

An Approach to Monitoring the Long-term Impact Creation Activities in EU Research Projects

Kim JANSSON, Iris KARVONEN, Outi KETTUNEN, Martin OLLUS
VTT Technical Research Centre of Finland, P.O. Box 1000, FI-02044 VTT, Finland
Tel: +358 20 722 7070, Fax: +358 20 722 7604

Emails: Kim.Jansson@vtt.fi, Iris.Karvonen@vtt.fi, Outi.Kettunen@vtt.fi, Martin@ollus.net

Abstract: The impact creation process of European Union-funded R&D projects is an area needing attention, and is discussed in this paper. European tax-payers' money must be spent in the most beneficial way. The resources used must contribute to European wellbeing and have a wide and positive impact on industry, society and the citizens. One problem is that the impact creation process, on a large scale, takes a long time. The time frame for impact creation is much longer than the duration of the R&D project. The major part of the impact that can be achieved through R&D activities will take place well after completion of the actual R&D work. Care must be taken during execution of the project that all possible actions are performed for maximum post-project impact creation. The paper introduces an innovative methodology for impact monitoring during a project. The method used is based on impact waves and success tree approaches. Examples are given of practical implementation in the EU FI-PPP Project FITMAN.

1. Introduction

Over four decades, the European Union has financed research and development activities through different programmes. The European Union spends huge amounts of money on funding project research work and managing research programmes. R&D and other projects that are launched typically cover a time span from one to five years. The number of partners involved in a European R&D project can vary from fewer than ten up to more than fifty. The main beneficiaries of the R&D are the participating organisations, which are usually companies, universities, research institutes and non-profit organisations. The initial benefit these organisations obtain is the monetary support for the R&D work. The main benefit comes from gaining access to the research results and innovations which potentially improve their operations. It is, however, not sufficient that only the participants benefit from EU R&D funding. The tax-payers' money must be spent better. The resources used must contribute to European wellbeing and have a wide and positive impact on industry, society and the citizens. These issues are stressed to a high degree, and are well-known both to the European Union authorities managing the research programmes and the research participants.

One problem is that the impact creation process, on a large scale, affecting industry, citizens and society is in general a very time consuming process. The time frame for impact creation is much longer than the duration of the R&D project. The major part of the impact that can be achieved through R&D activities will take place well after the completion of the actual R&D work.

As explained above, during the project only prerequisites for impact can be created. After the project, it is beyond the control of the project. It is in the hands of the individual project partners that perform the exploitation activities. The impact potential depends on the

results and promotion activities of the R&D project. Only valuable results and high quality promotion actions can have enough potential for successful impact. These features and activities can be monitored during the project.

Even when the research results are of high quality, active promotion of the achievements towards potential impact domains is needed. Although much of the impact occurs after the R&D project, the promotion activities can be carried out during its execution. The better these activities are planned and performed, the higher the impact potential of the project results.

The objective of this paper is to describe an activity monitoring process-based methodology intended to maximise the potential for post-project impact creation. The paper describes the steps that can be applied during the execution of the project in order to create the largest possible future positive impact. The aim is to be in line with long-term EU objectives. Additionally, the paper will report on the practical implementation and usage of the methodology in the European Framework Seven FI-PPP project FITMAN.

The European Commission is promoting an initiative called FI-PPP with the objective of accelerating the development and adoption of Future Internet Technologies in Europe, advancing the European market for smart infrastructures, and increasing the effectiveness of business processes through the Internet. An important contribution to this programme comes from the EU FP7 FITMAN project [6], which aims at providing a vehicle for the evaluation of the “the suitability, openness and flexibility” of the software components developed and shared on a common platform, and assessing the business benefits of the Future Internet solutions in the manufacturing industry. The proposed method has been elaborated in the context of FITMAN.

The paper is organised as following; Chapter 2 presents the objectives of impact assessment and the impact dimensions. A generic impact monitoring method, including six steps, is introduced in Chapter 3. Chapter 4 goes into more detail on the innovations in the paper, the *impact waves* and *success tree approaches*. Chapter 5 reports on practical implementation and use of the methodology in the EU FI-PPP Project FITMAN. Conclusions and ways forward are given in Chapter 6.

2. Objectives

In the FITMAN project, the impact assessment is performed using three main dimensions, as presented in Figure 1: The industrial impact, impact on academia and the scientific community, and impact on society and social innovation. Because of the different types of stakeholders in FITMAN, impact on industry is viewed in this paper through two different roles and routes; impact on manufacturing industry and impact on the IT industry.

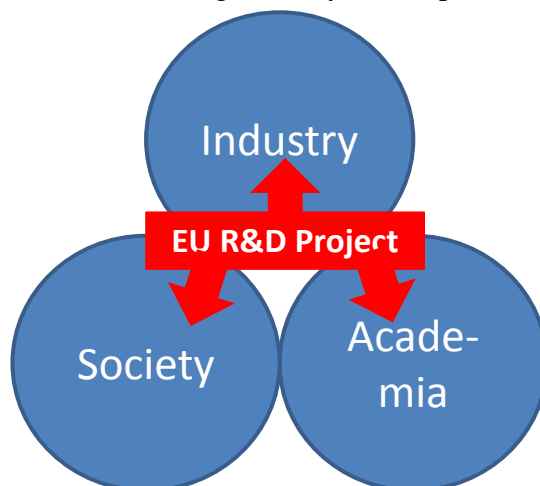


Figure 1. Impact dimensions.

The main objective of the impact monitoring task is to supervise that the activities needed for the project impact are properly implemented. Thus, it involves the collection of information from a large number of the project actions and documents, and the consolidation of this knowledge. In brief, the impact-related activities can be seen as four linked and partly overlapping activities in the project. In more detail, the impact-related activities are performed in different project tasks, e.g.:

- Impact Planning Activities
 - Exploitation planning,
 - Dissemination planning,
- Impact Creation Activities
 - Building the foundation for impact, e.g. producing high quality results
 - Dissemination actions
 - Preparing for the future after the R&D project
 - Collection lessons learned, recommendation, best practices
- Impact Assessment Activities
 - Measuring impact
- Impact Monitoring Activities

Thus the role of impact monitoring activities is not to assess the impact as such, but *to monitor that the activities needed to achieve the impact are performed in the project*, both regarding the activities for the project duration and the planning for activities after the project. In case of shortcomings and uncertainties, recommendations for the project management are given.

The objective of the paper is to describe an impact monitoring methodology and associated processes. The presented methodology can be applied in different project with the aim to ensure maximum potential for post-project impact (e.g. industrial, scientific and social).

3. Methodology

The development process for the impact monitoring is illustrated in Figure 2. The impact monitoring method has been developed into six steps:

3.1 Step 1: Impact Objectives

This step includes the identification of the impact objectives that are often based on EU research Work Programmes and detailed in the R&D project Description of Work (DoW).

3.2 Step 2: Impact Creation Mechanisms

Step 2 contains the identification of the short- and long-term impact creation mechanisms. The long term socio-economic impact depends on the time span. The impact creation mechanisms are broken down into “impact creation waves”. The distinct waves cover the time during the R&D project and the time after the project.

3.3 Step 3: Impact Success Tree

The impact creation mechanisms are broken down into a hierarchy of prerequisites or factors influencing the realization of impact objectives, an impact success tree. The hierarchy will be detailed at a sufficient level allowing the usage of indicators to check whether the prerequisites have been fulfilled. The prerequisite factors are allocated to the impact creation waves.

3.4 Step 4: Impact Indicators

In step 4, the managerial assessment methods and impact indicators are defined. The indicators are used to control the fulfilment of the prerequisites in the impact creation mechanism hierarchy. This involves the mapping of project objectives and indicators and their extension to the prerequisite factors, as well as use of other indicators e.g. questionnaires. Managerial assessment methods are needed in order to identify sources of data for the measurement. Target values are presented, if they have been given.

3.5 Step 5: Measure

The step involves the actual measurement of the indicators. The impact creation and monitoring mechanism is highly time-dependent, and therefore not all indicators can be measured and evaluated at the same time. The measurement will be performed at certain milestones during the R&D project.

3.6 Step 6: Corrective Actions

The final step in the methodology will assess the achievement and fulfilment of the target values for the indicators. The first assessment will take place at the first milestone. The status compared to the target value at the milestone can be visualised using the success tree. If a risk of not achieving the impact objectives is identified, corrective actions will be proposed to the project management for implementation before the next milestone.

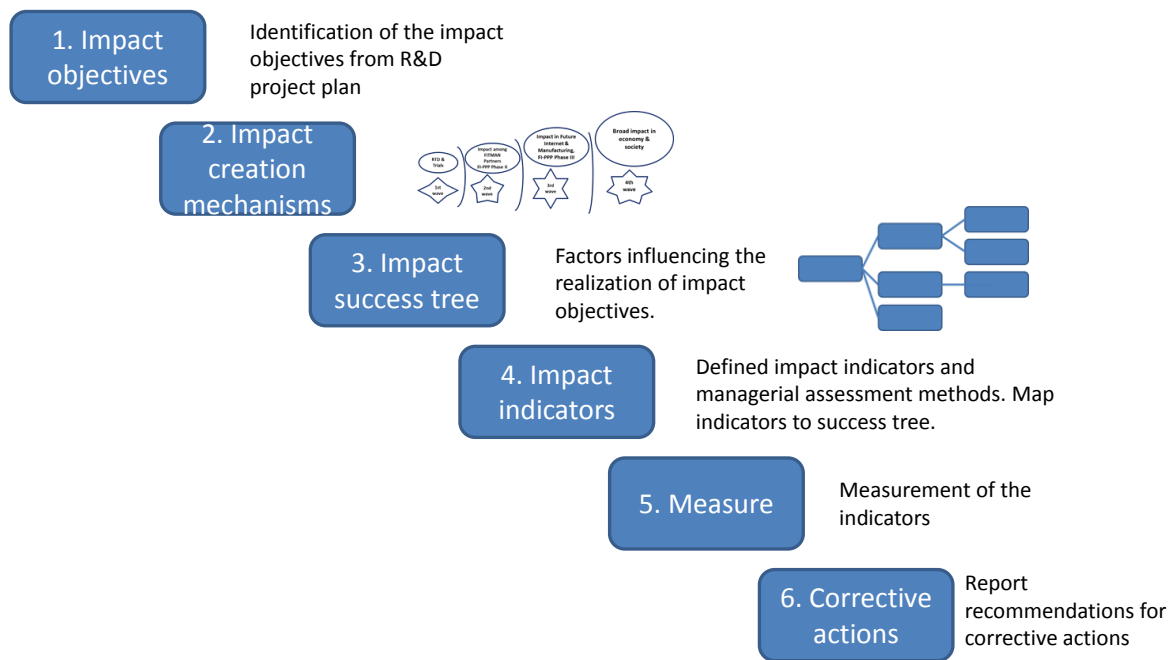


Figure 2. The six step impact monitoring methodology

4. Impact Waves and Success Tree Approach

The methodology developed is based on impact creation “waves”, as depicted in step 2 of the methodology. The waves approach is illustrated in Figure 3. The first impact wave contributes to the advancement of knowledge in the research domain and to improving R&D building capacity among the partners. During this wave, the main results of the R&D project are also developed, and these are evaluated in the context. In this content the meaning R&D results is broad, covering much more than ideas that eventually may become products, but also other results e.g. information and knowledge, methodologies, processes,

opportunities, defaults, behaviours. During the first wave, the project partners gain immediate experience of the achievements in the project.

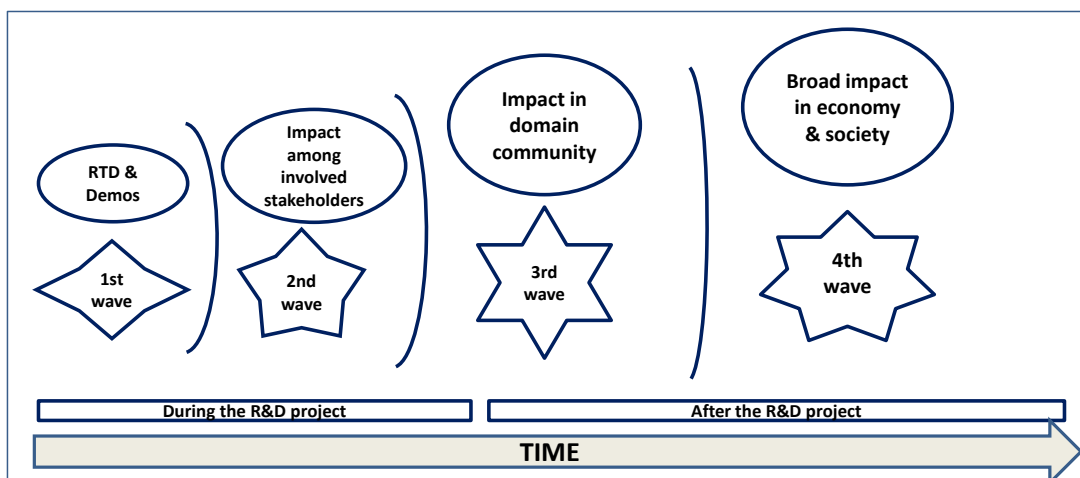


Figure. 3. Impact process illustrated as impact waves

The experience forms the basis for the second impact wave. By further developing the use of the R&D results, the stakeholders can acquire an early take-up of results even before the end of the project. In the third wave, the commercialisation based on the project results takes place in relevant industries. In this wave, the dissemination activities are expected to have created interest among other users in the domain. The interest is also expected to result in concrete applications of the results and products. This wave will start close to the end of the project, when all the final technical results are available and published.

In the fourth wave, exploitation of the results is supported by industry-wide standardization and policy-making. Naturally, the quality and availability of commercial solutions built on the R&D results are the main prerequisites for a successful impact. However, the efficiency of the dissemination and exploitation activities in the project is vital in order to promote and create awareness of the solutions among potential end-users.

In Figure 3 the impact process is described through the impact waves that advance over time from the start of the project, during the project, and after the end of the project. To secure optimal impact, the activities and quality of the results needed from each wave must be secured and assessed. In order to be able to assess that the results from each wave are sufficient, it is important to have a detailed view of the impact process. The process (waves) must be broken down into semi-independent streams for the different types of impact, e.g. industrial, scientific and social.

To monitor the factors and activities needed for the impact goal, an impact model is needed. In this paper, the impact model is formulated into a structure called “Success Tree”. A success tree is a complement to a fault tree, describing in a top-down analysis the factors needed in order to achieve success, i.e. the defined goal. The analysis is performed in a hierarchical way, by detailing the sub-goals or steps and again the factors needed to achieve them. In general, in a success tree, logical gates (AND, OR...) can be used to describe whether all the sub-factors (tree branches) are needed in order to achieve the goal (AND) or whether there are alternative routes to achieve it (OR).

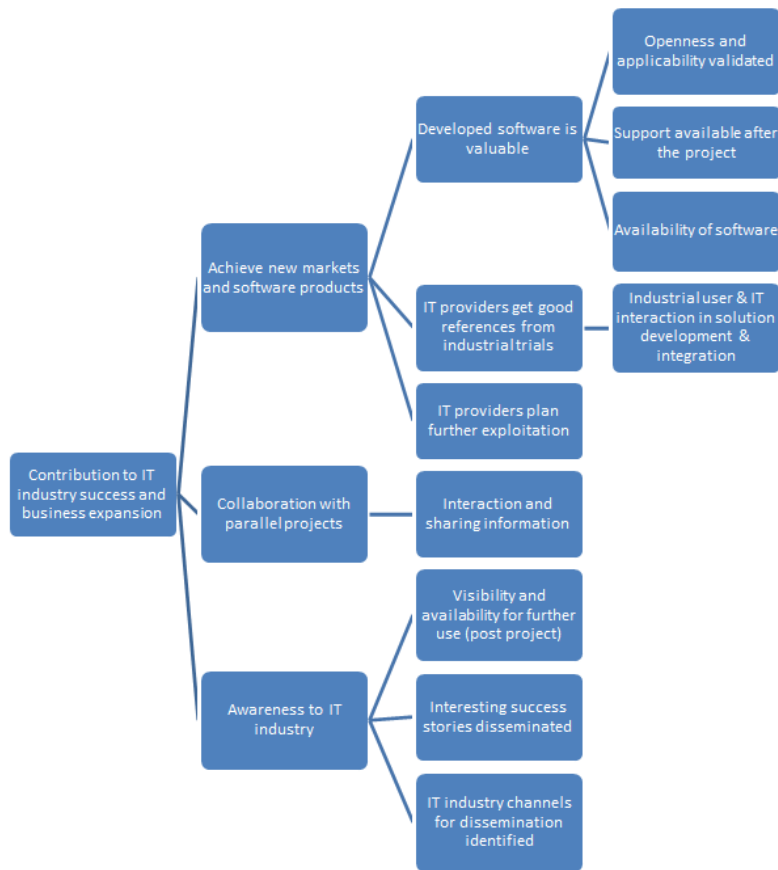


Figure 4. A success tree (a simplification of one of the overall four trees elaborated in the FITMAN project)

In the impact model used, the logic between the branches is not binary (yes or no). There are different channels to reach different dimensions of the impact. Behind the different dimensions, the same factors or activities may also appear. These repeating activities are very important from the impact creation viewpoint. For the goal to achieve all the potential, maximum impact, all the different channels are required. On the other hand, if not all subtasks are successful, the impact is not zero, and some impact, even if not the maximum, is achieved. Thus, in the impact success tree, if we are looking at the achievement of the maximum impact, the logical relation between the sub-factors or branches would be “AND”. If we are looking at achieving some impact level (different branches adding more impact), the logical gate could be “OR”. For simplicity’s sake, the denotation is left out in the example in Figure 4. The interpretation should be that all the impact success tree branches contribute to the R&D project impact, and in order to achieve the maximum all the factors are needed. The success tree, “Contribution to IT industry success and business expansion”, presented in Figure 4 is a simplification of one of the overall four success trees elaborated in the FITMAN project.

5. Practical Implementation and Use of the Methodology

The above described six step impact monitoring methodology has been applied in the FITMAN project. The monitoring covered the first impact wave and the first year (half way milestone) of the project. Figure 3 exemplifies a success sub-tree used in FITMAN.

Impact objectives. In all, twenty project impact objectives were identified. Example:

Collection and elaboration of a set of lessons learned and guidelines for manufacturing industry and enterprises synthesizing the experiences gained by the 10 trials during the experimentations. At least three Workshops will be organised to disseminate the knowledge to a larger audience in the Factories of the Future and FInES [3] environments [6].

Impact creation mechanisms. The FITMAN “impact creation waves” are identical to the ones presented in Figure 3.

Impact success tree. The top level of the success tree, taking into account the four dimensions of impact. The most complicated dimension, *impact on manufacturing industry*, covers a tree structure of 5 levels, 15 leaves and 11 nodes, spanning three waves. It should be noted that impact monitoring is a continuing activity; the tree structure will be modified and updated further during the project according to new needs and observations.

The success tree structures are based on the various sources and knowledge; FI-PPP programme & projects [5] and [1], FInES cluster activities, workshops, roadmaps and position papers [3] and [7], Literature in the manufacturing research domain [2], European Union FP7 Work programme [4], the FITMAN Project [6] and expert workshops conducted by the authors. The Roadmap identifies [3] and [7] research needed by European industry in order to meet its goals and the challenges of the coming years.

Impact indicators. 13 different managerial assessment and data collection methods were identified and applied at the lowest level of the impact hierarchy, for example, *Internal peer review of deliverables*. Only impact creation waves 1 and 2 were considered. The impact creation activities during waves 3 and 4 cannot be monitored during the project. Also, the data source for the monitoring and the potential target value are shown, for the example: the target value for internal peer review is that *100% peer of the report-type deliverables should be reviewed*.

Measure. The factors relating to the first-year milestone were collected together into a table including the main monitoring data source, potential target value, status and explanation. The explanation column shows how each factor looks from the viewpoint of different data sources: + means that the source verifies the positive realization, 0 indicates partial realization and – shows that the factor has not been realized according to the mentioned source. The status is presented using three levels: a status column with the three levels OK (sufficient), OK- (minor shortages or lack of clarity, not OK (not sufficient) and, correspondingly colours of the tree structure boxes can be used to indicate the status. a green box refers to OK, a yellow box refers to OK- (minor shortages), a red box refers to NOT OK, and the boxes shown in blue are not yet topical for the assessment, Figure 5.



Figure 5. Impact tree, with colours indicating status

Corrective actions. Based on status and looking further into the next project phase, a number of recommendations were given. The recommendations were further refined to actions, including due dates and responsibilities, to be implemented during the second period. The objective is to ascertain that all possible success tree factors are considered so as to maximize impact.

6. Conclusions and Recommendations

The paper presents a methodology to monitor and model the impact creation activities in a European research project. The methodology includes a wave-based approach, taking into account that not all impact creation activities can be performed during a research project, but that the project should build strong prerequisites for the impact extension after the project. To support the monitoring activity during the project, a success tree modelling approach has been applied. The success tree presents in a hierarchy the actions and conditions required during the project to enable project benefits.

The approach has been applied at the first milestone of the EU FoF PPP project FITMAN which is focused on the application of Future Internet technologies in manufacturing industry. Based on the first observations, visualised with the success tree, recommendations for the next project period have been given. The first experiences show that the methodology is able to concretize and show the weak points in the impact creation activities. However, its usefulness is highly dependent on the quality of the success tree model. In FITMAN, the short timeframe has not allowed a strong engagement of different stakeholders in the creation of the model. In future projects, the modelling could be performed in a more participatory way. Another point to be considered is the amount and availability of the information needed to analyse the impact creation status and setting up a suitable point in time for the analysis. In FITMAN the information was openly available for the analyses, but to some extent the information was merely consolidated at the same time as the analysis should have happened. Thus it could be useful to set up the time for the monitoring task right after each milestone, and not at the same time.

After the FITMAN project, the experience can be further utilised to develop the methodology. If used in other projects, the success tree model could be developed into generic or context-dependent versions which are instantiated for the conditions and objectives of other projects.

The methodology can be recommended to other (EU) research project. However these project need to define individual impact waves, impact dimensions, success tree structures as well as used assessment methods and indicators.

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