☐	☐
3.4	after the event:	**20'**	**60'**	**3h**	**6 h**
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☐	☐	☑	☐
	after the event:	**12 h**	**24 h**	**48 h**	**later**
3.5	How much time could you or your staff invest in **training** to use the system?	**1 h** ☐	**1 day** ☑	**1 week** ☐	**more** ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):				
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				

User Requirements
Questionnaire AB09

3	Post Crisis Needs Assessment Tool (PCCDN)				
3.1	**What would be your reasons to use a PCCDN?** To identify **losses and needs**...	Must	Should	Could	Wont
a	.. in **single buildings**.	☐	☐	☑	☐
b	.. in several **buildings equipped with sensors.**	☐	☐	☑	☐
c	.. an **affected area.**	☐	☑	☐	☐
d	Other: _____	☐	☐	☐	☐
3.2	**What would be the specific losses and needs to be identified?**	Must	Should	Could	Wont
a	**Repair costs**	☐	☐	☑	☐
b	**Structural and nonstructural** damages	☐	☑	☐	☐
c	**Shoring** or demolition needs	☐	☐	☑	☐
d	Needed **manpower** for repair or reconstruction	☐	☐	☑	☐
	Need of **shelter**, camps, housing	☐	☐	☑	☐
e	**Detailed maps** (information for single buildings) of the whole affected area in case of a disaster	☐	☑	☐	☐
f	**Overview maps**, information summarized for blocks of 100m x 100m	☐	☑	☐	☐
d	Damages to **lifelines** like roads, water supply, electricity, and needs	☐	☑	☐	☐
d	Human losses, needs for **medical** treatment	☐	☑	☐	☐
h	Other: _____	☐	☐	☐	☐
3.3	I need to **receive the results** of the PCCDN **via the internet**.	☐	☐	☐	☐
3.4	after the event:	20'	60'	3h	6 h
	When do you need maps with **detailed information for large areas** and not only for single buildings?	☐	☐	☐	☐
	after the event:	12 h	24 h	48 h	later
3.5	How much time could you or your staff invest in **training** to use the system?	1 h ☐	1 day ☐	1 week ☐	more ☐
3.6	**Who should operate the system** (e.g. building owner, governmental organization (which?), non-profit association...):				
3.7	**Comments about Post Crisis Needs Assessment Tool (PCCDN):**				

User Requirements

Questionnaire CD06

4	**General Requirements**				
		Must	**Should**	**Could**	**Wont**
4.1	Is it necessary, that the system can **exchange data** with other systems?	☑	☐	☐	☐
4.2	What would be the systems you would intend to exchange data with?	GIS, for example CatNet			
		Must	**Should**	**Could**	**Wont**
4.3 a	In case of a major disaster: Do you need **damage information per building** for **all** buildings **in the affected area**, indicating in **5 steps** from "minor damage" to "completely destroyed"	☐	☐	☑	☐
b	Do you need **more detailed** information than 5 steps **for all buildings**?	☐	☐	☑	☐
4.4	Is it necessary, that the system gives **alarm** when **not working properly**?	☐	☐	☑	☐
4.5	**Security:** Is it necessary, that the data exchanged cannot be accessed by others?	☐	☐	☑	☐
	Security: Is a **classification system** (public, restricted, ...) necessary?	☐	☐	☑	☐
4.6	after the event:	**30'**	**2 h**	**8 h**	**24 h**
	How long must the system work after **power breakdown**?	☐	☑	☐	☐
	after the event:	**3 days**	**7 days**	3 weeks	more
5	**Additional requirements from your point of view**				
		Must	**Should**	**Could**	**Wont**
5.1		☐	☐	☐	☐
5.2		☐	☐	☐	☐
5.3		☐	☐	☐	☐
5.4		☐	☐	☐	☐
5.5	**General comments:**				

THANK YOU!

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