European Commission

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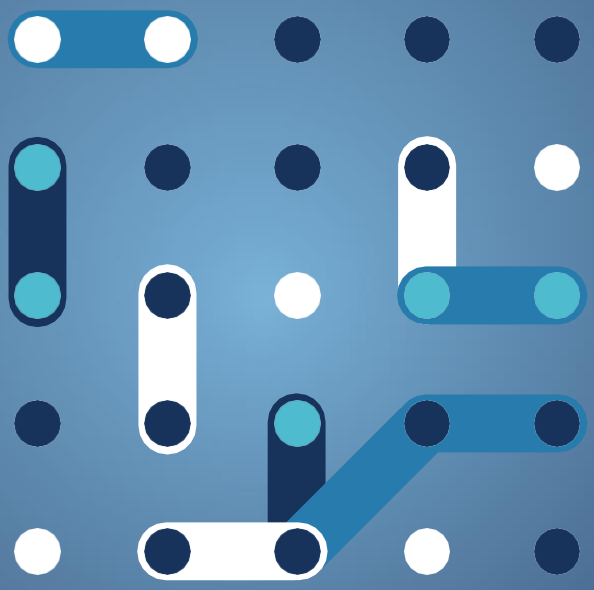
2020 Annual Report

Replicability and Scalability Task Force



Replicability and Scalability TF 2020 annual report

April 2021

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Editors

- Venizelos EFTHYMIOU, *University of Cyprus*
- Lola ALACREU GARCIA, *ETRA investigación y desarrollo; S.A.*
- Martin BRACKEN, *CLERENS, BRIDGE Secretariat*

Support from BRIDGE secretariat

- Martin BRACKEN, *CLERENS, BRIDGE Secretariat*
- Shenja Ruthenberg, *CLERENS, BRIDGE Secretariat*
- Valentina FERRARA, *CLERENS, BRIDGE Secretariat*
- Marcos Jareño, *ZABALA, BRIDGE Secretariat Coordinator*

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INDEX

Executive Summary **6**

Introduction **8**

1. Drafting of a questionnaire to test the approved guidelines **9**

1.1 The first version of the questionnaire 9

1.2 The second version of the questionnaire 15

2. Evaluation of the Outcome of the Questionnaire and Corrective outcomes **20**

2.1 Background 20

2.2 Collection of Project's Information 20

2.3 Breaking down the SRA Process 20

3. The Revised Methodology **22**

3.1 Subroutine 1: Mapping of project objectives into the SGAM architecture 24

3.1.1 Application of subroutine 1 to the GOFLEX project 25

3.2 Subroutine 2: KER Identification 34

3.3 Subroutine 3: Quantifiable KPI Identification 36

3.4 Subroutine 4: Results analysis, identification of limitation factors and alternative solutions 37

3.5 Next Steps 38

3.6 Methodology: Best practice approach (use case collection – link with Data Management WG) 38

3.6.1 Building the methodology repository: Best practice approach 38

3.6.2 Cooperation with WG Data Management of BRIDGE 38

4. Conclusions **42**

Appendix – Figures **43**

Appendix - Tables **44**

Executive Summary

This report is a compilation of the activities and results of the Replicability & Scalability Taskforce (TF RS) of BRIDGE. The work of the TF within 2020 took off through a virtual web call on the **22nd of April 2020.** During that virtual meeting a proposal was put forward for the new plan for the coming period aiming to complete the guidelines and generate through this work a useful repository with guiding best practices for project consortia to use in their endeavours to build a scalability and replicability prospective of their projects.

Since the General Assembly of BRIDGE in February 2020, whose outcome has been circulated to all for information and records by INTENSYS4EU (since September 2020 SPRING), discussions were ongoing for possibilities for further work, and this is as indicated below:

- In preparing the planned timeline careful consideration was given to the conclusions and the next steps for the TF RS that were amended during the last BRIDGE General Assembly.
- Following that, it was identified that the way forward was for the TF RS to work on the definition/specification of a common repository with useful information for helping projects in implementing the guidelines.
- Moreover, since, synergies have been identified with ETIP SNET WG5, the work of the TF was presented to the ETIP SNET WG5 together with the outcomes of the TF.

Following the general assembly of 2020, the first questionnaire was structured to reflect as a minimum the following and was circulated to selected projects for feedback:

- Key Exploitable Results (KERs) with relevant KPIs details,
- Tools from existing projects,
- Best practices and lessons learned from SRAs.

The methodology for building a Scalability and Replicability Analysis (SRA) was principally built to be dependent on the Smart Grid Architecture Model (SGAM) framework:

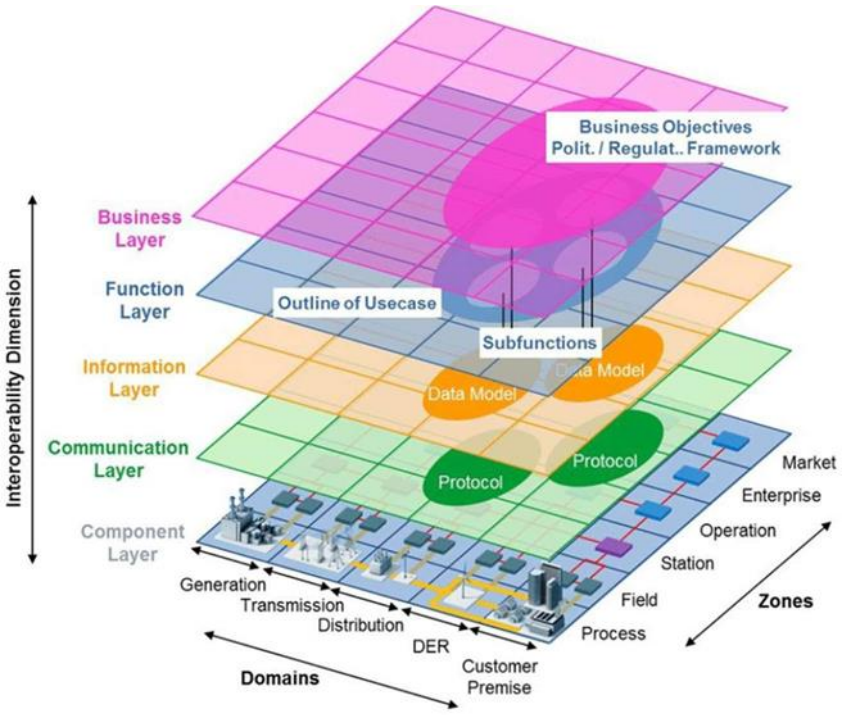


Figure 1: Smart Grid Architecture Model (SGAM)

Following detailed discussions on the feedback from members of the TF on the first questionnaire that was circulated, an attempt was made to address all problematic issues in order to streamline the procedure and

the understanding of the various options. The end result of this exercise is given below with details of the changes that were implemented in response to the issue raised.

- Identification of main objectives (related to R&I areas or declared goals) of projects
- Build SGAM path of identified objectives for reaching Key Exploitable Results
- Define Key Exploitable Results
- Conduct selected and targeted interviews with identified stakeholders to test the need of KERs; refine them where necessary
- Generate relevant KPIs details for trucking KERs
- Tools from existing projects,
- Best practices and lessons learned from SRAs.

The modified questionnaire was circulated to the members of the TF and responses were collected. However, due to encountered difficulties in the implementation of the guidelines that raised negative reaction from the members of the task force we have taken the decision to address all raised issues and look for possible improvements to achieve the initial targeted objectives.

Based on the findings, the following corrective actions were proposed and taken on board by the TF to implement and improve the guidelines:

- Update/Rebuild the questionnaire and target only the quantitative aspect
- Include a section on project's key objectives in order to involve early-stage projects.

Examples are needed and the process should be broken down to help projects in building the SGAM path. A four-step approach was proposed.

The main objective of this exercise is to develop a methodology based on the SGAM architecture capable of being universal in approach covering all the spectrum of projects based on the findings of the first phase of guidelines development. A paradigm change in the revised approach is the adaption of a full process capable of delivering quantified indexes of replicability and scalability of each projects' key exploitable results that can serve as:

- Feedback for the projects themselves to better monitor their innovations and advancements in their scientific endeavours.
- Input to the process conducted in the BRIDGE task force of new R&I Priorities at the project evaluation level, contributing to the quantification of maturity of related technologies and through that the R&I Priorities in support of the energy transition.
- A data base for use case plotting in the SGAM architecture based on the objectives of projects that would form the basis for replication and/or advancement in covering the needs of new projects in the respective field.

For this reason, 4 subroutines and 5 steps have been identified with clear step by step description helping projects to map themselves depending on their maturity (i.e. early stage / on-going / ending project). The experts have been separated into groups to support the development of each subroutine separately. Development work concluded till today is the following:

- Each subroutine has a task leader that is responsible to coordinate the work to deliver the final description of the routine
- Each subroutine is supported by the selected experts coming from projects working as a team to deliver the detailed description of the subroutine taking as input the work output of the previous subroutine and passing on its output to the following subroutine. Regular meetings of the members of the TF are convened working collectively on the set-out objectives.
- The TF chairs assure the continuity and the complementarity of the subroutines to support the overall objective.
- The developed work of the TF of each subroutine is validated using real data from the contributing projects. Based on the results achieved further refinement of the process is pursued.

Introduction

The objective of the TF was to build a complete repository that will facilitate the work of project consortia in implementing effectively their own SRA as dictated by the guidelines that we have adapted.

Since the General Assembly of BRIDGE in February 2020, whose outcome has been circulated to all for information and records by INTENSYS4EU (since September 2020 SPRING), discussions were ongoing for possibilities for further work, and this is as indicated below:

- In preparing the planned timeline careful consideration was given to the conclusions and the next steps for the TF RS that were amended during the last BRIDGE General Assembly.
- Following that, it was identified that the way forward was for the TF RS to work on the definition/specification of a common repository with useful information for helping projects in implementing the guidelines.
- Moreover, since synergies have been identified with ETIP SNET WG5, the work of the TF was presented to the ETIP SNET WG5 together with the outcomes of the TF.

The outcome of this analysis was based on the 'Draft methodological guidelines to perform an SRA' and the contribution of the two pilot projects GOFLEX & WiseGrid. This has helped to identify the next steps and to draft, with the ETIP SNET WG5 – WT4, a detailed easy questionnaire.

1. Drafting of a questionnaire to test the approved guidelines

As previously mentioned, the questionnaire was seeking for:

a. Use cases /scenario from existing projects with relevant KPIs details,
b. Tools from existing projects,
c. Best practices and lessons learned from previous SRAs.

Since this topic is a BRIDGE initiative the TF took the responsibility of approving the survey that was initially developed by WT 4 of WG5. Once validated by the EC, **the questionnaire was circulated to all the TF members and the ended BRIDGE projects**.

The replies were analysed with TF leaders and volunteer TF members in order to define the 1st specifications of the repository. Outcomes were shared with ETIP SNET WG5-WT4 for comments and expert advice and develop a methodology for classifying replies and have an on- line process that can make them useful and usable by any R&I interested projects.

A first draft of the specifications was circulated among the TF members to have their feedback. Repeat cycles to collect information from the BRIDGE projects were done. The intention is in the future, the repository will be fed by other R&I projects in the field (e.g., projects represented during ETIP SNET regional workshops etc.).

Following the approval of the guidelines during the annual meeting in February 2020 and the subsequent meetings of the TF, the TF has moved forward with the drafting of an appropriate questionnaire to test the guidelines, generate feedback and refine the guidelines before proceeding to the next phase which was the setting up of the use case repository.

1.1 The first version of the questionnaire

The questionnaire as was initially structured is described below together with notes that were passed to the participants:

- Key Exploitable Results with relevant KPIs details,
- Tools from existing projects,
- Best practices and lessons learned from SRAs.

The methodology for building an SRA should be, in principal, dependent on the SGAM framework:

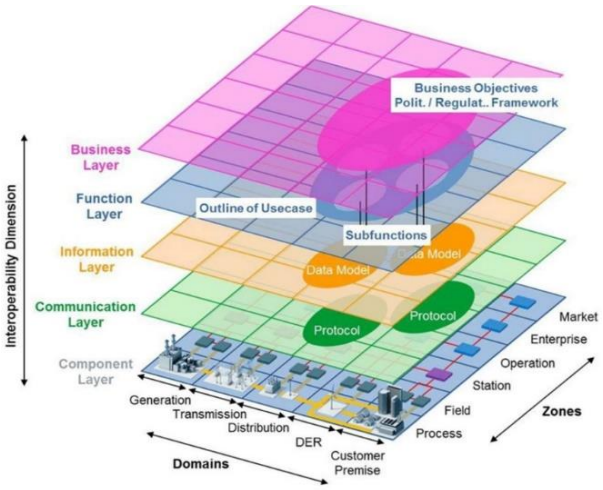


Figure 2: Smart Grid Architecture Model (SGAM)

The adapted guidelines of the Task Force are based on this and hence the questions should lead / encourage consortia of projects to such an approach but be adequately flexible to fish out any other practices that have delivered satisfactory results.

As indicated above, the questionnaire was divided in three sections so as to address distinctly the above identified needs.

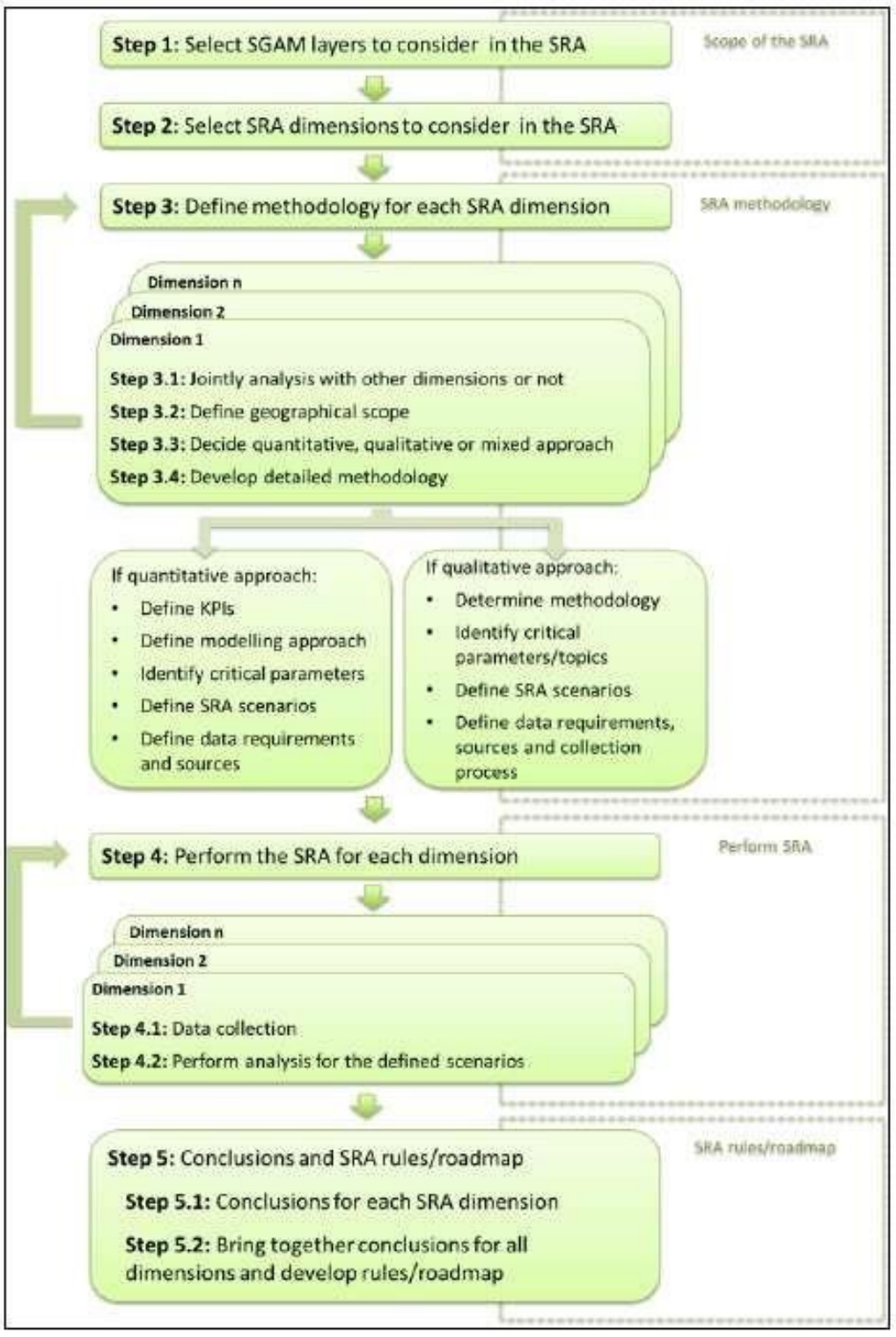


Figure 3: First version of the Task Force RS steps

No	Question	Details / answer
	A. Project details	
1	**Acronym of project**	
2	**Name of respondent**	
3	**Email of respondent**	
4	**Active period of project**	
5	**Targeted TRL of project if applicable giving single number or range**	
6	**Consortium members and countries of origin**	
	B. Key exploitable results	
7	The three most important key exploitable results of the project (KER) (5 to 10 lines maximum describing in short, the KER of the project)	
7.1		
7.2		
7.3		
8	Associated KPIs (Description and data required for evaluating them; use multiple KPIs if appropriate for defining each distinct KER)	
8.1		
8.2		
8.3		
	C. Developed tool or methodology used for Replicability & Scalability / raising Impact	
9	Identification of steps leading to the stated KERs and related KPIs and how these can be related to the SGAM layers	
9.1		
9.2		
9.3		
	Give the best fit to the identified steps / SGAM layers by combining the 3 identified sets into a single project process but keep separate if KER are distinct and follow different trajectories for Scalability Replicability.	
9.4		

10	Is the project following a qualitative approach in evaluating results and fulfilment of objectives?	
11	Is the project following a quantitative approach in evaluating results ana fulfilment of objectives?	
12	If the answer in 10 is yes then give your answers in the cells below for defining the methodology for the SRA KPI / or project, otherwise go to the next question.	
12.1	Identify modelling approach used for evaluating results	
12.2	Identify critical parameters affecting results and give content to them	
12.3	Give data results if available validating objectives achieved and KPIs fulfilled. Source for data should be clearly identified and process used for collecting and evaluating.	
12.4	Specify alternative solutions / scenarios achieved and parameters fulfilled validating performance	
13	If the answer in 11 is yes then give your answers in the cells below for defining the methodology for the SRA KPI / or project, otherwise go to the next question.	
13.1	Identify modelling approach used for evaluating results	
13.2	Identify critical parameters affecting results and give content to them	
13.3	Give data results validating objectives achieved and KPIs fulfilled. Source for data should be clearly identified and process used for collecting and evaluating	
13.4	Specify alternative solutions / scenarios achieved and parameters fulfilled validating performance	
13.5	Quantify results indicating Replicability and Scalability dimension.	

14	(If not unified approach for all KERs) Repeat set of questions in 12 for KER2 which refers to ……
14.1	Identify modelling approach used for evaluating results
14.2	Identify critical parameters affecting results and give content to them
14.3	Give data results if available validating objectives achieved and KPIs fulfilled. Source for data should be clearly identified and process used for collecting and evaluating.
14.4	Specify alternative solutions / scenarios achieved and parameters fulfilled validating performance
15	(If not unified approach for all KERs) Repeat set of questions in 13 for KER2 which refers to ……
15.1	Identify modelling approach used for evaluating results
15.2	Identify critical parameters affecting results and give content to them
15.3	Give data results validating objectives achieved and KPIs fulfilled. Source for data should be clearly identified and process used for collecting and evaluating
15.4	Specify alternative solutions / scenarios achieved and parameters fulfilled validating performance
15.5	Quantify results indicating Replicability and Scalability dimension.
16	(If not unified approach for all KERs) Repeat set of questions in 12 for KER3 which refers to ……
16.1	Identify modelling approach used for evaluating results
16.2	Identify critical parameters affecting results and give content to them

16.3	Give data results if available validating objectives achieved and KPIs fulfilled. Source for data should be clearly identified and process used for collecting and evaluating.
16.4	Specify alternative solutions / scenarios achieved and parameters fulfilled validating performance
17	(If not unified approach for all KERs) Repeat set of questions in 13 for KER3 which refers to
17.1	Identify modelling approach used for evaluating results
17.2	Identify critical parameters affecting results and give content to them
17.3	Give data results validating objectives achieved and KPIs fulfilled. Source for data should be clearly identified and process used for collecting and evaluating
17.4	Specify alternative solutions / scenarios achieved and parameters fulfilled validating performance
17.5	Quantify results indicating Replicability and Scalability dimension.
18	Conclusions reached that can be validated by the responses to the above questions separately for each KER or the project as a whole.
18.1	
18.2	
18.3	
19	Indicate validated roadmap for the project based on the individual conclusions reached
D. Best practices and lessons learned from the conducted SRA	
20	Use as many lines required to describe in detail best practices and lessons learned from the SRA conducted for the project you are reporting. Attempt will be made for unifying the lessons learned and related best practices to develop the current guidelines and mode of reporting for the benefit of future projects and consortia working for their Replicability and Scalability plans and objectives.

Table 1: First version of the questionnaire

1.2 The second version of the questionnaire

Following detailed discussions on the feedback from members of the TF on the first questionnaire that was circulated, an attempt was made to address all problematic issues in order to streamline the procedure and the understanding of the various options. The end result of this exercise is given below with details of the changes that were implemented in response to the issue raised.

- Identification of main objectives (related to R&I areas or declared goals) of projects
- Build SGAM path of identified objectives for reaching KERs
- Define KERs
- Conduct selected and targeted interviews with identified stakeholders to test the need of KERs; refine them where necessary
- Generate relevant KPIs details for trucking KERs
- Tools from existing projects,
- Best practices and lessons learned from SRAs.

The methodology for building a Scalability and Replicability Analysis (SRA) should be in principal dependent on the SGAM framework shown in Figure 1.

The adapted guidelines of the Task Force are based on this and hence the questions should lead / encourage consortia of projects to such an approach but be adequately flexible to fish out any other practices that have delivered satisfactory results.

As indicated above the questionnaire is to be divided in three sections so as to address distinctly the above identified needs.

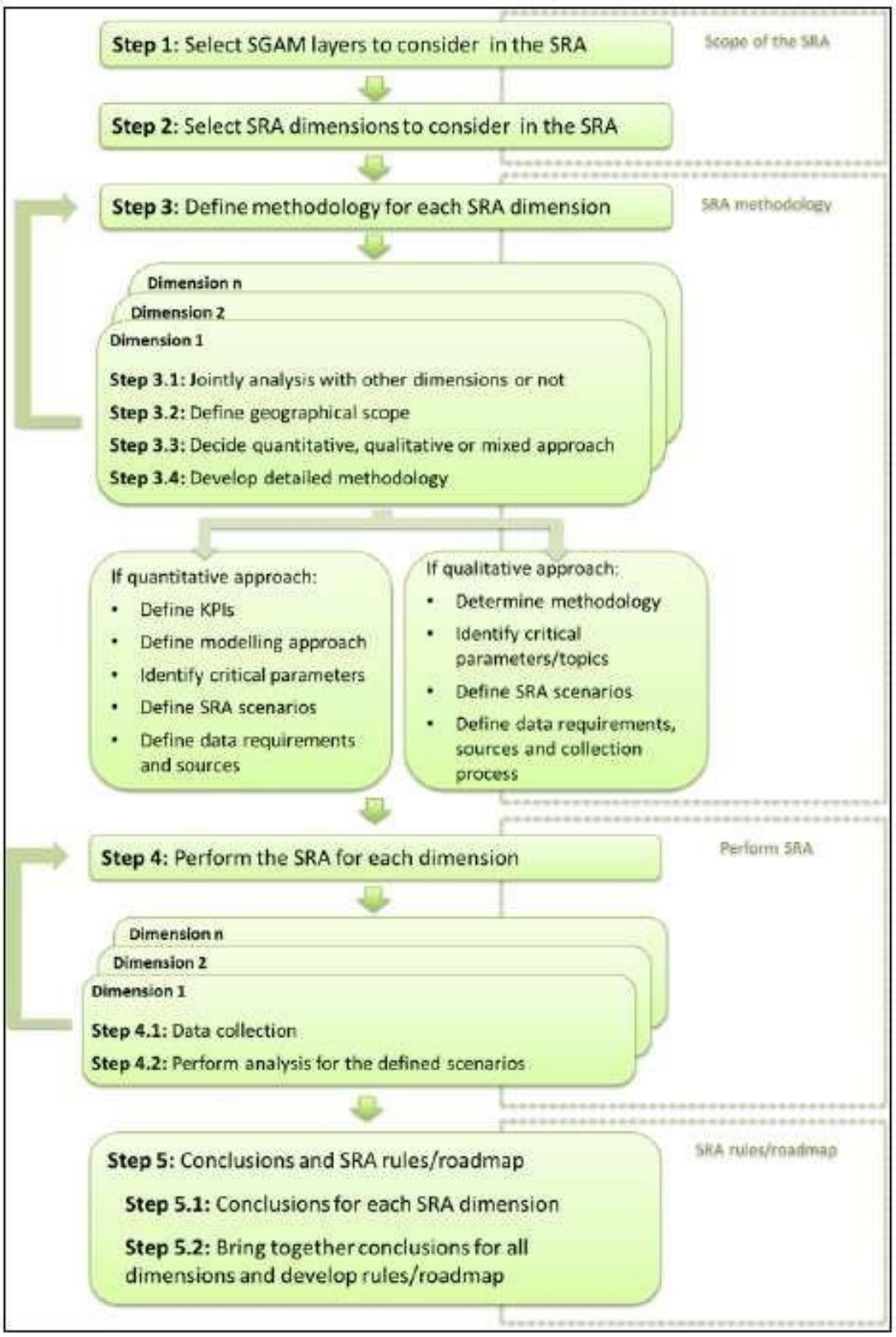


Figure 4: Second version of the Task Force RS steps

No	Question	Details / answer
	E. Project details	
1	**Acronym of project**	
2	**Name of respondent**	
3	**Email of respondent**	
4	**Active period of project**	
5	**Targeted TRL of project if applicable giving single number or range**	
6	**Consortium members and countries of origin**	
	F. Key objectives of the project	
7.1	For the purpose of this questionnaire, identify the most important key objective and describe it within 5 to 10 lines maximum (Consortia will repeat this process for all the key objectives of the project)	
7.2		
7.3	Build an SGAM path for the selected key objective	
7.4	Identify in detail the layers that compose the selected key objective of the project giving details of the planned R&I activity in every selected layer.	
	G. Key exploitable results	
7	Generate from the composition of the key objective in the SGAM layers the main KER of the project. The three most important key exploitable results of the project (KER) (5 to 10 lines maximum describing in short, the KER of the project)	
7.1	Describe the generated KER of the project within 5 to 10 lines maximum	
7.2		
7.3	Build a targeted questionnaire for selected stakeholders for sounding key objective and KER	
7.4	Conduct the targeted interviews using the generated questionnaire.	
7.5	Refine the KER to be targeted through the project with possible revision of the SGAM path linked to the KER and the key Objective. Describe below the revised KER of the project within 5 to 10 lines maximum	

H. KPIs and associated data for evaluating them for tracking development and progress of the refined KER. This section to be completed by mature projects that have reached this stage of development (Use multiple KPIs if appropriate for quantifying correctly the KER).	
8.1	
8.2	
8.3	
I. Quantification of Replicability & Scalability / raising Impact	
9.1	Identify critical parameters affecting results and give content to them
9.2	Give data results validating objectives achieved and KPIs fulfilled. Source for data should be clearly identified and process used for collecting and evaluating
9.3	Specify alternative solutions / scenarios achieved and parameters fulfilled validating performance
9.4	Quantify results indicating Replicability and Scalability dimension.
10	Conclusions reached that can be validated by the responses to the above questions for the main selected KER of the project.
10.1	
10.2	
10.3	
11	Indicate validated roadmap for the project based on the individual conclusions reached
J. Best practices and lessons learned from the conducted SRA (This section to be filled by all projects to the degree and details that the maturity of the project allows)	
12.1	How useful did you find the structured way of building the SRA methodology of your project?
12.2	Very useful but… Please give your recommendations in the text box below (if any)
12.3	How necessary do you consider the detailed structuring of a scalability and replicability process from project concept or from the beginning of the project to govern the activities of the project in meeting targeted objectives of the project towards the useful exploitation / utilization of the achieved results?

12.4	Necessary and critically important but… Please give your recommendations in the text box below (if any)
12.5	Use as many lines required to describe in detail best practices and lessons learned from the SRA conducted for the project you are reporting. Attempt will be made for unifying the lessons learned and related best practices to develop the current guidelines and mode of reporting for the benefit of future projects and consortia working for their Replicability and Scalability plans and objectives.
12.6	

Table 2: Second version of the questionnaire

2. Evaluation of the Outcome of the Questionnaire and Corrective outcomes

Both questionnaires quoted in the previous section were circulated to the members of the TF and responses were collected.

However, due to encountered difficulties in the implementation of the guidelines that raised negative reaction from the members of the task force we have taken the decision to address all raised issues and look for possible improvements to achieve the initial targeted objectives.

2.1 Background

However, due to encountered difficulties in the implementation of the guidelines that raised negative reaction from the members of the task force we have taken the decision to address all raised issues and look for possible improvements to achieve the initial targeted objectives.

In its present state (version 1), the methodological guidelines to perform a scalability and replicability analysis would benefit from being illustrated by more examples of Scalability Replicability Analysis (SRA) application in ongoing and ending/ended BRIDGE projects. By illustrating the methodological guidelines, the Replicability and Scalability Task Force needs to make sure that the information is useful and usable by any R&I project.

To do so, it has been agreed during the last BRIDGE General Assembly (February 2020), that the TF will work on the definition/specification of a common repository with useful information for helping projects in implementing the guidelines. As a basis, the repository could help to collect:

- Use cases / scenarios from existing projects with relevant Key Performance Indicator (KPI) details;
- Tools from existing projects;

Best practices and lessons learned from previous SRAs;

2.2 Collection of Project's Information

To collect this information and to draft the specification of the SRA common repository, as indicated in the previous section a questionnaire has been circulated from 28 May 2020 to 10 July 2020.
12 out of 27 projects replied to this survey and among them 3 mentioned that they were not mature enough to provide their Key Exploitable Results (KERs) and KPIs. The analysis of the answers led to the following conclusions:

- There is a confusion between the qualitative and the quantitative approach to evaluate project results. More quantitative responses were expected.

For early-stage project, the questionnaire might be too complex: they either do not have results to provide regarding replicability and scalability, or they are not always familiar with SGAM

2.3 Breaking down the SRA Process

Based on the findings, the following corrective actions were proposed and taken on board by the TF to implement and improve the guidelines:

- Update/Rebuild the questionnaire and target only the quantitative aspect

- Include a section on project's key objectives in order to involve early-stage projects.

Examples are needed and the process should be broken down to help projects in building the SGAM path. A four-step approach is proposed and detailed in the next chapter.

3. The Revised Methodology

The next phase was to generate a revised methodology for implementing the required SRA and the task force has moved through careful consideration of proposed actions, agreed on content of revised guidelines and is currently in the face of developing the guidelines in detail.

The main objective of this exercise is to develop a methodology based on the SGAM architecture capable of being universal in approach covering all the spectrum of projects based on the findings of the first phase of guidelines development covered in the above paragraphs. A paradigm change in this new approach is the adaption of a full process capable of delivering quantified indexes of replicability and scalability of each projects' key exploitable results that can serve as:

- Feedback for the projects themselves to better monitor their innovations and advancements in their scientific endeavours.
- Input to the process conducted in the BRIDGE task force of new R&I Priorities at the project evaluation level, contributing to the quantification of maturity of related technologies and through that the R&I Priorities in support of the energy transition.
- A data base for use case plotting in the SGAM architecture based on the objectives of projects that would form the basis for replication and/or advancement in covering the needs of new projects in the respective field.

For this reason, 4 subroutines and 5 steps have been identified depicted in the following logical diagram / process with clear step by step description helping projects to map themselves depending on their maturity (i.e. early stage / on-going / ending project). The experts have been separated into groups to support the development of each subroutine separately. Development work concluded till today is the following:

- Each subroutine has a task leader that is responsible to coordinate the work to deliver the final description of the routine
- Each subroutine is supported by the selected experts coming from projects working as a team to deliver the detailed description of the subroutine taking as input the work output of the previous subroutine and passing on its output to the following subroutine. Regular meetings of the members of the TF are convened working collectively on the set-out objectives.
- The TF chairs assure the continuity and the complementarity of the subroutines to support the overall objective.
- The developed work of the TF of each subroutine is validated using real data from the contributing projects. Based on the results achieved further refinement of the process is pursued.

The progress of the subroutines is described in paragraphs below.

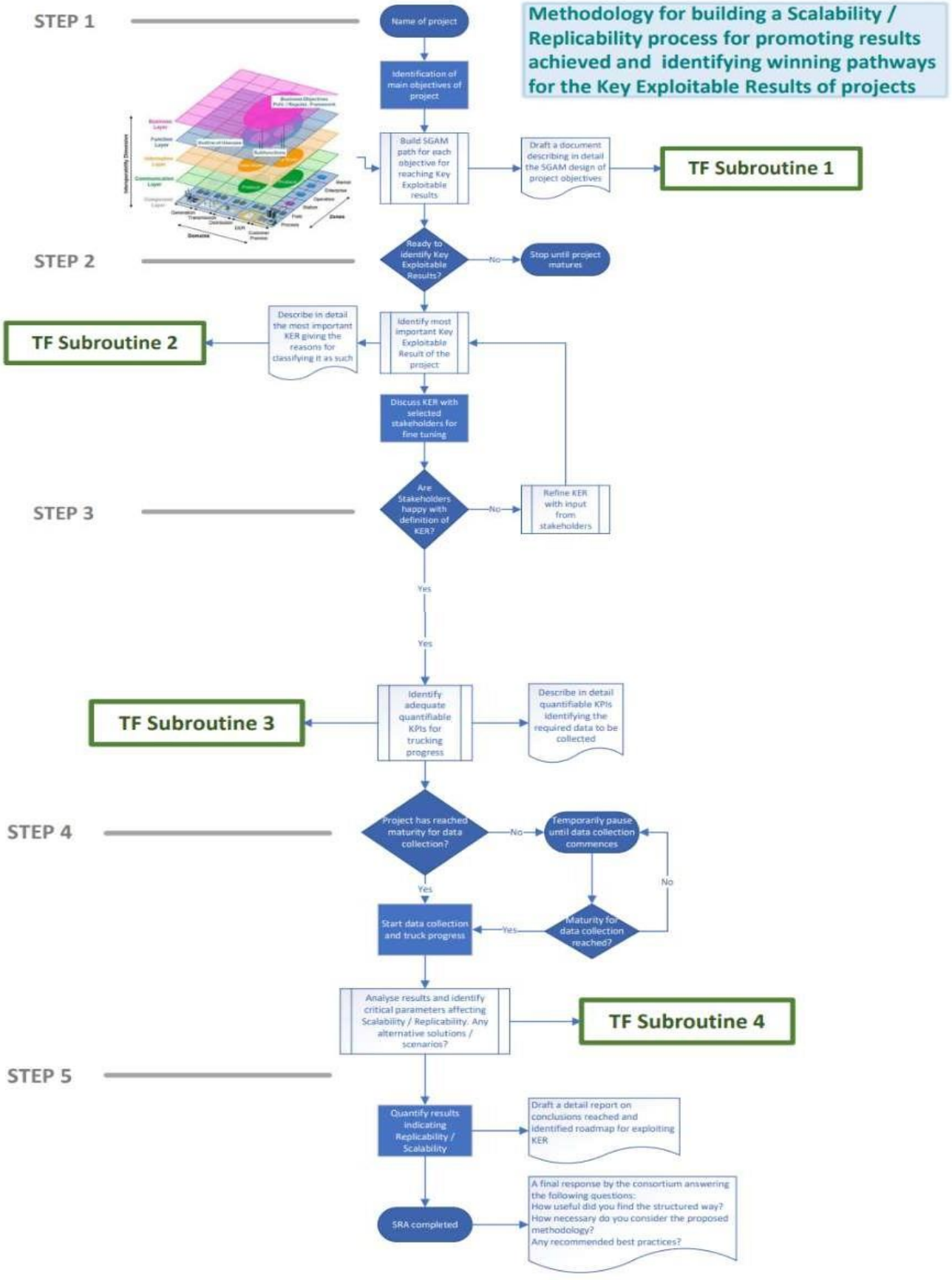


Figure 5: The logical diagram depicting the replicability /scalability process

3.1 Subroutine 1: Mapping of project objectives into the SGAM architecture

Example:

Develop and demonstrate mature and commercially viable, scalable and easy-to-deploy solutions for distributed flexibilities through an automated dynamic pricing flexibility market for distributed resources and Demand Response as a flexibility service to the integrated grid.

The starting point is the key objective of the project as indicated above with the GOFLEX project as an example.

Through a detailed analysis of the project objective the following step and subroutines should be addressed, depending on the project maturity. This is done once for every project and the targeted SGAM plot should contain all envisaged actions / steps addressing the formulated objectives as one single process irrespective of how many branches it may have.

To do this and to be in line with the universal classification of projects within BRIDGE, it is required to align with the adapted classification of technologies and systems.

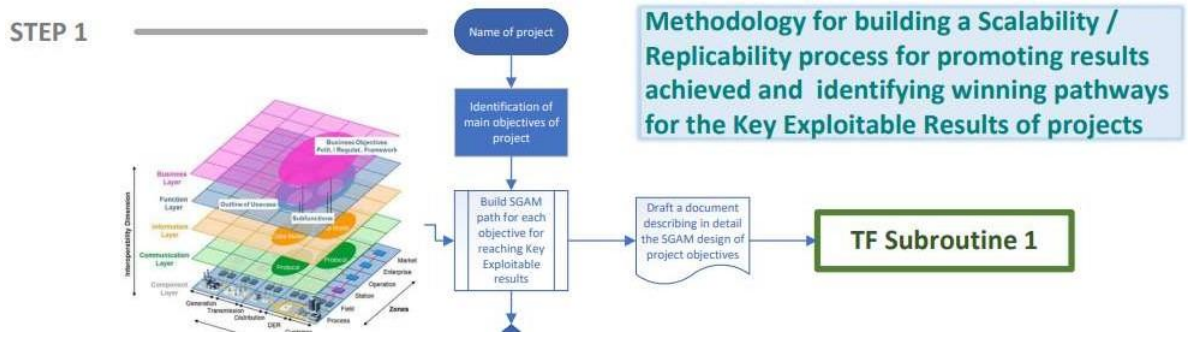


Figure 6: Logical diagram of subroutine 1

- Mapping starts with the component layer: the physical system is detailed including physical system components serving the various operational zones, the market and appropriate roles.
- Based on the component layer the communication and data layers are generated.
- The physical linking of the various layers is developed with all connectivity details.
- Building on the underlying concepts of the project the required roles and responsibilities of involved actors is sketched that will form the basis for serving the envisioned functions and business objectives to be developed in layers 4 and 5 of the SGAM architecture / process.

An example of the application of the methodology for the GOFLEX project is described in paragraph 3.1.2.

This subroutine of the methodology has been reviewed and validated and it is considered complete.

3.1.1 Application of subroutine 1 to the GOFLEX project

The GOFLEX project aims to accelerate the GOFLEX technology solution in Europe by developing and demonstrating mature and commercially viable, scalable and easy-to-deploy solutions for distributed flexibilities. Automated dynamic pricing is utilized to enable the establishment of a flexibility market for distributed resources and Demand Response in order to improve the secure energy supply at local level and increase the economic efficiency of the overall energy system. To meet these strategic goals, the main objective of GOFLEX is to make a set of technology solutions for distributed flexibilities and automated dynamic pricing market ready which enables regional actors like Generators, Prosumers, Flexible Consumers and Demand Side Operators, Energy Suppliers, Microgrid Operators and Energy Communities to aggregate and trade flexibilities.

What is the key objective of the GOFLEX project?

> Develop and demonstrate mature and commercially viable, scalable and easy-to-deploy solutions for distributed flexibilities through an automated dynamic pricing flexibility market for distributed resources and Demand Response as a flexibility service to the integrated grid.

Step 1: Map the key objective in the Smart Grid Architecture Model

How can this be mapped in the SGAM model shown in Figure 1? Analysing the requirements for addressing the needs of the GOFLEX project it is identified that all interoperability layers are required:

- Business Layer
- Function layer
- Information layer
- Communication layer
- Component layer

To detail the required mapping, it is important to note the reference designs of the SGAM related to the following and shown in figures 11, 12 and 13 below:

- SGAM: Mapping of Harmonised role model
- SGAM: Mapping of communication networks
- SGAM: Data modelling and harmonization work mapping

Moreover, the SGAM layers listed and described in Table 1, should be well understood prior to any attempt to map projects. It is for this reason that consortia of projects should be well conversant with the SGAM architecture and the manual "**SGAM User Manual - Applying, testing & refining the Smart Grid Architecture Model (SGAM)"**[1] must be well studied to learn how to implement for best results.
In this process, it is important to note that Interoperability is fundamental in the technology evolution progressing the interconnected grid and associated markets towards the envisioned smart options capable of facilitating the seamless operation of the emerging technologies in support of energy transition to the low carbon economy of 2050.

Hence, mapping objectives of projects in the SGAM model provide consortia with the readymade solutions for developing the interoperability layers using approved standards that broader scope and enrich the replicability and scalability capabilities of the project and its targeted objectives.

Table 3: SGAM Layers

Layer	Description
Business	The business layer represents the business view on the information exchange related to smart grids. SGAM can be used to map regulatory and economic (market) structures (using harmonized roles and responsibilities) and policies, business models and use cases, business portfolios (products & services) of market parties involved. Also business capabilities, use cases and business processes can be represented in this layer.
Function	The function layer describes system use cases, functions and services including their relationships from an architectural viewpoint. The functions are represented independent from actors and physical implementations in applications, systems and components. The functions are derived by extracting the use case functionality that is independent from actors.
Information	The information layer describes the information that is being used and exchanged between functions, services and components. It contains information objects and the underlying canonical data models. These information objects and canonical data models represent the common semantics for functions and services in order to allow an interoperable information exchange via communication means.
Communication	The emphasis of the communication layer is to describe protocols and mechanisms for the interoperable exchange of information between components in the context of the underlying use case, function or service and related information objects or data models.
Component	The emphasis of the component layer is the physical distribution of all participating components in the smart grid context. This includes system & device actors, power system equipment (typically located at process and field level), protection and tele-control devices, network infrastructure (wired / wireless communication connections, routers, switches, servers) and any kind of computers.

[1] https://manualzilla.com/doc/6919852/sg-cg-m490-k_-sgam-usage-and-examples-sgam-user-manual

The mapping process starts with the component layer shown in Fig 4, on which the physical system is detailed as shown in Fig 2 with the components to be deployed up to and including the market with appropriate roles.

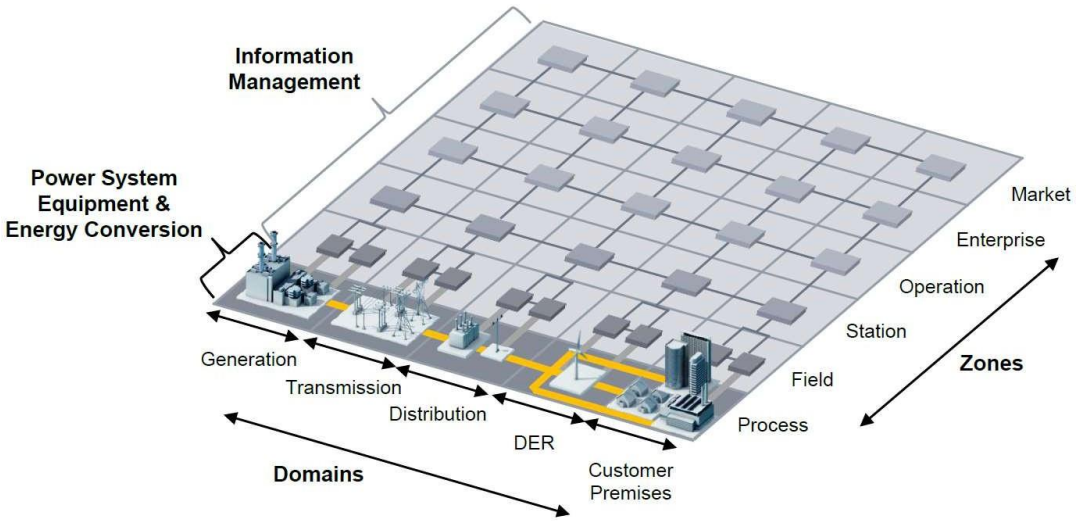


Figure 7: SGAM: Smart Grid Plane – Domains & zones

In building this architecture, it is important to note that power system management distinguishes between electrical process and information management. These viewpoints can be partitioned into the physical domains of the electrical energy conversion chain and the hierarchical zones for management of the electrical process. The *Smart Grid Plane* spans in one dimension the complete electrical energy conversion chain, partitioned into five domains: (Bulk) Generation, Transmission, Distribution, DER and Customer Premises.

In the other dimension the hierarchical levels of power system management are partitioned into six zones: Process, Field, Station, Operation, Enterprise and Market. This smart grid plane enables the representation of the zones in which power system management interactions take place between domains or within a single domain.

Table 4: SGAM Domains

Domain	Description
(Bulk) Generation	Representing generation of electrical energy in bulk quantities typically connected to the transmission system, such as by fossil, nuclear and hydro power plants, off- shore wind farms, large scale solar power plant (i.e. PV, CSP).
Transmission	Representing the infrastructure which transports electricity over long distances.
Distribution	Representing the infrastructure which distributes electricity to customers.
DER	Representing distributed electrical resources directly connected to the public distribution grid, applying small-scale power generation and consumption technologies (typically in the range of 3 kW to 10,000 kW). These distributed electrical resources may be directly controlled by e.g. a TSO, DSO, an aggregator or Balance Responsible Party (BRP).
Customer Premises	Hosting both end users of electricity and also local producers of electricity. The premises include industrial, commercial and home facilities (e.g. chemical plants, airports, harbours, shopping centres, homes). Also generation in form of e.g. photovoltaic generation, electric vehicles storage, batteries, micro turbines.

Table 5: SGAM Zones

Zone	Description
Process	Including the physical, chemical or spatial transformations of energy (electricity, solar, heat, water, wind ...) and the physical equipment directly involved (e.g. generators, transformers, circuit breakers, overhead lines, cables, electrical loads, any kind of sensors and actuators which are part or directly connected to the process,...).
Field	Including equipment to protect, control and monitor the process of the power system, e.g. protection relays, bay controller, any kind of intelligent electronic devices which acquire and use process data from the power system.

Station	Representing the areal aggregation level for field level, e.g. for data concentration, functional aggregation, substation automation, local SCADA systems, plant supervision…
Operation	Hosting power system control operation in the respective domain, e.g. distribution management systems (DMS), energy management systems (EMS) in generation and transmission systems, microgrid management systems, virtual power plant management systems (aggregating several DER), electric vehicle (EV) fleet charging management systems.
Enterprise	Including commercial and organizational processes, services and infrastructures for enterprises (utilities, service providers, energy traders …), e.g. asset management, logistics, work force management, staff training, customer relation management, billing and procurement.
Market	Reflecting the market operations possible along the energy conversion chain, e.g.energy trading, retail market.

Following the above definitions, the identified key objective of the GOFLEX project is first mapped on the component layer, making sure that all processes are included starting from the physical processes and field components to the systems that will serve the market through appropriate communication channels that will generate the required data that is managed in line with the detailed European standards.

This is presented in Fig 2 below. Based on this detailed component layer, the communication and data layers are generated as depicted in Figs 3 and 4 below.

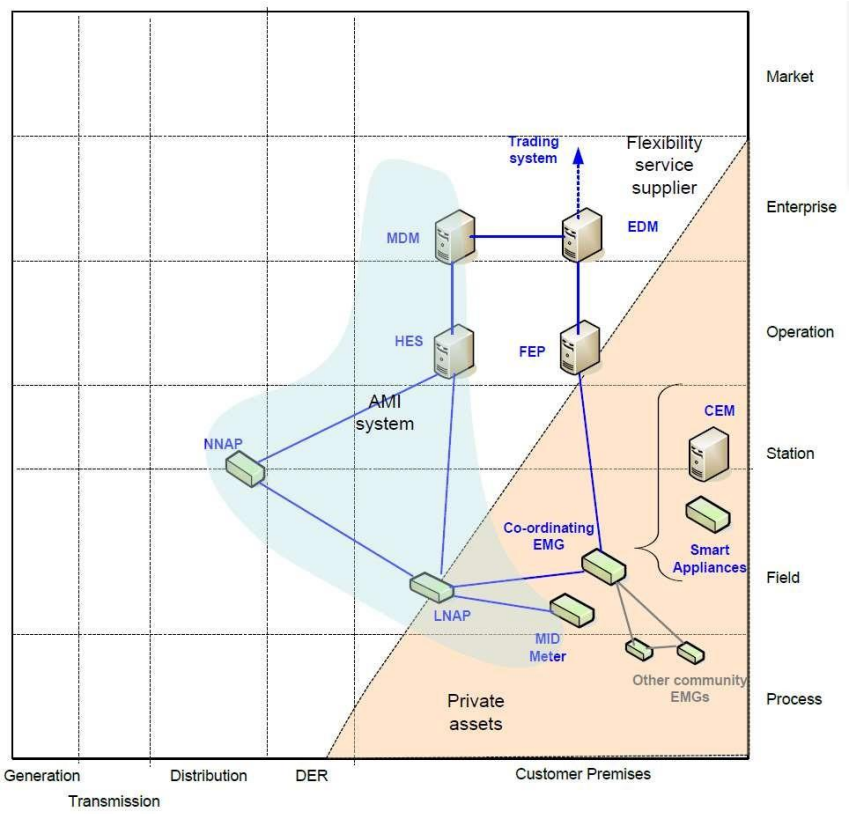


Figure 8: SGAM: GOFLEX mapping at the component layer for flexibility trading

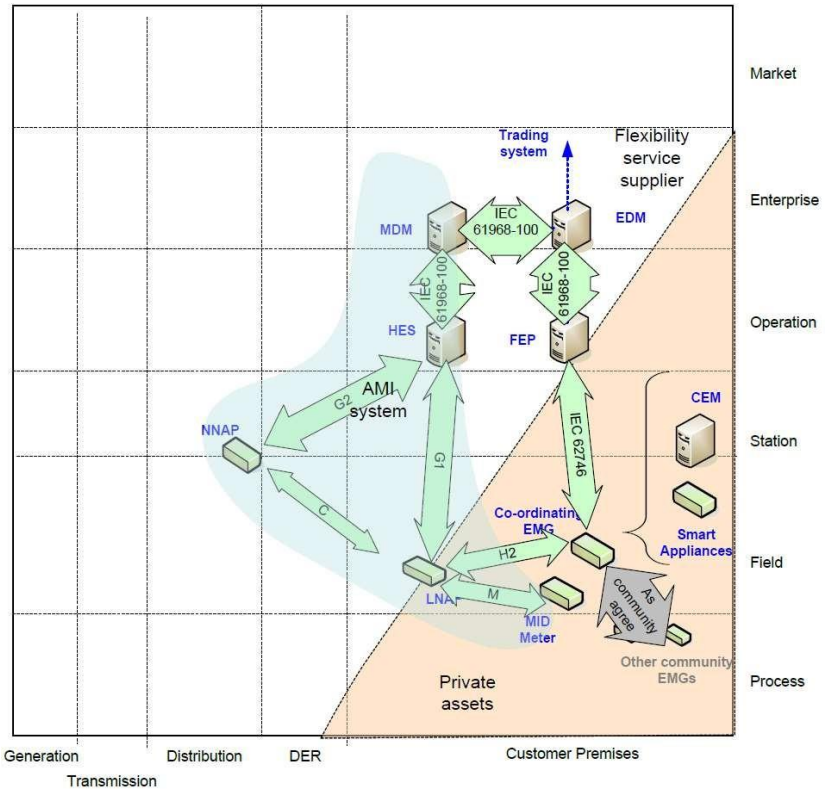


Figure 9: SGAM: GOFLEX mapping of the communication layer for trading flexibility

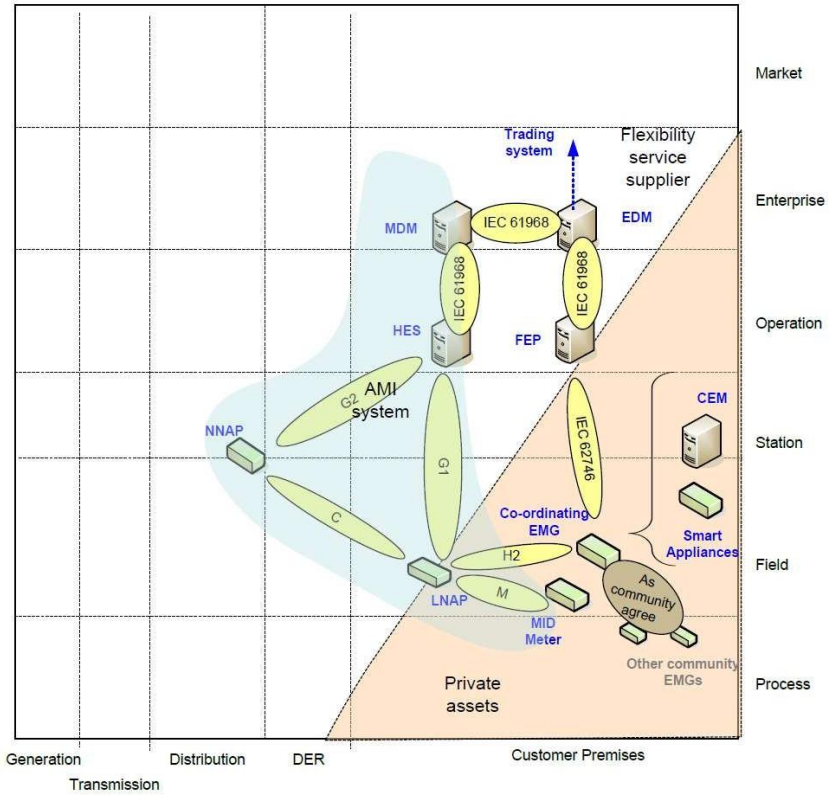
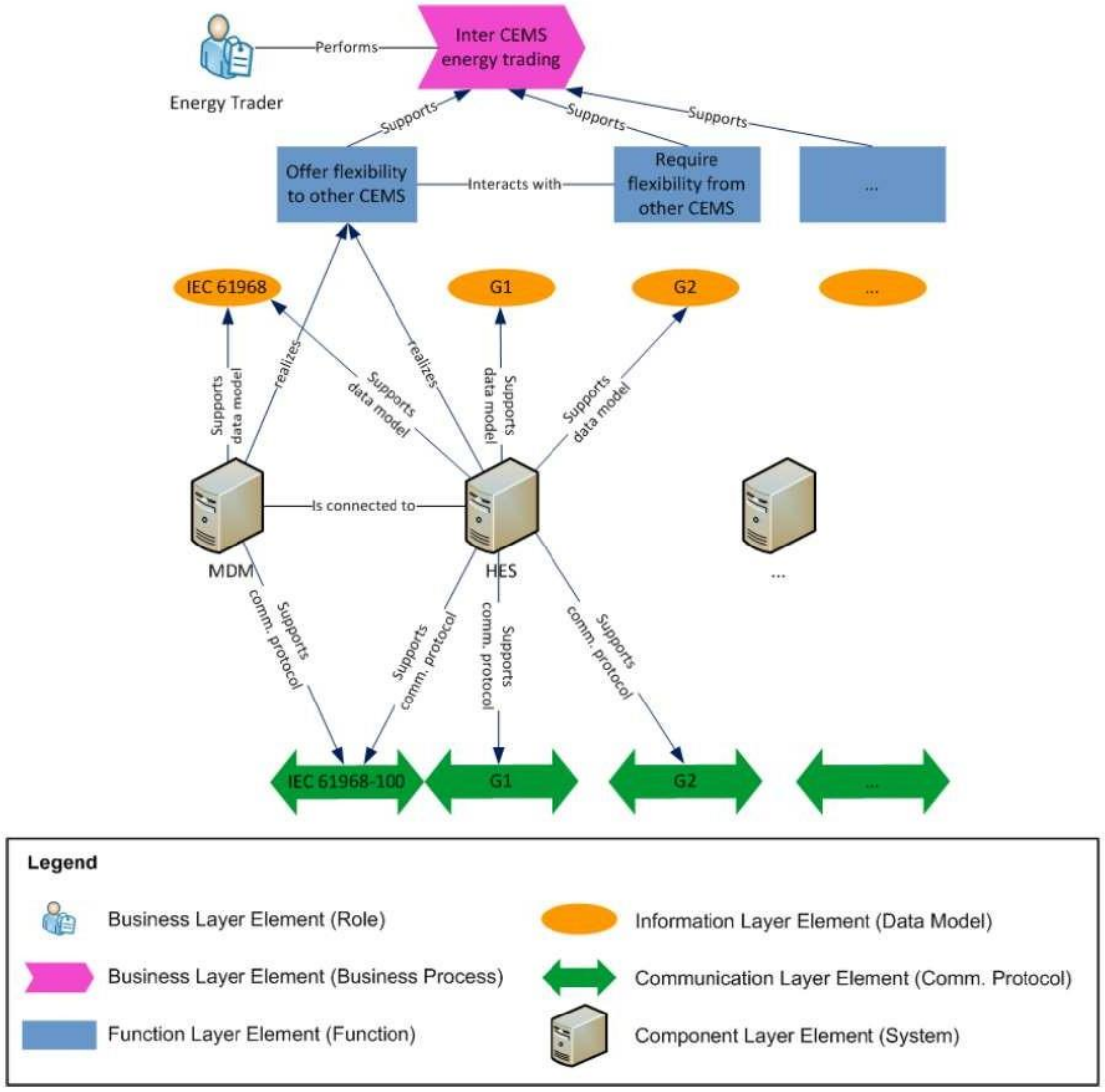


Figure 10: SGAM: GOFLEX mapping of the information layer

The above mappings form the basis for transforming the key objective of the project into at least one detailed use case within the SGAM framework. This use case has physical linking between the various layers as depicted in Fig. 5. In general, projects are targeting more than one use case that can be developed using the same procedure and detailing connectivity in all layers as required.

For each identified use case, roles are identified and market participants defined using the role model mapping of Fig 6.

Use cases are a well-proven approach in systems engineering and used worldwide to derive a common understanding for the objectives of the project. Despite (or because of) the large set of use cases available in different databases, the level of granularity differs widely in these use case descriptions. A simple classification for the design and scope of the selected use case is preferred and this should be adopted as a general rule. In this process, differentiation should be made between use case concepts (or high level use cases), business use cases and device/system use cases.



(CEMS: Customer Energy Management System, MDM: Meter Data Management, HES: Hypertext Editing System)

Figure 11: Interrelationships between concepts on different levels in the SGAM model

Following, this procedure the underlying concepts of the project are described by defining the roles involved and sketching their responsibilities with details on the underlying business models or processes thus distinguishing use cases between them with the required granularity for unique mapping in the SGAM.

For the purpose of this exercise, we will limit further steps to only one-use case to prove the process but consortia of projects will need to complete all use cases of their project to the required detail that will facilitate all next steps that will lead to the evaluation of Replicability and Scalability indices of the project.

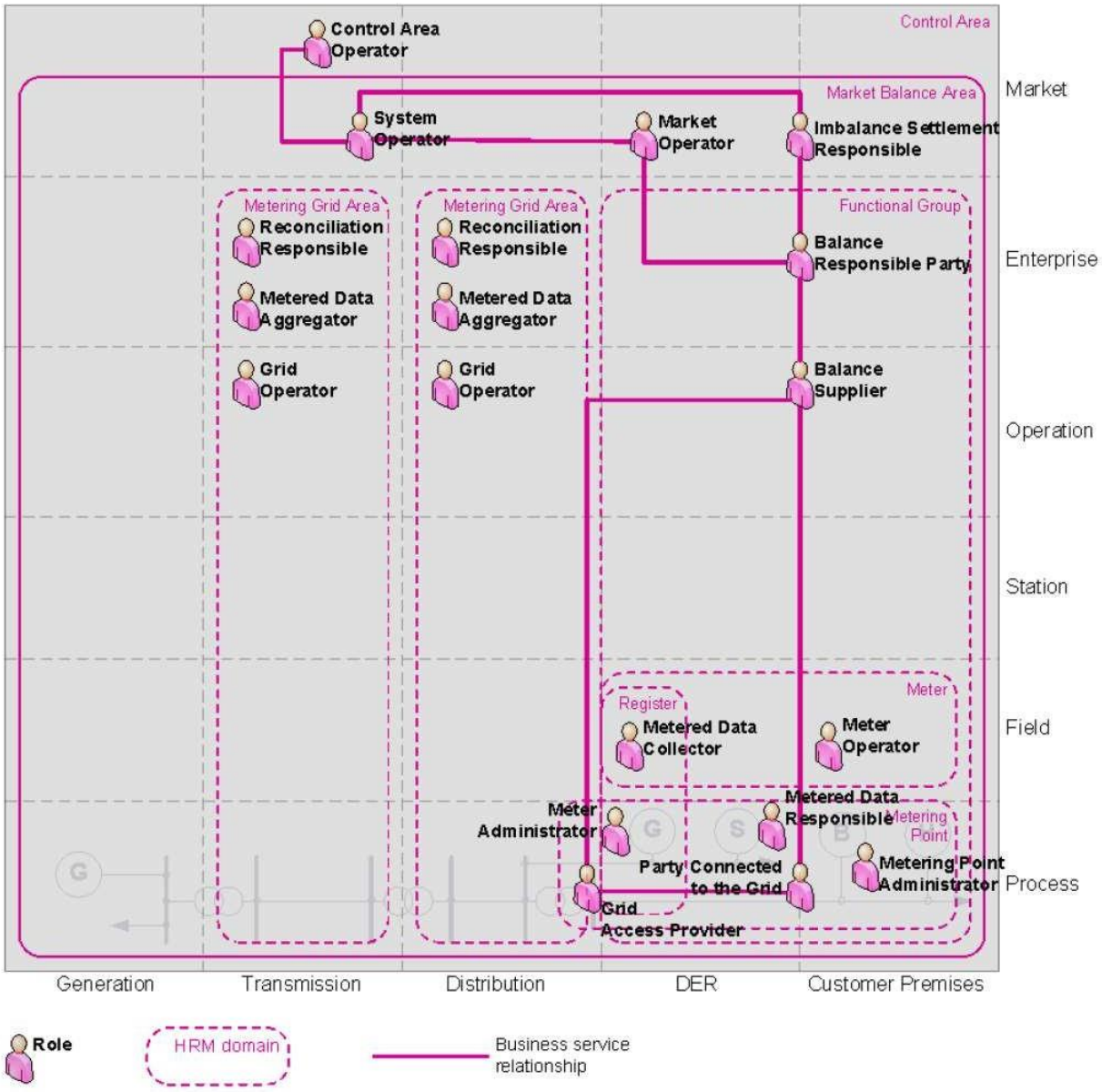


Figure 12: SGAM: Mapping of Harmonised role model

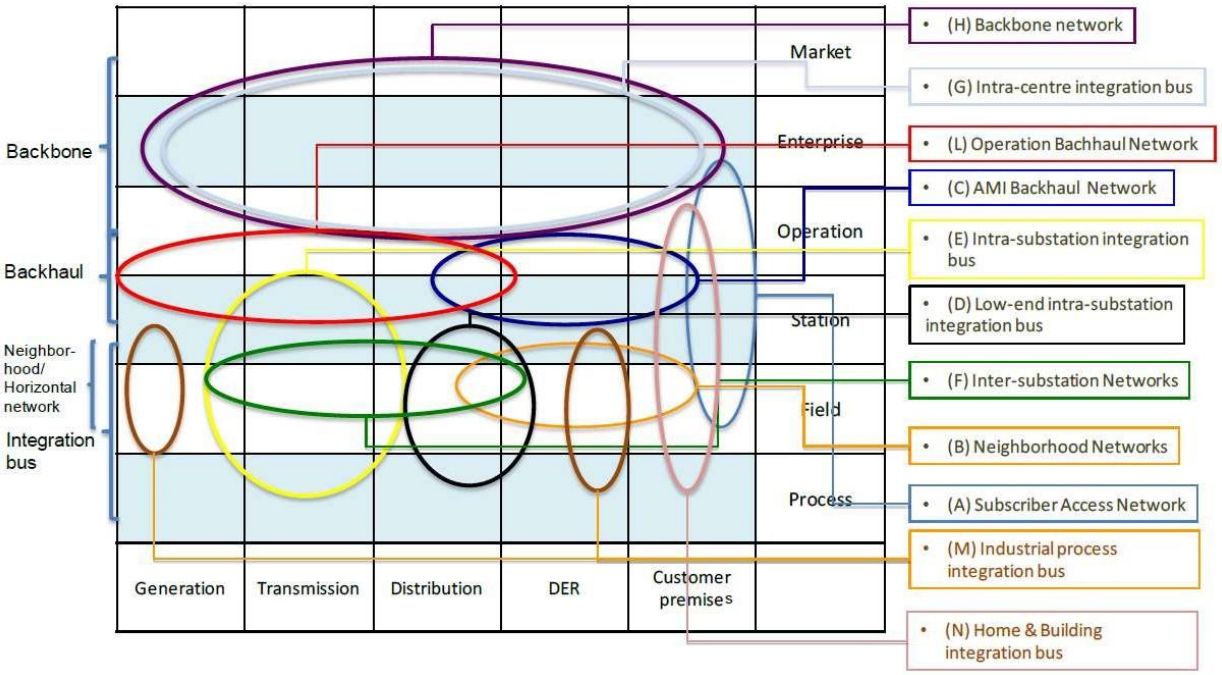


Figure 13: SGAM: Mapping of communication networks

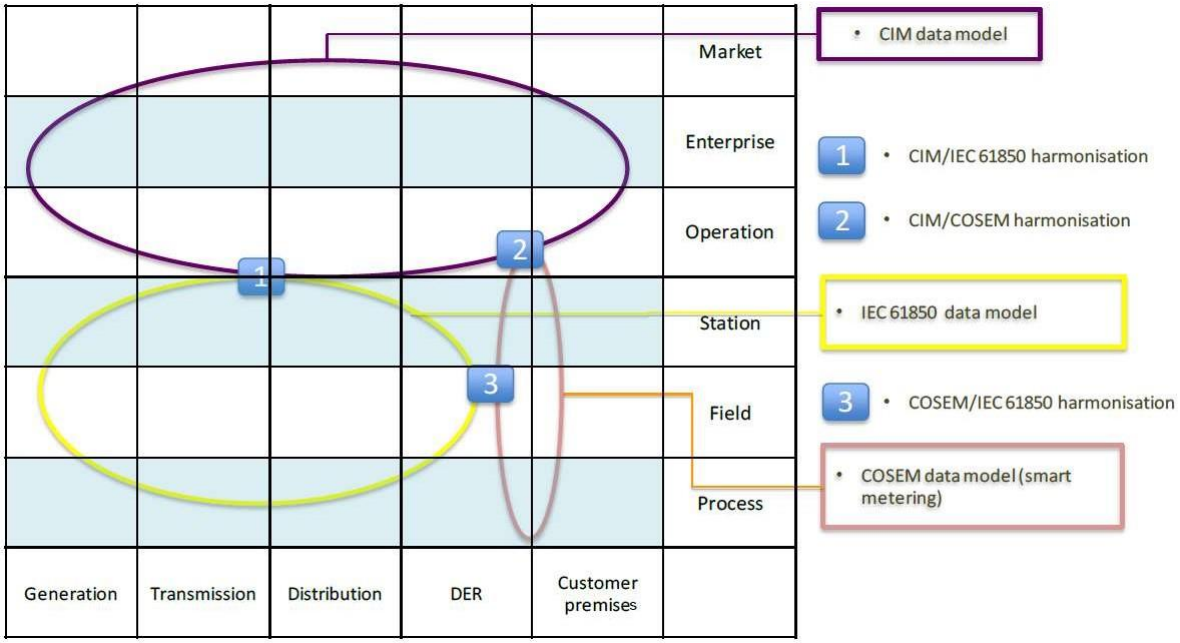


Figure 14: SGAM: Data modelling and harmonisation work mapping

3.2 Subroutine 2: KER Identification

Within this section, the main advancements that the project offers in certain technologies / systems under the prism of their objectives are going to be formulated into KERs. [2]

Exploitation definition: The utilisation of results in further research activities other than those covered by the action concerned, or in developing, creating and marketing a product or process, or in creating and providing a service, or in standardisation activities.

Key Exploitable Result (KER) is an identified main interesting result (as defined above) which has been selected and prioritised due to its high potential to be 'exploited' downstream the value chain of a product, process or solution, or act as an important input to policy, further research or education

In this process, Table 4 needs to be filled by the projects for every identified KER having the following main objectives:

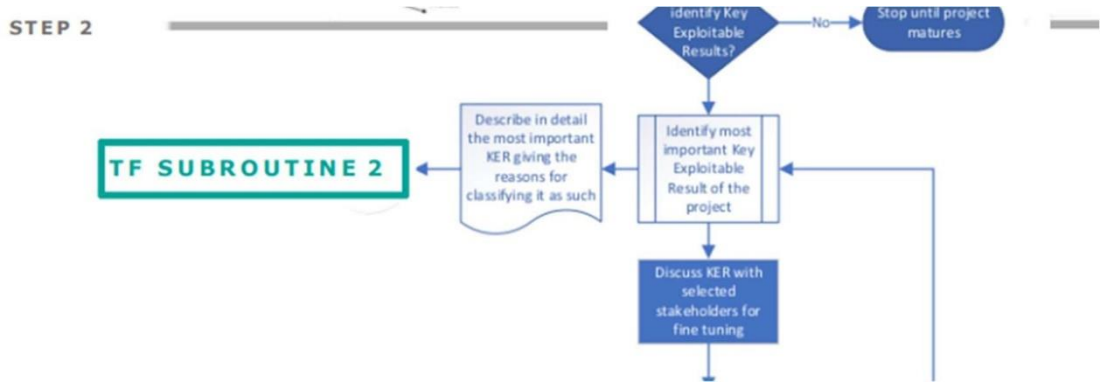


Figure 15: Logical diagram of subroutine 2

- Define in detail the innovation areas of the project and build through them the KERs of the project
- Identify role of innovation areas in building and operating wider systems following the SGAM approach
- Identify missing links from the state of the art of systems that the project targets to solve and deliver, and
- Through detailed analysis qualify starting TRL and finishing TRL for each KER and note it in TABLE 6.

[2] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/support/glossary

Table 6: The KER table of the project

KER1 short description	
Main advancements of KER1	
Qualification of KER1 based on R&S characteristics	
TRL of KER1 at the end of the project	

The main R&S characteristics that the KER will be quantified against are listed in Table 7. Each characteristic should be scaled between 0 and 1 depending on technologies / systems used that are non-proprietary. The overall Replicability / Scalability index for the specific KER will be the product of the individual indices.

Table 7: R&S characteristics

	Replicability characteristics	Scalability characteristics
1	**Data addresses using open standards (a no between 0 and 1)**	In addition to what is specified for R, does scaling up require additional resources that are based on open standards?
2	**Open technology or communication standards (a no. between 0 and 1)**	In addition to what is specified for R, does scaling up require additional resources that are based on open standards?
3	**Interoperable systems (0 or 1)**	In addition to what is specified for R, does scaling up require additional resources that are based on open standards?

The table above is of critical importance for identifying how scalable and replicable are the main KERs of projects and give a solid feedback for the analysis in TF4. A project having all characteristics met for both indexes is considered to be fully replicable and scalable. Of course, this is linked to the technologies and systems that each of the project advances. In order to map the KER advancements to the objective and the technologies/systems classification the following table is essential to be completed.

The indexes above are fundamental in shaping the maturity indexes of systems and functionalities forming the integrated smart grid of 2030 and beyond.

Table 8: KER mapping into the SGAM plane

Layers	objective 1	objective 2	objective 3	objective 4	objective 5	objective 6	KER
Component layer			x	x			KER1
Communication layer	x				x		KER2
Information layer							KER3
Function layer	x	x					KER4
Business layer			x		x		KER5

The projects need to identify through this exercise how the KERs are linked to the objectives as set in TF1 and with which layer is linked. All KERs can serve more than one project objective but link to only one SGAM layer i.e. technology. So, projects need to separate or merge the identified KER to the appropriate degree so as to avoid duplication and complexity in delivering the results of the project and at the same time raising the impact of each distinct KER. This process, however, should not lose any important detail or diversification that is useful in the application phase.

The main outputs of this subroutine are the following:

- Populate the list of KERs of the project and provide it as input to TF3.
- Develop an exhaustive description of the most valued KERs (in terms of replicability and scalability) and the anticipated advancement of the related technology/system.
- Identify the most valued KER of the project from the qualified list.
- Provide the required input to TF4 by quantifying the Replicability & Scalability that is expected to be achieved through the identified KERs and the related technologies / systems.

This Subroutine is still under development and thus amendments of what is described here maybe expected.

3.3 Subroutine 3: Quantifiable KPI Identification

Using the detailed description of the primary KER identify a list of possible Key Performance Indicators that can validate the achievable results of the primary KER.

- Identify in detail the source of data that will be used to evaluate the identified KPIs.
- Identify the missing source of required data for tracking progress achieved and evaluating the required KPIs.
- Evaluate the possibility of alternative sources of data or alternative quantifiable KPIs that can be used for tracking progress and validate the achieved results of the primary KER.

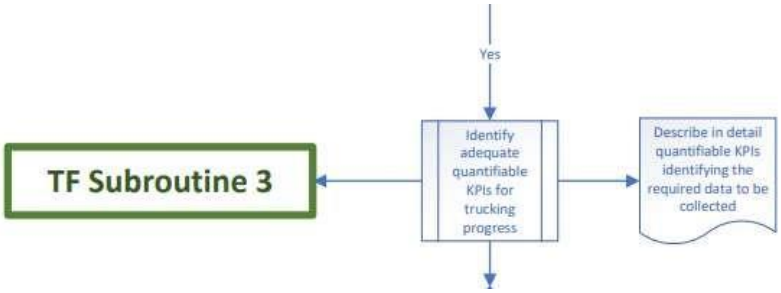


Figure 16: Logical diagram of subroutine 3

- For the chosen KPIs, build the missing data resource and develop the automated process for collecting the identified data that will feed the KPI evaluation process.
- For each chosen KPI, identify the base case scenario that will be compared to for validating the performance of the primary KER.
- For each base case scenario, establish the sourcing of the required data to be automated in the evaluation process.

This Subroutine is still under development and thus amendments of what is described here maybe expected.

3.4 Subroutine 4: Results analysis, identification of limitation factors and alternative solutions

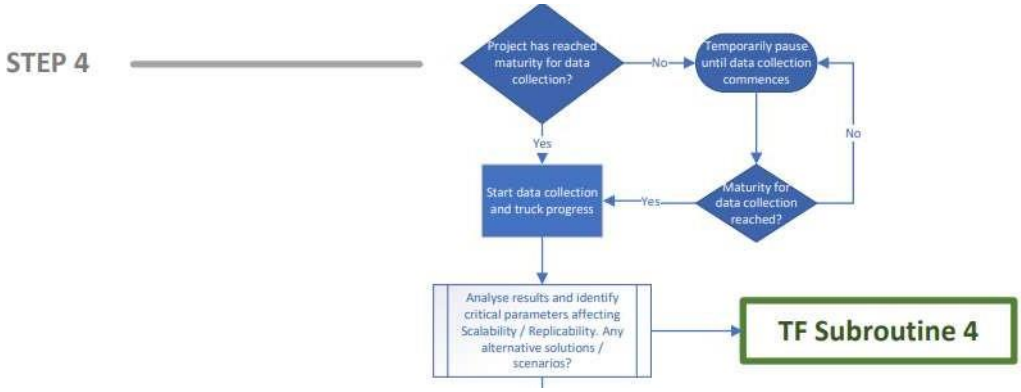


Figure 17: Logical diagram of subroutine 4

- Monitor continuous flow of results and contact continuous analyse.
- Through the analysis, identify critical parameters affecting replicability/scalability. The critical parameters can be:
    - Proprietary solutions that require the development of open standards in linking them to the various SGAM layers.
    - Missing communication standard
    - Missing data standard
    - Missing system code

- Missing market rule or mechanism
- Any other

- Generate a project quality loop for developing the solutions that will minimize the identified limiting factors for achieving seamless scalable and replicable solutions.
- Quantify the identified limitation factors for achieving seamless replicability and scalability aiming to limit this limitation factor to the minimum.
- Identify future work that will surpass any remaining limitation factors.

This Subroutine is still under development and thus amendments of what is described here maybe expected. It has to be mentioned that the main inputs of this Subroutine are derived by the others Subroutines.

3.5 Next Steps

As indicated in the paragraphs above the objective of the TF is:

- To complete the detailed guidelines for the Replicability and Scalability approach by detailing the above step by step process.
- Build the process using 7 to 10 projects reporting to BRIDGE for detailed mapping and trying out the various identified steps. Conduct a refinement of the process were identified as required.
- After finalizing the guidelines and approved by the Task Force through the detailed trial out, proceed to set up the request for all projects reporting to BRIDGE to conduct their individual Replicability and Scalability exercise and report it to the Task Force for completing a full report for submitting to the Commission as a deliverable.

3.6 Methodology: Best practice approach (use case collection – link with Data Management WG)

3.6.1 Building the methodology repository: Best practice approach

- In support of the above identified guiding methodology for building the replicability/scalability process of projects, there is an identified need for developing the following supporting libraries:
- Use case technology solutions for developing the smart system of 2030 / 2050 mapped in the SGAM architecture. This library of use cases should continuously grow to facilitate the solution adaption of project consortia in mapping their planned project objectives and maximising the benefits of the SGAM process.
- The family of solutions provided through the adapted use cases will be exhaustively linked to approved standards and codes provided by the appropriate EU bodies: CEN, CENELEC, ETSI, ENTSO-E etc

This step will be the last to be delivered and will be integrated into the platform that is handling the data / information / knowledge of the BRIDGE project.

3.6.2 Cooperation with WG Data Management of BRIDGE

The objective of this task is to build a library of use cases from the projects of the TF RS kept in a common repository in order to facilitate the knowledge sharing among R&I community. It has been decided to combine efforts in the building up of the required repository with the Action 1 of the BRIGDE Data Management WG, where such repository has been developed.

This Use case repository, based on the Use-Case Methodology defined in the standard IEC 62559-2:2015, is a an easily accessible tool that will be used for alignment of new BRIDGE projects started recently (such as X-FLEX) with ongoing projects (such as EU-SysFlex) or completed projects and serve as a foundation for future research activities process. So far, three formats to describe use cases are supported: MarkDown documents, XML files complying with IEC 62559-3 as well as Excel sheets following the format defined by the BRIDGE WG Data Management. Since the repository is built in a modular way, support for new use case formats can be added without changing the existing setup.

The support for Excel files translation to XML has been developed following the IEC 62559 data schema (XSD file), which provides a formal description for the attributes and relationships between the different objects defined in the standard itself. This XSD schema file is translated into Python objects using the package pyxb and its tools (pyxbgen), that generates a Python file containing the object definition from XSD, later used within the Excel translator to XML. This program is built utilizing Python language and works like an ETL. The process involved in the translator program consists of parsing the Excel file and creating a Python object tree with the data read, which is later transcribed into an XML file that respects the relationships via XML nesting.

The resultant or otherwise uploaded XML files are treated automatically through GitHub Workflows, running a translator from XML to MarkDown files that are used as the input to the website generator. MarkDown files are processed by the static website generation framework Hugo, whereas the tools to process XML files and Excel sheets have been developed by RWTH Aachen University (Platone project) and ETRA I+D (XFLEX project). The GitHub repositories and the automation of the website generation whenever use cases are added or updated is currently maintained by RWTH Aachen.

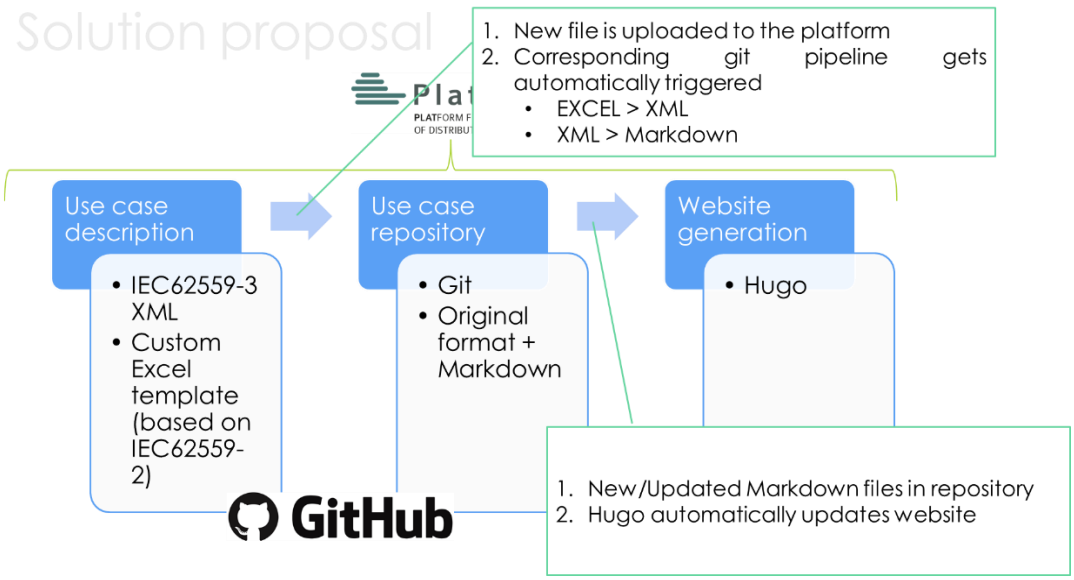


Figure 18: Use case repository development process

The result of this Action 1, is an easily accessible use case repository to be used for every type of stakeholder, in order to generate a common list of Use case for all BRIDGE projects.

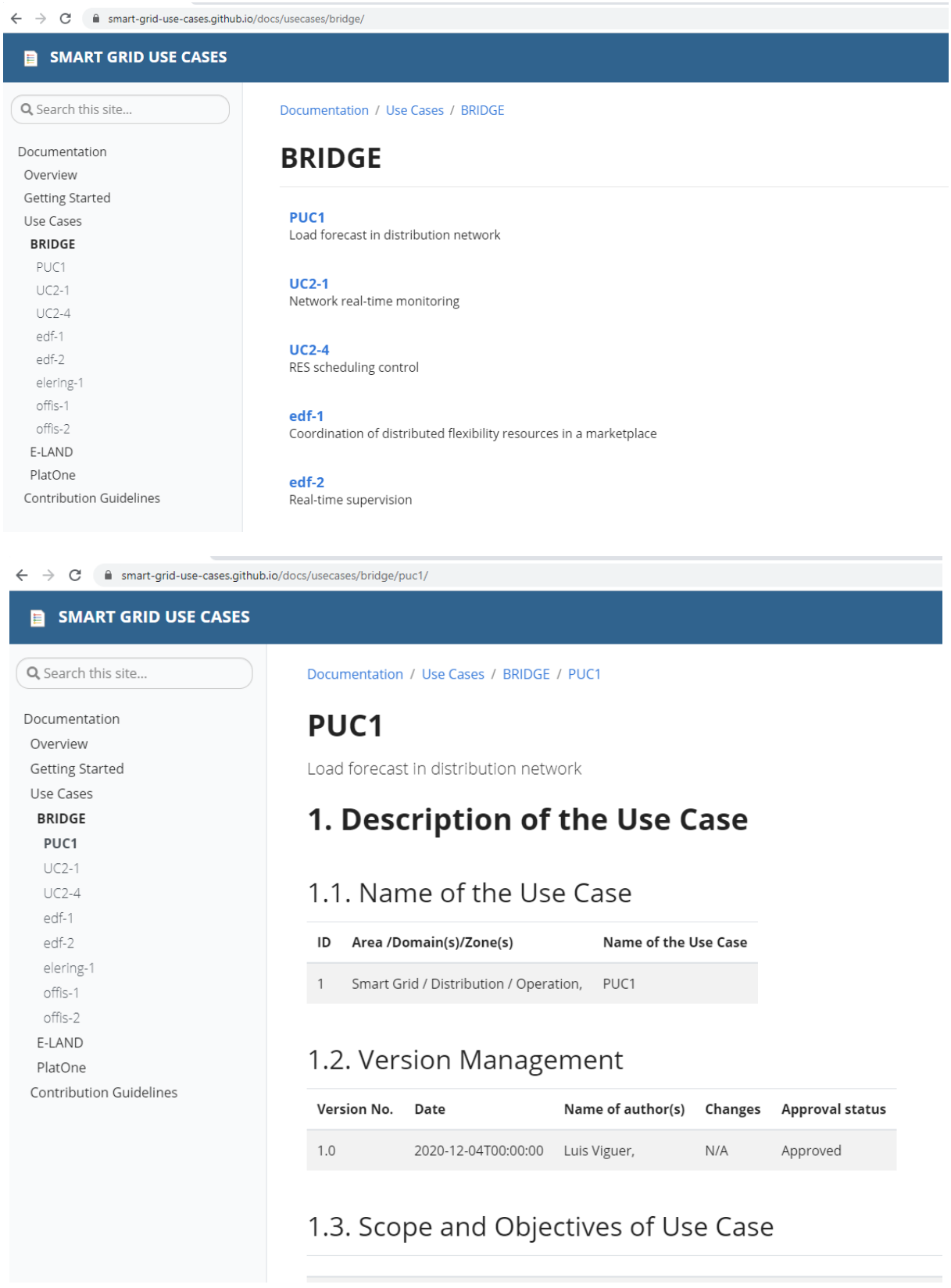


Figure 19: BRIDGE Use case Repository website

The validation of the use case repository has been an iterative process, where all projects have been invited to test the draft repository, in order to evaluate the tool and send feedback for improving the repository in the new versions.

Based on the feedback received so far, it has been identified
some errors, fixed already and some additional functionalities to be added in the next iterations, such as:

- Versioning & Revisions
- Authoring
- Web-based edition of UCs
- Advanced search, combining with roles' repository and with CIM repository

After the testing process finishes, the tool will be made available to all the projects of BRIDGE. The type of licenses for the use of the tool that have been suggested are:

- Creative Commons license for the use case files.
- Apache2 for the processing tools.

This will allow the redistribution and modification of written code, so that anyone can not only use it, but also adapt/improve.

4. Conclusions

As of late January 2021, the TF is at a stage where it is finalising the guidelines to go to all projects as a guide to their replicability and scalability endeavours. At this moment only a few projects that have been selected but the verified guidelines will not be ready by the beginning of March, before the BRIDGE General Assembly, to consider the Task Force as complete. There are still the following pieces of work that should be completed for the work done to be of value to the projects:

- The guidelines that TF aims to have completed by the hopefully by the 2nd of March 2021. With the guidelines, the TF would like to test it with more projects and if needed conduct some refinements to the guidelines.
- Populate a use case repository that will be helpful to the projects when the will be mapping their objectives in the SGAM architecture, a step which is of vital importance for projects to plan and conduct their replicability and scalability objectives. This planned repository is to be hosted on the already designed repository of the Data Management Working Group.

In order to complete these last pending issues, the TF believes a minimum of 6 to 9 months more will be necessary before the fruits of the TF's work may be shared and used by all current and future BRIDGE projects.

Rainer would like to go through each 90sec pitch and ask a question to the pitcher.

After these pitches, Rainer would like to ask panel 5 questions about digitalisation use-cases and after the panel possibly have an audience poll

Then he would like to go to the 3rd part which would again be 5 questions focused on research in the digitalisation space and let a conversation flow but probably end with an audience poll too.

Appendix – Figures

Figure 1: Smart Grid Architecture Model (SGAM) 6
Figure 2: Smart Grid Architecture Model (SGAM) 9
Figure 3: First version of the Task Force RS steps 10
Figure 4: Second version of the Task Force RS steps 16
Figure 5: The logical diagram depicting the replicability /scalability process 23
Figure 6: Logical diagram of subroutine 1 24
Figure 7: SGAM: Smart Grid Plane – Domains & zones 27
Figure 8: SGAM: GOFLEX mapping at the component layer for flexibility trading 29
Figure 9: SGAM: GOFLEX mapping of the communication layer for trading flexibility 30
Figure 10: SGAM: GOFLEX mapping of the information layer 30
Figure 11: Interrelationships between concepts on different levels in the SGAM model 31
Figure 12: SGAM: Mapping of Harmonised role model 32
Figure 13: SGAM: Mapping of communication networks 33
Figure 14: SGAM: Data modelling and harmonization work mapping 33
Figure 15: Logical diagram of subroutine 2 34
Figure 16: Logical diagram of subroutine 3 37
Figure 17: Logical diagram of subroutine 4 37
Figure 18: Use case repository development process 39
Figure 19: BRIDGE Use case Repository website 40

Appendix - Tables

Table 1: First version of the questionnaire 15
Table 2: Second version of the questionnaire 19
Table 3: SGAM Layers 26
Table 4: SGAM Domains 27
Table 5: SGAM Zones 27
Table 6: The KER table of the project 35
Table 7: R&S characteristics 35
Table 8: KER mapping into the SGAM plane 36

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