

# INTERNAL VALIDATION

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## DELIVERABLE

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### D2.3.1. INTERNAL VALIDATION

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This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

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# TABLE OF CONTENTS

Revision History .....	3
Table of Contents .....	4
List of Tables .....	5
Executive Summary .....	6
1 Introduction.....	7
2 Methodology .....	9
2.1 Methodology.....	9
2.1.1 Focus group .....	9
2.1.2 Questionnaire.....	9
3 Validation results .....	12
3.1 Deployed enablers .....	12
3.2 Enablers validation.....	15
4 Conclusion.....	17
Annex 1: Questionnaire .....	18

## LIST OF TABLES

Table 1: Usability validation criteria .....	10
Table 2: Functionality validation criteria .....	10
Table 3: SDI2Apps Functionality and Enablers .....	11
Table 4: Requested and provided SDI2Apps Enablers .....	13
Table 5: Average values of SDI2Apps Enablers main criteria provided by developers .....	14
Table 6: Average values of SDI2Apps Enablers Usability criteria provided by developers .....	15
Table 7: Average values of SDI2Apps Enablers Functionality criteria provided by developers .....	15

## EXECUTIVE SUMMARY

The Internal validation report summarises internal validation actions and the results from the first year. The methodology from D.2.2 is used and the main focus is on defining SDI4Apps general enablers and on measuring usability of these enablers by developers. Information necessary for the Internal validation report of first year was generated using focus group discussion and questionnaire filled by the SDI4Apps partners' developers. It was found that the partner's developers have identified 10 enablers for the SDI4Apps platform in the cloud operated by CERIT-SC. Developers evaluate most enablers good in their usability and functionality, so they should be readily applied by them.

# 1 INTRODUCTION

This report documents the first year results of Task 2.3. “Internal Validation” in the project’s WP2 “Community Building and Social validation”. According to the DoW, the main objective of WP2 is to build the SDI4Apps user community that actively participates in the processes of design, integration, validation and uptake of the proposed SDI4Apps platform. Internal validation is based on the following elements:

- a methodological approach which is adaptive: focusing on monitoring and evaluating the innovative solutions of community groups within key processes of developments;
- a promotion of a stakeholder’s active interaction and participation: the monitoring and evaluation methodology for assessing the effectiveness of ICT tools and in particular of the SDI4Apps platform.
- assessment of the impact of the adoption of new solutions, from the community’s point of view, the feasibility and viability of the new solutions will be performed in a cycle of three iterations where the interplay between diagnostics and assessment will be sought.

Internal Validation within the project duration consists of 3 tasks and deliverables:

- D2.3.1 Internal Validation Report - first year results: This report summarise internal validation actions and the results from the first year. The methodology from D.2.2 is used and the main focus is on indicators measuring usability of the SDI4Apps general enablers by developers.
- D2.3.2 Internal Validation Report - second year results: The report will summarise internal validation actions and the results from the second year. The methodology from D.2.2 will be used and the main focus will be on usability of pilot applications by end users.
- D2.3.3 Internal Validation Report - third year results: The report will summarise internal validation actions and the results from the third year. The methodology from D.2.2 will be used and the main focus will be on usability of pilot applications by end users and new possibilities for developers.

Before the SDI4Apps components will be available for the community at large, there is extensive internal technical testing by project partners of all components, including:

- Testing and quality assurance of integrated sub-systems and components towards the overall user-requirements;
- Resolution of problems identified throughout the testing activities.

SDI4Apps’ validation will take into account important issues such as functionality, usability, performance, accessibility, scalability, location independence, but also privacy and security, and will include Internal Validation, by SDI4Apps partners, which will be focused on:

- Indicators measuring usability of the SDI4Apps components by developers in year one.
- Usability of pilot applications by end users in year two.
- Usability of pilot applications by end users and new possibilities for developers in year three

This report summarises the internal validation actions and results from the first year. The methodology from D.2.2 has been used and the main focus is on indicators measuring the usability of the SDI4Apps general enablers by developers.

For the first year results two validation criteria have been identified and used for the agreed list of 10 enablers provided from D3.1, D3.2.1, and D3.5 and list of enablers requested in D2.2:

- **Usability** - Capability of the enablers to be understood, learned, used and liked by the user

- **Functionality** - Capability of the enablers to provide functions which meet stated & implied needs when the framework is used under specified conditions

For the validation report 2 methods were used- a focus group and questionnaire by internal technical developers to identify the strengths and weaknesses of each provided enabler and its usability and functionality, and also to draw conclusions and recommendations both for WP2 (Community Building and Social Validation) further validations, and the work of WP3 (Basic Cloud Functionality Deployment).



## 2 METHODOLOGY

### 2.1 Methodology

In year 1 the project is undertaking the following twin track parallel work:

1. Technical: Provide the SDI4Apps Architecture and Basic Functionality
2. Social: Build the Communities for Social Validation.

Task 2.3. Internal Validation is carried out on the basis of validation methodology published in Month 6 in Task 2.2. The focus of this deliverable 2.3.1. report is on measuring the usability of the SDI4Apps components by developers in year one. Thereby only a small part of the Social Validation methodology is used. The much more complex validation of the “usability of pilot applications by end users” which is the focus of most of D2.2, will be addressed in D2.3.2 in year 2. To collect information for the validation report two methods were used- a focus group and questionnaire by internal technical developers.

#### 2.1.1 Focus group

To generate necessary information for defining the year 1 deployed SDI4Apps enablers a focus group discussion was organised during the project meeting at Pilsen on 5-6<sup>th</sup> March 2015. Focus groups are a form of qualitative interviewing. The defining element of focus groups is the use of the participants’ discussion as a form of data collection. For evaluation research, focus groups can be used in both preliminary phases, such as needs assessment or program development, and in follow-up or summative evaluation, to hear about the participants’ experiences<sup>1</sup>.

In this particular situation the point of interest was participants’ conversation and ability to settle an agreement about the topic. By bringing together SDI4Apps developers who share different backgrounds, the focus group created an opportunity for participants to engage in discussion about the topics that participants wish to understand and agree with. This form of discussion revealed considerable differences among developers’ perceptions, but also promoted reducing to a common denominator and basis for future discussion.

Main outcomes of the focus group discussion:

- Need to harmonise terminology to ensure common interpretation of the concepts
- Clarification of the SDI4Apps architecture scope and role of the enablers
- Identification of the issues to be clarified with the role of the APIs
- Better understanding of the pilot requirements
- Agreement for further interaction with the external communities.

#### 2.1.2 Questionnaire

To collect information from SDI4Apps developers about their opinion of the enablers provided in year 1, a simple questionnaire was used (Table 1 and Table 2). The questionnaire was prepared on the basis of D2.2. “Social Validation Methodology” deliverable. As stated in the DoW internal validation of year 1 focuses on measuring the usability of the SDI4Apps components, so two main criteria for evaluation were chosen:

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<sup>1</sup> The Sage encyclopedia of qualitative research methods. Volumes 1&2.

- **Usability** - Capability of the enablers to be understood, learned, used and liked by the user
- **Functionality** - Capability of the enablers to provide functions which meet stated and implied needs when the framework is used under specified conditions

Usability in this sense includes:

- Understandability - The capability of the enablers to enable the user to understand whether the software is suitable, and how it can be used for particular tasks and conditions of use
- Learnability - The capability of the enablers to enable the user to learn its application
- Operability - The capability of the enablers to enable the user to operate and control it
- Attractiveness - The capability of the enablers to be attractive to the user.

While, functionality includes:

- Suitability - The capability of the software product to provide an appropriate set of functions for specified tasks and user objectives
- Accuracy - The capability of the enablers to provide the right or agreed results or effects
- Interoperability - The capability of the enablers to interact with one or more specified systems
- Security - The capability of the software product to protect information and data so that unauthorized persons or systems cannot read or modify them; to authorized persons or systems are not denied access to them
- Compliance - The capability of the enablers to adhere to standards, conventions or regulations in laws and similar prescriptions.

During focus group discussion it was agreed among the SDI4Apps partners' developers that following ten enablers will be included and evaluated in the questionnaire:

1. Cloud Platform
2. HSLayers visualisation enablers
3. HSLayers Next Generation visualisation enablers
4. Postgres-XL
5. Micka
6. Sesame triple store framework<sup>2</sup> and D2RQ Platform<sup>3</sup>
7. Virtuoso
8. MapServer
9. Geoserver
10. SensLog and Orion FIWARE Generic Enabler for sensors management used as a standalone component. Orion actually supports both NGS10 and NGS19.

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<sup>2</sup> <http://rdf4j.org/>

<sup>3</sup> <https://github.com/d2rq/d2rq>

Criterion ID	Main Criterion	Criterion	SDI4Apps enablers										Comments and suggestions		
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.			
Enablers 5 from D.2.2.	Usability	Understandability													
		Learnability													
		Operability													
		Attractiveness													

Table 1: Usability validation criteria

Criterion ID	Main Criterion	Criterion	SDI4Apps enablers										Comments and suggestions		
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.			
Enablers 3 from D.2.2.	Functionality	Suitability													
		Accuracy													
		Interoperability													
		Security													
		Compliance													

Table 2: Functionality validation criteria

Developers were introduced to the prepared questionnaire and it was filled in by them from partners MAC, HYPER, HSRS, CCSS, Avinet, E-Pro, Pronatur, SAŽP and BOSK by using the following metrics:

- 1- Very easy
- 2- Easy
- 3- Average
- 4- Difficult
- 5- Very difficult.

## 3 VALIDATION RESULTS

### 3.1 Deployed enablers

The DoW provided the initial set of planned enablers required by the Pilots, they are also summarised in D2.2. “Social Validation Methodology” deliverable and are discussed in the D3.1. “Architecture Concept” deliverable:

SDI4Apps Functionality	SDI4Apps Enablers	P1 - Easy Data Access	P2 - Open Smart Tourist Data	P3 - Open Sensor Network	P4 - Open Land Use Map Through VGI	P5 - Open INSPIRE4Youth	P6 - Ecosystem Services Evaluation
Advanced visualisations	1. Advanced Visualisation framework & API (of GI & non-GI components)	X	X	X	X	X	X
Data harmonisation	2. Scalable GI to LOD transformation and harmonisation service, from many heterogeneous database sources, including HALE <sup>4</sup> support.	X	X	X		X	X
	3. Validation and integration enablers				X	X	X
	4. Scalable publishing of harmonised data sets.	X	X	X	X	X	X
Integration of mobile apps	5. Scalable crowdsourced/VGI real-time data collection with Open API.	X	X	X	X	X	
Interoperability between local and global geospatial models.	6. Scalable Geo-focused Crawler for automatic collection of OGC services endpoints representing spatial content available via the deep web.	X			X		X
	7. Scalable intelligent deep-Web GI/LD Search & discovery with Open API		X	X		X	X
	8. Scalable Smart Sensor Networks and SensorML support, to extend the PPP FI ENVIROFY Specific Enablers <sup>5</sup>			X			
	9. Interoperable scalable access to sensors			X			
	10. Analytical and modelling enablerset			X			X
Linked Open Data	11. Scalable INSPIRE GI schema to LOD transformation and harmonisation service, with persistent URIs.	X			X		X
	12. Scalable RDF Triple Storage service for LD	X	X	X	X	X	X
	13. Semantic indexing infrastructure to transform GI to LOD	X	X	X	X	X	X
Scalable execution of spatial models	14. Scalable fast PostGIS and concurrent PostgreSQL support, providing clustered real-time updates on all master databases.		X	X	X		X
	15. Scalable GeoServer implementation		X		X		X

Table 3: SDI2Apps Functionality and Enablers

A detailed description of the SDI4Apps platform enablers can be found in D3.2.1. “Enablers Deployment” deliverable. During the focus group discussion among developers it was agreed that

<sup>4</sup> HUMBOLDT Alignment Editor, see <https://joinup.ec.europa.eu/software/hale/description>

<sup>5</sup> See the ENVIROFI central repository of Specific Enablers (SE) for the environmental Usage Area within the Future Internet Public Private Partnership programme (FI-PPP) at <http://catalogue.envirofi.eu/>

the following enablers for the SDI4Apps platform in the cloud operated by CERIT-SC have been deployed in year 1:

1. Cloud Platform - IaaS cloud operated by CERIT-SC, based on the OpenNebula cloud management system, KVM and Xen hypervisors, disk images with preinstalled Debian Linux operating system, Perun account management system, and powerful hardware machines
2. HSLayers visualisation enablers - based on the current HSLayers product with extended functionality. HSLayers combines capabilities of ExtJS and OpenLayers and several helping scripts to establish truly Web GIS applications.
3. HSLayers Next Generation visualisation enablers - It extends the OpenLayers 3 functionality and takes some ideas from the original HSLayers library, but doesn't use Ext3 as the frontend JavaScript framework and is more lightweight in general. It is still under development and published under the GNU/GPL licence version 3.
4. Postgres-XL - clustered database with PostGIS extension, nginx web server with MapProxy caching, HAProxy load-balancer, and Apache - deployed in the CERIT-SC cloud in the form of two virtual machine templates with corresponding virtual machine images.
5. Micka metadata catalogue management system (metadata creation, editing, storing, etc.), supporting discovery of existing geospatial data and services.
6. Sesame triple store framework<sup>6</sup> and D2RQ Platform<sup>7</sup>. Sesame is a Java framework for processing and handling RDF data, with an easy-to-use API that can be connected to all leading RDF storage solutions. While D2RQ exposes the contents of relational databases as RDF. It includes a Mapping Language, a SPARQL-to-SQL Engine, and Server web application that provides access to the database via SPARQL.
7. Virtuoso - middleware and database engine hybrid that combines the functionality of a traditional RDBMS, ORDBMS, virtual database, RDF, XML, free-text, web application server and file server functionality in a single system.
8. MapServer - simple CGI<sup>8</sup> program and thus it is more scalable by simply running it multiple times independently.
9. Geoserver - provides functionality for the publication of the data resources as Web Map Service (WMS) as well as Web Coverage Service (WCS)<sup>9</sup>. A set of available WMS encodings including the OpenLayers and KML formats are available via Layer preview interface<sup>10</sup>. The Web coverage services can be accessed via web and desktop clients<sup>11,12</sup>.
10. SensLog and Orion FIWARE Generic Enabler for sensors management - SensLog is a complex software framework for sensor networks. This integrated solution includes a data model and a server-side application which is capable to store, analyse and publish data in various ways over the network. The Orion Context Broker (Orion) is an implementation of the Configuration Manager GE. Orion provides the NGSI 9 interfaces and within the Internet of Things (IoT) chapter, it is aimed to be used in combination with IoT Broker GE although Orion can be also used as a standalone component. Orion actually supports both NGSI10 and NGSI9.

<sup>6</sup> <http://rdf4j.org/>

<sup>7</sup> <https://github.com/d2rq/d2rq>

<sup>8</sup> Common Gateway Interface - a standard interface between a web server and programs that generate web content

<sup>9</sup> <http://www.opengeospatial.org/standards/wcs>

<sup>10</sup> <http://147.251.252.167:8080/geoserver/web/?wicket:bookmarkablePage=:org.geoserver.web.demo.MapPReviewPage>

<sup>11</sup> <http://147.251.252.167:8080/geoserver/ows?service=wcs&version=1.1.1&request=GetCapabilities>

<sup>12</sup> <http://147.251.252.167:8080/geoserver/wcs>

SDI4App provided enablers corresponds with the list of requested enablers in D2.2, as follows:

SDI4Apps Enablers to be provided from D3.1, D3.2.1, D3.5	SDI4Apps Enablers requested in D2.2
1. Cloud Platform - IaaS cloud operated by CERIT-SC, based on the OpenNebula cloud management system, KVM and Xen hypervisors, disk images with preinstalled Debian Linux operating system, Perun account management system, and powerful hardware machines	3. Validation and integration enablers
2. HSLayers visualisation enablers	1. Advanced Visualisation framework & API (of GI & non-GI components)
3. HSLayers NG visualisation enablers	Advanced visualisation and mobile enablers
4. Postgres-XL clustered database with PostGIS extension, nginx web server with MapProxy caching, HAProxy load-balancer, and Apache	5. Scalable crowdsourced/VGI real-time data collection with Open API.  14. Scalable fast PostGIS and concurrent PostgreSQL support, providing clustered real-time updates on all master databases.
5. Micka metadata catalogue management system, supporting discovery of existing geospatial data and services	6. Scalable Geo-focused Crawler for automatic collection of OGC services endpoints representing spatial content available via the deep web.  10. Analytical and modelling enablerset
6. Sesame triple store framework and D2RQ Platform	12. Scalable RDF Triple Storage service for LD
7. Virtoso	Scalable RDF Triple Storage
8. MapServer Web Map Service	15. Scalable GeoServer implementation
9. Geoserver	Scalable GeoServer implementation
10. SensLog and Orion FIWARE Generic Enabler for sensors management	8. Scalable Smart Sensor Networks and SensorML support, to extend the PPP FI ENVIROFY Specific Enablers  9. Interoperable scalable access to sensors
Sesame/D2RQ/Postgres-XL-PostGIS	2. Scalable GI to LOD transformation and harmonisation service, from many heterogeneous database sources, including HALE support.  4. Scalable publishing of harmonised data sets.  11. Scalable INSPIRE GI schema to LOD transformation and harmonisation service, with persistent URIs.  13. Semantic indexing infrastructure to transform GI to LOD
Micka/Sesame/D2RQ/Postgres-XL-PostGIS	7. Scalable intelligent deep-Web GI/LD Search & discovery with Open API

**Table 4: Requested and provided SDI2Apps Enablers**

## 3.2 Enablers validation

Each of the provided enablers were assessed through 9 criteria. The averages of assigned values by the partner's developers are mostly rated Easy to Average, while SDI4Apps enablers number 6 (Sesame triple store framework and D2RQ Platform), 7 (Virtuoso) and 10 (SensLog and Orion FIWARE Generic Enabler for sensors management) were rated just above Average difficulty in Usability evaluation as well as in Functionality evaluation (Table 4). Overall on average previously mentioned enablers Usability and Functionality were evaluated as just above Average, with no enabler being rated Difficult or Very Difficult in general.

Criterion ID	Main Criterion	SDI4Apps enablers									
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Enablers 3 and 5 from D.2.2	Usability	2,5	2,4	2,5	2,3	2,8	3,3	3,4	2,1	2,2	3,3
	Functionality	2,3	2,4	2,3	2,1	2,3	2,9	3,0	2,1	1,7	3,2

Table 5: Average values<sup>13</sup> of SDI2Apps Enablers main criteria provided by developers

Enablers number 6 and 7 were rated as Difficult or Very difficult by some of developers in Operability and Attractiveness, showing the potential weak point of these enablers. However, in other aspects they are evaluated mainly Average or Easy.

Analysing each criteria individually three enablers were rated as Easy among most of developers in comparison with other SDI4Apps enablers by specific criteria:

- Postgres-XL clustered database with PostGIS extension, nginx web server with MapProxy caching, HAProxy load-balancer, and Apache (Number 4) - good results in evaluating criteria Operability, Attractiveness and Suitability
- MapServer Web Map Service (Number 8) - good results in valuating criteria Learnability, Operability, Attractiveness, Accuracy, Security and Interoperability
- Geoserver (Number 9) - good results in valuating criteria Understandability, Operability, Suitability, Accuracy, Interoperability, Security and Compliance.

<sup>13</sup> Rating values are: 1- Very easy, 2- Easy, 3- Average, 4- Difficult, 5- Very difficult.

Criterion ID	Main Criterion	Criterion	SDI4Apps enablers									
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Enablers 5 from D.2.2	Usability	Understandability	2,6	2,0	2,4	2,4	2,9	3,3	3,3	2,3	2,1	3,4
		Learnability	2,4	2,3	2,6	2,7	2,9	3,0	3,0	2,1	2,5	3,4
		Operability	2,5	2,1	2,7	1,8	2,4	3,6	3,6	2,0	2,0	3,3
		Attractiveness	2,6	3,1	2,4	2,1	3,0	3,3	3,6	2,1	2,3	3,3

Table 6: Average values of SDI2Apps Enablers Usability criteria provided by developers

Criterion ID	Main Criterion	Criterion	SDI4Apps enablers									
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Enablers 3 from D.2.2	Functionality	Suitability	2,1	2,1	2,4	1,9	2,4	2,7	3,0	2,4	1,4	3,4
		Accuracy	2,6	2,6	2,1	1,9	2,1	2,7	2,7	1,9	1,4	2,7
		Interoperability	2,1	2,0	2,1	2,2	2,3	2,6	2,6	1,9	1,4	3,1
		Security	2,3	2,7	2,6	2,2	2,4	3,4	3,7	2,1	2,1	3,1
		Compliance	2,4	2,3	2,2	2,1	2,3	2,9	3,0	2,0	1,8	3,4

Table 7: Average values of SDI2Apps Enablers Functionality criteria provided by developers

As noted during the focus group discussion, the SDI4Apps partners' developers have different backgrounds and points of view regarding enablers' evaluation. Some of the enablers were valued by the SDI4Apps developers almost the same, but others were evaluated rather opposite. The difference between highest and lowest assigned value of each enabler by each criteria was calculated. There was a marked divergence of views in the evaluation of enabler number 10, meaning that this enabler was valued by some of developers as very good and by others as less so. Difference between highest and lowest assigned value for enabler number 10 reached 4<sup>14</sup> in various criteria: Understandability, Learnability, Operability and Accuracy. Quite the contrary can be seen in the evaluation of enablers number 2 and 3, where the difference between highest and lowest assigned value for all of criteria among all of developers is 1 or 2

<sup>14</sup> If difference between highest and lowest assigned value of criteria is 4, it means some of the SDI4Apps partners' developers have evaluated the criteria as Easy, but others at the same time with 5.



## 4 CONCLUSION

This Internal validation report summarises the internal validation actions and results from the first year. The methodology from D2.2 is used and the main focus is on defining SDI4Apps general enablers and on measuring the usability of these enablers by developers.

To meet the needs of the project's pilot, as discussed in section 3.1, the internal validation found that the partner's developers have identified 10 enablers for the SDI4Apps platform in the cloud operated by CERIT-SC. While in section 3.2 it is clear that the developers find most enablers to be between Easy or Average in their usability and functionality, so they should be readily applied by them.

The outcomes of the internal validation confirmed the higher preferences for the well-established enablers providing the support for the relational data storage and management (Postgres-XL clustered database with PostGIS extension) together with the web publishing solutions (Map&GeoServer). On the other side of the evaluation chain with the lower ratings were identified solutions for triplestores (Sesame, D2RQ and Virtuoso) that should be taken into consideration in connection with the semantic web related requirements.

However there was a divergence of views in the evaluation of enabler number 10 (SensLog and Orion FIWARE Generic Enabler for sensors management), meaning that this enabler was evaluated by some of developers as Easy and by others as less so, with some developers rating it as Difficult in its Understandability, Learnability, Operability and Accuracy. So it is recommended that WP3 might look again at this enabler, or its supporting documentation.

The results of the internal evaluation show the strong influence of previous knowledge and good understanding of technologies, which are commonly used. For better understandability of the less common tools, the project needs to provide additional tutorials and training. It is also clear, that for better utilisation of such tools it is important to develop APIs which will allow use of these tools without the need for a deep understanding of the technologies involved.

# ANNEX 1: QUESTIONNAIRE

## Questionnaire Number 1

Criterion ID	Main Criterion	Criterion	SDI4Apps enablers										Comments and suggestions
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Enablers 5 from D.2.2	Usability	Understandability	2	3	3	2	4	3	2	3	3	4	
		Learnability	2	3	3	2	4	3	2	2	2	3	
		Operability	3	3	3	2	3	3	3	2	2	3	
		Attractiveness	3	3	3	2	3	3	3	3	3	2	
Enablers 3 from D.2.2	Functionality	Suitability	1	2	2	1	3	2	2	2	2	3	
		Accuracy	2	2	2	2	2	2	2	2	2	2	
		Interoperability	1	3	3	2	3	2	1	3	3	3	
		Security	2	3	3	3	3	2	2	3	3	3	
		Compliance	1	3	3	2	2	2	2	3	3	3	

## Questionnaire Number 2

Criterion ID	Main Criterion	Criterion	SDI4Apps enablers										Comments and suggestions
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Enablers 5 from D.2.2	Usability	Understandability	1	1	1	3	2	3	3	2	2	3	
		Learnability	1	1	2	3	1	3	3	2	3	4	
		Operability	1	2	3	1	2	4	4	1	1	3	
		Attractiveness	1	4	2	4	1	4	4	2	4	3	
Enablers 3 from D.2.2	Functionality	Suitability	2	2	2	3	1	3	3	2	1	2	
		Accuracy	2	2	1	3	1	3	3	2	1	1	
		Interoperability	1	1	1	2	1	2	2	1	1	2	
		Security	1	3	2	1	1	4	4	1	2	2	
		Compliance	1	2	1	2	1	3	3	2	2	3	

## Questionnaire Number 3

Criterion ID	Main Criterion	Criterion	SDI4Apps enablers										Comments and suggestions
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Enablers 5 from D.2.2	Usability	Understandability	3	2	3	3	2	3	3	2	1	5	
		Learnability	2	3	3	3	2	2	2	2	3	4	
		Operability	3	3	3	4	3	3	2	3	2	4	
		Attractiveness	4	3	3	1	4	2	3	1	1	4	
Enablers 3 from D.2.2	Functionality	Suitability	2	3	3	3	4	2	3	2	2	4	
		Accuracy	4	4	2	3	3	3	2	2	2	4	
		Interoperability	3	3	3	4	3	3	3	3	2	4	
		Security	3	3	3	4	4	4	4	3	3	4	
		Compliance	3	3	3	3	3	3	3	2	2	5	

## Questionnaire Number 4

Criterion ID	Main Criterion	Criterion	SDI4Apps enablers										Comments and suggestions
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Enablers 5 from D.2.2	Usability	Understandability	2	1	2	1	3	3	3	2	2	2	
		Learnability	2	1	2	1	3	3	3	2	3	3	
		Operability	2	1	2	1	1	4	4	1	1	3	
		Attractiveness	2	3	2	1	3	4	4	2	2	3	
Enablers 3 from D.2.2	Functionality	Suitability	3	2	3	1	1	3	3	1	1	3	
		Accuracy	3	2	1	1	1	2	2	1	1	1	
		Interoperability	3	1	1	1	1	2	2	1	1	2	
		Security	3	2	2	1	1	4	4	1	2	2	
		Compliance	3	2	1	1	1	2	2	2	2	3	

## Questionnaire Number 5

Criterion ID	Main Criterion	Criterion	SDI4Apps enablers										Comments and suggestions
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Enablers 5 from D.2.2	Usability	Understandability	4	2	3	4	2	5	5	3	3	4	
		Learnability	4	2	2	4	3	5	5	3	3	4	
		Operability	4	1	3	1	1	5	5	3	3	4	
		Attractiveness	4	4	2	3	3	5	5	3	3	4	
Enablers 3 from D.2.2	Functionality	Suitability	2	2	3	1	1	4	4	2	2	4	
		Accuracy	2	2	3	1	1	4	4	2	1	3	
		Interoperability	2	1	2	1	1	4	4	1	1	3	
		Security	2	2	2	1	1	4	4	1	1	3	
		Compliance	2	1	2	1	1	4	4	1	1	3	

## Questionnaire Number 6

Criterion ID	Main Criterion	Criterion	SDI4Apps enablers										Comments and suggestions
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Enablers 5 from D.2.2	Usability	Understandability	4	2	2	3	3	4	4	2	2	3	
		Learnability	3	3	3	4	3	3	3	2	2	3	
		Operability	2	2	2	2	3	4	4	2	2	3	
		Attractiveness	3	2	2	3	3	3	3	2	2	3	
Enablers 3 from D.2.2	Functionality	Suitability	2	1	1	2	3	3	3	2	2	3	
		Accuracy	2	3	3	2	3	3	3	2	2	3	
		Interoperability	2	2	2	2	3	2	2	2	2	3	
		Security	2	3	3	2	3	2	3	3	3	3	
		Compliance	2	2	2	2	3	3	3	2	2	3	

## Questionnaire Number 7

Criterion ID	Main Criterion	Criterion	SDI4Apps enablers										Comments and suggestions
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Enablers 5 from D.2.2	Usability	Understandability	2			2					3		
		Learnability	2			2					3		
		Operability	2			1					4		
		Attractiveness	1			1					2		
Enablers 3 from D.2.2	Functionality	Suitability				2					1		
		Accuracy				2					2		
		Interoperability				2					1		
		Security				2					2		
		Compliance				2					2		

## Questionnaire Number 8

Criterion ID	Main Criterion	Criterion	SDI4Apps enablers										Comments and suggestions
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Enablers 5 from D.2.2	Usability	Understandability				1						1	
		Learnability				2						1	
		Operability				2						1	
		Attractiveness				2						2	
Enablers 3 from D.2.2	Functionality	Suitability				2					1		
		Accuracy				1					1		
		Interoperability				1					1		
		Security				1					1		
		Compliance				1					1		

## Questionnaire Number 9

Criterion ID	Main Criterion	Criterion	SDI4Apps enablers										Comments and suggestions
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Enablers 5 from D.2.2	Usability	Understandability	3	3	3	3	4	2	3	2	1	5	
		Learnability	3	3	3	3	4	2	3	2	1	5	
		Operability	3	3	3	2	4	2	3	2	1	5	
		Attractiveness	3	3	3	2	4	2	3	2	1	5	
Enablers 3 from D.2.2	Functionality	Suitability	3	3	3	2	4	2	3	2	1	5	
		Accuracy	3	3	3	2	4	2	3	2	1	5	
		Interoperability	3	3	3	5	4	3	4	2	1	5	
		Security	3	3	3	5	4	4	5	3	2	5	
		Compliance	3	3	3	2	4	2	3	2	1	5	