INITIAL USER REQUIREMENTS

Deliverable D1.2.1

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Authors:	Márta Belényesi (co-editor), Nguyen Thai Binh, Eva Klien, Tamás Kovács, Iván Kovács, Dániel Kristóf (co-editor), Róbert Lehoczki, Gábor Mikus, Angéla Olasz, Sebastien Saur, Michela Spagnuolo
Quality controller:	Ewald Quak
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Consisting of

SINTEF	STIFTELSEN SINTEF, Department of Applied Mathematics, Oslo, Norway
Fraunhofer	Fraunhofer Institute for Computer Graphics Research (IGD), Darmstadt, Germany
CNR-IMATI-GE	Institute for Applied Mathematics and Information Technologies of the National Research Council (CNR-IMATI), Genova, Italy
MOSS	M.O.S.S. Computer GrafikSysteme GmbH (MOSS), Munich, Germany
HRW	HR Wallingford Ltd (HRW), Wallingford, UK
FOMI	Hungarian National Mapping and Cadastral Agency (FOMI), Institute of Geodesy, Cartography and Remote Sensing, Budapest, Hungary
UCL	University College London (UCL), Research centre for Photogrammetry, 3D Imaging and Metrology, London, UK
TUDelft	Delft University of Technology (TUDelft), Department of Earth and Climate Sciences & Man-Machine Interaction Group, Delft, The Netherlands
IGN	Institut National de l'Information Géographique et Forestière (IGN), Paris, France
UBO	Université de Bretagne Occidentale (UBO), European Institute for Marine Studies, Brest, France
Ifremer	L'Institut Francais de Recherche pour l´Exploitation de la Mer (Ifremer), Brest, France
Liguria	Regione Liguria, Genova, Italy

DOCUMENT HISTORY

Version[1]	Issue Date	Stage	Content and Changes
1.0	29.03.2013		First release submitted to the Project Officer

[1]Integers correspond to submitted versions

EXECUTIVE SUMMARY

This deliverable is the documentation of the “Initial user requirements” arising from Task 1.3. Project partners having deep insight into the current state of the art in all areas where IQmulus aims at generating significant progress are involved in this task, as well as test bed users, to already ensure user-driven developments at the strategic level, and to make selected users aware of the progress to be expected.

User requirement gathering has been conducted using a methodology inspired by AGILE practices and defined in Task 1.1, mainly through two documents: a questionnaire and a guidance document. The first results from user requirement surveys are User Stories, which are short natural language sentences of the intended functionality of a software system, written in the language of the user or stakeholder of the system. User Stories have then been translated into Use Cases. Use Cases follow a formal structure (template) and cover details such as preconditions, steps in a success scenario or input/output data. In a third step, Functional Requirements are formulated; they intend to present a complete description of how the system will function from the user perspective. Besides Functional Requirements, a set of requirement types exist that are usually subsumed by the term non-functional requirements, e.g., regarding performance, reliability, system and human-machine interface, security, standards or documentation. These final steps, which will directly be used by developers, are to be stored in the Redmine information system that will be used all along the project for issue tracking. This ensures that all functional and non-functional requirements identified at any time of the project will be taken into account in the development phase and will be assessed and evaluated.

At the production date of this document, 9 workshops have been carried out so far, addressing a total of 117 users. To date, 75 User Stories have been elaborated based on the needs of external users (in addition to the 53 already available in D1.1). This is an on-going and iterative process as additional workshops are already planned for the next weeks; thus, the number of user stories is continuously increasing. The project partners are now already working on requirement consolidation and prioritisation.

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1 INTRODUCTION

This document is the first result of the IQmulus Task 1.3 “User requirement survey”. The overall aim in this phase is the investigation of user needs by the involvement of both consortium-internal and external users. Users involved in the test beds have a major role in determining concrete and practical requirements. Moreover, a stakeholder analysis will identify additional prospective users who may influence or who may be impacted by the system.

Identification of user needs is being carried out by means of analysis workshops, interviews, questionnaires and the submission of individual requirements. The result is an initial, well-categorised set of requirements, currently formulated at the level of “User Stories”. This adds to the set of 53 User Stories already included and analysed in D1.1 “State of the art analysis”, determined by consortium-internal users. Altogether, the project is increasingly covering the manifold user needs and aspects arising in test beds and trials.

The current document describes the status of the requirement collection at the end of March 2013. Due to the dynamic nature of the requirement collection, this document is complemented by an online part accessible in the eRoom document management system. A dynamic on-line structure, described and explained in the following chapters, has been elaborated to support requirement gathering, analysis and transition into use cases in a well-documented and logical way to support the transparent and user-driven development process. This on-line resource is accessible under “User-related activities”:

https://project.sintef.no/eRoom/math/IQmulus/0_2ef9a.

Access is granted to all IQmulus participants, administrators and reviewers. It is recommended to explore the current state on-line, as the amount of information available is continuously increasing.

Requirements collected in this stage can be regarded as “raw material”. In the subsequent phase of T1.4 “Requirement consolidation”, they will be further refined, extracted and prioritised, and will be transformed to use cases along with supplementary information and acceptance criteria. The results of that process will be described in D1.2.2 “Consolidated User Requirements”. Also, a collection and revision process will result in D1.2.3 “Revised User Requirements” at the end of Project Month 18, and the requirement collection process will be concluded in Project Month 30, documented in D1.2.4 “Finalized User Requirements”.

2 METHODOLOGY

2.1 DOCUMENTATION

Use Cases derived from User Stories collected in the previous and current phase of WP1 (Task 1.2, Task 1.3) serve as the basis for deriving the exact functional and also non-functional requirements for system specification in the IQmulus project in the future. Therefore User Stories have to fulfil certain criteria in structure and content for easy extraction of the maximum amount of information for further tasks.

Methodological choices have been described and shared by all IQmulus partners involved in that work package through two main documents: the Guidance Document and the Questionnaire.

Guidance document

The Guidance Document to the Requirements Methodology and Infrastructure provides guidance to the requirements gathering and managing activities within the IQmulus project. The document is a working document, which will be constantly updated. The current version of the Guidance Document is included here as Annex 1. The main topics touched by the document are:

- Introduction of the Requirements Methodology
- Definition of the term ”User Role” and ”User Story” (examples included)
- Guidance for deriving Use Cases / Requirements from User Stories (functional requirements)
- Short description of requirement categories and traceability criteria of requirements
- Guidance for conducting User Workshops and Interviews (materials and an example set-up for a User Workshop are provided, instructions for requirements gathering and post-workshop activities are also included.)
- Questionnaire for User Workshops and Interviews
- Technical Infrastructure for Requirements Management (Guidance for installation and usage of the Redmine System)
- Organisational Issues related to User Requirements

Questionnaire

The Questionnaire for User Workshops and Interviews is a tool for guiding the information gathering from users through workshops and interviews. It covers all the topics that are of interest for the project: current user practices in terms of data and tools used, and decision making processes, difficulties and issues faced, and finally user wishes and requirements. The latter topic aims at the formulation of User Stories.

Certain parts of the questionnaire – Section A (General User Background), D (General Comments or Feedback), and E (General Feedback on Workshop) – were filled out individually by every participant, while the information gathering for Section B (How are decisions made today and what is needed in addition for making better decisions?) and Section C (Specific questions towards technical topics of the IQmulus project) were organized in breakout sessions / group work during a workshop. The final version of the Questionnaire can be found in Annex 2 of this document.

2.2 ORGANIZATION

Four local boards have been created for the user requirement gathering process. Each board is led by one identified IQmulus partner who is in charge of user workshop and interview organisation, as well as compilation and extraction of use cases and requirements from the collected user stories. Each local board uses the local language in order to ease the relationship with the users and to ensure a comprehensive gathering of requirements. Minutes and user stories are of course translated into English before they are shared with all IQmulus partners.

The four local boards are the following:

- Hungary, leader: FÖMI
- Italy, leader: Liguria (with CNR-IMATI)
- Marine applications, leader: UBO and IFREMER (with HRW)
- France, leader: IGN

2.3 REQUIREMENT COLLECTION PROCESS

The requirements gathering methodology in IQmulus is partly based on what is known as AGILE methodologies for software development[2]. The common process for gathering requirements for software systems is to gather as many requirements as possible at the beginning of the project, assuming that the more requirements there are, the better the developed software will be. It is also necessary that the requirements collected need prioritization, clear references to the tasks and use cases from which the requirements are derived, and explanations of ambiguous terms.

The AGILE methodologies are focusing on user tasks in the beginning and on refining the high-level requirements in a communication process with the users and stakeholders afterwards.

The summary and conclusions of the preliminary survey of the requirements collected during the early phase of user engagement were published in D1.1[3]. Mainly consortium-internal test bed users have been involved at this stage to make them aware of the foreseen IQmulus results and to start comparing their expectations and desiderata with respect to the state-of-art solutions for heterogeneous data handling and processing. The User Stories collected in this phase can be found in Annex 1 of D.1.1, while Annex 2 of D.1.1 contains the metadata table describing what is already available in the IQmulus Data Repository.

As a continuation of the User Story collection shortly described in the previous paragraph, the next steps were taken as part of the Task 1.3.

1. Gathering materials and deriving User Stories
   a. Workshops and interviews were organized by the Local Boards with their local stakeholders (external users). Presentations and notes relevant to the topics were collected and documented.
   b. User Roles and User Stories have been derived based on the information collected before. Aspects covered by the Guidance Document to the Requirements Methodology and Infrastructure (Annex 1) were kept in mind during the work, and the Questionnaire presented in Annex 2 of this document was also used for gathering

[2] http://agilemanifesto.org/

[3] Deliverable D1.1: State of the Art Analysis. Link in eRoom: https://project.sintef.no/eRoomReq/Files/math/IQmulus/0_2e93f/D1.1_State-of-the-art-analysis.pdf

information. The form and composition of a User Story was pre-defined in the Guidance Document.

2. The User Stories derived were reviewed and translated to English by the Local Boards
3. All user-related activities were uploaded to eRoom, such as:
   a. all workshop materials, notes, and presentations to the IQmulus partner's folder
   b. User Stories in a pre-defined, uniform way to the User Story database in eRoom.
4. Preparatory steps were taken for the smooth transfer of the User Stories from eRoom to the Redmine System

As the next step in the coming months Use Cases will be identified from the User Stories collected in the Redmine System. The Use Cases serve as the basis for deriving the exact functional and also non-functional requirements for the system specification of the IQmulus project.

2.4 REQUIREMENTS FROM INTERNAL USERS

Some IQmulus partners undertake data production/exploitation activities besides their participation in the project. Therefore they face similar problems and issues as external users. Such User Stories have been formulated by these partners at the very beginning of the work package as part of Task 1.2 High-level Requirement Identification (documented in D1.1 State of the Art Analysis), and therefore transformed into Use Cases and Requirements following the same methodology.

The following partners have provided User Stories in that stage: UBO, SINTEF, IGN, FOMI, Liguria and HRW.

3 RESULTS

3.1 ONLINE DOCUMENTATION OF THE RESULTS

The documentation of workshop related activities and User Stories formulated in the workshops currently takes place in the eRoom. As the next step, the User Stories will be transferred to the Redmine System. In this section the documentation folders and databases currently used in the eRoom are introduced with a short description. Direct links to the folders and databases are also listed.

The eRoom

User-related activities (Folder)

In the eRoom a well-defined structure was established for gathering user-related activities and User Stories, namely in the folder named "User-related activities":
https://project.sintef.no/eRoom/math/IQmulus/0_2ef9a

A short summary of the folder structure is presented by Table 1.

Databases and Folders	Type	Content
User Workshops	Database	Information on workshops held on the topic (date, participants, etc.)
User Relations	Database	Local Users related to IQmulus partners (contact information)
Workshop material	Folder	All workshop materials (list of participants, presentations, notes, etc.)
User Stories	Database	User Stories stored in a structured way

Table 1. Contents of the "User-related activities" folder

User Workshops (Database)

Information on all the interviews and workshops organized by the Local Boards has been collected in the "User Workshop" database. The database – besides the basic information about the workshop such as the organising partner, date of the event, number of participants – provides information on the user type of the attendees, the sectors and topics the attendees belonged to, and the workshop topic's relation to the IQmulus Test beds and Trials. Recording other additional information about the attendees, the workshop circumstances or the results is also possible, see:

https://project.sintef.no/eRoom/math/IQmulus/0_2ef9d

User Relations (Database)

All the external (non-consortium) contributors, i.e., scientific or governmental institutions and authorities, private companies, etc. ,which currently take part in the IQmulus project as data or user story providers, are listed in this database, grouped by related IQmulus partners. Most of these stakeholders represent different levels of user roles from GIS expert to decision-maker. The contact person's name and the institution's homepage are included in the database. The number of contacted persons per institution is also presented:

https://project.sintef.no/eRoom/math/IQmulus/0_2f3e0

Workshop Material (Folder)

Different types of workshop and interview material are collected by the IQmulus partners in this folder. The list of workshop participants, a summary of the meetings in English, presentations, notes in the host language or in English, or links to any other documents in the eRoom connected to the given topic or the user who participated in the workshop were uploaded. The link to the main folder of workshop material in the eRoom is:

https://project.sintef.no/eRoom/math/IQmulus/0_2f356

User Stories (Database)

This database serves to collect User Stories resulting from workshops and interviews. The link to the User Story database in the eRoom is:

https://project.sintef.no/eRoom/math/IQmulus/0_2f478

User Stories have to be uploaded in a pre-defined, structured form to the eRoom. The fields presented in Table 2 have to be filled when entering a new User Story.

Field	Description	Usage
ID	Unique ID	Generated automatically
Epic*	Top-level application categories taken from the Description of Work	Select one or multiple relevant to the user story
Owner*	IQmulus consortium member who collected the user story	User fills this in
Source*	Institution who has been contacted by the IQmulus partner	User fills this in
Expertise*	Competence/function of the user (person) responsible for the user story	Select one or multiple relevant to the user story, or type a new one
Scale of work*	Scale of the user activity connected to the user role	Select one or multiple relevant to the user story, or type a new one
Sector of activity*	Sector of the institution the user story is originating from	Select one or multiple relevant to the user story, or type a new one
User story description*	User story without giving the user role (which is already determined by the combination of Expertise / Scale / Sector)	User fills this in
Input data	Input data for the user story to process	User fills this in
Output data	Output of the user story, which can be data, map, statistics or a decision, the aim of the user story	User fills this in
Time constraint	The time to be respected when fulfilling the user needs	User fills this in

* Designates mandatory fields – the others are optional, but useful in the use case formulation.

Table 2. Field usage and description of the User Story database

There are four fields with pre-defined categories in the database.

The field “Epic” defines the Trial(s) the User Story belongs to, thus describes the high-level context (according to the categories in the Description of Work).

The next three fields correspond to the respective fields of the Questionnaire (see Annex 2). They can be regarded as elementary components of a User Role. Thus, a User Role can be

described in a structured way by the combination of *expertise*, *scale of work* and *sector of activity*. In this initial phase, an important objective was to collect information on potential User Roles. Each unique combination of submitted values is therefore examined and recorded to be used as a potential individual User Role during the subsequent steps of requirement analysis and consolidation.

Trial categories (corresponding to the Description of Work):

- Trial 1.1 Morphological coastal change
- Trial 1.2 Identification of underwater seabed features
- Trial 2.1 Rapid and more reliable response for floods, flash floods and landslides
- Trial 2.2 Rapid and more reliable response for industrial accidents
- Trial 2.3 Disaster management in urban areas
- Trial 2.4 Territorial management

Pre-defined (but expandable) expertise categories are the following:

- Governmental executive
- Decision maker
- Administrator
- Scientific researcher
- GIS expert
- Remote Sensing expert
- IT administrator/system operator
- Field expert
- Other (type in)

Pre-defined (but expandable) scale of work categories are the following:

- European level
- Country level
- Regional level (1000-10000 sq km)
- City/Local level (<1000 sq km)
- Other (type in)

Pre-defined (but expandable) list of sectors of activity:

- Monitoring and managing disasters
- Water management
- Risk assessment/ management
- Government/municipality
- Geodata provider/integrator
- Land use planning
- Land cover/land use monitoring
- Coastal monitoring
- Security
- Spatial planning
- Other mapping
- Specific scientific research
- Other (type in)

This structure is flexible enough to give the possibility of covering a wide spectrum of User Stories.

The Redmine System [4, 5]

After the User Story database in eRoom is completed, the User Stories will be transferred to the Redmine System.

Redmine is an open source issue tracking system that comes with all required features for creating, managing, maintaining and categorizing issues such as software requirements and for assigning them to people, prioritizing them and setting deadlines for their implementation. The Redmine System will be one of the most important communication tools besides the eRoom. It will be used for managing and documenting the whole lifecycle of software development work in IQmulus, starting with user requirements gathering, to ticketing and issues tracking in the development phase up to validation. Redmine allows specifying relationships between issues that allow an easy navigation, e.g., from User Roles to related User Stories or vice versa. Further, issues in Redmine get unique identifiers that are maintained throughout their whole lifecycle in Redmine and that can therefore be easily referenced. Additionally, in the development phase of IQmulus, Redmine will be used as a requirements monitoring and management system. This means that all requirements having been developed in the initial phase of the project will later on be transferred to the Redmine system and will reference, where possible, the User Roles and User Stories currently maintained in the system. Furthermore, for all IQmulus developers, accounts will be created, allowing the assignment of requirements/issues to developers and the tracking of the implementation progress, e.g., via Gantt-charts available in Redmine.

[4] http://www.redmine.org/
[5] Guidance Document to the Requirements Methodology and Infrastructure. Extract. (Annex 2)

3.2 STATISTICS

Basic statistics of the relevant information connected to the workshops, user relations and User Stories are presented here.

General statements on the number of workshops and interviews organised by IQmulus partners and the number of contacted institutions and key users by country are provided in Table 3 and Table 4.

Organising IQmulus partner	Number of workshops (planned in April 2013)	Cumulated number of involved persons
FÖMI	4	47
UBO-IFREMER	1	7
CNR-IMATI and Regione Liguria	1	42
CNR-IMATI	2	14
IGN	1(3)	7
https://project.sintef.no/eRoom/math/IQmulus/0_2ef9d		

Table 3. Number of workshops and interviews organised by IQmulus partners

Country	Name of institution	Number of involved persons
Hungary	National Directorate General for Disaster Management (BM OKF)	3
	Water management authorities (OVF, ÉMVIZIG, ÉDUVIZIG)	4
	Agricultural research institute (AKI)	2
	Hungarian Nonprofit Ltd. for Regional Development and Town Planning (VÁTI)	4
	Hungarian Geodetic and Mapping Company Ltd. (Geodézia Zrt)	1
	Károly Róbert College	3
France	Bordeaux Urban Community Department of Geospatial information	7
	City of Geneva (Switzerland)	(planned)
	City of Nice GIS and risk management authorities	(planned)
	RFF - French company in charge of Railroad Network management	(planned)
	Research Institutes (Institut Universitaire Européen de la Mer, Ifremer)	10
	Saint Malo town hall with its department in charge of the Risk Prevention Plan for marine	2

	submersion	
	DREAL (The Regional Directorate of Environment) of Brittany	3
	ACTIMAR (Private Company - Operational Oceanography)	2
	SHOM (Hydrographic and Oceanographic Service of the Navy)	5
	CETMEF (Center of Maritime and River Engineering)	3
	PNMI (Marine Natural Park of Iroise)	1
	CEDRE (Centre of Documentation, Research and Experimentation on Accidental Water Pollution)	3
Italy	Dept. of Civil, Chemical and Environmental Engineering (DICCA) Univ. of Genova	1
	Genova Municipality - Regione Liguria	1
	Regione Liguria - ARPAL	1
	Regione Liguria - Civil Protection	1
	Regione Liguria - Environment Dept. 6	1
	Valle d'Aosta Region	1
	Tuscany Region	1
	Province of Genova	1
eRoom link: https://project.sintef.no/eRoom/math/IQmulus/0_2f3e0		

Table 4. Number of contacted institutions and persons by IQmulus partners

The most important information on the number of user stories by Epic (Table 5) and by Expertise (Table 6) as well as sector and activity (Table 7) are summarised also in the tables below.

Epic (top-level application categories taken from the DoW)	**Number of user stories**
Trial 1.1 Morphological coastal change	28
Trial 1.2 Identification of underwater seabed features	20
Trial 2.1 Rapid and more reliable response for floods, flash floods and landslides	13
Trial 2.2 Rapid and more reliable response for industrial accidents	11
Trial 2.3 Disaster management in urban areas	8
Trial 2.4 Territorial management	35

Table 5: Number of user stories by Epic

Expertise (competence/function of the user (person) responsible for the user story)	Number of user stories
Governmental executive	17
Decision maker	37
Administrator	15
Scientific researcher	7
GIS expert	41
Remote Sensing expert	12
IT administrator/system operator	5
Field expert	24
Other	7

Table 6. Number of user stories by Expertise

Sector of activity (sector of the institution the user story is originating from)	Number of user stories
Monitoring and managing disasters	29
Water management	25
Risk assessment/ management	41
Government/municipality	19
Geodata provider/integrator	20
Land use planning	1
Land cover / land use monitoring	1
Coastal monitoring	36
Security	26
Spatial planning	22
Other mapping	6
Specific scientific research	5
Other	5

Table 7. Number of user stories by the sector of activity

The User Story database is available in eRoom:
https://project.sintef.no/eRoom/math/IQmulus/0_2f478

4 CONCLUSIONS

The process of (both internal and external) user requirements gathering provided IQmulus partners with a large set of User Stories addressing all application categories (or “Trials”) that have been identified in the Description of Work, and even more. It thus ensures that Use Cases and Functional Requirements that are derived from this material will cover all the areas where IQmulus aims at generating significant progress for users. Consolidation work has now to be carried out in order to identify redundancies, similarities and also incoherencies in the requirements. Categorizing and prioritizing requirements is also necessary so that developers are able to prepare a development roadmap. Another major issue will be the preparation of Work Package 7 “Assessment and evaluation” through the identification of relevant acceptance criteria for each functional and non-functional requirement.

Furthermore, the workshops and interviews that have been carried out during this phase are the first steps for the creation of the IQmulus User Group. This User Group is the organizational unit to involve the stakeholders and inform them about the on-going activities, progress and results of IQmulus, and which issues calls for participation in specification, testing, assessment and validation exercises.

ANNEX 1: GUIDANCE DOCUMENT TO THE REQUIREMENTS METHODOLOGY AND INFRASTRUCTURE

IQmulusProject
WP1, Task 1.1 Guidance Document to the Requirements Methodology and Infrastructure (extract)

Editor of the original document: Eva Klien, Fraunhofer IGD

Extracted by: Marta Belenyesi FÖMI

Version: 1.0 (draft)

Contents

1 Scope of the Document

This document is an extract of the "Guidance Document to the Requirements Methodology and Infrastructure"[1].

The original document provides a guidance to the requirements gathering and managment activities within the IQmulus project. As such it documents the results of Task 1.1 of the IQmulus DoW:

Task 1.1: Requirements Infrastructure and Methodology (Fraunhofer, ALL consortium partners)

Within this task, we will investigate requirement handling and then make the choice of the most appropriate methodology in accordance with the development work packages. Setting up the IT infrastructure required for the analysis phase and also later in the development and integration phases is then carried out. Specifically this will include an issue tracking system and its adoption to the methodology.

Chapters directly relevant to the Deliverable 1.2.1 (namely: definitions, guidance for deriving Use Cases/Requirements from User Stories, guidance and material for conducting user workshops/interviews) are kept, others were deleted from the original document, which is available in eRoom: https://project.sintef.no/eRoomReq/Files/math/IQmulus/0_2ea13/13-01-18%20Task1-1%20Guidance%20Document%20v03.docx

The main topics touched by the original document are (directly relevant ones to deliverable 1.2.1 are highlighted):

- **Introduction of the Requirements Methodology**
- **Definition of the term "User Role" and "User Story" (examples included)**
- **Guidance for deriving Use Cases / Requirements from User Stories (functional requirements)**
- **Short description of requirement categories and traceability criteria of requirements**
- **Guidance for conducting User Workshops and Interviews (materials and an example set-up for User Workshop are provided, instructions for requirements gathering and post-workshop activities are also included.)**
- **Questionnaire for User Workshops and Interviews**
- Technical Infrastructure for Requirements Management (Guidance for installation and usage of the Redmine System)
- Organisational Issues related to User Requirements

The original document is a working document, which will be constantly updated.

[1] Guidance Document to the Requirements Methodology and Infrastructure.

2 Introduction

The original document introduces the Requirements Methodology for the EU-Project IQmulus and it provides guidance and material for conducting user workshops/interviews and for inserting the results into the requirements management infrastructure of the project.

The requirements gathering activities are within the responsibility of WP1, while the subsequent activities of system specification and system validation fall into the responsibility of WP2 and WP7, respectively. Figure 1 gives an overview on the approach, responsibilities and instruments related to User Requirements Management within the first 12 months of the IQmulus project.

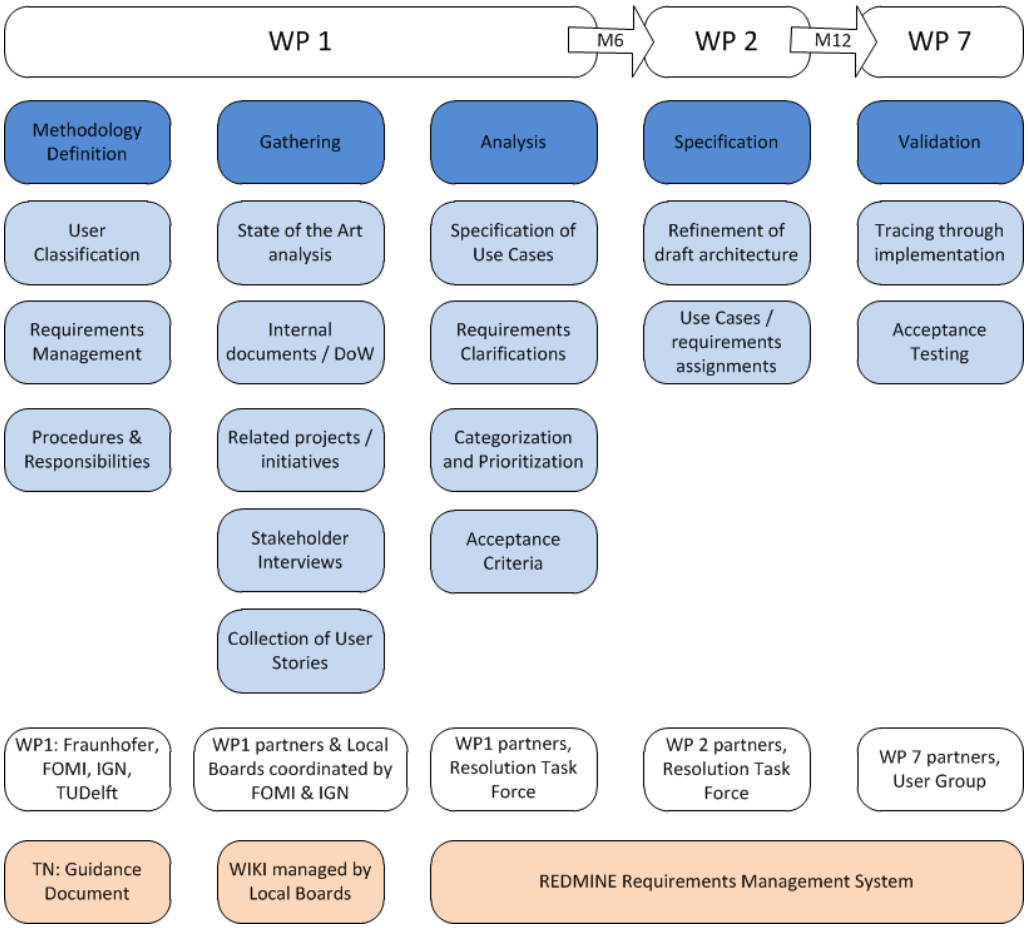

Figure 1: Approach, Responsibilities and Instruments related to User Requirements within the first 12 months of the IQmulus project

3 Methodology

The requirements gathering methodology developed for IQmulus is based on AGILE methodologies [1] and the VOLERE templates [2] and it builds on experiences gained from the user requirements activities in previous projects like HUMBOLDT, GeoViQua and TELEIOS.

In short, at the beginning of the project and at the initial user community workshops, we capture requirements at the level of user stories, known from AGILE software methodologies and described in several works such as [1]. The user stories will be collected by the Local Boards through interviews and workshops with their local stakeholders. These user stories are then reviewed by the Local

Boards, translated into English and transferred to the Redmine system. The user stories serve as basis for deriving the functional (and also non-functional) requirements in form of use cases. This task will be conducted by the Requirements Resolution Board, which involves representatives from management, user and technical roles within the IQmulus project.

The following sections give a justification for using the mentioned methodologies, especially the AGILE ones and give a short introduction.

3.1 User Roles and User Stories

The requirements gathering methodology in IQmulus is partly based on what is known as AGILE methodologies for software development.[2] The common process for gathering requirements for software systems is to gather as many requirements as possible at the beginning of the project, assuming that the more requirements there are, the better the developed software will be. However, as described in [1]: "Extensive upfront requirements gathering and documentation can kill a project in many ways". Capturing requirements in a few hundred pages of documents without a clear prioritization of requirements, references to the tasks and use cases where the requirements are derived from, and explanations of ambiguous terms might result in a situation where it is almost impossible for the developers to start developing the software. Therefore, the AGILE methodologies, focusing on user tasks at the beginning and refining the high-level requirements in a communication process with the users and stakeholders afterwards seemed to fit quite well to the project. From our point of view, capturing all requirements at the beginning of a project is impossible. Requirements evolve during project runtime, especially when first prototypes are available and given to users.

3.1.1 User Roles

It is a common mistake in the process of capturing the functional requirements for a software system to lose sight of the type of user that issued a requirement. Often, the assumption is that there is a single type of user of a system and all requirement specifications (let them be IEEE-styled requirements à la "The SYSTEM should…" or user stories) are written for this single type of user, sometimes referred to as "the user". However, in most cases, a software system has multiple types of users with different experiences, backgrounds and goals while using the software. Delivering requirement specifications without a clear reference to the type of user that issued the requirement leads to problems in grouping and especially prioritizing them. Therefore, it is of huge importance to clearly identify the types of users (User Roles) and to unambiguously link them to the requirement specifications.

3.1.2 User Stories

User stories are short natural language sentences of the intended functionality of a software system, written in the language of the user or stakeholder of the system. As described in [1], user stories are composed of three aspects:

- "a written description of the story used for planning and as a reminder"
- "conversations about the story that serve to flesh out the details of the story"
- "tests that convey and document details and that can be used to determine when a story is complete."

[2] http://agilemanifesto.org/

As suggested in [1] and proven useful in several other works on requirements, a user story might follow the template:

As a <user>, I want <something> so that <benefit>.

Stories following that template usually contain some relevant information that might sometimes be missed, namely:

i. Which user role/actor issued the requirement (<user>) and
ii. What is the rationale behind the requirement (<benefit>).

In the following, some examples of user stories are listed that were captured by FOMI for IQmulus from initial user interviews:

Trial 2.1, „Rapid and more reliable response for floods, flash floods and landslides"

User Story 2.1.1: *„As a GIS expert at a Water Authority, I want to integrate LIDAR data acquired on a subset of my area of interest with pre-existing Digital Elevation Model (DEM) in order to obtain an accurate, up-to-date and hydrologically correct DEM as an input for my Inundation Simulation model."*

User Story 2.1.2: *„As a GIS expert at a Civil Protection Authority, I want to overlay polygons of inundated areas (derived from simulations and image analysis) with cadastral data so that I can identify the land parcels affected".*

User Story 2.1.3: *„As a field expert at a Civil Protection Authority, I want to display a map showing orthophotos, inundated areas and affected land parcels on my mobile device so that I can navigate on the field for damage assessment"*

Trial 2.3, „Disaster management in urban areas"

User Story 2.3.1: *„As a GIS expert at a Civil Protection Authority, I want to perform direct georeferencing of UAV video stream to obtain an image map for quick damage assessment."*

User Story 2.3.2: *„As a GIS expert at a Civil Protection Authority, I want to overlay polygons of different risk zones with building-level census data and facility map so that I can plan evacuation."*

User Story 2.3.3: *„As a terrain agent at a Civil Protection Authority, I want to display basemap data and evacuation plans on my mobile device so that I can perform evacuation operations."*

Trial 2.4, „Territorial management"

User Story 2.4.1: *„As a GIS expert at the National Planning Authority, I want to perform an integrated spatial analysis of agricultural suitability, environmental sensitivity and socio-economic data in order to determine planning zones at a national level."*

User Story 2.4.2: *„As a land use planner at a municipality, I want to overlay country-level and local-level planning zone polygons so that I can update my planning zones according to country-level regulations."*

User Story 2.4.3: *„As an investor, I want to display cadastral data and local planning zones on my mobile device in order to identify possible locations and land parcels for my small factory while exploring the surroundings by car."*

Further, there can be different levels of details for user stories. Although, in general, user stories should be kept small in terms of the functionality to implement, there can be generic user stories that capture whole use cases in a single sentence. Such stories are often called *epics*. For example, a generic user story or epic derived from the IQmulus use cases is *"As an end user, I want to search for EO images"*. Obviously, this is a rather generic user story capturing a whole lot of use cases and therefore, a huge set of details is missing such as what are the search criteria (thematic, spatial or temporal or all of them), is it possible to store the queries, etc. Such details can be captured in additional low-level detailed user stories derived from the epic.

3.2 From User Stories to Use Cases (Functional Requirements)

As described in [1] and extensively discussed by the people who "invented" user stories (e.g., at several websites such as [3]), user stories differ from use cases. While user stories are short natural language sentences describing desired functionality of a system, use cases often follow a formal structure (template) and cover details such as preconditions, steps in a success scenario or processed data. However, the relationship between user stories and use cases is not simply a generic matter of detail but highly depends on the scope of a user story. In some cases, a single user story might be transferred to a whole use case specification. For example, the user story or epic "As an employer, I want to post a job offering" covers a whole use case. Instead, more detailed user stories such as "As an employer, I want to put details on the job offering such as start date, payment and qualification" do not cover a whole use case but only a single step in the main success scenario. The main differences between user stories and use cases can therefore be summarized as:

- User stories are shorter and do not follow a formal template
- User stories are written in the language of potential users of the system
- A single user story might be transferred to a single use case or to (steps in) a main success scenario of a use case.
- Use case specifications might already include details on the user interface, which should be avoided for user stories.

Therefore, the process of transferring user stories to use cases depends on the scope of the stories. A successful approach typically involves the following steps:

- Identify user stories that cover functional requirements on the system
- Group the user stories and identify related user stories and the nature of the relationship such as generalization, specialization.
- Identify user stories that can be transferred to whole use cases and those that correspond to parts of use cases.

Identifier	The unique identfier for the use case
Version	*Specified in the form <Version>, <Date>.* *Example: 1.0, 23.02.2007* *Each minor change (changing descriptions within the use case) will be reflected by an increase by 0.1 of the version number.*
Description	*A short natural language description of the use case.*
Actors	*A reference to the actors as identified beforehand.*
Initial conditions	*A description of any relevant precondition that might be fulfilled before the use case can be executed.*
Final results	*A description of the final results of the use case.*
Main process	*The steps required for achieving the final result.*
Alternative processes	*Any alternatives that might occur in the main process.*
Exceptional situations	*Any exceptional situation that might occur durcing the main process.*
Processed data	*A description of the data types relevant / processes in this use case.*
Generated data	*A description of the data generated by executing this use case and, e.g., whether it is persisted or not.*
Activity diagram	*An activity diagram showing the main process diagrammatically.*
Related User Stories	*A reference to related user stories using the identifiers in the Redmine system.*

3.3 Requirement Categories

This section introduces the requirement categories for IQmulus. The categories for non-functional requirements serve as a basis for categorizing and identifying the non-functional requirements for the IQmulus system. The non-functional requirement specifications follow the identifier scheme TB1.<requirement type abbreviation>.<number>. For example, a performance requirement for IQmulus Testbed I might have the identifier TB1.PR.01.

3.3.1 Functional requirements

Functional requirements refer to requirements on what the system is expected to do. Functional requirements "present a complete description of how the system will function from the users' perspective. They should allow both business stakeholders and technical people to walk through the system and see every aspect of how it should work – before it is built." [4].

Most of the requirements captured in the form of user stories during the user community workshop are functional requirements. Besides functional requirements, a set of requirement types exist that are usually subsumed by the term non-functional requirements.

3.3.2 Non-functional requirements

In addition to functional requirements, non-functional requirements exist that can be grouped into the following categories.

3.3.2.1 Performance requirements (PR)

Performance requirements typically relate to the response time of a system and the amount of data the system is expected to deal with. For IQmulus, initial performance requirements are already indicated in the Technical Annex of the Description of Work.

3.3.2.2 Reliability Requirements (RR)

Reliability requirements usually relate to the availability and reliability of the system. Typical examples are: The system should be up at least 90% of the time.

3.3.2.3 System interface requirements (SIR)

Interface requirements refer to the software interfaces offered by the system. A typical system interface requirement is "The system should offer all mandatory operations of the OGC Web Feature Service standard version 1.1.0."

3.3.2.4 Security requirements (SR)

Security requirements refer to any requirement related to access restriction to the system.

3.3.2.5 Standard requirements (STR)

Any requirement related to standards (OGC, ISO, etc.) can be grouped into this category.

3.3.2.6 Human-Machine interface requirements (HMR)

Human-Machine Interface requirements relate to requirements on the user interface offered by the system.

3.3.2.7 Documentation Requirements (DR)

Documentation requirements capture those requirements that are related to the software documentation such as "The user manual should be delivered in English and Greek".

3.4 Traceability of requirements

An important aspect is the traceability of the requirements. Different common characterizations of traceability exist, such as *"Requirements traceability refers to the ability to describe and follow the life of a requirement, in both forwards and backwards direction (i.e., from its origins, through its development and specification, to its subsequent deployment and use, and through all periods of on-going refinement and iteration in any of these phases.)"*[3] or *"Requirements traceability refers to the ability to define, capture and follow the traces left by requirements on other elements of the software development environment and the trace left by those elements on requirements."*[4]. Traceability in IQmulus is ensured by the use of the Redmine system and by providing clear references between all the different requirement related issues such as user roles, user stories, use cases or non-functional requirements: Within the *Redmine* system, user roles are linked to the user stories. Further, user stories will be linked within the formal use case and non-functional requirements specifications.

4 Guidance for User Workshops and Interviews

The questionnaire is the central instrument for organising the workshops and for extracting a relevant set of user stories from the participants. The questionnaire is not targeted towards a specific user type. Thus, not all questions will be relevant or answerable by all participants and it is up to the interviewer/moderator to choose the right level of detail in order to avoid that users feel inappropriately addressed.

The Questionnaire is added in Annex 2.

The diversity of different user types will be reflected in the results. From the feedback collected through this questionnaire, it will be possible to develop a IQmulus position paper that presents the view points from different users.

Responsible for conducting workshops and documenting the results are the Local Boards.

4.1 Further Material for User Workshops

- Information package to be sent to the users prior to the Workshop as preparation material
  - IQmulus Fact Sheet (SINTEF)
    https://project.sintef.no/eRoom/math/IQmulus/0_2d49d
  - Written explanation about the questionnaire, so users know what will be expected from them
  - Request for application demos from the participants
- Introductory Slides for IQmulus (SINTEF)
- Examples / Demos from the Testbed area (either HRW or FOMI)
- Technical Demos that illustrates the potential of innovative developments in IQmulus

[3] http://en.wikipedia.org/wiki/Requirements_traceability#cite_note-5

[4] http://en.wikipedia.org/wiki/Requirements_traceability#cite_note-5

4.2 Example Set-up for User Workshop

The following agenda proposes an example set-up for a 1-day user workshop. Of course this needs to be adapted depending on the timeframe available for the Workshop as well as depending on the number of external participants.

9:00-10:00	**Workshop Methodology + IQmulus Introduction** • Presentation of the methodology and agenda of the workshop. • Presentation of IQmulus project and ideas ➔ Provide a time slot for the users to fill in Section A of the Questionnaire
10:00-12:00	**Introductory Round & initial discussions** • External workshop participants have the opportunity to give a statement on their generic expectations towards the project. • External workshop participants have the opportunity to present demos from their application domain • Demos from IQmulus testbeds ➔ Questionnaire Section B: How are decisions made today and what is needed in addition for making better decisions?
13:30 – 17:00	**Requirements Gathering Sessions (see more details in Section 4.3)** Depending on the number of workshop participants, this part of the workshop can be organised in the plenary or in parallel working sessions. ➔ Questionnaire Section C: Specific questions towards technical topics of the IQmulus project ➔ Result: Set of User Stories on the functionality and usability requirements of the IQmulus System
17:00 – 18:00	**Wrap-up of results and outlook** • Summary of the work achieved in the previous working sessions • Outlook on how we planned to proceed with the outputs of the workshop and how to continue communication + discussion with the users ➔ Provide a time slot for the users to fill in Section D of the Questionnaire

4.3 Requirements Gathering Sessions

The requirements gathering session is meant to capture user requirements in the form of user stories and related acceptance criteria. Experiences from organizing similar workshops, e.g., in the HUMBOLDT project[5] and the TELEIOS project have shown that discussions in small groups are more efficient. In smaller groups, the possibility of involving each single participant in the discussions is much higher and the work on requirements can be more focused. In general, we propose to follow the structure of Section C of the IQmulus Questionnaire to organise the Requirements Gathering Session. Depending on the type of users and their background experience, there are different possibilities for organising parallel working groups, e.g.:

- Groups might work in parallel on the same topics, and the results are compared and consolidated in the wrap-up session
- Groups might work in parallel on different subsets of the topics proposed in the Questionnaire, and the results are reported and integrated in the wrap-up session

Similar to the workshop methodology described in [4], we propose not to apply any filtering or prioritization mechanism on requirements already at the workshop. Instead, the participants will be asked to brainstorm on requirements in the form of user stories, which need to be captured and documented by the session moderators.

Coming up with such a methodology mainly boils down to answering the question: *How much formality/guidance is required to structure the discussions at the workshop*? Completely open discussions potentially lead to a huge set of unstructured requirement specifications captured implicitly or explicitly in notes. On the other hand, a methodology based on more formal specifications such as use case templates or IEEE-requirement sentences to be developed by the attendees would not reflect well the more generic discussion required at the beginning of a project. Therefore, user stories seem to be a good trade-off between formality (formalizing the outcome already at the workshop) and openness of discussions. User stories capture useful information in a semi-formal way. They are well suited for the level of detail for requirements we want to capture in the workshops, since they help answering a set of questions, namely *"Who has this requirement/ which type of user/user role?"*, "*What is the system expected to do (the requirement)?"* and *"What is the goal of the user/why does he need this functionality?".*

4.4 Post-Workshop Activities

Post-workshop activities include:

- Setting up the communication platform for discussions and future interaction with users on the workshop results («IQmulus User Wiki»)
- Documentation of Workshop Results
    - Inserting feedback from Questionnaire Section A and D into the database
    - Documentation/Report on material gathered during the requirements gathering session in the «IQmulus User Wiki»)
    - Initial categorization, prioritization, translation of the User Stories
    - Transfer of all relevant user stories into the Redmine System («IQmulus»)

[5] http://www.esdi-humboldt.eu/home.html

5 References

[1] M. Cohn, *User Stories Applied: For Agile Software Development*. Addison-Wesley Longman, Amsterdam, 2004.

[2] S. Robertson und J. C. Robertson, *Mastering the Requirements Process*, 2nd Edition. Addison-Wesley Professional, 2006.

[3] "User Story And Use Case Comparison." [Online]. Available: http://c2.com/cgi/wiki?UserStoryAndUseCaseComparison. [Accessed: 07-Dec-2012].

[4] "Requirements: An introduction," 16-Apr-2004. [Online]. Available: http://www.ibm.com/developerworks/rational/library/4166.html. [Accessed: 07-Dec-2012]

ANNEX 2: QUESTIONNAIRE FOR USER WORKSHOPS AND INTERVIEWS

IQMULUS QUESTIONNAIRE

Name: _____

Affiliation: _____

Email: _____

Event: _____

Note: this questionnaire is a tool for guiding the information gathering from users in workshops and interviews. It is not meant as a questionnaire to be filled out without supervision. Section A, D, and E should be filled out individually by every participant, while the information gathering for Section B and Section C could also be organized in breakout sessions / group work during a workshop.

A. General User Background

For each of the following items, please select at least one option. If possible, please try to also provide more specific information in the text fields.

1. What is your current occupation?

2. How would you define your role(s) for interacting with geodata?
   - ☐ Data provider / Data custodian
   - ☐ GIS expert
   - ☐ Field expert
   - ☐ End user / Decision maker
   - ☐ IT administrator / System operator
   - ☐ Researcher: _____
   - ☐ other: _____

3. Which is your application domain?
   - ☐ monitoring and managing disasters, please specify the kind of disasters: _____
   - ☐ land use planning
   - ☐ land cover / land use monitoring
   - ☐ coastal monitoring
   - ☐ security
   - ☐ other mapping: _____
   - ☐ specific scientific research: _____
   - ☐ other: _____

4. What is your typical scale of work?
   - ☐ City level (<1000 sqkm)
   - ☐ Regional level (1000-10000 sqkm)

- ☐ Country level
- ☐ European level
- ☐ Global level
- ☐ Other _____

5. Do you work with time-critical applications (where time-critical means that action in real or near-real time is required)? If yes, please specify
   - ☐ Yes: _____
   - ☐ No

6. Do you have experience with high-volume data?
   - ☐ working with high-volume data is part of my daily work
   - ☐ several times a month
   - ☐ several times a year
   - ☐ very occasional use only
   - ☐ no experiences so far

7. If you have experience with high-volume data, please specify the kind of data (e.g. DTM, Lidar / point cloud, …) and their approximate volume

   Kind of data Approx. Volume

   _____
   _____
   _____
   _____

8. If you have experience with high-volume data, where in the data provision chain would you locate yourself?
   - ☐ Collection
   - ☐ Integration
   - ☐ Analysis
   - ☐ Provision
   - ☐ Utilisation
   - ☐ Other: _____

9. If you have experience with high-volume data, please describe your most common use(s) of big data:

10. Does your work involve the combination of high-volume and/or heterogeneous datasets? If yes, please precise with which combinations you work, e.g. aerial photograph draped on DTM and the heterogeneities that have to be handled (e.g. dimension / resolution heterogeneity)
    - ☐ No
    - ☐ Yes:

      _____
      _____

11. Do you have experience with temporal data sets? If yes, which is the data type and size for each time frame and which is the time frame of the acquisition?
    - ☐ No
    - ☐ Yes:

      _____
      _____

With the next question no 12, please decide as interviewer / moderator which part of the question a) or b) you are going to ask – this depends on the level of experience of the user with working with high-volume data

12. What type of geographic data are you working with?

a) What type of geographic data are you working with (multiple choice)?

- ☐ Topographic databases
- ☐ DEM/DTM
- ☐ Raster maps
- ☐ Aerial imagery
- ☐ Terrestrial imagery
- ☐ point clouds from airborne system
- ☐ point clouds from static terrestrial system
- ☐ point clouds from mobile mapping systems
- ☐ 3D models
- ☐ Simulation data (flooding…)
- ☐ Others _____
- ☐ I do not work with geographic data

b) What type of geographic data are you working with (detailed response)?

i. Dimensionality

- ☐ 1D
- ☐ 2D
- ☐ 2.5D
- ☐ 3D
- ☐ 3D + time
- ☐ Multidimensional

ii. Data Type

- □ Point Cloud
- □ Raster
- □ Vector
- □ Coverage
- □ Other _____

iii. File Storage Type

- □ ASCII (column/tabular)
- □ Structured Data Modeling (e.g. GML / KML
- □ Binary (all kinds of file formats
- □ Relational spatial database
- □ Non-relational spatial database
- □ Other _____

iv. Please specify the file formats you are working with (e.g. ESRI shape, GeoTIFF, etc)

_____

v. Please specify the sensor and the platform categories for your sensor data:

Sensor Category

- □ LIDAR
- □ SAR
- □ Echosounding
- □ Spectral camera
- □ Spectroadiomater
- □ Metric Camera
- □ Metrological radar
- □ Geophysical sensor
- □ Other: _____

Platform Category

- □ Airborne
- □ Space-borne
- □ Static
- □ Mobile (vehicle)
- □ Mobile (hand-held)
- □ Other: _____

13. Please list the software that you are using in your application environment

_____
_____
_____
_____

14. On which level are you interacting with your application environment?

- □ Algorithms
- □ Workflow
- □ Scene definition
- □ Map display
- □ other: _____
- □ I never use GIS or similar software

15. What kinds of interfaces of GIS software do you use?

- □ Graphical User Interface on the desktop
- □ Web-based User Interfaces internal to the organization (i.e. on the intranet)
- □ Web-based User Interfaces provided by third parties (i.e. on the internet), namely:

  _____
- □ Command Line Interfaces (CLI)
- □ Web services internal to the organisation (i.e. on the intranet)
  - ○ the following standard interfaces or formats (e.g. WMS, WFS, WPS / GML, Shapefiles, KML, GeoTIFF) are involved: _____
- □ Web services provided by third parties on the internet (i.e. on the intranet)
  - ○ the following standard interfaces or formats (e.g. WMS, WFS, WPS / GML, Shapefiles, KML, GeoTIFF) are involved: _____
- □ I directly use APIs and/or SDKs to utilize GIS software components or services by the aid of scripts or custom software components
- □ Not sure / don't know exactly

16. How would you describe your level of experience with regard to your application domain?

expert ○ ○ ○ ○ ○ ○ novice _____

17. How would you describe your level of expertise with regard to using GIS (or similar software)?

expert ○ ○ ○ ○ ○ ○ novice _____

18. How would you describe your level of experience with regard to handling high-volume data?

expert ○ ○ ○ ○ ○ ○ novice _____

B. How are decisions made today and what is needed in addition for making better decisions?

The intention for Section B is to stir a generic discussion with the user(s) in order to identify:

1) what do the users today? What is their thinking for making a decision?

2) what do the users need in addition for making a better decision?

If possible, please ask the users to give a short presentation of their work environment and how they arrive at decisions today. Based on this user input, you can extract through specific questions (see Section C as guideline) their user stories on what would be expected from a system to make life more easy and happy

Alternatively, the generic discussion on the current situation could also be stirred with the following seed questions from FÖMIs user workshop (again, this should be done in combination with Section C questions and with the goal of extracting a number of user stories).

1. What are the basic (current and potential) questions to be answered in your thematic area?

2. What kind of solutions do you currently use to answer the above-mentioned questions?

   - *data*
   - *analysis, models*
   - *output (displaying, publishing, etc.)*
   - *reliability, robustness, speed*

3. What are the limitations/hindrances you encounter during answering?

   - *lack of data*
   - *problems/limitations with analysis methods, models*
   - *problems/limitations with output (displaying, publishing, etc.)*
   - *problems with reliability, robustness, speed*

4. What kind of ideal (even futuristic) solutions can you imagine to help you better perform your tasks in the future?

   - *data*
   - *analysis, models*
   - *output (displaying, publishing, etc.)*
   - *reliability, robustness, speed*

5. What did we forget to ask...?
6. Suggested study area?

C. Specific questions towards technical topics of the IQmulus project

Thinking of your current application environment, we would like to know very concretely about specific limitations and potential improvements of your daily work. In the following section, a number of specific topics are listed. These are technical topics that are of interest for the development work in the IQmulus project.

In the first part of this section, we ask you to elaborate on the 2(-n) main limitations and the 2(-n) main improvements you see for the FUNCTIONALITY of your infrastructure.

In the second part of this section, we ask you to elaborate on the 2(-n) main limitations and the 2(-n) main improvements you see for the USABILITY of your infrastructure.

Further, please specify your acceptance criteria relative to the improvements.

For the moderators / interviewers: the user statements regarding improvements should be formulated as user stories! ("As a <role> I want <something> so that <benefit>")

For each topic, short explanatory texts or examples should be provided.

1. Limitations and Improvements for the FUNCTIONALITY of your current infrastructure with respect to:

1.1 Performance issues related to working with high-volume data

Performance issues for the functionality are related to e.g. methods of the processing of high-volume data, methods to realise a high processing speed, the kind of optimisation of the process control, the architecture and data management in a network with distributed processes, the data transfer.

A. Limitations:

1 _____

2 _____

B. Improvements (+ if possible with acceptance criteria):

User Story 1: _____

User Story 2: _____

1.2 Data Integration

The integration of data from very different sources and processes sets requirements on the delivered data formats and interfaces, the networking of the data processing, effective extraction, transforming and loading processes etc.

A. Limitations:

1 _____

2 _____

B. Improvements (+ if possible with acceptance criteria):

User Story 1: _____

User Story 2: _____

1.3 Functional Processing (e.g. data integration and fusion)

Functional services offer data processing functionalities that are relevant to many applications. This includes for instance, the handling and analysis of remotely sensed image series taken at different times from different sources, or the integration of airborne laser and laser mobile mapping data of the same neighbourhood.

A. Limitations:

1 _____

2 _____

B. Improvements (+ if possible with acceptance criteria):

User Story 1: _____

User Story 2: _____

1.4 Domain Processing (e.g. semantic / feature extraction)

Domain processing services will provide functionalities that reply to the needs of specific application domains. This may include, for instance, the extraction of small-scale drainage networks from very detailed terrain models, the characterization of land-slides, the monitoring of the changes of coastal lines and zones

A. Limitations:

1 _____

2 _____

B. Improvements (+ if possible with acceptance criteria):

User Story 1: _____

User Story 2: _____

1.5 Dealing with Accuracy and Uncertainty

Any processing service we may envisage has to deal with an amount of uncertainty which may be caused by a variety of reasons: for instance, geo-referencing errors in the acquisition phase, registration errors, accuracy of the classification, errors of approximation of the surfaces extracted by fused datasets.

A. Limitations:

1 _____

2 _____

B. Improvements (+ if possible with acceptance criteria):

User Story 1: _____

User Story 2: _____

1.6 Visualisation / visual decision support

A preliminary analysis of the workflow processes of the stakeholders within IQmulus revealed that nowadays, decision making is often a two-staged process involving the following users and roles:

- *experts prepare the decision-making using sophisticated tools to collect and combine information in an appropriate way, and*
- *generate visualizations where the essence of the analysis is rendered in an obvious way for decision-makers who actually take the decisions.*

The latter form of visualisations is of limited interactivity – if interactive at all. Whereas the preparation requires – more than ever – the possibility to interactively analyse digital information in a visually revealing form. Efficient visual interaction/interactive visualisation is key for human beings in generating hypotheses about causes and effects and their inter-relationships; thus, supporting the visual thinking of human beings.

The IQmulus stakeholders strongly believe that this splitting of roles and responsibilities will continue as a typical work habit. Therefore, we foresee two dedicated components on the visualization layer in our conceptual IQmulus system architecture:

- *Interactive visual decision support component based on leading-edge GPU technology to facilitate new levels of interactivity when handling large heterogeneous data sets;*
- *Web-application deployment component based on an innovative declarative 3D Internet approach allowing for deployment of dedicated 3D Web applications to decision makers.*

Examples of the core technology can be found in the following link:
http://iqmulus.igd.fraunhofer.de/redmine/projects/iqmulus-user-wiki/wiki/Visualization

A. Limitations:

1 _____

2 _____

B. Improvements (+ if possible with acceptance criteria):

User Story 1: _____

User Story 2: _____

2. Limitations and Improvements for the USABILITY of your current infrastructure with respect to:

2.1 Performance issues related to working with high-volume data

A. Limitations:

1 _____

2 _____

B. Improvements (+ if possible with acceptance criteria):

User Story 1: _____

User Story 2: _____

2.2 Data Integration

A. Limitations:

1 _____

2 _____

B. Improvements (+ if possible with acceptance criteria):

User Story 1: _____

User Story 2: _____

2.3 Functional Processing (e.g. data integration and fusion)

Examples are: integrating aerial and terrestrial datasets, representing 3D point clouds from LIDAR data in a scalable manner

A. Limitations:

1 _____

2 _____

B. Improvements (+ if possible with acceptance criteria):

User Story 1: _____

User Story 2: _____

2.4 Domain Processing (e.g. semantic / feature extraction)

Examples are: the reliability of classification, analysing large 3D point clouds coming from LIDAR data in a scalable manner

A. Limitations:

1 _____

2 _____

B. Improvements (+ if possible with acceptance criteria):

User Story 1: _____

User Story 2: _____

2.5 Dealing with Accuracy and Uncertainty

Examples are: lack of guidelines for documenting uncertainty in all its forms, lack of appropriate ground-truth cases for many applications, lack of modalities to convey information about accuracy or precision.

A. Limitations:

1 _____

2 _____

B. Improvements (+ if possible with acceptance criteria):

User Story 1: _____

User Story 2: _____

2.6 Visual decision support

Examples of the core technology can be found in the following link:
http://iqmulus.igd.fraunhofer.de/redmine/projects/iqmulus-user-wiki/wiki/Visualization

A. Limitations:

1 _____

2 _____

B. Improvements (+ if possible with acceptance criteria):

User Story 1: _____

User Story 2: _____

D) General Comments or Feedback

E) General Feedback on Workshop

1. What kind of expectations did you have towards the workshop/event?

_____

_____

_____

_____

2. From my perspective, the workshop was a successful and worthwhile event.

strongly agree ○ ○ ○ ○ ○ ○ strongly disagree _____

3. What could be improved?

_____

_____

_____

_____

4. Would you like to receive information on the development of the IQmulus project?

☐ Yes

☐ No

5. Would you be interested in participating in other IQmulus User Community Events?

☐ Yes

☐ No

6. Other Comments

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