
 The logo for SEQUOIA features three overlapping circles in shades of brown and grey above the word "SEQUOIA" in a bold, sans-serif font. The 'S' and 'A' are brown, while the 'E', 'Q', 'U', 'O', 'I', and 'O' are grey.	<p><b>SEQUOIA PROJECT</b> <i>“Socio-Economic Impact Assessment for Research Projects”</i></p> <p>Contract n° 258346</p>
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**WP3: Socio-Economic Impact Assessment of Research Projects**

**Deliverable D3.3b - SEQUOIA Self-Assessment How-To Guide**

 The logo for the Seventh Framework Programme consists of a stylized blue graphic of horizontal lines forming a shape that resembles the number 7, with the text "SEVENTH FRAMEWORK PROGRAMME" below it.	<p>Project funded by the European Commission “Information Society and Media Directorate - General”, Support Action</p>
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**Contract Number:** 258346  
**Project Acronym:** SEQUOIA

**Deliverable N°:** D3.3b  
**Due date:** 30 June 2011  
**Delivery Date:** 9 January 2012

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**Made available to:** public

Versioning		
Version	Date	Name, organisation
1	1/05/2011	Antonella Passani (T6) and Fabiana Monacciani (EK)
2	1/09/2011	Fabiana Monacciani, EK
3	15/09/2011	Fabiana Monacciani (EK), Antonella Passani (T6)
4	1/10/2011	Fabiana Monacciani (EK), Antonella Passani (T6 ECO), Francesco Bellini (EK), Marie Debicki (T6 ECO)
5	20/10/2011	Fabiana Monacciani (EK), Antonella Passani (T6 ECO), Francesco Bellini (EK), Marie Debicki (T6 ECO)
6	15/11/2011	Fabiana Monacciani (EK), Antonella Passani (T6 ECO), Francesco Bellini (EK), Marie Debicki (T6 ECO),
7	1/12/2011	Marie Debicki (T6 ECO)
8	21/12/2011	Antonella Passani (T6 ECO), Francesco Bellini (EK), Marie Debicki (T6 ECO)
9 <sup>1</sup>	09/07/2012	Antonella Passani (T6 ECO), Marie Debicki (T6 ECO)

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D3.3b - SEQUOIA Self-Assessment How-To Guide

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<sup>1</sup> The last modifications have been made after the final review.

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## 1. Introduction

The aim of this document is to provide the necessary information to understand and apply the SEQUOIA methodology for socio-economic impact self-assessment to SaaS and IoS research projects.

SEQUOIA is a support action (7FP – DG Information Society and Media) that has developed a methodology for a socio-economic impact self-assessment suitable for SaaS and IoS projects. Its approach and data gathering instruments have been developed and tested with the support of Call 1 and Call 5 projects and, at the time of writing, it has been applied to 30 projects. The results of the assessment exercise conducted by the SEQUOIA team are described in D.3.1 “*Call 1 and Call 5 Projects’ Assessment Report*”. That deliverable is therefore complementary to this How-To Guide.

To learn more about the theoretical foundations of the SEQUOIA methodology and its technical specifications, the reader can refer to D.3.3a “*SEQUOIA Final Self-assessment Methodology*”, which is available on the project website: [www.sequoiaproject.eu](http://www.sequoiaproject.eu). In addition, a short animated description of SEQUOIA impact assessment methodology is available here: <http://prezi.com/jm1zsr2vphv7/sequoia-self-assesment-how-to-guide/>.

Before describing the SEQUOIA methodology, the following section outlines the scope and the characteristics of this guide.

### 1.1 - Scope and characteristics of the SEQUOIA How-To Guide

The aim of this guide is to support research projects in the areas of SaaS and IoS by enabling them to assess their socio-economic impacts. In other words, by applying the SEQUOIA methodology, projects will be able to answer the following questions:

- What is the difference the project will make?
- Why is the project relevant and for whom or what?
- To what extent does the EU investment in the project produce benefits for social and economic actors?
- Taking into account the various potential types of impact, where can the project have the greatest impact? And where can the project increase its impact?

Clearly, answering these questions in a systematic and well-documented way is not an easy task. The SEQUOIA methodology and this How-to Guide can assist the reader in this process; however, he/she should be aware of few important things:

- a) An effective impact assessment should engage various partners (if not the entire project consortium) and should be based on an internal system for gathering the data needed for the impact assessment. The sooner a project starts gathering information and data (even at the stage of proposal writing) the easier it will be to assess its impacts.
- b) Conducting an impact assessment requires the interpretation of the methodology described in this guide and its adaptation to project-specific characteristics, as well as the collection and analysis of the required data. If the project’s consortium includes a sociologist and/or an economist, these professionals are best suited to apply the SEQUOIA methodology. If the project does not have these skills in the consortium, it may be necessary to consider contracting one or two such professionals.

Having said this, the reader will find next (Chapter 2) a step-by-step guide for conducting a socio-economic impact self-assessment using the SEQUOIA methodology. Chapter 2, more specifically, will guide the reader in:

- Defining the areas of impact,
- Defining the stakeholders affected by the project,

- Defining the baseline scenario,
- Describing specific financial, economic, and social impacts generated by the project and
- Quantifying financial, economic and social impacts generated by the project,
- Elaborating collected data and performing the final assessment.

In Chapter 3, the reader will find a support for benchmarking project performance and a proposal for a socio-economic impact report.

In the Annex, the reader will find a questionnaire that may be useful when running the assessment.

## 1.2 - How to use this guide

Chapter 2 is the core of this document and contains a step-by-step guide to project assessment. It guides the reader from data gathering to data analysis and synthesis. While reading this chapter the reader will be invited to answer some questions. Additional questions are in the SEQUOIA questionnaire in the Annex. We recommend printing the questionnaire and completing it while reading Chapter 2 of this How-To Guide. Moreover, the description of each step will be accompanied by an example that will show, in more practical terms, how to run the assessment. The project used as example (FOREST) is purely fictional, and it is used only for better exemplifying the activities to be performed in the various steps.

This guide is not exhaustive. In fact, each project needs to adapt, at least partially, the process described here in order to more closely match the project's particular needs. Moreover, we suggest to support the instruments described in this guide with an internal monitoring system so as to gather the necessary information from project partners on a regular basis (e.g. gather – on a monthly basis – information about the number of scientific conferences at which the project has been presented). This will speed up the assessment process.

Finally, it may be interesting to consider the possibility of contacting the project's users/beneficiaries and involving them in the assessment. In fact, as the reader will see in Chapter 2, the SEQUOIA methodology asks for information about the benefits deriving from the use of the project's outputs. Project partners and evaluators can describe such benefits thanks to their previous experiences and their knowledge of the project's users, but a project may be interested in asking its users directly to describe and possibly quantify perceived benefits. This, of course, will provide more solid and richer data.

## 1.3 - When to use this guide

The Sequoia methodology can be used at different stages of a project's life-cycle. This section will first explain the "ideal" usage of this methodology and then it will consider other ways to apply the SEQUOIA methodology.

The ideal procedure to apply the SEQUOIA methodology is to run a self-assessment at the beginning of the project and then repeat the assessment exercise at regular intervals during the project. Let's assume the project to be assessed will last 3 years. Following this usage schema, the evaluator will run an *ex-ante* impact assessment (at the beginning of the project), two *in-itinere*<sup>2</sup> impact assessments (at the end of Year 1 and of Year 2), and an *ex-post* impact assessment at the end of the project.

By following this schema, it will be possible to monitor the progress of the project in terms of socio-economic impact and to see, at the end of the project, the extent to which it has succeeded in reaching the expected impacts described in the *ex-ante* impact assessment. In fact, as stated later in this Guide, the SEQUOIA methodology is based on an *ex-ante/ex-post* approach. In other terms,

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<sup>2</sup> A *in-itinere evaluation* is a common term which literally stands for "in-process evaluation" or "intermediate evaluation" and, to some extent, "monitoring".

the SEQUOIA methodology compares the state of the art without the project (that we will call later “baseline scenario”) with the situation as it is as a result of the modifications generated by the project; this can of course also be achieved via different time-frames (Fig. 1).

Ideally, in order to map the achieved impacts of a project it would be necessary to run an impact assessment activity one to three years after the end of the project. In fact, research projects tend to deliver (at the end of the project life-cycle) outputs that are not yet ready to be fully exploited by the final users. However, unfortunately, due to the way in which EU research projects are planned and executed, it would be difficult to run an impact assessment after the funded lifetime of a project (project partners will be engaged in other activities, they will not have the necessary resources/interest for running such an assessment, and so on). For this reason, despite the limitations inherent in this approach, we suggest using the SEQUOIA methodology within the project’s funded lifetime.

Other possibilities for using the SEQUOIA methodology are as follows:

- Run an ex-ante impact assessment at the proposal writing stage. This will help to strengthen the project proposal and can feed into the Impact section of the proposal. In addition, the ex-ante impact assessment will be of help in thinking about sustainability and dissemination issues in a more concrete and informed manner.
- Run an ex-post evaluation one to three years after the project has ended. This option comes with some challenges as outlined earlier but it can be of great relevance, especially if a consortium is looking for commercial exploitation of project outputs and/or for venture capital. By performing this ex-post evaluation a consortium will be able to, for example, show how the number of users has increased during the project and after the end of the project, and as such, how the project offers a community of early adopters. In addition, the project consortium will be able to demonstrate that the research and development activity did not finish together with the project end. Very often, in fact, project outputs can only be finalised and transformed into commercially exploitable products after the end of the project lifetime.

In the next chapter, the reader will be guided through the logic of impact assessment and the necessary steps needed to apply the SEQUOIA methodology.

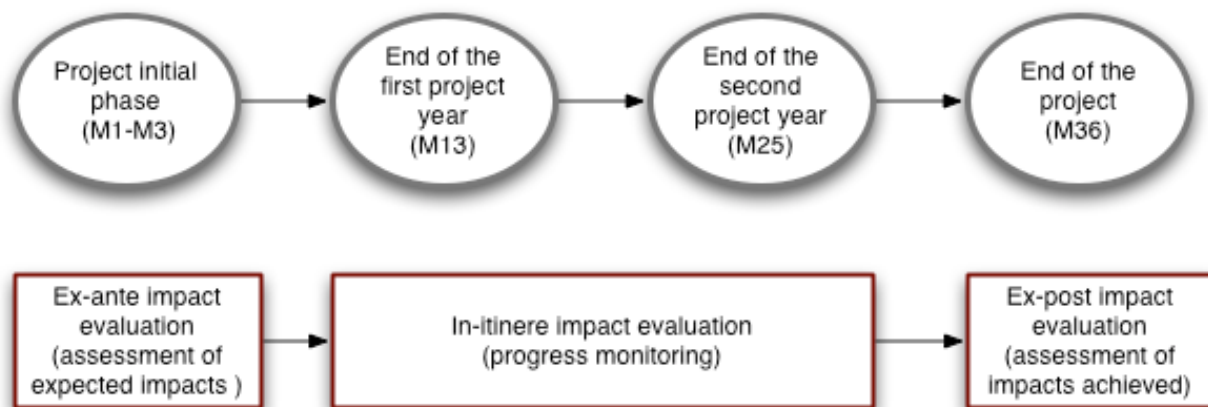


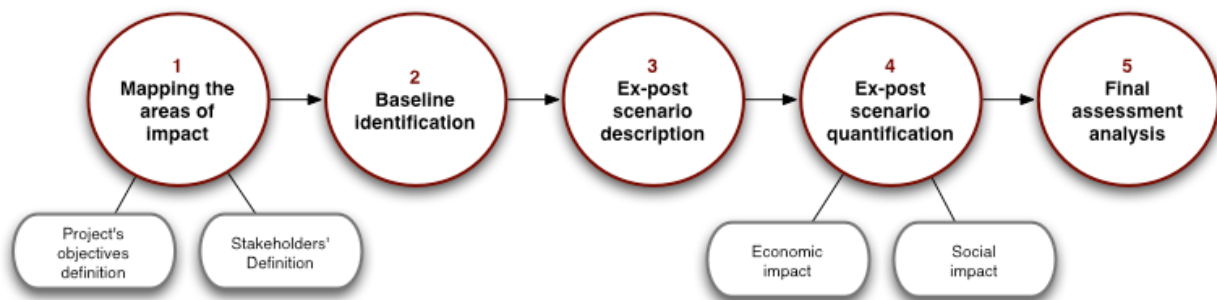
Fig. 1 - When to apply the SEQUOIA methodology (for a typical 3-years project)

### 1.4 – SEQUOIA assessment process: high level overview

This paragraph offers a brief overview of the analytical process involved in carrying out a robust self-assessment of the socio-economic impacts generated by a research project in the IoS/SaaS domain. It is structured as a proposed agenda and check-list for the research consortium partners or for external evaluators, to assess the socio-economic impacts generated by the project's outputs.

The process of project impact self-assessment contains five steps (Fig. 2):

1. Mapping the areas of impact
2. Baseline identification
3. Ex-post scenario description
4. Ex-post scenario quantification
  - o economic impact
  - o social impact
5. Final assessment analysis: calculation of iROI, xROI, tROI and RORI



**Fig. 2 - Process of project impact assessment**

In the following chapter each assessment step is described in terms of its main aims, the main questions to be answered, and the key features of the evaluation approach/technique to be used.

## 2. Step-by-Step Guide for Socio-Economic Impact Self-Assessment

As mentioned before, this chapter will support the evaluator in understanding and carrying out a socio-economic impact assessment using the SEQUOIA methodology. This chapter is structured in five paragraphs, corresponding to the five steps of the assessment process.

### 2.1 - Mapping the areas of impact



The first step of the project assessment aims at the identification of the objectives of the project, in order to understand whether the project will generate some form of socio-economic value. This step asks the evaluator to define what kind of impacts can be expected from the project and on whom these impacts will have an effect. More specifically, in this step the evaluator will need to briefly describe the project objectives, then he/she will map project stakeholders. After the stakeholders mapping, the evaluator will need to select those stakeholders that are more relevant for the project under assessment and for each of them clearly describe the expected/experienced impacts.

The figure below shows the activities to be performed in this step.

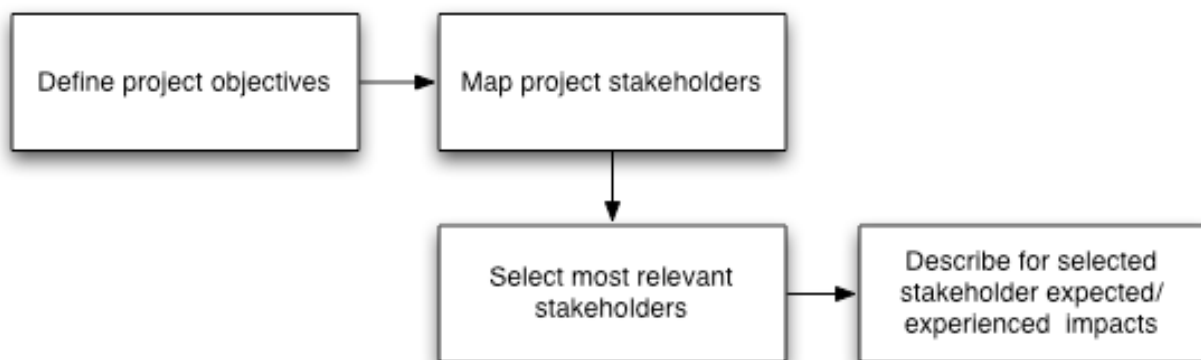


Fig. 3 – Activities to be performed in Step 1

On an operational level, the evaluator can use the following questions when analysing the project's objectives:

- 1) What is the “problem” the project is expected to resolve (or help to resolve)?



2) How did/will the project outputs resolve it (or help resolve it)?

Having described the project objectives, the next question is the following:

3) What stakeholders are impacted by the outputs of the project?

When answering this question, it is important to take into consideration not only the stakeholders that are *directly* affected by the project's *intended* outputs<sup>3</sup>, but also to consider: a) the stakeholders that could be *indirectly* affected by its *intended* outputs; b) the stakeholders that could be *directly* affected by its *unintended* outputs<sup>4</sup>; c) the stakeholders that could be *indirectly* affected by its *unintended* outputs.

A checklist of some of the main possible stakeholders for IoS/SaaS research projects could include:

- Developers and software engineers
- Service providers
- Infrastructure providers
- TELCO operators
- Researchers and research communities
- Industry and SMEs
- Citizens/consumers/end-users
- Project partners
- Other

Of course, the project can have impacts on more than one stakeholder and not all the stakeholders are equally relevant for a SaaS/IoS project. For this reasons, in order to better focus the project assessment, it is reasonable to rate the relevance of the stakeholders effected by the project' outputs and concentrate the effort only on those stakeholders that emerge as more relevant for the project.

For each selected category of stakeholders, then, the evaluator should answer the following question:

4) In what ways are the stakeholders impacted by the project outputs?

Here are some examples of possible impacts generated by the research projects in the IoS/SaaS domain:

- Improvements in quality (e.g. of life, of an activity, etc.)
- Improvements in quantity (e.g. number of users, number of outputs produced, number of data points available/exploitable, etc.)
- Improvements in variety (e.g. number or typologies of activities performable, etc.)
- Improvements in efficiency (e.g. cost reductions, time savings, etc.)
- Improvements in satisfaction (e.g. better targeted users/beneficiaries' needs)

The evaluator should try to be as specific as possible. The example that follows may be of help in understanding the level of detail that is preferable in this step.

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<sup>3</sup> The intended outputs are identified with question n° 1 and are presented in the project's main objectives.

<sup>4</sup> The unintended outputs can be defined as the "collateral effects" of the project (generally negatively affecting some groups of stakeholders) which are not identified in the project's main objectives, but which could be, at least, broadly foreseen during the implementation of the project.

*FOREST is a 3 years project. The main problem the project aims to solve is the lack of interoperability related to mobile devices. FOREST main objective is, therefore, to develop a platform able to automatically migrate services from one mobile device to another.*

*The list of stakeholders' categories impacted by FOREST's outputs is as follow:*

- *Developers and software engineers*
- *Service providers*
- *Infrastructure providers*
- *TELCO operators*
- *Researchers and research communities*
- *Industry and SMEs*
- *Citizens/consumers/end-users*

*All the above-mentioned stakeholders will be affected by project's outputs but not to the same extent. In order to define which categories of stakeholders will experience the greatest impacts, the evaluator attribute a value from 1 to 5 to each stakeholder category where 1 is not very relevant and 5 is very relevant.*

*As a result, developers and software engineers, service providers and SMEs emerged as most relevant stakeholders.*

*In the table below the evaluator describes, for each category of stakeholders, the expected impacts.*

<b>Stakeholder categories</b>	<b>Expected/experienced impacts</b>
<i>Developers and software engineers</i>	<i>They will experience a significant time saving. In fact, once developed a service for a device they will be able to deploy the service also on other devices and other operating systems.</i>
<i>Service providers</i>	<i>They will be able to reach more users by deploying services on different devices with reduced adaptation costs.</i>
<i>SMEs</i>	<i>SMEs of the software sector will take advantage of FOREST outputs because they will be allowed to focus their effort on the development of new services instead of spending resources adapting a service to various devices. Beside, they will be less dependent on infrastructure providers.</i>

**Tab. 1 – Expected impacts of the FOREST project on each stakeholder category**

## 2.2 - Baseline identification



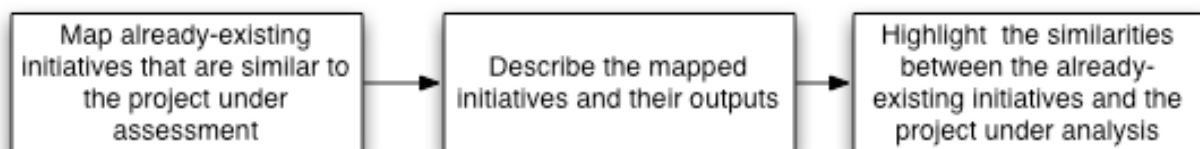
Once the areas of impact have been mapped, the next step consists in verifying whether the project outputs have brought/may bring some improvements to the social/economic welfare of its intended beneficiaries/target audience (who are a sub-set of the stakeholders mapped in the previous stage). The basic approach of such an assessment is to compare the situation with and without the output(s) of the project.

The situation without the project output(s) could be defined as "baseline scenario".

This will usually be a forecast of the future without the project outputs or, in other words, a sort of no-investment forecast of what will happen in the future in the context under consideration without the project under assessment.

More in detail, the evaluator should map all commercial and non-commercial initiatives that have some similarities with the project under assessment and/or that a potential user can see as an alternative to the project under analysis. He/she should, then, describe such initiatives and their outputs and possibly highlight the similarities between the project under analysis and the initiatives identified.

Fig. 4 visualises the activities to be performed in order to define the baseline scenario.



**Fig. 4 - Activities to be performed in Step 2**

Operationally speaking, the evaluator should try to answer the following questions:

- 5) Do other projects/commercial initiatives whose objectives are similar to those of the research project outputs already exist?
- 6) What are the outputs of other such project/commercial initiatives?
- 7) What are the main features of these existing outputs? How do these existing outputs work?
- 8) To what extent are these existing outputs similar to the ones that are/will be provided by the project under analysis?

Answering these questions should help the evaluator clarify, at least in qualitative terms, what the benefits generated by the outputs of the research project under assessment are, with the understanding that such benefits are additional to those already created by other existing

initiatives. In addition, the evaluator should also clarify the relevance of the benefits to the different categories of stakeholders identified in the previous step.

In order to better understand what a "baseline scenario" is, how to construct it, and how to use such estimation for the further impact analysis, the box below provides an example.

*There are two initiatives that are similar to FOREST in terms of target audience and objectives. Both are commercial. The first one is called OCEAN and its main output is a middleware that enables data and applications to automatically migrate from Apple to Android smartphones. The second one is called DESERT and its main output is an analytical software that quantifies the hours of work needed in order to adapt a service to a mobile device different from the one for which the service was originally designed.*

*Both the initiatives are only partially similar to FOREST. Synthetically, FOREST is more than the sum of these two initiatives.*

*The service provided by OCEAN costs 5 Euro for each MB transferred from a device to another.*

*DESERT service cost 10 Euro for each service analysed.*

*In any case, a SME, which developed a game for iPhone and wishes to transfer it to an Android device, will need more than the services offered by OCEAN and DESERT. So, the hypothetical SME will spend 30 Euro for using the service offered by OCEAN (10 Euro x 3 MB of data to be transferred), plus 10 Euro for taking advantage of DESERT analysis. Such analysis indicates that the SME will need to invest 30 hours for adapting the game developed for iPhone to the Android platform. Considering the average hour cost for a game programmer equal to 100 Euros, the labour cost for adapting the game to the new device is of 3.000 Euros.*

*The total cost for adapting the game to a device different from the one for which it was originally designed is, consequently, of 3.040 Euros*

$$\begin{array}{rccccccc} \text{OCEAN service} & + & \text{DESERT service} & + & \text{Game programmer labour cost} & = & \text{Total cost} \\ (30 \text{ Euros}) & & (10 \text{ Euros}) & & (3.000 \text{ Euros}) & & (3.040 \text{ Euros}) \end{array}$$

*This is the baseline scenario for the main output of FOREST.*

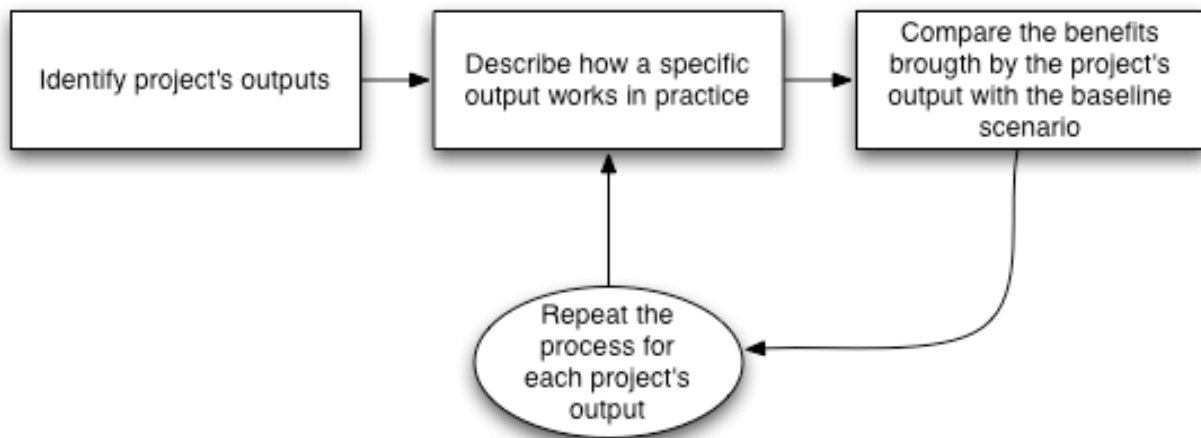
### 2.3 - Ex-post scenario description



This step aims at describing/forecasting the situation after project completion and after the exploitation of the research outputs.

In the ex-post scenario, the evaluator must try to describe the changes brought by the SaaS/IoS project outputs. The evaluator should consider the possible application of project outputs to real life and, therefore, describe the way in which such outputs can be used practically. More specifically, the evaluator should identify all project outputs, describe how each of them works in practice (e.g. how it will be used by beneficiaries) and then compare the advantages brought by each project output compared to the situation described in the baseline scenario.

Fig. 5 synthesises the activities to be performed in this step.



**Fig. 5 - Activities to be performed in Step 3**

Operationally speaking, the evaluator must answer the following questions:

- 9) Does the project envisage one or more concrete applications, in practical terms?
- 10) How do such application(s) work?
- 11) What are the main improvements (advantages) brought by the application of the project outputs to those of the projects/initiatives identified in the baseline scenario?

Sometimes, answering these questions could seem a very difficult task, given that the main outputs of a research project in the IoS/SaaS domain could be intangible or conceptual (e.g. the

development of a programming language, or of an architecture) which, at a first glance, seems not to have any direct impact on end-users, consumers or economic actors.

In such cases, the evaluator should try not to prematurely limit the concept of "output" generated by the research to the "direct product", but should also think about the wide range of exploitation possibilities that could be achieved by third parties (both within and outside the research consortium), in their own specific domains of action.

Another way to answer these questions is to think about the case pilots that have been/must be performed during the life of the research project. This should help identify at least one use case in which substantial (operational) differences are likely to emerge between the assessed research project outputs and the baseline scenario.

In other words, when the evaluator is not able to directly answer Questions 9,10 and 11, some other useful questions are the following:

12) Did the project perform any pilot?

13) Which sector was engaged?

14) What are the differences (improvements) that emerged with respect to the starting situation (baseline scenario)?

As evident from Questions 11 and/or 14, a correct evaluation of the research project outputs should always be made in "differential" or relative terms. The costs and the benefits brought by each specific research project output could be captured by looking at the differences (rather than the absolute values) introduced by the project outputs with respect to the original baseline scenario.

When answering Questions 11 or 14, the evaluator should keep in mind that a comprehensive and exhaustive quantitative assessment is almost impossible. In order to understand what the main financial and socio-economic impacts generated by the project outputs are, and really understand the most important welfare changes brought by the project, a very wide number of fields should be investigated.

Furthermore, considering the diversity of the components, the SEQUOIA methodology recommends that the evaluator focus on a specific set of micro-economic variables that will be introduced in the next sections.

Another important consideration to keep in mind is related to the complexity of most of the SaaS and IoS projects. Each project will deliver more than one output; in addition, each project normally develops several technological components that may have different impacts and may follow different exploitation paths. This complexity should be respected in the project assessment. Thus, we suggest dividing the project in its main outputs/components and running the assessment on each specific component. Each component will have specific stakeholders, and a specific baseline scenario, as well as clearly defined social and economic impacts.

The box below provides an example that may support the evaluator in better understanding how to define the ex-post scenario.

*FOREST will generate the following outputs:*

- *FOREST platform (for the automatic migration of services between mobile devices)*
- *FOREST online course*

*FOREST platform will enable its users to automatically migrate services from one mobile device to another. The platform works as a PaaS, is Open Source and is free of charge for the users. Providing a tangible example, a game programmer will be able to migrate a game from iPhone to Android in 3 hours.*

*If we compare this data with the base line scenario (that required 30 hours for the game migration), we see that the benefit for the user in term of **time saving** is significant and is equal to 27 hours saved.*

*As stated before, besides the platform, FOREST will also generate an online training course for software developers. The online training course will be freely available for everybody, so it will not generate any financial revenues for the project. However, it will give a benefit to its users by improving their knowledge and in building a community with shared interests. The FOREST online course is totally new and no similar initiatives are available at EU level. Consequently the benefits for the users cannot be compared with other similar initiatives. Asking the users to describe and evaluate the quality/quantity of knowledge provided and the relevance of the networking aspect of the course may assess the benefits. If this is not possible, the evaluator can count the hours of training delivered and the learning modules developed; he/she can use those values as a qualitative measure of the knowledge produced for the benefit of users.*

The next step in the description of the assessment process is the quantification of economic and social impacts.

## 2.4 - Ex-post scenario quantification



In this step, the evaluator will be guided in transforming the qualitative information gathered so far into quantitative data. Therefore, detailed information needs to be gathered to quantify two kinds of impacts generated by the projects:

- Economic impacts
- Social impacts

First, we consider the quantification of economic impacts, which is followed by the description of social impacts.

### The economic impacts of the IoS/SaaS research projects

The table below (Tab. 2) shows the data that will be gathered in this step for quantifying the economic impacts. As the evaluator will notice, the data are divided in two categories: monetisable and non-monetisable. This division will be useful in the next step; in fact, the two categories of data will be treated differently and will provide different outputs in term of impact indexes.

<b>Monetisable data</b>
Project total cost
Cost for running the outputs of the project after the formal end of the project
Project revenues
Cost for running a single operation without the project outputs (accordingly to the baseline scenario)
Cost for running a single operation using the project outputs
Energy needed for running a single operation without the project outputs (according to the baseline scenario)
Energy needed for running a single operation using the project outputs
Number of PhD students sponsored/funded by the project
Number of post-doc researchers sponsored/funded by the project
Number of employment positions generated by the project through collaboration agreements with enterprises and third parties and/or through the creation/enlargement of spin-offs
<b>Non-monetisable data</b>
Technological advances

**Tab. 2 – Monetisable and non-monetisable data to gather for quantifying the economic impacts**



Below is a checklist of the main economic impacts that should be considered for the assessment:

1. Effects on cash inflows/outflows
2. Effects on technological advances
3. Effects on welfare derived from technological advances
  - 3a. Effects on efficiency
  - 3b. Effects on environment
  - 3c. Effects on labour market
  - 3d. Other effects on welfare

Each effect will now be discussed.

#### *Effects on cash inflows/outflows*

In order to estimate these effects, the evaluator should answer the following questions:

- 15) What is the total cost of the research project being evaluated? **(IMP. 1)<sup>5</sup>**

When answering this question, the evaluator should consider both European financing and private co-financing of the consortium. The unit of measurement to be used is the Euro.

- 16) How much is the total cost for running the output(s) of the project? **(IMP. 2)**

When answering this question, the evaluator should consider all the data on the disbursements foreseen for the purchase of goods and services, which are not of an investment nature since they are consumed within each accounting period.

According to the SEQUOIA methodology, the evaluator should consider, at least as "Operational" costs, all the disbursements made for personnel and maintenance. A quantification of the personnel cost for running the project outputs (after the end of the project financing) can be obtained by multiplying the number of personnel involved in the operational phase of the research project by the average cost of the labour force (depending on the type – e.g. skilled/unskilled). Maintenance costs can be either precisely estimated according to the features of the assessed output, or roughly calculated as 20% of operational labour cost.

These components together will comprise the bulk of the operating costs. Other specific operational costs may be added, if needed, on a case-by-case basis. The unit of measurement to be used is the Euro.

If on the one hand we have operational costs, on the other hand projects may also generate revenues from the sale of services to end-users. These revenues will be determined by forecasting the quantities of services provided and their respective prices.

The guiding question for identifying such revenue is:

- 17) What are the revenues obtainable by exploiting the project outputs? **(IMP.3)**

According to the SEQUOIA methodology, the evaluator must consider as financial income, all of the revenue arising from the exploitation of project outputs from, for example, sales or royalties or other funding. Of course, different business models can be taken into account. The unit of measurement to be used is the Euro.

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<sup>5</sup> In this section we numbered various typologies of impacts, as they are described; these numbers will be useful in the next sections where the formulas for the quantification of impacts are described.

### *Effects on technological advances*

One of the main outputs of a research project in the IoS/SaaS domain is to provide technological advances in the specific domain of application. The evaluator can measure such technological advances in a qualitative way, by rating, on a scale of 1 to 10, the improvement realised by the project outputs in terms of the following characteristics:

- Functionality<sup>6</sup>
- Reliability<sup>7</sup>
- Usability<sup>8</sup>
- Efficiency<sup>9</sup>
- Maintainability<sup>10</sup>
- Portability<sup>11</sup>
- Quality in Use<sup>12</sup>.

The global technological effect (**IMP. 4**) can be obtained by calculating the mean value of the above ratings. The unit of measurement for the technological impact, therefore, is a score on a scale of 1-10.

### *Effects on welfare derived from technological advances*

Effects on welfare derived from the technological advances generated by the projects can be articulated as follows: a) effects on efficiency, b) effects on environment and c) effects on labour market, d) other effects on welfare. We will now deal with these categories of effect separately.

#### a) Effects on efficiency

Normally, the implementation of research project outputs in the IoS/SaaS domain enables technological advances which bring about a higher efficiency (a reduction of costs for performing an activity and/or higher output with the same inputs, in a given time-frame, etc.) and, therefore, generates benefits for users either in terms of time and effort savings, or in terms of higher productivity.

To measure this kind of benefit, the evaluator should estimate, for each project outputs and related use-case scenario, the cost to perform the activity before (baseline scenario) vs. after project output exploitation. The differences in costs will then be the benefit of the project itself.

On an operational level, the evaluator should answer the following questions:

18) What is the cost of performing a given activity without the use of the project outputs?

19) What is the cost of performing a given activity with the use of the project outputs?

20) What is the difference in cost for performing a given activity between the baseline and the ex-post scenarios? (**IMP 5**)

The cost for performing an activity (either with or without the project output) can generally be calculated by summing up the cost for accessing/buying/using the software/database/product (if any), the cost for the labour force employed in the activity, and the

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<sup>6</sup> The ability of the software product to provide functions which meet stated and implied needs when the software is used under specified conditions.

<sup>7</sup> The ability of the software product to maintain a specified level of performance when used under specified conditions.

<sup>8</sup> The ability of the software product to be understood learned, used and attractive to the user, when used under specified conditions.

<sup>9</sup> The ability of the software product to provide appropriate performance, relative to the amount of resources used, under stated conditions.

<sup>10</sup> The ability of the software product to be modified. Modifications may include corrections, improvements or adaptation of the software to changes in environment, and in requirements and functional specifications.

<sup>11</sup> The ability of the software product to be transferred from one environment to another.

<sup>12</sup> The Quality-in-Use score measures whether a product meets the needs of specified users to achieve specified goals with effectiveness, productivity, safety, and satisfaction in a specified context of use. This can be only achieved in a realistic system environment.

value of the time<sup>13</sup> spent in performing the activity (multiplied by the number of activities completed each year).

Other specific effects on efficiency should be defined and monetised on a case-by-case basis. The unit of measurement to be used is the Euro.

#### b) Effects on the environment

The use of project outputs may bring a reduction in energy consumption for performing user activities. Therefore, in order to assess this kind of benefit, the evaluator should answer the following questions:

21) How much energy is needed to perform an activity without the use of the project outputs?

22) How much energy is needed to perform an activity with the use of the project outputs?

23) What is the difference in energy costs between the baseline and the ex-post scenarios?

#### **(IMP 6)**

Environmental benefits, therefore, could be measured by the evaluator in terms of savings of energy consumption (KWh) (calculated as the difference between the baseline and the ex-post scenario). Saving in energy consumption, calculated for a single activity, will need to be multiplied for the total number of activities carried out on an annual base by the project's users.

In addition, other specific effects on the environment could be defined and monetised on a case-by-case basis. Other possible environmental impacts are linked, for example, to the savings of consuming and selling of papers, CDs, DVDs and other storage-related costs, but also to savings due to reductions in travel. The unit of measurement to be used is the Euro.

#### c) Effects on the labour market

In addition to other more indirect impacts on quality of life, that the evaluator should take into consideration in the social part of the analysis, one of the most important socio-economic impacts could be the creation of new jobs/roles. These could be measurable, for example, in terms of the number of PhD students and post-doctoral researchers sponsored by the project, but also in terms of the number of new employment positions generated through collaboration agreements with enterprises and third parties and through the creation/enlargement of spin-offs. Therefore, to assess this kind of benefit the evaluator should answer the following questions:

24) How many PhD students have been sponsored/funded by the project?

25) How many Post-Doc researchers have been sponsored/funded by the project?

26) How many employment positions have been generated through collaboration agreements with enterprises and third parties and/or through the creation/enlargement of spin-offs?

These benefits on the labour market (**IMP 7**) can be quantified by multiplying the number of new job positions generated (Q24+Q25+Q26), divided by typology, by the average income of each. Alternatively, the evaluator can use the European average salary for skilled personnel, which for a PhD student is equal to 2.753 Euros/month and for a post-doc researcher 3.128 Euros/month.

The unit of measurement to be used is the Euro.

#### d) Other effects

Each project output may also generate other specific effects (**IMP 8**) that the evaluator should try to capture, describe and monetise by using the most appropriate proxies.

Note that this task exceeds the scope of this Guide, the main aim of which is to provide basic instructions for performing a standardised assessment for each research project in the IoS/SaaS domain. A customised assessment, therefore, requires a case-by-case analysis.

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<sup>13</sup> A proxy for the value of the time is the average income obtained by the workers employed in the activity.

In the box that follows, the evaluator can find the data gathered with relation to the example we used so far in demonstrating the SEQUOIA assessment process.

We said that by using FOREST main output (the FOREST PLATFORM) a potential user will save 27 hours for adapting a game developed for iPhone on Android. Now we have to transform this benefit (time saving) in monetary terms. For doing this, we can multiply the hours saved for the average hour salary of a game programmer (100 Euros). Consequently, the saving in terms of labour costs is of 2.700 Euros. This result is based on the fact that the game programmer will need only 3 hours (100 Euros \* 3 hours, in red in the table below) for adapting the service to the new platform. However, the total cost of the baseline scenario was of 3.040 that included the costs for using DESERT and OCEAN services that are not longer needed. Consequently the total saving for one operation will be:

$$3.040 - 300 = 2.740 \text{ Euros}$$

In order to be more precise, it is necessary to multiply this benefit (2.740 Euros) by the number of FOREST users, and by the number of operations to be performed on a year base by each user. Let us assume that FOREST is on-going but that, thanks to a pilot case run in the game sector, the evaluator estimates a number of users equal to 100. Each game programmer will migrate 50 games each year.

Consequently, we can calculate IMP.5 that is the difference between the cost for performing activities between the baseline and the ex-post scenario by multiplying the cost saving for one operation by the total number of operation executed annually. Imp. 5 will be as follows:

$$2.740 * 5000 = 13.700.000 \text{ Euros}$$

With reference to the cost for running project's outputs after the formal end of the project, FOREST is not planning to create a spin-off or to sell its outputs, but the University leading the project will provide the maintenance of FOREST outputs and will further develop them. It will also support the users by providing assistance. FOREST consortium foresees that 10 people will be doing those activities, mainly PhD holders (7 persons) and Post-Doc researchers (3 persons). The labour cost for running the outputs of the FOREST project will be, therefore, of 34.375 Euros/month. That is equal to 343.860 Euros on an annual base.

Below the formula used for reaching this figure (in green in the table below)<sup>14</sup>.

Personnel cost (343.860 Euros)	+	Maintenance cost (68.772 Euros)	=	Total operational cost (412.632 Euros)
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Here below (Tab. 3) a table with all the data needed for quantifying economic impacts.

<b>Monetisable data</b>	
Project total cost (IMP.1)	3.200.000 Euros (EU funding + partners' co-funding)
Cost for running the outputs of the project after the formal end of the project (IMP.2)	<b>412.632 Euros</b>

<i>Project revenues (IMP.3)</i>	<i>None (no commercial exploitation planned)</i>
<i>Cost for running a single operation without the project outputs (accordingly to the baseline scenario)</i>	<i>3.040 Euros</i>
<i>Cost for running a single operation using the project outputs</i>	<b><i>300 Euros</i></b>
<i>Energy needed for running a single operation without the project outputs (accordingly to the baseline scenario)</i>	<i>90 KWh</i>
<i>Energy needed for running a single operation using the project outputs</i>	<i>30 KWh</i>
<i>Number of PhD students sponsored/funded by the project</i>	<i>6</i>
<i>Number of Post-Doc researchers sponsored/funded by the project</i>	<i>2</i>
<i>Number of employment positions generated by the project through collaboration agreements with enterprises and third parties and/or through the creation/enlargement of spin-offs</i>	<i>0</i>
<b><i>Non-monetisable data</i></b>	
<i>Technological advances (IMP.4)</i>	<i>7</i>

**Tab. 3 – FOREST data needed for quantifying economic impacts**

### **The social impacts of the IoS/SaaS research projects**

For most projects it can be very difficult to imagine and map social impacts. On the one hand, this may be due to the interdisciplinary background of SaaS and IoS project partners, who are not necessarily accustomed to thinking about social issues; or, on the other hand, to the fact that most of these projects are developing *enabling technologies/solutions* that may have very diverse and partially not-predictable applications and uses.

In general, we can say that it is easier to map and describe social impacts when dealing with the development of services than when dealing with languages, infrastructures, methods, or framework development. In other words, it is easier to map social impacts when the technology developed leads to the engagement of end-users and citizens.

But we know that most of the SaaS and IoS projects are developing solutions dedicated to software developers and consequently social impacts will be mainly *indirect* impacts. For example, impacts will be on the ICT industry first and – once the project outputs are exploited by the ICT industry – they will then impact citizens and European society as a whole.

Clearly, these difficulties need to be taken into consideration when applying the SEQUOIA methodology, but we suggest to make an effort to map potential social impacts. From a methodological point of view, the SEQUOIA team tried to keep the social impact variables as concrete and close to the context of research projects as possible.

As described in the SEQUOIA methodology (D.3.3a), social impacts have been articulated in three main categories:

- Impact on employment and working routines
- Impact on knowledge production and sharing
- Impact on social capital

We will discuss each category separately in the next paragraphs. We anticipate in the table (Tab. 4) below the data that the evaluator will need to gather in order to perform the quantification of social impacts.

Work positions generated by the project
Improvement of users' working routines
Number of journal articles published or submitted in peer-reviewed journals
Number of books published
Number books chapters edited
Number of articles presented at conference or published in proceedings
Number of scientific deliverables produced
Number of knowledge exchange initiatives performed
Number of new scientific collaboration links established
Number of training modules created
Number of scientific events where project has been presented
Availability of papers and deliverables through project website
Improvement in supporting ICT usage for all and democratic participation
Number of new collaboration links established with research institutes
Number of new collaboration links established with industry partners
Number of new project proposals submitted
Social capital increment for users and beneficiaries

**Tab. 4 – Data needed for quantifying social impacts**

*Impact on employment and working routines*

First of all, we have to remember that the ability of a project to generate new employment positions has already been considered in the economic impact. Here we will only consider those variables/aspects related to employment that cannot be transformed into monetary values. In order to estimate these impacts, the evaluator should answer the following questions:

- 27. How many persons worked/are working on the project? *Please consider the entire duration of the project (or its duration up to now) and count them using full-time equivalent (FTE= one person working fulltime for a year<sup>15</sup>).*
- 28. How many additional researchers (in companies and universities) were recruited specifically for this project? *Please consider the entire duration of the project (or its duration up to now) and count them using full-time equivalent (Full Time Equivalent (FTE = one person working fulltime for a year).*

The metric will be a finite number equal to the sum of job positions created and counted using Full Time Equivalent.

Additionally, the following question, which is related to the ability of the project to impact on the working routines of the project's users/beneficiaries, may need to be answered. Ideally, the evaluator should get in touch with project users and ask them to describe how and to what extent the project outputs will/do improve their working routines. If this is not possible, the evaluator should estimate those improvements by using the following question:

- 29. To what extent do you agree with the following statements?

<b>The project will:</b>	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly agree</b>
Provide solutions for working efficiently and conveniently for all sizes of organisations				
Reduce the work of the users (more operations will be automated)				
Allow your users to do their everyday work more quickly				

The evaluator should select the box that matches his/her opinion and then calculate his/her choice by using the following scale of equivalence. The evaluator will need, then, to calculate the average value.

<b>Level of agreement</b>	<b>Scale</b>
Strongly disagree	1
Disagree	2
Agree	3
Strongly agree	4
No answer	0

The metric will be a finite number on the above scale (a value from 0 to 4).

*Impact on knowledge production and sharing*

For any research project, the ability to produce knowledge and systematize it in scientific outputs and diffuse it within and outside the scientific community is crucial. The evaluator that wishes to access the project impact in this way should be able to answer the following questions:

30. How many scientific products did your project produce? Answer by filling in the table below.

Journal articles	Articles presented at conferences or published in proceedings	Books	Chapters in books	Scientific Deliverables <sup>16</sup>

31. How many of the following activities did you perform? (If you did not perform these activities insert "0" in the appropriate cell)

N. of knowledge exchange initiatives	
N. of new collaboration links established thanks to the participation in the project (in terms of exchange of information, exchange of resources, joint teaching courses, etc.)	
N. of scientific conferences and seminars at which your project has been presented	

32. How many new training modules, online courses and seminars did/will the project develop, if any?



For questions 29, 30 and 31 the unit of measurement will be an absolute value (a finite number).

Other questions that the evaluator should answer are the following:

33. Are scientific outputs generated by the project publicly available on the project website or in other open repositories?

Yes	
No	
Partially	

The unit of measurement will be a number from 0 to 1. The evaluator should use 0 if the answer is NO, 1 if the answer is YES, and 0,25 – 0,5 or 0.75 according to the availability of scientific outputs on the project’s website.

The above questions were strictly related to project activities, while the following ones ask the evaluator to consider benefits provided by the project outputs to the project’s stakeholders/beneficiaries.

As for question n. 29, ideally the evaluator should contact or monitor the project stakeholders/beneficiaries in order to have more effective data on this important aspect. If this is not possible, the following question can support the evaluator in gathering information about the project’s ability (as perceived by the project itself) to support ICT usage for all and to foster users’ democratic participation.

34. To what extent do you agree with the following statements?

<b>Your project will:</b>	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly agree</b>
Make information/knowledge available to a larger number of interested users				
Support knowledge transfer between universities/research centres and industry/SMEs				
Make highly innovative services available to citizens				
Develop services that will positively impact on citizens’ everyday life				
Make available high-quality knowledge/information to citizens				
Reduce the digital divide				
Support democratic processes/democratisation				
Positively impact education				
Enable diversity and individual expression				
Promote flexibility for personalisation on a large scale/high interface adaptability				

The evaluator should select the box that matches best the project performance and then transform the selected choice by using the following scale of equivalence. The evaluator will need, then, to calculate the average value.

Level of agreement	Scale
Strongly disagree	1
Disagree	2
Agree	3
Strongly agree	4
No answer	0

The metric will be a finite number on the above scale (a value from 0 to 4).

### *Impact on social capital*

The last aspect to consider in assessing the social impact of the project is related to social capital. One of the most important value added of EU co-funded projects is, indeed, that of reinforcing and enlarging research networks and, by doing so, strengthening the European Research Area. Social capital represents the immaterial wealth generated by the fact of belonging to multiple relational networks<sup>17</sup>. In other words, we will see how SaaS and IoS can support project partners and project outputs' beneficiaries in enlarging and making their social networks denser. In addition to this, we will consider the impact on trust, considering trust as one of the most important components of social capital.

In assessing the impact of the project on social capital the evaluator should answer the following questions:

35. How many new collaboration links did you establish with industrial actors thanks to the project and its outputs?
36. How many new partnership agreements did you establish with other universities, research centres, enterprises or public bodies thanks to the project and its outputs?
37. How many new projects proposals have you and other partners submitted thanks to the participation in the project?

For questions 34, 35 and 36 the metric will be an absolute value (a finite number).

The last question to be considered when analysing impact on social capital would be:

38. To what extent can you agree with the following statements?

<b>Your project will:</b>	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly agree</b>
Improve the way in which users communicate and collaborate with each other (the quality of the collaboration)/ facilitate social interaction				
Improve trust among your target users				
Improve citizens' trust in public administration				
Improve citizens' trust in ICT and the Internet				
Support network creation/collaboration of enterprises in the sector				
Support network creation/collaboration among citizens				
Support network creation/collaboration in academia				
Enlarge already-existing networks				

The evaluator should select the box that best matches the project performance and then transform the choice made in ordinal terms, by using the following scale of equivalence. The evaluator will need, then, to calculate the average value.

<b>Level of agreement</b>	<b>Scale</b>
Strongly disagree	1
Disagree	2
Agree	3
Strongly agree	4
No answer	0

The metric will be a finite number on the above scale (a value from 0 to 4).

In the box that follows, the evaluator can find the data gathered with reference to the example we used so far in illustrating the SEQUOIA methodology.

The first data required when quantifying social impacts is related to the number of persons that worked on the project. SEQUOIA methodology suggests using full-time equivalent.

Considering the entire duration of FOREST project, and all the partners, 62 persons were engaged in research and administrative activities. However, not all worked on a full-time base on the project. More specifically, 20 persons worked full time, 30 worked part-time and 12 worked 5 day per month. All of them were employed for the entire duration of the project (3 years). Adding this figures the evaluator obtains the following result: 38 is the total number of persons that worked on the project each year. Below the counting made to obtain this result.

$$20 + (30/2) + (12/4) = 38 \quad (\text{The evaluator considered a full month to be composed of 20 working days})$$

No additional researchers were recruited specifically for FOREST project.

Then, the evaluator considered the project ability to improve users/beneficiaries' working routines. Unfortunately, FOREST did not have the budget needed for directly engaging its users in the assessment of social impacts; consequently, the table below shows the evaluator opinion on the subject.

<b>The project will:</b>	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly agree</b>
Provide solutions for working efficiently and conveniently for all sizes of organisations			X	
Reduce the work of the users (more operations will be automated)				X
Allow your users to do their everyday work more quickly				X

As we have said before, FOREST's main output considerably reduce the time needed for migrating a application from one device to another, so we can see the project's benefit in term of improving the working routines of their users. The evaluator should now transform his/her evaluation using the 0-4 scale suggested (see Question 29) and calculate the average value. Below the result obtained.

$$(3 + 4 + 4) / 3 = 3,6$$

Once considered the impact on employment and working routines, the evaluator considered the project impact on knowledge production and sharing by answering to Question 30, 31, 32, 33 and 34.

Below the data related to questions 30, 31 and 32.

Number of journal articles published or submitted in peer-reviewed journals	4
Number of books published	1
Number books chapters edited	2
Number of articles presented at conference or published in proceedings	20
Number of scientific deliverables produced	20
Number of knowledge exchange initiatives performed	10
Number of new scientific collaboration links established	5
Number of training modules created	12
Number of scientific events where project has been presented	13

Question 33 asks if the scientific outputs are available on the project web site. In fact, all the scientific output are available. The evaluator transformed this information in a number; 1 is the value to be attributed to the project if all the outputs are publically available as in this case.

Finally, the evaluator expressed his/her opinion on the statement proposed in question 34, transformed the results in a 0-4 scale and calculated the average. Below the results for FOREST project.

<b>Your project will:</b>	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly agree</b>
<i>Make information/knowledge available to a larger number of interested users</i>			X	
<i>Support knowledge transfer between universities/research centres and industry/SMEs</i>		X		
<i>Make highly innovative services available to citizens</i>		X		
<i>Develop services that will positively impact on citizens' everyday life</i>			X	
<i>Make available high-quality knowledge/information to citizens</i>		X		
<i>Reduce the digital divide</i>		X		
<i>Support democratic processes/ democratisation</i>		X		
<i>Positively impact education</i>		X		
<i>Enable diversity and individual expression</i>		X		
<i>Promote flexibility for personalisation on a large scale/high interface adaptability</i>			X	

It is evident that FOREST project does not have a high direct impact on the dimensions considered in the above table. The result of question 34 is: 2,3.

The evaluator followed the same process in analysing FOREST impact on social capital and discovered that the project did not invest too much on this aspect either. In fact, no collaboration link where established by FOREST's partners with industrial actors (question 35), no partnership agreement where signed with universities outside FOREST consortium (question 36) and only one project proposal was submitted as a follow up of FOREST. FOREST project showed a low ability in enlarging its partner's networks and, similarly, did not influence the social capital of its users even if – thanks to the summer school - it facilitated the social interaction of researchers and software developers in the area of mobile devices. The results of questions 38 is 1,3.

We will see in the next steps how to use the data gathered so far.

In the following section we will see the last step of project assessment. The evaluator will be supported in aggregating and making comparable and consistent the data gathered so far.

## 2.5 - Final assessment analysis



Once all the information regarding the economic and social impacts of the research project have been generated and collected, the last step is to process this data to assess the project's performance globally with the use of aggregated and synthetic indices.

Specifically:

- All the information regarding the economic impacts (except the technological ones) should be used by the evaluator in order to perform the Economic Impact Assessment, which aims at understanding whether the project output(s) is able to improve the total welfare of society by measuring, in economic terms, the range of direct and indirect impacts affecting both the users and non-users of the project outputs. The final output of the economic assessment, then, will be condensed into three indices: the **iROI**, the **xROI** and the **tROI**.
- All the data related to social impacts, instead, should be used by the evaluator to perform the social impact assessment, which aims at understanding the improvement made by the project in terms of impact on employment and working routines, knowledge production and sharing, and social capital. The final output of the social assessment, then, will be a multicriteria and multidimensional description of the attained impacts in the social sphere. In other words, the evaluator will have an index for each of the three social dimensions just mentioned (working routines, knowledge production and sharing and social capital).
- Finally, the economic indices (iROI, xROI and tROI) and the multicriteria description of the social impacts will be condensed into a global indicator called **RORI**.

Fig. 6 shows the activities to be performed in this step.

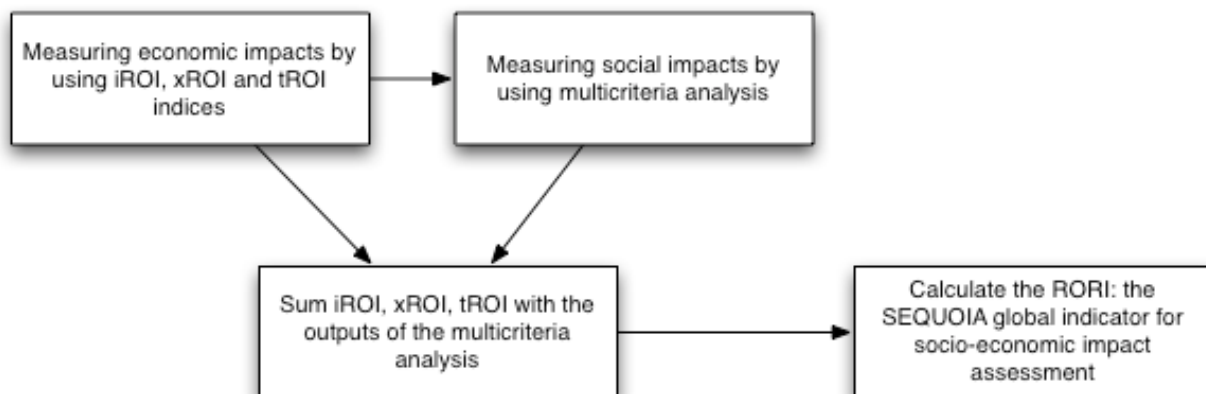


Fig. 6 - Activities to be performed in Step 5

The next sections describe in greater detail the meaning of each indicator/index and show the inputs to be included and formulas to be used for calculating such indicators/indices.

### **iROI (Internal Return On Investment)**

This indicator provides information about the financial sustainability of the project, by measuring the (potential and/or future) financial return for the consortium partners. The iROI indicator is based on the financial evaluation of the total cost for performing the research project and on the identification of the financial returns for the consortium partners, deriving mainly from selling the output(s) produced.

The formula for iROI calculation is the following:

$$iROI = \frac{\text{investment financial inflow} - \text{investment financial outflow}}{\text{Investment cost}}$$

In order to better identify what data must be included for iROI calculation, the above formula can be “described” using the symbols that have been introduced in the previous sections, thereby obtaining the following:

$$iROI = \frac{IMP.3 - IMP.2}{IMP.1}$$

An iROI higher than zero means that the financial returns estimated over the project output lifetime cover the expenses that the consortium itself must sustain in order to run the project, both during the research phase and during the exploitation of the results phase.

Such an indicator is measured as a percentage - e.g. if iROI = 5 % - or 0.05 -, this means that the financial net benefits are 5% of the investment costs.

Given that many research project outputs are provided as open source or as a free service/tool to the end-users, and many possible exploitations of the research outputs are not foreseeable at the end of research project life-cycle, the evaluator can normally expect an average iROI somewhere between 0 and 5%.

### **xROI (External Return On Investment)**

This indicator quantifies the net economic benefits (other than the financial ones) that the project generates in society as a whole (considering both users and non-users of research outputs). In order to be included into the xROI, each impact of the project (positive or negative), other than the financial ones, must be expressed in monetary terms by using appropriate proxies<sup>18</sup>.

The formula for xROI calculation is the following:

$$xROI = \frac{\text{Socioeconomic Benefits} - \text{Socioeconomic Costs}}{\text{Investment cost}}$$

In order to better identify what data must be included for xROI calculation, the above formula can be “described” using the symbols that have been introduced in previous sections, thereby obtaining the following:

$$\text{xROI} = \frac{(\text{IMP.5} + \text{IMP.6} + \text{IMP.7} + \text{IMP.8})}{\text{IMP.1}}$$

An xROI higher than zero means that the economic benefits estimated over the project's lifetime are higher than the economic costs society has to pay for enjoying the outputs of the project itself.

The xROI should be normally higher than the iROI, given the wider meaning of project costs and benefits than a project's inflows and outflows. Therefore, the evaluator should normally expect an average xROI somewhere between 5% and 20%; values higher than 20% would denote, therefore, a very high economic impact of the project.

Note that, in some cases, especially for research projects that are not close to the market (i.e. closer to basic research than applied research), the xROI value could be negatively affected by the underestimation of the project's total long-term intangible and highly unpredictable benefits. For this reason, xROI values lower than 5% can be considered acceptable as well.

### **tROI (Total Return On Investment)**

This indicator quantifies the total monetisable impacts of the research project, both those experienced by the consortium's partners and by the whole society. It is calculated by summing up all the information gathered by the iROI and the xROI indices.

The formula for xROI calculation, therefore, is the following:

$$\text{tROI} = \text{iROI} + \text{xROI}$$

The average expected tROI is somewhere between 5% and 25%. However, values lower than the average can be considered acceptable in some specific cases (see above).

Here below an example that may help the evaluator in understanding how to calculate the SEQUOIA indices.



The table below recaps the monetisable values gathered so far for FOREST project; the last column on the right labels some of the data for better matching the format of the iROI, xROI and tROI formula. The proposed labels will be of help in calculating FOREST iROI, xROI and tROI.

<b>Monetisable data</b>	<b>FOREST values</b>	
Project total cost	3.200.000 Euros (EU funding + partners' co-funding)	<b>IMP.1</b>
Cost for running the outputs of the project after the formal end of the project	<b>412.632 Euros</b>	<b>IMP.2</b>
Project revenues	Zero (no commercial exploitation planned)	<b>IMP.3</b>
Cost for running a single operation without the project outputs (accordingly to the baseline scenario)	3.040 Euros	<b>A</b>
Cost for running a single operation using the project outputs	<b>300 Euros</b>	<b>B</b>
Energy needed for running a single operation without the project outputs (accordingly to the baseline scenario)	90 KWh	<b>C</b>
Energy needed for running a single operation using the project outputs	30 KWh	<b>D</b>
Number of PhD students sponsored/funded by the project	6	<b>E</b>
Number of Post-Doc researchers sponsored/funded by the project	2	<b>F</b>
Number of employment positions generated by the project through collaboration agreements with enterprises and third parties and/or through the creation/enlargement of spin-offs	0	<b>G</b>

**Tab. 5 – Monetisable values gathered for the FOREST project**

**iROI**

By applying the iROI formula to FOREST project the evaluator obtains the following:

$$iROI = \frac{IMP.3 - IMP.2}{IMP.1} = \frac{0 - 412.632}{3.200.000} = -0,13$$

FOREST iROI is negative, due to the fact that the project is not planning any commercial exploitation of its results and has obtained no revenues so far.

**xROI**

To calculate the xROI we need to add and transform some of the data gathered so far and reported in the table above.

The xROI formula is, in fact, as follow:

$$\text{xROI} = \frac{(\text{IMP.5} + \text{IMP.6} + \text{IMP.7} + \text{IMP.8})}{\text{IMP.1}}$$

IMP.5 is the difference between the cost to perform the activities between the baseline and the ex-post scenario (A – B), multiplied by the number of activities performed (50 activities, for 100 users accordingly to the ex-post scenario described in previous paragraphs).

As described before, in FOREST case we will have a total cost saving of 13.700.000 Euros. Below the formula used:

$$\text{IMP.5} = (3.040 - 300) * (50*100) = 13.700.000$$

IMP.6 is the difference in energy cost between the baseline and the ex-post scenario.

FOREST users will save 60 KWh for each activity (C –D); considering an average cost of 0,13 Euros for 1 KWh, the evaluator can calculate an energy-cost saving of 7,8 Euros for each activity. The evaluator has now to multiply the energy-cost saving for a single activity by the total number of activities performed annually by FOREST users. In FOREST case the evaluator estimated a total number of activities equal to 5.000; consequently, the saving in energy costs is of:

$$\text{IMP.6} = (60 * 0,13) * 5000 = 39.000 \text{ Euros}$$

IMP.7 considers the project effect on the labour market that is possible to describe in monetary terms. In FOREST case, IMP.7 is obtained by multiplying the average annual salary of a PhD holder and Post-Doc researcher for the number of PhD students and Post-Doc researchers engaged by FOREST project (E+F). Below the value of IMP.7:

$$\text{IMP.7} = (6*33.000) + (2*37.500) = 273.000 \text{ Euros}$$

FOREST does not have any other outputs to be transformed in monetary form, so IMP.8 is equal to zero.

Therefore, FOREST's xROI, is as follows:

$$\text{xROI} = \frac{(\text{IMP.5} + \text{IMP.6} + \text{IMP.7} + \text{IMP.8})}{\text{IMP.1}} = \frac{(13.700.000 + 39.000 + 273.000 + 0)}{3.200.000} = 4,38$$

The xROI value for FOREST is extremely positive and indicates a high positive economic impact on the society.

### **tROI**

Finally the evaluator should calculate the tROI as the sum of iROI and xROI.

tROI for FOREST would be as follows:

$$\text{tROI} = - 0,13 + 4,38 = 4,25$$

### **Multicriteria assessment**

As discussed above, not all the impacts generated by the projects can be measured in monetary terms: the impact on the environment, on working routines, on knowledge production and sharing, and on social capital, or even the technological improvements brought by the project outputs, in fact, cannot be easily transformed into economic/financial values.

According to the SEQUOIA methodology, therefore, the evaluator should assess such impacts through the use of the Multicriteria Techniques (MCA), according to which, where monetization is not possible, each impact must be expressed in its most appropriate and suitable unit of measurement (see also D3.3a).

The main impacts to be considered in the MCA, with an indication of the most suitable metric to be used for their measurement, are:

1. Technological benefits (scale 1 -10)<sup>19</sup>
2. Impact on employment and working routines (absolute values and scale 0-4)
3. Impact on knowledge production and sharing (absolute values, scale 0-4 and scale 0-1)
4. Impact on social capital (absolute values and scale 0-4)

The evaluator can collect all the above impacts into a matrix where some impacts (e.g. technological, social capital) will be described by using an ordinal scale (e.g. 1-10 scale), while others will be expressed by the set of indicators listed in the table below and measured in their most suitable units.

Macro variable	Meso variable	Micro variable/indicator	Unit of measurement	
<b>Technological benefits</b>				
		Self-assessment	Scale 0-10	
<b>Impact on employment and work-routines</b>				
	<i>Impact on general employment</i>	Number of persons working on the project	Absolute value (using full-time equivalent)	
	<i>Improvement of working routines</i>	Self-assessment	Scale 0-4	
<b>Knowledge production and sharing</b>				
	<i>Scientific impact</i>			
			N. of journal articles published/submitted	Absolute values
			N. of books published	Absolute values
			N. of books chapters edited	Absolute values
			N. articles presented at conf. or pub. in proceedings	Absolute values
			N. of scientific deliverables	Absolute values
	<i>Knowledge sharing</i>			
			N. of knowledge exchange initiatives	Absolute values
			N. of scientific collaboration links	Absolute values
			N. of training modules	Absolute values
			N. of scientific events where project was presented	Absolute values
			Availability of papers and deliverables through project website	Scale 0-1
<i>Support ICT usage for all and democratic participation</i>				
	Self-assessment	Scale 0-4		
<b>Social capital (trust, collaboration, networking)</b>				
	<i>Social capital increment for project participants</i>			
			New collaboration links established with research institutes	Absolute values
			New collaboration links established with industry partners	Absolute values
		New project proposals submitted	Absolute values	
<i>Social capital increment for users and beneficiaries</i>				
	Self-assessment	Scale 0-4		

Tab. 6- Variables and indices related to the multicriteria analysis

### **The need for normalisation**

Since all the impacts analysed are measured with different units of measurement, it is necessary to normalize them in order to obtain values that can be compared and summed between them. In order to normalize the value obtained for each impact, it is necessary to divide each value by the highest possible value obtainable. For the impacts described using an ordinal scale, the highest value of the scale is used. For the impacts using an absolute value, the highest value encountered in the projects analysed is used (see D3.1).

The table below (Tab. 7) shows how to normalize the values, with the highest values used for each impact.

	<b>Project values</b>	<b>Max values</b>	<b>Normalized values</b>
<b>Technological benefits</b>	A	10	<b>A/10</b>
<b>Impact on employment and work-routines</b>			
Impact on general employment			
<i>Work positions generated by the project</i>	B	200	<b>B/200</b>
Improvement of working routines			
<i>Self assessment</i>	C	4	<b>C/4</b>
<b>Total impact on employment and working routines</b>			<b>SUM a</b>
<b>Impact on knowledge production and sharing</b>			
Scientific impact			
<i>N journal articles</i>	D	15	<b>D/15</b>
<i>N books</i>	E	2	<b>E/2</b>
<i>N books chapters</i>	F	10	<b>F/10</b>
<i>N articles presented at conf. or pub. In proceedings</i>	G	100	<b>G/100</b>
<i>N scientific deliverables</i>	H	50	<b>H/50</b>
Knowledge sharing			
<i>N knowledge exchange initiatives</i>	I	60	<b>I/60</b>
<i>N scientific collaboration links</i>	J	120	<b>J/120</b>
<i>N training modules</i>	K	50	<b>K/50</b>
<i>N of scientific events where project presented</i>	L	150	<b>L/150</b>
<i>Availability of papers and del through website</i>	M	1	<b>M/1</b>
Support ICT usage for all and democratic participation			
<i>Self-assessment</i>	N	4	<b>N/4</b>
<b>Total impact on knowledge production and sharing</b>			<b>SUM b</b>
<b>Impact on social capital</b>			
Social capital increment for project participants			
<i>New collaboration with research institutes</i>	O	17	<b>O/17</b>
<i>New collaboration with industry partners</i>	P	5	<b>P/5</b>
<i>New project proposals</i>	Q	17	<b>Q/17</b>
Social capital increment for users and beneficiaries			
<i>Self-assessment</i>	R	4	<b>R/4</b>
<b>Total impact on social capital</b>			<b>SUM c</b>
<b>TOTAL Impact Multicriteria Analysis</b>			<b>Total SUM = (SUM a + SUM b + SUM c)</b>

Tab. 7– Normalised values

Once all the values gathered for the multicriteria analysis have been normalised, the evaluator can sum them all and he/she will obtain the Total Impact Multicriteria analysis. In addition, he/she can derive 4 meso-indices related to the three components of social impact plus the technological benefits.

As shown in Tab. 7, in fact, the evaluator can obtain the following aggregated indices summing the related variables:

- Technological benefits
- Total impact on employment and working routines
- Total impact on knowledge production and sharing
- Total impact on social capital

As described in the next paragraph, the above-mentioned meso-indices, besides being necessary to calculate the RORI, are also useful in describing the performance of the project in the different areas of potential impact.

In the box that follows, the results of the multicriteria analysis applied to the FOREST project.

*The table below reports – in the first column, FOREST data as gathered so far by the evaluator and – in the third column – its normalised values.*

*As described before, normalised values are obtained dividing the project values by the maximum values observed in the 30 projects analysed by the SEQUOIA team (see D3.1).*

	<b>Project values</b>	<b>Max values</b>	<b>Normalized values</b>
<b>Technological benefits</b>	7	10	$7/10 = 0,7$
<b>Impact on employment and work-routines</b>			
Impact on general employment			
<i>Number of persons working on the project</i>	38	200	$38/200 = 0,19$
Improvement of working routines			
<i>Self assessment</i>	3,6	4	$3,6/4 = 0,9$
<b>Total impact on employment and working routine</b>			<b>SUM a = 1,79</b>
<b>Impact on knowledge production and sharing</b>			
Scientific impact			
<i>N journal articles</i>	4	15	$4/15 = 0,27$
<i>N books</i>	1	2	$1/2 = 0,5$
<i>N books chapters</i>	2	10	$2/10 = 0,2$
<i>N articles presented at conf. or pub. In proceedings</i>	20	100	$20/100 = 0,2$
<i>N scientific deliverables</i>	20	50	$20/50 = 0,4$
Knowledge sharing			
<i>N knowledge exchange initiatives</i>	10	60	$10/60 = 0,17$
<i>N scientific collaboration links</i>	5	120	$5/120 = 0,05$
<i>N training modules</i>	12	50	$12/50 = 0,24$
<i>N of scientific events where project presented</i>	13	150	$13/150 = 0,09$
<i>Availability of papers and del through website</i>	1	1	$1/1 = 1$
Support ICT usage for all and democratic participation			
<i>Self-assessment</i>	2,3	4	$2,3/4 = 0,58$
<b>Total impact on knowledge production and sharing</b>			<b>SUM b = 4,51</b>
<b>Impact on social capital</b>			

Social capital increment for project participants			
<i>New collaboration with research institutes</i>	0	17	<b>0/17=0</b>
<i>New collaboration with industry partners</i>	0	5	<b>0/5=0</b>
<i>New project proposals</i>	1	17	<b>1/17=0,07</b>
Social capital increment for users and beneficiaries			
<i>Self-assessment</i>	1,3	4	<b>1,3/4=0,33</b>
<b>Total impact on social capital</b>			<b>SUM c=0,40</b>
<b>TOTAL Impact Multicriteria Analysis</b>			<b>Total SUM = (SUM a + SUM b + SUM c)= 6,70</b>

**Tab. 8 – Data gathered for the multicriteria analysis of the FOREST project**

Looking at the meso variables of the multicriteria analysis, FOREST results are as follows:

- Technological benefits= 0,7
- Impact on employment and working routine= 1,79
- Impact on knowledge production and sharing= 4,51
- Impact on social capital= 0,4

## RORI

Once all the information about the financial (iROI) and economic (xROI) performance of each project is summarized and after the assessment of other non-monetisable impacts through the use of the MCA, the last step consists in calculating a global index, synthesizing all the information generated during the assessment, and showing the total performance of each research project. This index is called **RORI**, as it expresses the global **Return On Research Investment**.

The issue, here, is to put together all the information generated during the analysis, both qualitative and quantitative, both monetary (or monetisable) or not. The resulting index, therefore, does not have a strict economic meaning but, at least, it provides a measure of the whole performance of a IoS/SaaS research project in a given moment. It is useful to compare the project performances in different time-frames, and it allows the comparison with other projects.

The RORI index is calculated as a weighted sum of the iROI, the xROI, and the other non-monetisable impact indicators collected in the multicriteria table.

The formula for the calculation of the RORI is the following:

$$RORI = \sum_{n=1}^N X_n w_n$$

where:

$n = 1, \dots, N$  (N is the number of variables)

w are the *indicators weights*<sup>20</sup>  $\sum_{n=1}^N w_n = 1$

X are the *normalized indicators* synthesizing the following impacts:

- Financial (iROI)
- Economic (xROI)
- Technological benefits
- Impact on employment and working routine



- Impact on knowledge production and sharing
- Impact on social capital

As mentioned above, it is necessary to attribute to each variable a proper weight; the weights express the relative importance of each impact assessed.

A way for defining the weights could be to select a panel of experts and follow their indication. At the present stage, the SEQUOIA team suggests the weighting system reported in the table below (Tab. 9) that assigns equal relevance to monetisable and non-monetisable impacts.

<b>iROI</b>	<b>xROI</b>	<b>Technical benefits</b>	<b>Impact on employment and working routine</b>	<b>Impact on knowledge production and sharing</b>	<b>Impact on social capital</b>
0,15	0,35	0,10	0,10	0,20	0,10
0,5		0,5			

**Tab. 9 - Weighting system**

Below, the calculation of RORI applied to the example used so far.

*The process followed so far, quantified FOREST's impacts as follows:*

- *iROI= -0,13*
- *xROI= 4,38*
- *Technological benefits=0,7*
- *Impact on employment and working routine= 1,79*
- *Impact on knowledge production and sharing= 4,51*
- *Impact on social capital= 0,4*

*The evaluator should now multiply the values obtained so far (iROI, xROI and multicriteria outputs) by their relative weights (see table below).*

<b>iROI</b>	<b>xROI</b>	<b>Technical benefits</b>	<b>Impact on employment and working routine</b>	<b>Impact on knowledge production and sharing</b>	<b>Impact on social capital</b>
0,15	0,35	0,10	0,10	0,20	0,10

*The evaluator will obtain the following:*

$$RORI = (-0,13 * 0,15) + (4,38 * 0,35) + (0,7 * 0,10) + (1,79 * 0,10) + (4,51 * 0,20) + (0,4 * 0,10) = 2,7$$

*As mentioned, the RORI index has not a strict economic value, but it can be useful as a synthetic value of project performance. For example, the evaluator can repeat the assessment after one year and compare this first RORI (2,7), with the new RORI that hopefully will be higher.*

Once the RORI has been calculated, the project assessment process is concluded. However, all the indices calculated so far are not self-explicative; rather, they need to be discussed and considered in the context of each specific project. In the next chapter we will see how to prepare an impact assessment report in order to communicate the project's assessment outputs in an effective way.

### 3. After the impact assessment

In this chapter we briefly examine what to do after the calculation of the SEQUOIA indices: iROI, xROI, tROI, multicriteria indices and RORI.

#### 3.1 - Evaluating your performance using the SEQUOIA average RORI

We have seen in Chapter 1 that projects can use the SEQUOIA methodology in different time-frames. If a project follows the ideal process (assessing ex-ante, in-itinere and ex-post impacts) this section can be skipped. Such a project will not need an external benchmark to evaluate its progress. This is because even if such a project will not have a benchmark at the time of the ex-ante assessment, it will have it later on, when the ex-ante assessment will become the benchmark for the following assessment exercises.

If this is not the case, and the evaluator needs an external benchmark in order to be able to “read” the impact assessment outputs, the evaluator can use the average values calculated by the SEQUOIA team. The average values that have been calculated by analysing 30 SaaS and IoS projects are presented below. The evaluator can use them to know if the project he/she is assessing is in line with other projects, if it is below average, or above average.

Unfortunately, most of the projects assessed by SEQUOIA are still running and it was not possible to calculate their iROI and xROI. However, in the table below we report all the values obtained and that can be still useful as points of reference. It is important to consider that these values are not weighted.

Tab. 10 shows the calculation of the normalized value of each impact with reference to the average values obtained by the set of 30 projects assessed by SEQUOIA.

	Average value
<b>ECONOMIC IMPACTS</b>	
<b>Average % of cost savings</b>	6%
<i>Hardware cost savings</i>	4%
<i>Connectivity cost savings</i>	0%
<i>Maintenance cost savings</i>	8%
<i>Software development cost savings</i>	16%
<i>Cost savings due to increment in software re-usability</i>	12%
<i>Cost savings due to improvement of test-deploy-rework cycle management</i>	5%
<i>Cost savings due to less process break/system failure/etc.</i>	3%
<i>Cost saving related to compliance with reg./leg.-bus./legislation constraints</i>	5%
<i>Other</i>	3%
Technological benefits	6,7
<b>Impact on labour market</b>	
<i>PhD students sponsored by the project</i>	6,16

<i>Post-Doc researchers sponsored by the project</i>	3,21
<b>Knowledge production and sharing</b>	
<b><i>Scientific impact</i></b>	
N. of journal articles submitted of published	5,69
N. of books published	0,67
N. of book chapters edited	2,9
N. of articles presented at conf. or published in proceedings	18,78
N. of scientific deliverables	13,29
<b><i>Knowledge sharing</i></b>	
N. of knowledge exchange initiatives	8,64
N. of new scientific collaboration links established	10,56
N. of training modules	8,38
N. scientific events where project where presented	19,9
Availability of papers and deliverables through project website	0,7
<b><i>Support ICT usage for all and democratic participation</i></b>	
Self-assessment	2,33
<b>Impact on employment and work-routine</b>	
<b><i>Impact on general employment</i></b>	
Work positions generated by the project (head count)	40,67
<b><i>Improvement of working routine</i></b>	
Self-assessment	2,84
<b>Social capital</b>	
<b><i>Social capital increment for project participants</i></b>	
New collaboration links with research institutes established	3,28
New collaboration links with industry partners established	0,81
New project proposals submitted	2,58
<b><i>Social capital increment for users and beneficiaries</i></b>	
Self-assessment	2,46
<b>Average investment</b>	5.134.823

**Tab. 10 - Average values calculated by the SEQUOIA team based on 30 SaaS/IoS projects**

More information about the average performance of the 30 projects assessed by SEQUOIA team can be found in D3.1.

In the next section we will see how to organise an impact assessment report.

### 3.2 - The socio-economic impact report

After performing all the stages described in Chapter 2, you will have a completed socio-economic impact analysis. However, the process is not finished yet. There is a final important stage: reporting the results of the analysis to the various stakeholders. The evaluator's findings may be for internal management use, for public distribution, or the basis for discussions with various stakeholders. Preparing a report is useful to make recommendations, which can influence what happens as the research project moves forward.

Socio-economic impact assessment aims to increase accountability for the stakeholders; therefore, it is important that the results are communicated to the stakeholders in a meaningful way. This involves more than publishing the results on the project's website. It is possible, in fact, that external stakeholders too may be interested in hearing about the research project's socio-economic impact assessment – both the process that the evaluator went through and the results.

The final report, therefore, should comprise more than the final indices calculated. Rather, it should include qualitative, quantitative and financial aspects, to provide the reader with the salient information on the socio-economic value being created during the project's lifetime. The report should include enough information to allow another person to feel confident that the calculations are robust and accurate. Thus, it needs to include all the decisions and assumptions that the evaluator made along the way. The final assessment report should be as short as possible; evaluation should be supported by evidence and the process followed needs to be reported in a transparent way. It should also be consistent, using a structured framework that allows comparison between reports of different periods. The example provided in this Guide should be of help in writing the assessment report.

Details of the contents of the final assessment report can be found in the box below. However, the following quantitative and qualitative information is usually also included in a comprehensive socio-economic assessment report:

- Information related to the research project, including a discussion of its targets, key stakeholders and structure;
- Description of the main outputs and a qualitative description of the advances (benefits) brought about by the project for society;
- Case studies/use cases, or quotes from participants/users that illustrate particular findings;
- Details of the calculations, and a discussion of any estimates and assumptions.

The evaluator should try to present the findings in a balanced way; how the evaluator phrases his or her recommendations may affect how they are taken up. It is important, therefore, to stress the positive as well as negative findings and to present them in a sensitive fashion.

It is also important to be able to distinguish between benefits that are not achieved and benefits that may be achieved but cannot be documented and evidenced.

There is a risk, and perhaps a temptation, to focus on the final index RORI that shows the global socio-economic return of the project. However, the number by itself does not have much meaning – it is merely a shorthand way of expressing all of the values that the evaluator has calculated so far. By contrast, the RORI index should be presented alongside the other information, such as the story of how change is being created by the research project and a description of each single impact considered, one-by-one.

**Table of contents for a socio-economic impact assessment report: a proposal**

**1 - Mapping the areas of impact**

**Contents:**

- *Description of the story of the project, of its general targets, of the problems it addresses, of the final output(s) of the project.*
- *Description of the structure of the project's activities and of the project consortium.*
- *Identification of the main beneficiaries/users, description of the main activities it will be possible for them to perform by using the project's outputs, and first indication of the expected impacts of the project on each category of beneficiaries.*

**2 - Impact evaluation**

**2.1 - Economic impact**

**Contents:**

- *Detailed description of each project output and identification, for each, of the financial inflows and outflows generated, and of the economic effects on efficiency, environment, labour market and social welfare.*
- *Monetisation of all the estimated impacts.*

**2.2 - Social impact**

**Contents:**

- *Detailed description of all non-monetisable outputs and qualitative description of direct and indirect social impacts on project stakeholders, users, and society as a whole.*
- *Calculation of the multicriteria indices: technological benefits, impact on employment and working routines, impact on knowledge production and sharing, impact on social capital.*
- *Comments on the result of the multicriteria analysis.*

**3- Final assessment: project impact in one page**

**Contents:**

- *Calculation of iROI, xROI, tROI and RORI.*
- *Comparison with previous assessment (if any).*
- *Comments on the assessment and suggestions on how to improve the project's impacts.*

## 4 - Conclusions

The evaluator, at this point, should be ready to perform a socio-economic impact assessment using SEQUOIA methodology.

To learn more about its theoretical foundations, the evaluator can refer to D.3.3a “*SEQUOIA Final Self-assessment Methodology*”, which is available on the project website: [www.sequoiaproject.eu](http://www.sequoiaproject.eu). In addition, a short animated description of the SEQUOIA impact assessment methodology is available here: <http://prezi.com/jm1zsr2vphv7/sequoia-self-assesment-how-to-guide/>.

In addition, the evaluator may be interested in reading also D.3.1 “*Call 1 and Call 5 Projects’ Assessment Report*”, where the results of the assessment exercise conducted by the SEQUOIA team are described, or D.3.2 “*Best Practices Report*” which presents five case studies of the projects analysed that emerged as particularly promising in terms of positive impact on users and society as a whole.

It is important, moreover, to recall the importance and the need to adapt the SEQUOIA methodology to the characteristics of the project to be assessed; this is crucial in order to respect the unique way in which each research project creates value.

## **Annex – The SEQUOIA questionnaire**

In the next few pages the reader will find the SEQUOIA questionnaire to be used as starting point for project impact assessment. Of course each evaluator can add and change as many questions as he/she would like to or needs, he/she has just to be sure to work in parallel on the questionnaire and on the data gathering matrix and related calculations. In fact, if questions are added or changed, the matrix for data entry has to be updated consistently; the evaluator should also be sure to include the new/modified variables in the xROI, iROI, tROI and RORI formulas.

One last remark is related to the numbers assigned to the questions in the Annex. The questions numbering is not consistent with the numbering used in the How-To Guide text. This is due to the fact that the questionnaire that follows contains more questions than the Guide, this for supporting the evaluator in building a more complete data set. The structure of the questionnaire, however, matches closely the structure of the How-To Guide so that the evaluator can follow the process in the Guide while answering the questionnaire.



## **SEQUOIA questionnaire: towards a self-assessment model for socio-economic impact analysis**

This questionnaire is organized in the following 5 sections:

Section A - Mapping the areas of impact.

Section B - Baseline identification.

Section C - Ex-post scenario description.

Section D - Ex-post scenario quantification: economic impacts.

Section E - Ex-post scenario quantification: social impacts.



**Section A – Mapping the areas of impact**

1. What is the “problem” your project is expected to resolve (or help to solve)?<sup>21</sup>

.....

.....

.....

.....

2. How did/will your project output(s) resolve it (or help resolve it)?

.....

.....

.....

.....

3. What stakeholders are impacted by the outputs of you project?

Developers and software engineers	
Service providers	
Infrastructure providers and TELCO operators	
Researchers and research communities	
Industry and SMEs	
Citizens/consumers/end-users	
Project partners are project’s main users	
Other (please specify.....)	

4. Thinking about your project’s stakeholders/beneficiaries, please estimate the relevance of each stakeholders/beneficiaries category by assigning a value from 1 to 5, where 1 is not relevant and 5 is very relevant:

STAKEHOLDERS/BENEFICIARIES CATEGORIES	Value				
	1	2	3	4	5
Developers and software engineers	1	2	3	4	5
Service providers	1	2	3	4	5
Infrastructure providers and TELCO operators	1	2	3	4	5
Researchers and research communities	1	2	3	4	5
Industry and SMEs	1	2	3	4	5
Citizens/consumers/end-users	1	2	3	4	5
Project partners are project’s main users	1	2	3	4	5
Other (please specify.....)	1	2	3	4	5

*NOTE: From now on we suggest using as stakeholders/beneficiaries only those categories that scored more than 3.*

5. Please describe, for each stakeholder/beneficiary category that scored more than 3 in question n. 4, the main activities it will be possible for them to perform by using your project’s outputs. Additionally, please indicate the expected impact of your project on the selected categories. (For example: SEQUOIA users are: SaaS and IoS projects. They will be able to self-assess their socio-economic impact. The impact of SEQUOIA on those projects is that of improving their socio-economic impact).

STAKEHOLDERS/BENEFICIARIES CATEGORIES	Main activities	Expected impact
Developers and software engineers		
Service providers		
Infrastructure providers and TELCO operators		
Researchers and research communities		
Industry and SMEs		
Citizens/consumers/end-users		
Other (please specify.....)		

**Section B – Baseline identification**

The **baseline** is the scenario before the project starts. It is not just the state-of-the-art, but rather the good(s) - i.e. software - or service(s), similar or alternative, on the basis of which improvements brought by the results of the project' output(s) can be demonstrated. Of course, each project is the sum of several parts/components. Please, in answering this section's questions, consider only the three components that you think most innovative and/or promising in term of socio-economic impact.

6. Please provide (in the table below) a definition or a brief description of the three project components/outputs you will consider for the baseline identification.

Name of the component/output	Short description of the component/output

7. Do other projects/commercial initiatives whose objectives are similar to those of your project outputs already exist?

Yes	
No	

8. Do other project/commercial initiatives whose technical solutions are similar to yours already exist?

Yes	
No	

9. What are the outputs of other such projects/commercial initiatives?

.....  
 .....  
 .....  
 .....

10. What are the main features of these existing outputs? How do these existing outputs work?

.....  
 .....  
 .....  
 .....

11. To what extent are these existing outputs similar to the ones that are/will be provided by your project?

.....

.....

**Section C – Ex-post scenario description**

12. To the best of your knowledge, what are the main improvements (advantages) brought by the application of your project outputs to those of the project/initiatives identified in the baseline scenario?

.....  
 .....

13. Did/will your project perform any use cases/pilots?

None	
1 to 3	
4 to 6	
7 to 10	

14. If you performed or plan to perform any use cases/pilots, what sector was/will be engaged?

Environment/natural hazard forecasting/natural risk management	
Mathematics and natural science	
Transportation and logistics	
Telecommunications/interoperability and mobile services	
eHealth	
eGovernment	
eLearning	
eLiteracy	
eInfrastructure	
Other 1 (please specify).....	
Other 2 (please specify).....	

15. Are you able to identify at least one use case<sup>22</sup> in which substantial (operational) differences are likely to emerge/emerged between your project and the baseline scenario?

.....

16. If you answered yes to the previous questions, what are the differences (improvements) that emerged with respect to the starting situation (baseline scenario)?

.....

*In the table below you find some example of potential improvements*

Improve service/product/system quality	
Reach more users	
Lower entry barriers in a specific economic sector	
Improve the access to large amounts of data. Improve the possibility to exploit large amounts of data (more efficient data analysis)	
More efficient data exchange	
Improve scalability	
Expand the range and the typologies of research activities and services made available to research communities	
Cost reductions	
Reduce the time needed to deliver a service (reduce the time-to-market period)	
Reduce the time needed to deploy a service over the network/the architecture	
Keeping pace with competitors/with the research in the field	
Ability to better target users/beneficiaries' needs	
Increment the optimisation of resources/improve efficiency	
Other (please specify.....)	

17. If you selected “cost reduction” in the previous question, please specify what kind of cost reduction you expect and the percentage of cost saving you expect to achieve (please calculate the average cost reduction by comparing a user utilising your project’s outputs and a user utilising already existing solutions)

<b>Cost reduction typologies</b>	<b>Percentage of saving</b>
Reduce hardware costs	
Reduce connectivity costs	
Reduce maintenance cost	
Lower software development costs	
Cost reduction due to increment in software re-usability	
Cost reduction due to improvement of test-deploy-rework cycle management	
Cost reduction due to less process break/system failure/etc	
Reduction of cost related to compliance with regulatory/legal-business legislation/policies constraints	
Other1 (Please specify.....)	
Other2 (Please specify.....)	

**Section D – Ex-post scenario quantification - Economic Impact**

*Effect on cash inflows/outflows*

18. What is the total cost of your project?

.....

19. How much is the total cost for running the output(s) of the project?

.....

20. What are/will be your financial revenues?

<b>Revenue</b>	<b>Euro</b>
Incoming from solution sale	
Fees (and pay per use approach)	
Royalties	
Other monetary returns (please specify: .....)	

*Effect on technological advances*

21. How would you assess your project’s outputs in terms of the following characteristics? Probably your project will produce more than one technological output, in completing the table below please consider the most innovative outputs. (Please assign a score from 1 to 10, where 1 is the minimum score and 10 is the maximum score):

<b>Characteristic</b>	<b>Sub-characteristic</b>	<b>Score (from 1 to 10)</b>
<b>External Quality</b>		
<b>Functionality</b>		
	Suitability	
	Accuracy	
	Interoperability	
	Security	
	Functionality Compliance	
<b>Reliability</b>		
	Maturity	
	Fault Tolerance	
	Recoverability	
	Reliability Compliance	
<b>Usability</b>		
	Understandability	
	Learnability	
	Operability	
	Attractiveness	
	Usability Compliance	
<b>Efficiency</b>		
	Time Behaviour	
	Resource Utilisation	
	Efficiency Compliance	
<b>Maintainability</b>		
	Analysability	

	Changeability	
	Stability	
	Testability	
	Maintainability Compliance	
<b>Portability</b>		
	Adaptability	
	Installability	
	Co-Existence	
	Replaceability	
	Portability Compliance	
<b>Quality in Use</b>		
	Effectiveness	
	Productivity	
	Satisfaction	
	Safety	

*Effect on efficiency*

- 22. What is the cost of performing a given activity without the use of your project output(s)?  
.....
- 23. What is the cost of performing a given activity with the use of your project output(s)?  
.....
- 24. What is the difference in cost for performing a given activity between the baseline and the ex-post scenario?  
.....

*Effect on environment*

- 25. How much energy is needed to perform an activity without the use of project output(s)?  
.....
- 26. How much energy is needed to performing an activity with the use of project output(s)?  
.....
- 27. Which is the difference in energy costs between the baseline and the ex-post scenario?  
.....



**NOTE:** the result of the previous questions would be energy saving, you can now fill-in the following table, but you have to transform absolute values into monetary terms (example: you save 100 KWh, the cost of 1KWh is of 2 Euros, so your project saved 200 Euros).

28. In addition, you may consider other categories of saving that will imply an effect on environment.

Categories of costs	Difference in Euros between the baseline and the ex-post scenario
Consuming and selling off paper	
Consuming and selling off films/CD/DVD/etc...	
Storage-related costs	
Travels' costs	
Production of technological waste	

*Effect on labour market*

29. How many PhD students are/have been sponsored/funded by the project?

.....

30. How many Post-Doc researchers are/have been sponsored/funded by the project?

.....

31. How many employment positions have been generated through collaboration agreements with enterprises and third parties and/or through the creation/enlargement of spin-offs?

.....

**Section E – Ex-post scenario quantification - Social Impact**

32. Will your project have an impact on the following sectors? (up to three answers allowed)

eHealth	
eGovernment	
eLearning	
eLiteracy	
eInfrastructure	
eInclusion	
eEnvironment	
ICT based diffusion of culture, cultural diversity and cultural heritage	
ICT support to efficient transport and better mobility	
ICT industry in general	
The project does not directly provide/create a solution for these sectors, but it <b>enables</b> the creation of various solutions.	
Other (please specify.....)	

33. For the three sectors you selected, can you please provide brief examples of impacts?

Sector	Impact

34. Here below you find some of the goals of the European Digital Agenda 2020. Please assign a score from 1 to 5 describing the policy goal more related to your project (1 is no related and 5 is very related). In other words, how will your project work towards the fulfilment of the Agenda goals?

Social agenda 2020	Value				
	1	2	3	4	5
Creation of content and borderless services	1	2	3	4	5
Allow SMEs to enter new markets by lowering entry barriers for SMEs /lowering resource costs					
Creation of a united digital market	1	2	3	4	5
Increase ICT related Services demand	1	2	3	4	5
Basic broadband for all	1	2	3	4	5
Fast and ultra-fast broadband for all	1	2	3	4	5
Promote better use of standards	1	2	3	4	5
Make the network more secure/more trustworthy	1	2	3	4	5
Combating cybercrime	1	2	3	4	5
Digitalisation of European cinema	1	2	3	4	5
Increase the interoperability of Smart Grids at European level	1	2	3	4	5
Increase interoperability at a more general level	1	2	3	4	5
Increment eCommerce	1	2	3	4	5

*Impact on employment and working routines*

35. How many persons worked/are working on your project? *Please consider the entire duration of the project (or its duration up to now) and count them using full-time equivalent.*

.....

36. How many additional researchers (in the project consortium) were recruited specifically for this project? *Please consider the entire duration of the project (or its duration up to now) and count them using full-day equivalent.*

.....

37. To what extent do you agree on the following sentences?

<b>Your project will:</b>	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly agree</b>
Provide solutions for working efficiently and conveniently for all sizes of firms				
Reduce the work of the users (more operations will be automated)				
Allow your users to do their every-day work more quickly				

*Impact on knowledge creation and sharing*

38. Please fill in the table below indicating the number of scientific outputs produced by your project up to now (peer-reviewed articles, deliverables, books. ecc).

<b>Journal articles</b>	<b>Articles presented at conferences or published in proceedings</b>	<b>Books</b>	<b>Chapters of books</b>	<b>Scientific Deliverables<sup>23</sup></b>

39. How many of the following activities did you perform? (If you did not perform those activities insert "zero" in the appropriate cell)

N. of knowledge exchange initiatives	
N. of new collaboration links established thanks to the participation in the project (in terms of exchange of information, exchange of resources, joint teaching courses, etc.)	
N. of scientific conferences and seminars in which your project has been presented	

40. How many new training modules, online courses and seminars did/will your project develops, if any?

.....

41. Are scientific outputs generated by your project publicly available on the project website or in other open repositories?

Yes	
No	
Partially	

42. To what extent do you agree on the following sentences?

<b>Your project will:</b>	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly agree</b>
Make information/knowledge available to a larger number of interested users				
Support knowledge transfer between universities/research centres and industry/SMEs				
Make highly innovative services available to citizens				
Develop services that will positively impact on citizens' everyday life				
Make available high-quality knowledge/information to citizens				
Reduce the digital divide				
Support democratic processes/democratisation				
Positively impact education				
Enable diversity and individual expression				
Promote flexibility for personalisation on a large scale/high interface adaptability				

*Impact on social capital*

43. How many new commercial collaborations did you established with industrial actors thanks to the project and its output(s)?

.....

44. How many new partnership agreements did you established with other universities, research centres, enterprises or public bodies thanks to the project and its output(s)?

.....

45. How many new projects proposals have you and other partners submitted thanks to the participation in the project?

.....

46. To what extent do you agree on the following sentences?

<b>Your project will:</b>	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly agree</b>
Improve the way in which users communicate and collaborate with each other (the quality of the collaboration)/ facilitate social interaction				
Improve trust among your target users				
Improve citizens' trust in public administration				
Improve citizens' trust in ICT and the Internet				
Support network creation/ collaboration of enterprises in the sector				
Support network creation/collaboration among citizens				
Support network creation/collaboration in academia				
Enlarge already-existing networks				