Project no.: 282794

GRID+

SUPPORTING THE DEVELOPMENT OF THE EUROPEAN ELECTRICITY GRIDS INITIATIVE (EEGI)

Instrument: Coordination and support action
Thematic priority: ENERGY.2011.7.3-1 - Network of projects developing the future European electricity Networks
Start date of project: 01 October 2011
Duration: 36 months

D 4.3

DATA COLLECTION OF TSO PROJECTS

Revision: r0

Submission date: 2014-09-30

Comillas

Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential , only for members of the consortium (including the Commission Services)	

Submitted

Author(s)		
Name	**Organisation**	**E-mail**
L. Sigrist	Comillas	Lukas.sigrist@iit.upcomillas.es
K. May	KU Leuven	Kristof.May@esati.kuleuven.be
L. Rouco	Comillas	Luis.rouco@iit.upcomillas.es

Status of deliverable		
Action	**By**	**Date**
Verified		
Approved (GC)		

Abstract

Version history

Date	Version	Author(s)	Comments
2013-10-10	01	L. Sigrist	First issue
2013-10-19	01	K. May	Revision
2014-06-30	01	L. Sigrist	Revision

TABLE OF CONTENTS

Page

LIST OF ABBREVIATIONS

EXECUTIVE SUMMARY

GRID+ aims at ensuring cooperation among Member States in view of clustering national demonstration projects, mapping them to the implementation plan of the EEGI, thus leveraging on potential complementarities and fostering the extraction of the maximum European added value, and ensuring an optimal use of resources.

The objectives of Work Package 4 are to determine the scalability and replicability of smart grid projects of the EEGI, to propose methods and tools for this purpose and to propose solutions for enhancing the scalability and replicability of on-going and new projects.

The purpose of task 4.3 is to identify the data to be collected from TSO projects of the EEGI in view of scalability and replicability and to collect the data subsequently. The data collection itself is carried out by means of a set of questionnaires which are answered by the project demonstrators of the analyzed projects. Project demonstrators are then the target audience. Note that this not only includes projects with physical demonstrators but also projects developing software tools. Whereas salability and replicability factors already describe requirements for scalability and replicability, the answers to the questionnaires show the achievements and barriers.

In a first step, the scalability and replicability factors described in [4] have been revised and the methodology for the data collection of smart grid projects has been summarized. It is worthwhile to mention that the list of factors is not exhaustive and factors might be removed or added according to the demonstrators' answers to the questionnaires. The methodology consists in collecting data of TSO project demonstrators by means of questionnaires in order to assess and evaluate the identified scalability and replicability factors. Both, on-line and an off-line questionnaires have been used for that purpose. Whereas scalability and replicability factors already describe the requirements for scalability and replicability and thus necessary conditions, the answers to the questionnaires will show the achievements and barriers.

Finally and since different questionnaires have been used, the way answers have been received is analyzed. This gives a first insight into what type of questionnaire is more successful. So far, the InfoPath-written and Word-written questionnaire have been mainly used. The on-line questionnaire has been hardly used. In addition, a preliminary analysis of the participation and of the received answers of the questionnaires has been provided. With an average completeness of around 84% it can be stated that the received questionnaires were conclusively answered. The multiple choice questions and the questions regarding the importance of issue tackled by the questionnaire were fully answered by all projects. Questions asking for a description of a particular subject have been left blank sometimes, especially when the asked description is optional.

1 INTRODUCTION

1.1 Project Scope

GRID+ aims at ensuring cooperation among Member States in view of clustering national demonstration projects, mapping them to the implementation plan of the EEGI, thus leveraging on potential complementarities and fostering the extraction of the maximum European added value, and ensuring an optimal use of resources. The GRID+ project is a "Coordination and support action" that provides the necessary support to the EEGI Team (research centres, small and medium enterprises, universities, in close coordination with ENTSO-E and EDSO4SG)[1] during the 2012-2014 period.

1.2 Work Package 4

The objectives of Work Package 4 are to determine the scalability and replicability of smart grid projects of the EEGI, to propose methods and tools for this purpose and to propose solutions for enhancing the scalability and replicability of on-going and new projects.

The EEGI aims at accelerating innovation and development of the electricity networks of the future in Europe. Its RD&D programme focuses on system innovation rather than on technology innovation, and addresses the challenge of integrating new technologies under real life working conditions and validating the results. The functional demonstrators of the EEGI programme therefore aim at verifying at full-scale the functionality, usefulness, validity, interaction, and coordination of the different smart grids technologies and solutions envisaged. Currently, most smart grid projects are still in the R&D or the demonstration phases. The full roll-out of the tested solutions requires a suitable degree of scalability and replicability to avoid that demonstrators remain local experimental exercises.

Scalability can be defined as the ability of a system to change its scale in order to meet growing volumes of demand [1], [2]. A system is understood as a set of interacting elements with similar boundary conditions. By contrast, replicability denotes the property of a system that allows it to be duplicated at another location or time. Scalability and replicability are the preliminary requisite to perform scaling-up and replication successfully.

In order to achieve the objectives, this Work Package 4 aims at providing a practical common tool that can be used in support of actual R&D projects. For that purpose, the following needs to be achieved:

- Identification of factors affecting scalability and replicability
- Data collection from smart grid projects to evaluate the factors
- Evaluation of the factors
- Derivation of rules and barriers for scalability and replicability

Scalability and replicability of smart grid projects is affected by factors which have been identified in task 4.1 by means of a review of the state of the art of complex systems and smart grid projects.

[1] The EEGI team is a team set up under the European Electricity Grid Initiative (EEGI) in order to provide a platform for planning and programming of actions to implement the EEGI.

The results of task 4.1 are summarized in the deliverable D4.1 [4]. These factors are necessary conditions, describing the requirements for scalability and replicability.

Data collected from projects will assess and evaluate the identified scalability and replicability factors. The methodology for the data collection of smart grid projects has been presented in [3]. The data collection itself is the objective of task 4.2 and 4.3 and their corresponding deliverables D4.2 and D4.3. Task 4.2 is dedicated to DSO project demonstrators, whereas task 4.3 is dedicated to TSO project demonstrators. Task 4.4 is dedicated to the evaluation of the data collection and the identification of barriers and rules.

1.3 Data collection on scalability and replicability of TSO project demonstrators

The purpose of task 4.3 is to identify the data to be collected from TSO projects of the EEGI in view of scalability and replicability and to collect the data subsequently. TSO project demonstrators are the target audience. Note that this not only includes projects with demonstration but also projects developing software tools.

A first requirement of this task is to define the data to be obtained from the different project demonstrators (or coordinators). The methodology for the data collection of smart grid projects has been presented in D4.1b – Methodology for the data collection of smart grid projects [3]. The data collection itself is carried out by means of a set of questionnaires which are answered by the project demonstrators of the analyzed projects.

The data to be collected and in particular the questionnaires depend on the scalability and replicability factors identified within task 4.1[2] [4]. Scalability and replicability factors already describe requirements for scalability and replicability. The answers to the questionnaires show the achievements and barriers. Actually, questions are closely linked to the factors.

Task 4.3 focuses on collecting data on the scalability and replicability of TSO project demonstrators of the EEGI. For this study, candidates for TSO project demonstrators are the TWENTIES and the EcoGrid.EU demonstrators or the OPTIMATE project. Other national and European project demonstrators are included as far as possible.

First, scalability and replicability factors are revised and the methodology is summarized. The data collection of TSO project demonstrators is based on questionnaires. Both, on-line and an off-line questionnaires are used for that purpose. The complete questionnaire can be found in the appendix.

Finally, some statistics on the answering of the questionnaires are given. In particular, the number of participants, the number of questions fully answered and the number of questions not answered are analyzed. This provides an overview of the impact of the questionnaire and its easiness to fill it out.

The overall structure of task 4.3 is presented in the Figure 1 .

[2] The questionnaires only assess the identified scalability and replicability factors. However, no given set of KPIs is evaluated. Actually, there are no specific KPIs so far that measure a project demonstrator's scalability and replicability.

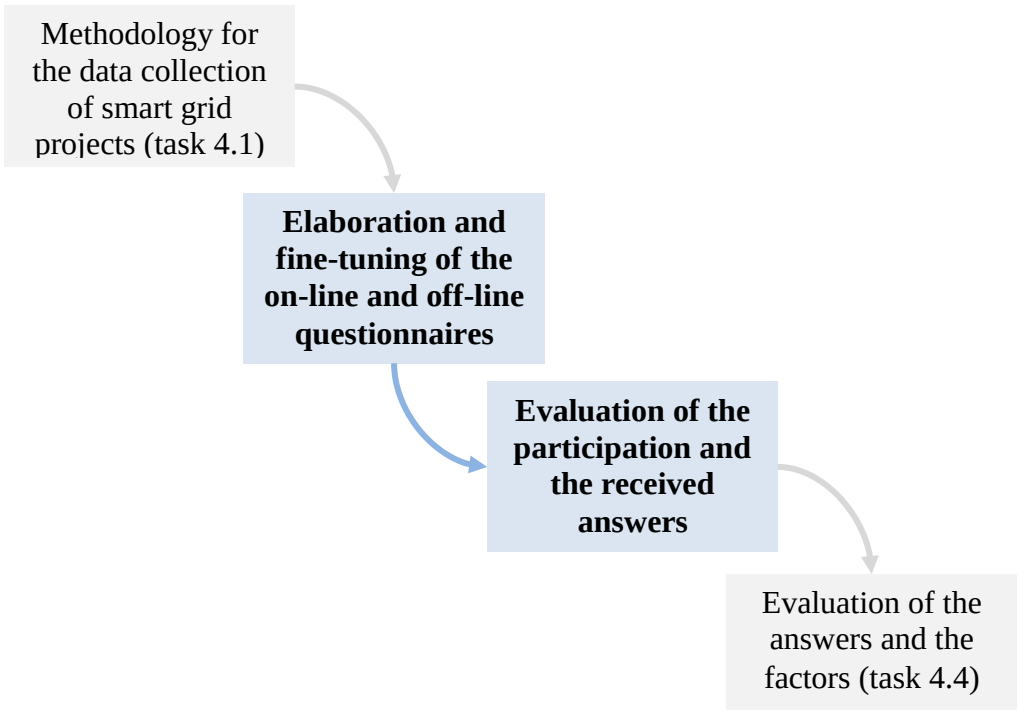

Figure 1: Overall structure of data collection

2 DESCRIPTION AND DEFINTION OF SCALABILITY AND REPLICABILITY FACTORS

This chapter describes and clearly defines scalability and replicability factors. Clear definitions allow deriving questions that are unambiguous and straightforward to answer and congruently, the questions and its associated scalability or replicability factors are easily evaluated.

Firstly, the scalability and replicability factors, which have been identified in task 4.1, are reviewed. From this initial set of factors, an extended set is elaborated. In a second step, clear definitions of both scalability and replicability factors are given. Examples are also provided.

2.1 Scalability and replicability factors

Both, prototypes of highly complex systems and European and national distribution smart grid projects have been reviewed in terms of scalability and replicability. The basic idea behind this review was to find a list of factors, playing a role in assessing scalability and replicability of a system. The main factors for scalability identified by this review of complex systems and smart grid projects were [4]:

- Evolution of technology (adopted solution)
- Modularity (easy adding of new functionalities, etc.)
- Interface design (control strategies, etc.)

The main factors for replicability were [4]:

- Technological standardization (e.g., the use of developed and available solutions)
- Interoperability (e.g., the compliance with universal standards)
- Plug & play characteristics
- Availability (presence of resources, customer involvement, etc.)
- Regulatory conditions

Additional economic and technical aspects such as costs, losses, etc. also appear to be important for the actual scaling-up and replication of a solution. However, these aspects primarily show whether and to what extent it is worthwhile or not to scale or replicate. For example, economic aspects determine if a project is economically interesting for different stakeholders at different times and in different places.

Starting from this initial set of scalability and replicability factor, an extended set of factors has been deduced on the basis of work done by ENTSO-E and the experience gained through the analysis of distribution-related demonstrator projects. **Errore. L'origine riferimento non è stata trovata.** and **Errore. L'origine riferimento non è stata trovata.** show the extended set of scalability and replicability factors. Note that some of the economic and technical aspects identified in task 4.1 have been included [4]. This became necessary since for example costs are essential for scaling-up and replication. For instance, a scalable project might be scaled-up by using some kind of subsidies and instigates this way an increase of the production of some of the projects components, reducing the component's price and enabling the further scaling-up. Further it shall be mentioned that this list is not exhaustive and factors might be removed or added according to the demonstrators' answers to the questionnaires.

Table 1: Extended list of scalability factors with their corresponding areas and subareas.

Areas	Subareas	Factors
Technical	Technology	Modularity
		Technology evolution
	Communication, control systems and interface	Interface design (interconnection with other systems)
		Software tools integration
	Infrastructure	Compatibility analysis
Economic	Economies of scale	Economies of scale
	Cost effectiveness	Profitability
Acceptance/involvement	Regulatory issues	Regulatory issues
	Consent by grid users, customers, local authorities and public	Consent

Table 2: Extended list of replicability factors with their corresponding areas and subareas.

Areas	Subareas	Factors
Technical	Technology	Standardization
		Interoperability
	Control systems and interface (both software and technology)	Standardization
		Interoperability
	Infrastructure	Network configuration (former: availability)
Economic	Profitability analysis	Macro-economic factors
	market design analysis (sensitivity analysis)	Market design
	Business model	Business model
Acceptance/involvement	Regulation	Regulation
	Acceptance	Acceptance

Within this extended set, three main areas of scalability and replicability factors have been identified. The first area includes the technical factors. They determine whether the solution developed in a particular project is inherently scalable and/or replicable. Paying attention to these

factors will not automatically guarantee the scalability/replicability, but a failure to do so will rule out any chances to it. They are therefore necessary but not sufficient conditions.

The second area, the economic factors, reflect whether it is economically viable to pursue scaling up or replication. This crucial step – validating whether investment analysis (NPV, IRR or similar) and business models hold at a larger scale or in a different setting than the original case – is often neglected and constitutes a major barrier in gaining a critical mass.

The third and final area contains the factors related to acceptance and involvement of users, regulators, authorities and stakeholders. They reflect the extent to which the new environment is suitable for receiving the project.

2.2 Summary of the methodology for the data collection

The methodology consists in collecting data of TSO project demonstrators to assess and evaluate the identified scalability and replicability factors. The evaluation of the factors allows then quantifying the status quo of on-going and new projects with respect to the scalability and replicability, i.e., they provide a feedback on to what extent projects take into account these factors and on whether the projects' results and solutions are actually able to be scaled-up and replicated.

The data collection is carried out by means of questionnaires. Both, on-line and an off-line questionnaires are used for that purpose. Predefined answers have been formulated for nearly all questions (see appendix). The questions are closely linked to the scalability and replicability factors. Whereas scalability and replicability factors already describe the requirements for scalability and replicability, the answers to the questionnaires show the achievements and barriers. The evaluation of a question translates its answer into a numerical value.

The methodology is summarized in Figure 2. For example, if a particular project is inherently scalable due to its technical design but benefits grow slower than costs do when increasing its size, the project is deemed to be potentially not scalable or it is only partially scalable. Similarly, if a particular project of country X is inherently replicable and its business model focus on loss reduction but country Y doesn’t incentive loss reduction, the project might be potentially not replicable in country Y. However, if the business model of the project can be adapted for example by envisaging the participation in reserve markets and this participation is allowed by the regulation of country Y, the project might be potentially replicable.

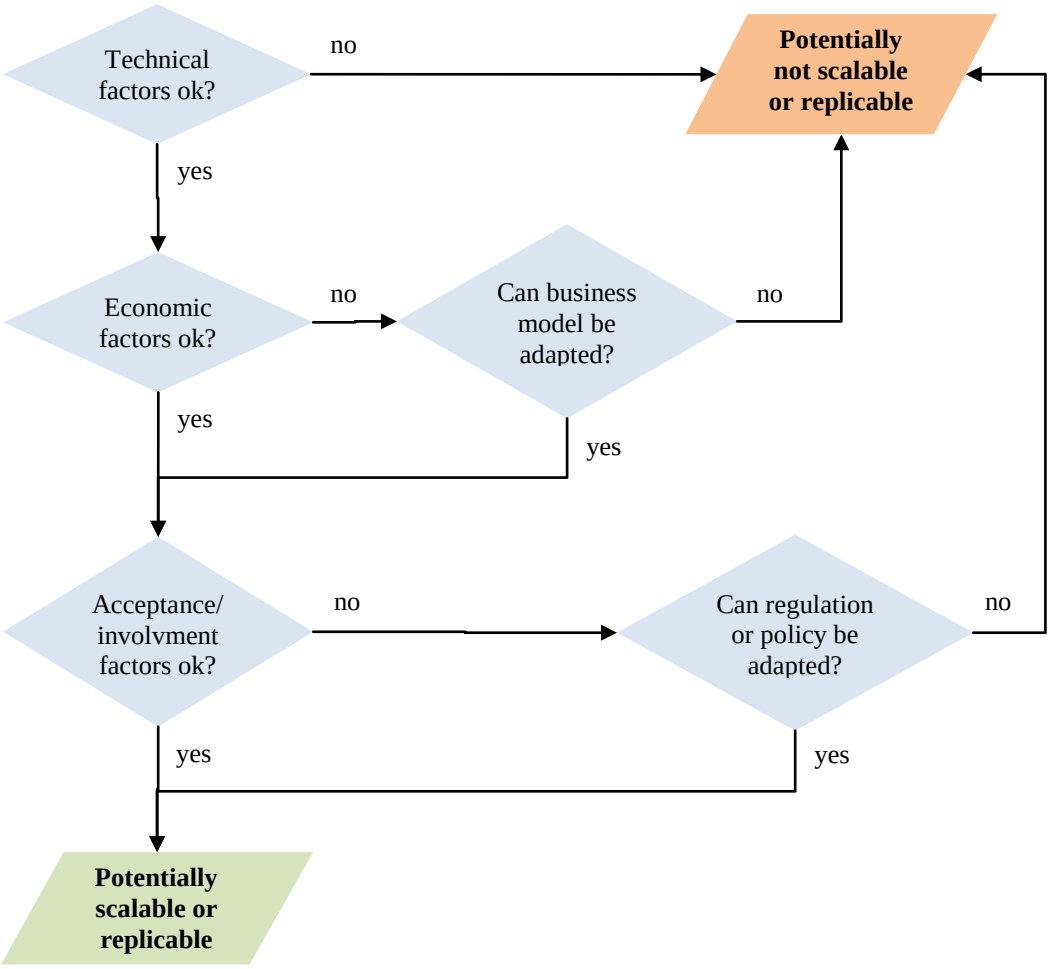

Figure 2: The overall methodology

In addition to the factor-related questions, additional questions on the project, its nature and on the importance of a specific question have been included. The latter provides a feedback on which questions and congruently, which factors the participant deems important.

3 PRELIMINARY ANALYSIS OF ANSWERS

Data collection has been carried out by means of on-line and off-line questionnaires. A questionnaire for physical demonstrators as well as a questionnaire for software-related projects have been used. This chapter deals with the preliminary analysis of the participation and the received answers of the questionnaires. The idea is not to analyze the answers in detail, but to give an overview to what degree the questionnaires have been answered.

First and since different questionnaires have been used, the way answers have been received is analyzed. This gives a first insight into what type of questionnaire is more successful. In a second step, a preliminary analysis of the participation and the received answers of the questionnaires is provided, highlighting questions which are difficult to answer and congruently to evaluate, etc.

3.1 Type of questionnaires

The data collection of TSO project demonstrators is based on questionnaires. Three types of questionnaires have been initially elaborated and used for physical demonstrators: two off-line questionnaires and one on-line. Similarly, three types of questionnaires have been developed for software-related projects. The off-line questionnaires have been written in Word and InfoPath. The latter uses Microsoft SharePoint for sharing its answers. In case of software tool projects, only a Word-written questionnaire exists[3]. All three types of questionnaire are available to the participants. The advantage of this three-fold way of collecting data is that

- the on-line questionnaire improves the visibility of the problem and that, in theory, a larger target group of participants is available
- the off-line questionnaire are sent out and re-collected by email, allowing for a closer contact with the participant
- the off-line questionnaire can be partially filled in and forwarded, i.e., the answers can be saved.
- the off-line questionnaire can be filled in by various members of the same project demonstrator.

The answers of all three types of questionnaires can be exported to an Excel file. This greatly simplifies the analysis of the questionnaires.

At present, mainly Word-written and InfoPath-written questionnaires have been received. From the received questionnaires, the following conclusions can be drawn:

- Web-based questionnaire:
  - This type of questionnaire has not been used so far.
  - The main drawback of this questionnaire is that answers cannot be saved and the questionnaire needs to be filled in at once.

- InfoPath-based questionnaire
  - This type of questionnaire has been sporadically used.

[3] The reason is that Word-written questionnaires have been more successful and that the data collection of software tool projects started after the data collection of physcial demonstrators.

- The advantage is that this questionnaire can be partially filled in and forwarded by email.
- It can be filled in without opening a program (e.g., Word).

- Word-based questionnaire
  - This type of questionnaire has been mostly used.
  - The advantage is that this questionnaire can be partially filled in and forwarded by email.
  - It is written in a well-known format.
  - This type has been available from the very beginning, which explaining to a certain extent is major use.

Table 3 shows an overview of the use and the type of used and answered questionnaire.

Type of questionnaire	Number of use
Web-based questionnaire	0
InfoPath-based questionnaire	2
Word-based questionnaire	2

Table 3: Overview of the type of questionnaire answered by TSO project demonstrators.

As a concluding remark, it can be said that the ability to save answers and share the questionnaire among members of a project demonstrator seems to be of high importance.

3.2 Statistics of answered questionnaire

Although the data collection is still on-going, some preliminary statistics can be extracted from the answered questionnaires.

3.2.1 Completeness of the answered questionnaire

With an average completeness of 84% it can be stated that the answered questionnaires were conclusively answered. The multiple choice questions and the question regarding the importance of issue tackled by the questionnaire were fully answered by all projects. Questions for a description of a particular subject were less completed, as especially when the asked description is optional, although at a very low level. Neglecting questions asking for a further description, the questionnaires were fully answered.

Errore. L'origine riferimento non è stata trovata. provides a general statistic of the total number of unanswered questions. The statistics are given in function of the type of the question (technical, economical, and regulatory). Most unanswered questions are to be found within the group of the technical questions. This group contains the bulk of the questions (55,7 %). In relative terms, most unanswered questions belong to the group of economic questions (19%). Compared with the DSO questionnaire (see [5]), the number of uncompleted answers within the group of regulatory questions is much smaller.

Table 4: General statistics of the total number of unanswered questions by type.

Type of question	Total number of questions asked	Number of completed answers	% completed answers
Introductory questions	16	14	
Technical questions	176	147	
Economical questions	64	51	
Regulations questions	60	53	
TOTAL	316	265	

Figure 3 graphically shows the answered and unanswered questions by participant.

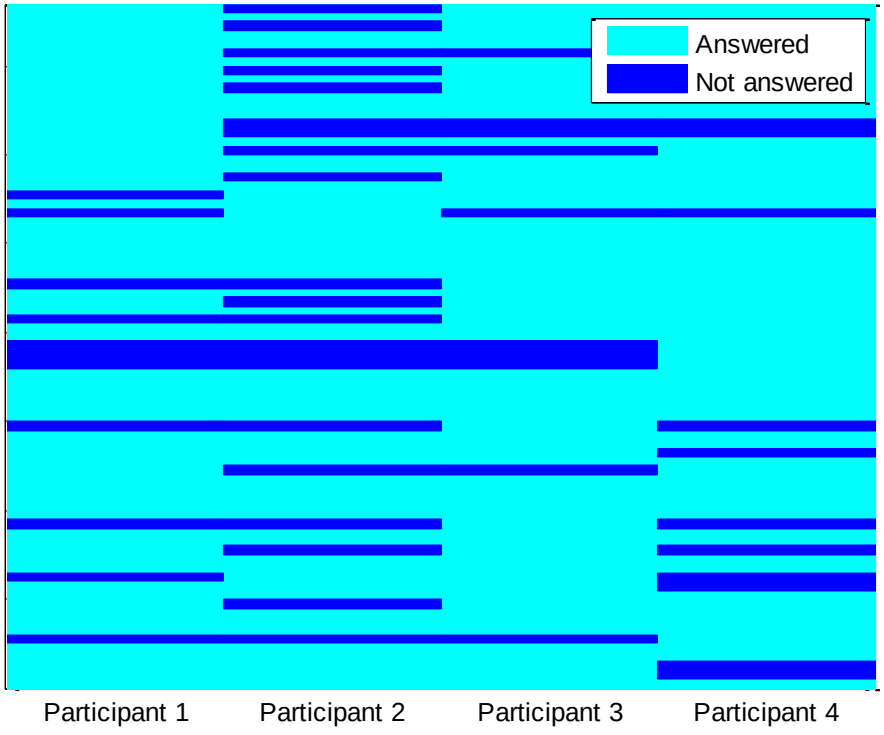

Figure 3: Representation of answered and unanswered questions by participant.

It can be readily seen that most questions were answered by all participants. Sometimes, a particular question was not answered by more than one participant. The questions, which were not answered by all or at least 75% of the participants, are:

- "*Do you foresee technological advances in the short to medium term that will make adding components easier (technologically)? If yes, which ones and why?*" and "*Is the functioning of the solution influenced by the specific infrastructure of the location of your demo? If yes, by which aspects?*", and in particular, the optional, additional descriptions of their answers,
- "*Is the solution standards compliant? If yes, with which standards (mandatory, voluntary, open or proprietary)? Could you mention the benefits and/or challenges you expect for being your system/solution compliant with the contemplated*

standards?" and in particular, the optional, additional description of the standards, benefits, and challenges,

- "*Are there barriers arising from the dependency on those elements of current regulation for the feasible deployment of your solution in other environments?*" and in particular, the optional, additional description of possible barriers.

3.2.2 Importance of treated topics seen by projects

The questionnaire also tries to determine whether projects consider the factors described in section 2.1 as important for their project. The intention behind this is to verify which scalability and replicability factors are seen by the project as important today and which are neglected. This way, a feedback is provided on the importance of the factors.

The majority of the factors approached during the survey are considered as important by the project themselves. On the average, 46% of the factors are important and 23% of the factors have been equally evaluated as important and unimportant. 69 % of the factors questioned by the questionnaire are seen as important by about 60% of the projects.

Finally, no questions asked are seen as unimportant by all the TSO projects.

REFERENCES

[1] Yaneer Bar-Yam, "Concepts: Scale", New England Complex System Institute, 2011. Available at http://necsi.edu/guide/concepts/scale.html.

[2] Bonnefoy, Philippe; Hansman, R. John, "Scalability of the Air Transportation System and Development of Multi-Airport Systems: A Worldwide Perspective", MIT, Report No. ICAT-2008-02, 2008.

[3] GRID+, D4.1b – Methodology for the data collection of smart grid projects, October 2013.

[4] GRID+, D4.1 – Review of the state of the art, January 2013.

[5] GRID+, D4.2 – Data collection of DSO projects, October 2013.

APPENDIX

The questionnaire for physical demonstrators of TSO projects can be found in [5].

Since several TSO projects are dedicated to the development of software tools, a specific questionnaire has been elaborated, too. This appendix contains the questionnaire for software-related TSO projects.

Questionnaire on Scalability and Replicability for projects dealing with software tools

Welcome to the GRID+ project

The overarching goal of the GRID+ project is to implement and support the management, planning and networking process of the European Electricity Grid Initiative (EEGI) over the years 2012-2014. The aim is to align the activities of demonstration projects within and beyond the European borders with the objectives of the EEGI roadmap. This will enhance the delivery by the European network operators of the new knowledge needed to deploy Smart Grid solutions in the most effective way possible in EU27. This questionnaire on Scalability and Replicability is a part of the WP4 of the GRID+ project.

What is the purpose of this questionnaire?

This questionnaire investigates the scalability and replicability of smart grid projects dealing with software tools, i.e. how can the developed software tool or program be deployed on a larger scale, and how can it be transferred to other countries? It takes +/-45min to answer.

The final goal is to create, for the very first time, a guideline for new projects to come concerning what is needed to be taken into account to be scalable and/or replicable. For more information, see: http://www.gridplus.eu/.

Who should fill it in?

The target group of this questionnaire are EEGI projects, both European and national ones.

Project leaders are encouraged to answer this questionnaire. However, additional input (on interoperability, technology evolutions, etc.) might be provided by or in collaboration with the remaining project demonstrator's partners (ICT providers, etc.).

Confidentiality issues

A major objective of GRID+ is to study and identify rules for and gaps of scalability and replicability of smart grid projects. The general results of the analysis of the received questionnaires will be publicly available. Achievements and barriers with respect to scalability and replicability will be highlighted.

Results and answers specific to your project will be anonymized for that purpose. The answers to the questionnaire will be public within GRID+, i.e. accessible by all GRID+ project partners, but the answers will not be publicly available outside GRID+ and the results will be anonymized.

Why is filling out this questionnaire important for your project?

Multiple smart grid projects test technology and functionalities on a small scale and the full roll-out of their solutions and functionalities depends on the projects' scalability and replicability. In this

case, scalability and replicability allow further use and developments (industrialisation) so that the software does not remain research tools.

Filling in the questionnaire provides the following feedback:

- A specific analysis of the questionnaire can be provided to each participant if desired, highlighting strong and weak aspects of the project with regard to scalability and replicability. This particular analysis is confidential (not publicly available).
- Each participant might receive (if desired) contact information from projects that successfully addressed an aspect determined as weak in the participant's project. This allows to learn from experiences with other projects.
- Filling-in the questionnaire repeatedly over a certain time horizon provides your consortium with useful information about the evolution of its project's scalability and replicability.
- The questionnaire and its results might be of interest for projects envisaging a continuation of their activities.

Contact info:

Lukas Sigrist
lukas.sigrist@iit.upcomillas.es

Questionnaire manual and definitions

The questionnaire is structured into four main categories: introductory questions, technical questionnaire, economical questionnaire and regulatory questionnaire. Most questions propose predefined answers to the questions, which could be enriched with additional information. This allows participants to respond quickly and in detail if they want. For some questions however, it will be mandatory to provide the additional information.

Definitions:

- **Scalability** can be defined as the ability of a system to change its scale in order to meet growing volumes of demand (e.g. increasing the number of elements interacting in the system).
- A system is understood as a set of interacting elements with similar boundary conditions.
- By contrast, **replicability** denotes the property of a system that allows it to be duplicated at another location or time (e.g. duplicating a system somewhere else).

1 - Introductory questions

1.1 Name of the project:

Your answer

1.2 Contact information and your function within the project:

Your answer

1.3 Could you shortly describe the developed software tool?

(Which objectives does the tool aim at and which solution(s) to achieve them will the project team develop?)

Your answer

1.4 Do you have plans to investigate the scalability and replicability of your software tool? If yes, describe them briefly. If not, why not?

☐	Yes
☐	No, not considered yet
☐	No

If yes, describe the plans briefly. If no, why not?:

Your answer

2 - Technical questionnaire on Scalability and replicability

2.1 Can you easily (technically) add functionalities to your tool? If yes, which ones and how? If no, why not?

E.g. can you integrate new modules to the existing software; are there standard I/O functions and format which allow interfacing with other software?

.

☐	Yes, with major change
☐	Yes, with certain change
☐	Yes, with minor change
☐	No, not considered yet

Describe which ones and how or why not (optional):

Your answer

Do you consider this important for your project?

☐	Yes
☐	No

2.2 Are there limits, affecting the proper functioning or calculation time of the tool, on adding extra functions? If yes, explain what the constraint will be.

E.g.: changing the character of the optimization from a linear problem to a mixed integer problem; adding more detailed models of the elements of the Smart Grid.

☐	Yes, major limits
☐	Yes, certain limits
☐	Yes, minor limits
☐	No

Describe that constraints and why they arise (optional):

Your answer

2.3 Does the current computer architecture, where the tool is running, have any limits on the maximum size of the system that can be modelled (memory size, CPU time, data storage)? If yes, what are these limits and can they be easily overcome?

E.g.: A powerful computer is needed to keep computation times manageable.

☐	Yes, major limits
☐	Yes, certain limits
☐	Yes, minor limits
☐	No

Describe the limits and how they can be overcome (optional):

Your answer

Do you consider this important for your project?

☐	Yes
☐	No

2.5 Do you foresee technological and technical advances (input data, solvers, etc.) in the short to medium term that will make the application of your tool easier? If yes, which ones and why?

E.g.: the program requires a specific piece of hardware, such as a new type of smart meter, making available the required or new kinds of data; a new type of solver, reducing computation time, could become available.

This question does not address the computational power of your computer.

☐	Yes
☐	No

Describe which ones and why (optional):

Your answer (optional)

Do you consider this important for your project?

☐	Yes
☐	No

2.6 Do you foresee technological advances in the short to medium term that will mitigate a possible performance reduction?

E.g.: Improved CPUs or using unused resources such as GPU

☐	Yes
☐	No
☐	Not of importance

If yes, describe these advances (optional):

Your answer (optional)

2.7 Does the current structure of your tool and the nature of the numerical solvers depend on specific elements and assumptions of the system that you are modelling?

E.g.: DC power flow omits line resistance and admittances; unit commitment does not necessarily provide the same result as running a market model.

☐	Yes, major dependence

☐	Yes, certain dependence
☐	Yes, minor dependence
☐	No

Describe the resource (optional):

Your answer (optional)

Do you consider this important for your project?

☐	Yes
☐	No

2.8 Is the tool system-specific? Is the functioning of the tool influenced by the specific infrastructure of the system your project is modelling? If yes, by which aspects?

E.g. different input data, such as grid topologies or system elements; some tools cannot model all elements such as FACTS, ICT models, etc.

☐	Yes, major influence
☐	Yes, certain influence
☐	Yes, minor influence
☐	No

Describe this infrastructure (optional):

Your answer (optional)

Do you consider this important for your project?

☐	Yes
☐	No

2.9 Programming language: free, open source? If not, for what specific reasons did you select a licensed tool?

E.g.: Modelica allows to model different time scales at the same time. Its licensed solvers are currently more powerful than the free alternatives.

☐	Yes
☐	No

Describe the reasons (optional):

Your answer (optional)

2.10 Does the choice of the programming language influence the ease with which you can adapt or develop your tool?

E.g.: part of the software code might not be accessible

☐	Yes, major influence
☐	Yes, certain influence
☐	Yes, minor influence
☐	No

2.11 Portability: are there any limitations?

E.g.: Dependence on operation systems (Windows, Unix, Apple, …).

☐	Yes, major limitations
☐	Yes, certain limitations
☐	Yes, minor limitations
☐	No

Describe why and how (optional):

Your answer (optional)

Do you consider this important for your project?

☐	Yes
☐	No

2.13 Is there anyutility/grid operator using your tool at the moment? If not, why ? If yes, why and how is it applied?

E.g.: No, the tool is an innovative solution and we are not aware of an application elsewhere; Yes, the tool is applied to …

☐	Yes
☐	No
☐	Not yet considered

Describe why and how (optional):

Your answer (optional)

3 - Economic questionnaire on scalability and replicability

3.1 Does the application of your tool create benefits? If yes, what is the main reason for the benefits (summarize briefly)? If no, why not?

E.g. operational improvement: more efficient operation of a grid. Planning improvement: evaluating the influence of policy measures, certain generation portfolios, etc.

Your answer

3.2 Do you foresee evolutions in the short to medium term which will have a positive influence on the benefits of applying your tool?

E.g. the application of a Smart Grid control algorithm could be more profitable once regulation is put in place to allow remuneration of certain new types of demand response.

☐	Yes, evolutions with major influence
☐	Yes, evolutions with certain influence
☐	Yes, evolutions with minor influence
☐	No

If yes, describe the evolutions (optional):

Your answer (optional)

3.3 If the size of your tool, or of the system where it is applied to, increases, how does the cost of your tool increase (economies of scale)?

E.g. By contracting more reserve, the profits of a demand response aggregator increase because of the more optimal use of the tool; marginal tool costs go down if the number of licenses increases, etc.

Your answer

Have you considered this for your project?

☐	Yes
☐	No
☐	Not yet considered

Describe why or why not (optional):

Your answer (optional)

3.4a Can your tool handle different macro-economic factors?

E.g.: the discount rate which defines the initial investment is a function of the inflation and the interest rate. These factors can differ between countries, leading to different initial investment costs. Another possible factor might be carbon cost.

☐	Yes (go to 3.4b)
☐	No/not applicable

Describe the factors (optional):

Your answer (optional)

3.4b Can your tool be applied to other regions and is the application of the tool still profitable considering the different macro-economic factors?

☐	Yes, with major effort
☐	Yes, with certain effort
☐	Yes, with minor effort
☐	No

Describe (optional):

Your answer (optional)

Do you consider this important for your project?

☐	Yes
☐	No

3.5a Does the application of you tool still create benefits under different settings of market designs (e.g., other EU member state)? Do you already have plans for applying your tool elsewhere?

E.g.: It is highly likely that the original project's business model will not hold – at least not without modification – in a new setting. For example, demand response might be limited by regulations at the moment (e.g. because of security of supply concerns).

☐	Yes, it does and concrete plans exist to export the solution abroad (go to 3.5b)
☐	Yes, it does. However NO concrete plans exist to export the solution abroad (go to 3.5b)
☐	No, it does not.
☐	Not analysed yet.

If no, please describe why not (optional)?

Your answer (optional)

Do you consider this important for your project?

☐	Yes
☐	No

3.5b If so, which barriers (economically and regulatory) did you detect?

Regulatory barriers	Economic barriers
Your answer	Your answer

4 - Regulatory questionnaire on scalability and replicability

4.1 Are there any barriers with respect to availability and accessibility of the data necessary for the tool?

E.g. Data not collected (on large scale) or not accessible due to privacy issues

☐	Yes, major barriers
☐	Yes, certain barriers
☐	Yes, minor barriers
☐	No

Describe which ones and how they affect the project's solution (mandatory):

Your answer

Do you consider this important for your project?

☐	Yes
☐	No

4.2 Is stakeholder and user acceptance important for your tool? If yes, explain.

E.g.: Acceptance of counter-intuitive results and models might result in new operational habits; is there a Graphical User Interface available? If users want to adapt or expand part of the code can they easily find where the necessary modifications have to be made?

☐	Yes, of major importance
☐	Yes, of certain importance
☐	Yes, of minor importance
☐	No

If yes, explain why (optional):

Your answer (optional)

4.3 Do you foresee any challenges with respect to the stakeholder acceptance? If yes, which ones and how could they be overcome?

E.g.: Transparency of the tool or results from the model increases its acceptance in general; the conclusion should be traceable

☐	Yes, major challenges
☐	Yes, certain challenges
☐	Yes, minor challenges
☐	No

Describe which ones and how they could be overcome (mandatory):

Your answer

4.4a Does your tool depend on (or implement) elements of current national or regional regulation, which are necessary for your system where the tool is applied to, to create benefits? If yes, which ones (describe these elements briefly)?

E.g.: privacy issues of data; in some European countries, it is not clear whether energy storage systems provide grid services or utility services with the corresponding impact on the ownership of such systems; Regulatory consistency may guarantee return on the investment; Tariff structure and remuneration schemes; Market players

☐	Yes (go to 4.4b)
☐	No

Describe which ones or why not (mandatory):

Your answer

Do you consider this important for your project?

☐	Yes
☐	No

4.4b Are there barriers arising from the dependency on those elements of current regulation for the feasible deployment of your tool in other environments?

☐	Yes, major barriers
☐	Yes, certain barriers
☐	Yes, minor barriers
☐	No

Describe the barriers (mandatory):

Your answer

4.5 Do you foresee acceptance problems when exporting your tool to other countries?

E.g. In which language is the manual and the documentation in the code available?

☐	Yes, major problems
☐	Yes, certain problems
☐	Yes, minor problems
☐	No

Describe the acceptance problems (optional):

Your answer (optional)

Do you consider this important for your project?

☐	Yes

☐	No

Thank you very much for completing this questionnaire!
Please send the completed version to lukas.sigrist@iit.upcomillas.es.