Large Scale Research Project, Daidalos Evaluation Framework

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Abstract: For large scale research projects operational over a phased timeframe of 2 years or more. the need to take a step back and evaluate their stance and direction is an important activity in providing relevant feedback and recommendations to guide the project towards success in its consecutive phase. The identification of measurable goals and evaluation profile procedures to effectively work towards a useful evaluation of the project was one of the main aims of the Evaluation taskforce. As part of the scope of the evaluation work in Daidalos, a set of evaluation criteria for Daidalos phase I processes, results and impact were determined and used as a scoreboard for the evaluation and recommendation report. Evaluating criterion such as Relevance, Potential Impact, Scientific & Technical Excellence and Resource Mobilisation provided beneficial recommendations, taking stock of previous achievements and future innovative ideas ensuring that they will impact the project as planned. As a starting point these criteria were derived from the ones used by European Commission for evaluating R&D projects. The final evaluation report included the scoreboard results, and an analysis of these results along with a set of recommendations for Daidalos Phase II. Qualitative scenario evaluation activities were adopted and implemented in an attempt to capture the richness of people's experience of the Nidaros scenario in their own terms, conveying the Daidalos technology concept transfer towards end users. By providing you with an insight into the evaluation methodology used within the Daidalos project, we hope to broaden your knowledge by introducing you to the large scale Daidalos evaluation framework used by the Daidalos research project and highlight some of the managerial and organisational aspects involved during this process.

Keywords: Evaluation, Integration, Validation, Scenario feedback, Recommendations

1. Introduction

The challenge of evaluating a project to produce useful and beneficial feedback, is essential when working towards optimizing the efficiency and productivity level of a project. When dealing with a large scale research project this task can become extremely daunting, as the most apt evaluation plan suitable for the project would need to be identified and implemented in order to achieve the expected results and outcome.

The project Daidalos, FP6 IST Integrated project DAIDALOS (2007), contains a consortium of 49 partners, well balanced between industry (with a major focus on telecom operators), SME's and academic research organisations. Daidalos aims to provide mobile users with a diverse range of personalized services – seamlessly supported by the underlying technology and transparently provided through a pervasive interface. The objective of Daidalos is to develop and demonstrate an open architecture based on a common network protocol (IPv6) that becomes a significant step towards approaching the Daidalos vision. The Daidalos project included in its overall project plan an evaluation activity specifically focused on identifying and carrying out the required evaluation tasks necessary to supply a detailed level of feedback that would be valuable towards improved project planning in the second phase of the project.

To achieve a successful Evaluation Phase with the end result being the achievement of valuable feedback, the following objectives were initially set to be accomplished:

- Decide the initial scope of the evaluation work.
- Identify and define the evaluation criteria necessary.
- Definition of the processes to be used for evaluation, i.e. Identify how to conduct the

evaluation of the specified criteria, defining what methods to be implemented.

Analyze the evaluation results and conclude with a set of recommendations.

With the intention of the evaluation being to provide input to Daidalos phase II regarding the experiences gained in the R&D and integration activities of the phase I work packages, both positive and constructive recommendations that could effectively be taken into consideration in the overall planning and co-ordination of the next phase of the project were taken into account, avoiding the repetition of identified pitfalls and overcoming obstacles encountered in Daidalos Phase I Leading therefore to vast improvement in the efficiency in Daidalos Phase II execution.

2. Daidalos Project Evaluation Framework Structure

Individual research projects have different needs depending on the technical level and formation of the project. Having a structured evaluation framework suitable to the project focuses the work needed to be completed. With the Daidalos project composing of both technical work packages and a management work package, where the main innovations focused on the following areas

- Layer 2-3 Network Integration technologies.
- Network Management and services, the level above layer 3.
- Pervasive systems, involving innovations within network technologies and software infrastructures.

These three main work groups were integrated into a single architecture driven by a scenario-based design approach. To effectively materialise the integration phase a separate working group was responsible for the success of this phase, allowing for the integration of the innovative achievements of the other technical work packages into practical assessment to allow for concept validation and system evaluation. The Daidalos project required evaluation of a wide spectrum of activities, processes and initial objectives in order to provide an overall measure of the effectiveness of these activities and processes implemented during phase I.

A 'Nidaros' user centric scenario approach was adopted to convey and demonstrate the main Daidalos innovations coming from the work packages. This proceeded to become a Nidaros demonstrator. Having this Nidaros scenario and demonstrator in existence, in turn lead to the need for a qualitative evaluation of this scenario to assess its impact and usefulness for the project as a whole. In order to complete this qualitative evaluation requirement, a Nidaros video was created and distributed to appraise the Daidalos framework within a real world environment to gain a proven evaluated measurement on its impact. More on this specific qualitative evaluation process will be covered in section 5. Figure 1 shows an overview of Daidalos I and evaluation task environment.



Figure 1: Overview of Daidalos Evaluation

Effective Evaluation Timeline Planning is essential to efficiently carry out an evaluation in an organised and manageable way. Within Daidalos a timeline plan was initially constructed over a timeframe of 12 months. Due to such a large scale research project the scope of the evaluation had to

be identified, initially taking into consideration the number of active work packages and other measurable processes within the project that were required to be evaluated and analysed. The timeline consisted of the following main identified tasks.

- 1. Identify evaluation profile Procedures (first 2 months)
- 2. Definition of evaluation report scoreboard criteria (first 2 months)
- 3. Assessment of individual Work packages (continuous over 8 months)
- 4. Definition and completion of Achievements and Impact Criteria (continuous over 8 months)
- 5. Completion of Evaluation report Scoreboard (completed within last 2 months timeframe)
- 6. Completion of recommendations and Conclusions (last 3 months timeframe).

3. Measurable Goals and Evaluation Profile procedures

Objectives and goals often quantify the measurable progress of a research project having markers and milestones to track the projects progress. For an evaluation to be successful all these milestones and work package activity markers need to be identified and the ways to measure them pinpointed. For a European based research project, a measure of the goals that were partly defined by the FP6 research program was also necessary to be completed. Daidalos project specific methods and processes used in Daidalos I execution phase were also taken into account along with various tangible results from the first phase of Daidalos such as

- Deliverables and publications
- Integrated demonstrators (Nidaros demonstrator)
- Successful processes
- The tacit knowledge among the participants gained from the project.

Questions had to be asked objectively if the predefined measurable goals were achieved, or if they were still considered reasonable goals, to help gain this most desirable information, questionnaires, surveys and interviews were used to gain consortium partners views and opinions.

1. Evaluation Profile Procedures

Generally evaluation is broken into Formative and Summative, Formative vs. Summative Evaluation, (2006), these evaluation profile procedures were adopted within Daidalos to identify, categorise and map various evaluation activities.

Activities still in progress who have not yet reached their completion milestone would be subject to Formative evaluation. This type of evaluation would cause for the continuous adjustment to the activities direction as corrections would be included mid-course, improving the project implementation and ongoing processes constantly promoting a reflective practice and assisting planning

This type of Formative evaluation involves tasks such as interviews, surveys, analysis reports and dialogue with participants.

Formative evaluation can take the following various different approaches as seen from William M.K. Trochim (2006).

- Planning and Strategy Evaluation: assess active Daidalos project plans, goals and timelines.
- Project Plan and Implementation Evaluation: examining how the Daidalos project is progressing according to its original plans and timeframe.
- Monitoring/Observational Evaluation: obtain and analyse views of external participants to the Daidalos project and its innovations i.e. Input from participants of a workshop.
- Progress Evaluation: assessment of the Daidalos projects progress to see if it is meeting its required targets.
- Formative evaluation to ascertain the overall worth of the Daidalos project while the program activities and tasks are being generated or executed.

For example, sample formative Daidalos related tasks: Evaluation questions through distributed Daidalos questionnaires on various topics, data gathering approaches based on input received from Nidaros qualitative evaluation.

On the other hand Summative Evaluation focuses on set objectives and milestones with the aid of numeric scores and records to gauge actualization in distinct areas. Taking stock of processes and methods that were implemented over the complete lifecycle of a project, it then provides a critical analysis of this and the overall performance.

Summative evaluation can be divided up into the following areas as seen from William M.K. Trochim (2006).

- Impact evaluation: assess the net effects of the Daidalos technology as a whole.
- Outcome evaluations: assess if the Daidalos technology caused effects on defined target outcomes.
- Produced Cost efficiency analysis: target questions on resourcefulness in terms of costs and quality of the Daidalos architecture.
- Developed Secondary analysis: re-evaluate Daidalos data available to focus on possible new and emerging questions.

Daidalos Summative evaluation was most likely to be completed near the end of a milestone, the following is a sample of some summative evaluation activities that can be completed near the end of a major milestone. For example: Methods/Tools /Analysis based on input from daidalos deliverables completed at various milestones.

2. Evaluation Management Structure

To support the formative and summative evaluation activities identified to take place, it was deemed necessary to assign and identify specific partners as work package evaluation leaders along with the identification and creation of explicit focus groups involving Daidalos Technical Management Team Members, Daidalos WP Leaders, Daidalos activity leaders and expert developers. Figure 2 represents the overall management structure defined and appointed during the evaluation lifecycle phase.



Figure 2 Evaluation management structure Framework

The Daidalos structure consisted of the following

- 1. Overall evaluation leader
- 2. Work package X leader
- 3. Each identified criteria was assigned a specific focus group.
- 4. Focus group leader to guide the process.

This management structure worked effectively through the evaluation timeframe and was very beneficial in completing the required evaluation tasks as it provided clear points of contact for the

responsibles assigned to lead the selected evaluation tasks, and also conveyed clearly the relevant focus groups formed to support the focus group activity tasks.

4 Workpackage Evaluation Methodology

Successful evaluation of the individual work packages of daidalos was deemed an extremely important task, to provide them with beneficial and relevant feedback that would enable them to reanalyse objectively their work ethic and achievements and to bestow them with valuable information to advantageously allow them to restructure and concentrate on highlighted issues. Further enhancing the work package outputs and the overall quality and standards from each work package during phase II. A methodology incorporating the analysis of work package specific deliverables was completed and considered the most suitable, providing recommendations of a technical level related to technical work within that work package and also providing recommendations of a non technical level that related to processes, their positives and negatives aspects. Evaluating the work packages implemented the following steps.

1. Identification of specific work package deliverables suitable to be evaluated.

2. Analysis of these identified deliverables, with the end aim of gathering technical recommendations.

3. Identification of processes and results related reports completed during the lifespan of the project.

4. Analysis of these reports to evaluate and obtain non technical recommendations.

An evaluation work package leader, was assigned to carry out the evaluation of their assigned work package, to implement the steps identified above to work towards highlighting valuable evaluation recommendations.

1. Evaluation Report Scoreboard Criterion Analysis Methodology

By identifying certain criteria, they can help in the formation of a strong methodological approach providing a clear structure.

Selection of the criteria for evaluation and inclusion in the Evaluation report scoreboard was completed initially by following the "Regulation of the European parliament for the rules in the implementation of the European community framework programs, see "Seventh research Framework Programme" 'Evaluation Forms', (2007).

We initially identified the main criteria and sub criteria as can be seen below in table 1, as these were considered the most appropriate and suitable criteria that should be included as selected evaluation criteria for such a large scale project such as Daidalos. These identified criteria would then form the sub sections of the Daidalos Evaluation Report Scoreboard based on "Seventh research Framework Programme" 'Evaluation Forms', (2007).

CRITERIA	SCORE			
1. Relevance				
Sub-criteria				
1. Relevance to IST Objective: European Leadership in the Generic & Applied				
Technologies				
Consolidated European Approach to technology, system & services.				
3. Socio-Economic Aspects				
4. Gender Action Plan				
2. Potential impact				
Sub-criteria				
 Contribution to Standards & Management of the Project Impact 				
2. Disseminating Knowledge				
3. Training				
3. S&T excellence				
Sub-criteria				
1. Activity Innovations achieved				
2. Deliverable Innovations Achieved				
3. Barriers in performing Scientific and Technical Excellence				
4. Resource Mobilisation				
Sub-criteria				

1.	Integration management Activities	
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2. Integration of resources

3. Test Bed resources

Table 1 Daidalos ERS Scoreboard

A focus group was formed for each criterion with an overall Focus group leader. This focus group consisting of activity leaders, expert developers and work package leaders that were responsible for evaluating the criterion they were assigned to and providing an overall end score for the project. This was completed through the creation and distribution of questionnaires and surveys distributed at technical weeks. Other activities also included the analysis of external auditors reports completed during phase I of the daidalos project.

2. Evaluation Report Scoreboard Marking

Taking into consideration the pre-determined blocks of defined evaluation criteria, namely relevance, potential impact, scientific & technical excellence and resource mobilisation, assigned criteria evaluator leaders were required to document a realistic score for each criteria into the specified Evaluation Report scoreboard. In order to capture realistic scores representative of the work completed and impact of the criteria within the projects first phase, individual surveys and questionnaires were specifically created that addressed aspects of the sub criteria and were distributed to the relevant focus groups. With the majority of the questions in the surveys incorporating a rating scale for each question posed, this in turned provided ample feedback towards obtaining a viable average score representative of the overall criteria under scrutiny.

The corresponding level of achievement of the defined overall scores, corresponds to the levels defined below on a scale of 1 to 5. In this scheme, the scores indicate the following with respect to the criteria under examination:

0 -Fail	1 –Poor	2 –Fair	3 –Good	4 -Very Good	5 - Excellent

Each criteria had a threshold score level applied with the threshold level being set at a higher level than the sum of the individual criterion thresholds. It was deemed that a minimum level of (2) Fair was a level to which a reasonable sense of quality was achieved. The application of the score from the scale of 1 to 5 was applied to the overall quotation achieved for each criterion section.

5 Evaluation Report Scoreboard Results (ERS)

With Daidalos covering many technologies and features that impact various sectors world wide, Daidalos will undoubtedly be used as a reference point by other entities.

The following provides an overview of the evaluated outcome of the Daidalos project during phase I in the Evaluation Report Scoreboard.

Obtaining a score of 4.3 for 'Relevance' was based on feedback obtained from relevant focus groups. Improvement within this criterion is foreseen in DII through more proactive communication externally on the projects innovations and achievements. This will mainly be completed through the introduction of Liaison managers, this will also have a positive knock on effect for the dissemination subsection of the 'potential Impact' criterion.

With 'potential Impact' gaining a good score of 3.9 in the Daidalos ERS scoreboard, it guides DII to focus more on increased interaction with standard bodies. Also through the provision of more integrated results in Phase II this will lead to the opportunity of presenting working prototypes to the public, all the while increasing dissemination and overall external project impact.

Scientific & technical excellence over all achieved a very good standard on its activity and deliverable innovations, conveyed through a score of 4.55 for this criterion. For the next phase of Daidalos more effective use of the vertical teams and scientific forums are being actively incorporated into the overall planning.

With the successful integration of Daidalos I during phase I, this provided a positive learning curve for DII, with the 'Resource Mobilisation' achieving a good score of 4.4 based on positive and beneficial feedback obtained from integration teams and management teams , this will lead to greater success

in phase II. More interaction between WP1 and WP5 in DII is already under way in DII to improve the overall process and benefit the resource mobilisation criterion.

The ERS scoreboard results above demonstrates the positive impact and productiveness of Daidalos Phase I, this is conveyed in Cleary et al (2006: 2.0).

6 Nidaros qualitative evaluation

Direct observation of the Nidaros scenario by the creation of a daidalos video provided an ideal route towards obtaining the essential qualitative evaluation sought after by the daidalos members. Through observing the human experience conveyed by the actors within the Daidalos Video, this provided end users with the ability to detail their feelings and opinions on the technological innovative interactions and project implementation activities within a human social environment, reflected through the Nidaros scenario enactment in the daidalos video.



Figure 4 Daidalos: Nidaros Scenario Video Demonstration

Nidaros Qualitative evaluation provided an in-depth understanding of people's experiences and perspectives in the context of their personal circumstances or settings.

The Daidalos video illustrates to the user many of the proposed and current features of the Daidalos framework by visualising the Nidaros Scenario. A user-centric questionnaire was compiled to investigate issues of concern to both end-users and 3rd party service providers Roddy et al (2006: 0.1). The questionnaire gathers factual information about the user and asks a series of questions regarding the video as well as general aspects of the Daidalos framework. Not only do we want to gather information about the impact Daidalos technology makes on the user but we also wanted to understand more about user's thoughts and feelings towards this technology and their likelihood of using such technologies if they become available. The video and accompanying questionnaire was put online and targeted at a sample population. Results of this questionnaire can be seen in section 7.

7 Qualitative Nidaros Analysis Results

Performing a qualitative analysis of the Nidaros demonstration was an attempt to capture the richness of people's experience of the Nidaros scenario in their own terms. Quantitative analysis allows us to test Nidaros functionality, a qualitative exploration of beliefs and understanding is needed to assess the likelihood of users utilizing the Daidalos framework in a real-world situation.

The distributed questionnaire was completed by a sample size of almost 100 people most of whom were students or academics with a background in science. A background in science was deemed necessary to fully comprehend the Daidalos demo video. The majority of the sample population were male over the age of 20. It proved difficult to find many females or users from other age groups to complete the questionnaire so unfortunately the age group sizes and the male/female divide are not equal. None the less, the overall sample size was sufficient to show obvious trends towards the questions posed in the questionnaire. Following the completion of the questionnaire, the results were compiled into tables and graphs.

The following conveys a sample of some results and outcomes following the analysis of the questionnaire results from Roddy et al (2006: 0.1)

1. Users were asked whether they would rather use video than voice when on a call, the majority would rather utilise the video option when on a call to friends and family. It was gathered that most people would use the video service "frequently" when talking to friends compared to "sometimes" when talking to work colleagues and a mixture of "sometimes" and "rarely" when on a call to services. In contrast to this most people agreed that being able to transfer data when on a call would be most useful when talking to services and least useful when talking to friends. Further, females were generally more positive about using video rather than voice on a call whereas males were more positive towards the transferral of data while on a call.



2. Another question investigated how comfortable users would feel having their location recorded for others to see. Users were split on their answers with 56% feeling "comfortable" or above but 44% feeling "uncomfortable". In the comments received it transpired that some users were worried that a "Big Brother" scenario could develop. The youngest age group seemed most comfortable with location recording while the eldest age group were the least comfortable. In between the over 20's, 30's and 40's were very similar in their responses and generally felt "comfortable" with this activity.



Conclusions can be drawn from the qualitative analysis based on the thoughts and feelings of different groups of potential users towards the Daidalos innovations. It is quite evident that there are differences of opinion between different age groups and also between males and females. In general, most responses to the questions were on the positive side although some questions did provoke a significant negative response, which highlights areas where thoughts must be focused to minimise these negative results and maximise the success of Daidalos in a business environment. The responses received conveyed how the various innovative aspects of the Daidalos system provoke different results. This in turn highlighted the main areas within Daidalos where a higher level of attention must be paid.

8 Feasibility of Daidalos Evaluation Methodology

Large scale research projects often lead to a numerous amount of documented hardcopy and softcopy outputs, and the analysis process of evaluating these outputs to conclude recommendations can most definitely be a difficult and painstaking task to complete. Through the identification of the Daidalos Evaluation Plan, Evaluation management structure and methodology, this contributed towards easing the overall evaluation task and defining the foreseen activities required towards completing this milestone.

By initially identifying the formative and summative evaluation profiles for the project proved to be a beneficial step in the planning stage, as it helped identify an initial idea of tasks, surveys and

questionnaires that needed to be completed and also worked towards highlighting what project milestone documentation needed to be analysed from each work package. With the planning stage being vitally important, the identification of the most apt evaluation activities that would produce sought after recommendation results needed to be identified as soon as possible in the initial stages of the planning phase. The application of a suitable and realistic timeframe over the 12 months allowed for well structured evaluation phases with well defined phase deadlines, providing a clear framework for the evaluation task force to work towards and prioritise their workload.

For an evaluation task force to be effective, a precise and logical evaluation management structure is a basic requirement to support the evaluation team. The Daidalos Evaluation management structure with an overall Evaluation leader and sub work package leaders worked effectively. By assigning an evaluation task force member as an evaluation leader of each workpackage ensured that all work packages were analysed equally, allowing them to concentrate solely on their individually assigned workpackages to produce fruitful results. Where possible the WP evaluation leader would be selected based on their level of familiarity with the work packages activities.

The management structure surrounding the implementation and completion of activities relating to the Evaluation report scoreboard that involved the creation of and interaction with focus groups guided by a focus group leader proved to be beneficial, once the correct focus group members were identified and willing to participate. These focus groups helped in the completion of specific evaluation criteria surveys and questionnaires covering topical areas such as integration, Potential impact, scientific and technical excellence. Having these focus groups in place in a project containing up to 49 partners and close to 200 individual participants, helped target the correct expertise and knowledge required to effectively provide valid input into the specific criteria related questionnaires.

The implementation of the Evaluation Report Scoreboard worked effectively in pulling together and conveying the level of achievement of the project in a visual way through the provision of scores for each criteria and the sub-criteria in each criteria group. Having the overall scores calculated based on a mean average weight allowed for realistic figures to be applied to each criteria.

Having a research based project that incorporates a user centric scenario based approach, the Nidaros qualitative evaluation via the use of the daidalos video with a corresponding survey exposed the concepts of the Daidalos architecture to end users external to the project. The creation and use of this video and corresponding survey worked extremely effectively in providing the Daidalos consortium with valuable feedback both on a business and technological level, giving an insight into the thoughts and opinions of possible future end users, allowing the end user to express their opinions whether they were negative or positive. Using this source of information the daidalos project could directly feed this input into phase II of the project and readdress or highlight problematic areas addressed or emphasised by participants who took part in the Nidaros video survey.

9 Conclusion

Were the benchmarks selected appropriate? Was the purpose of the evaluation met? Was the evaluation feasible in terms of available resources, time and budget? What were the benefits of the Evaluation? These are some of the questions that we need to ask ourselves following the implementation and execution of the evaluation process and methodology we used to assess phase I activities of the Daidalos project. Many research based projects will differ in their end objectives and therefore each evaluation process and methodology will differ for each research project. The methodology and processes used within the Daidalos project worked well towards the end objective of attaining valuable feedback for Daidalos phase II, to improve the general day to day working of each work package and improve the effectiveness of the various project lifecycle phases to work more efficiently. The visualisation of the Daidalos concepts through the video was immensely useful and beneficial to the project and was easy to use and incorporate into the evaluation process. This paper has focused on the planning, methodology and management structure adopted during the evaluation phase of the Daidalos project. The activities of the evaluation phase implemented during Daidalos I following the completion of the initial first 2 years of the project , produced realistic feedback and recommendations of both a technical and non technical nature that could be analysed and applied during the initial planning stages of Daidalos Phase II, to regroup and reorganise where highlighted issues that arose.

For such a large research based project to be effective and to strive to work towards future next generation technologies that will be accepted, practical and marketable, the evaluation methodology and process implemented within the Daidalos project continually works towards synching and aligning it so that it successfully follows and completes its initial objectives and innovative ideas to further progress the technological advancements available to the end user in the future. The evaluation contributed towards identifying and learning from the mistakes and successes of phase I of the Daidalos project conveying both the internal and external viewpoints of the project. The internal evaluation highlighted any process improvements or objective realignment changes required and the external evaluation provided feedback on the potential business possibilities of the Daidalos research project and the view of the end user in their willingness or openness to adopt such a new technology into their everyday lifestyle.

Important opinions and recommendations were gained especially from questionnaires that focused on Integration and validation activities within Daidalos I, with these being fed back into the initial reorganisation of Daidalos phase II. Process improvements as a result of these recommendations are already very evident within Daidalos Phase II. Sample generic recommendations include the following as noted in Cleary et al (2006: 2.0)

- 1. It is vital in Daidalos II that the overall integration is performed in a more structured way, so that incremental process is adapted
- 2. During Phase II it is recommended that all modelling tools must be evaluated and decided on very early in the life span of the project and all modelling activated must be carried out early in the design phase.
- 3. Standardisation activities must be co-ordinated efficiently and correctly within each work package. Setting up a ITU-T focus group in order to disseminate project results.

All evaluation activities and benchmarks concluded during the evaluation phase were deemed as being constructive and gainful towards improving the Daidalos processes and activities being defined and appointed for phase II. The recommendations provide each work package with a chance to reflect on their individual activities, to correct inefficient processes within their work packages and to review other work package specific expert's opinions on areas such as workpackage communication, integration and validation. This Evaluation Phase was deemed as an extremely useful activity in order to take stock of accomplishments, mismanagements and oversights that occurred during the Daidalos Phase I Cycle, providing this as worthwhile feedback to Daidalos Phase II. Following the Framework described within this paper, this evaluation process was essential within a large scale project such as Daidalos in order to provide the technical management team , board team and Daidalos consortium the opportunity to assess and analyse the various recommendations and act on them appropriately to further enhance Daidalos's success during phase II.

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