PEACOX – Persuasive Advisor for CO2-reducing cross-modal trip planning

*Project Reference:* 288466

*FP7-ICT 2011: 6.6 Low carbon multi-modal mobility and freight transport*

*Project Duration:* 1 Oct 2011 – 31 March 2015

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**Project Periodic Report 3**

AIT Austrian Institute of Technology

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PROJECT PERIODIC REPORT

Grant Agreement number: 288466

Project acronym: PEACOX

Project title: Persuasive Advisor for CO2-reducing cross-modal Trip Planning

Funding Scheme: ICT-2011.6.6 Low carbon multi-modal mobility and freight transport

Date of latest version of Annex I against which the assessment will be made: June 18th, 2014

Periodic report:  1st □ 2nd □ 3rd X  4th □

Period covered: from 01 October 2013 to 31 March 2015

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Declaration by the scientific representative of the project coordinator

1 Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement.

2 The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.
I, as scientific representative of the coordinator of this project and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;

- The project (tick as appropriate):
  - X has fully achieved its objectives and technical goals for the period;
  - □ has achieved most of its objectives and technical goals for the period with relatively minor deviations.
  - □ has failed to achieve critical objectives and/or is not at all on schedule.

- The public website, if applicable
  - X is up to date
  - □ is not up to date

- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 3.4) and if applicable with the certificate on financial statement.

- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 3.2.3 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

| Name of scientific representative of the Coordinator: Univ. Prof. Dr. Mag. Manfred Tscheligi |
| Date: 15.05.2015 |
| For most of the projects, the signature of this declaration could be done directly via the IT reporting tool through an adapted IT mechanism. |

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3 If either of these boxes below is ticked, the report should reflect these and any remedial actions taken.
1. Publishable summary

PEACOX - Persuasive advisor for CO2-reducing cross modal trip planning - is an international collaboration between nine organizations from six different countries aiming to provide travellers with personalised multi-modal navigation tools that allow, help and persuade them to travel and drive in a more ecological way. The project is supported by the EU under Framework Programme 7. The PEACOX consortium unites expertise from navigation systems, transportation sciences, environmental modelling, artificial intelligence, persuasive technology, human-computer interaction, social science and software development. These expertise cover all areas needed for addressing the PEACOX objectives successfully.

In our highly globalised world, work and leisure life are often geographically widely distributed. Increasing mobility and traffic result in a strong environmental impact, particularly in urban areas. Personal transportation is one of the greatest contributors of CO2 emissions. More people are becoming increasingly concerned with rising fuel costs and pollutant emissions. Strategies are urgently needed to promote environmentally friendly transport behaviour, and means to help people reducing their ecological impact are required. To convince users in making more sustainable travel choices PEACOX will enrich existing navigation approaches and systems with innovative approaches and features.

The overall goals of PEACOX can be summarized as follows:

- Research possibilities for influencing travel and driving behaviour of users with the use of targeted persuasive strategies, providing situated and personalized feedback and use of advanced travel information systems.
- The implementation of an integrated prototype system and infrastructure bringing developed approaches to the real world.

To reach these goals PEACOX developed a mobile smartphone application that enables the users to easily plan and organize their trips (e.g. by foot, bike, public transport, motorcycle, and car). To convince and stimulate the users in behaving more environmentally friendly within their travelling activities PEACOX enriches trip planning and information systems with innovative approaches and features, such as personalised travel recommendations,
automated trip purpose identification, individual emission modelling as well as exposure modelling, eco-friendly driving models, and persuasive presentation approaches.

To meet the users’ needs PEACOX offers a mobile smart phone application for eco-friendly route planning and navigation, eco-friendly travel suggestions with comfort, CO2 feedback for selected routes and transportation modalities, detection of individual travel patterns, personalised and green travel suggestions, real time GPS and traffic information service.

Figure 1 shows a graphical presentation of the collaboration of the projects’ activities, the WP-components and their interdependencies.

![Figure 1: Work package components and their interdependencies](image)

The main objectives of the third and final project period (October 2013 to March 2015) were to implement the second iteration of the functioning prototype that integrates the learnings from the first trial, and to evaluate the developed concepts, algorithms and prototypes in extensive field trials in Vienna and Dublin.

Based on the results of the first field trials in the last period the project partners worked jointly on designing and improving the user interface for the projects second prototype (see screenshot below).
In parallel the technical architecture and infrastructure was modified in order to address issues identified during the first field trials and to optimally integrating the single components of the different partners and developed in different work packages, especially WP3 and WP4. Additionally connections to required third-party services have been added (especially traffic information from Google-Maps for Dublin, and Telematix routing).

Based on this infrastructure and the code from the first trial a fully functional prototype using the Android operating system was implemented and has been thoroughly tested, both with regard to functionality as well as usability and acceptance.

A major focus of the third project period was the organization and conduction of the second field trials, in which the integrated prototype was evaluated by users in real life conditions over the period of two months in Vienna and Dublin. The results of this trial were analysed and provide valuable input for future work on trip planner applications.

Besides the main development work the project consortium continued to disseminate the project results by participating in events and publishing results in scientific journals, conferences and workshops. For more information about the project status and next steps visit the project’s website at www.project-PEACOX.eu. You can also contact the project coordinator:

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2. Core of the report for the period: Project objectives, work progress and achievements, project management

2.1 Project objectives for the period

In the third period of the PEACOX project the main focus was on the analysis of results from the first evaluation and on the development, integration and testing of the second integrated prototype. In detail the project’s focus was on a) analysing the quantitative and qualitative data from the first field trial, b) adapting the prototype architecture and modules based on the findings from the trials c) develop and implement new persuasive strategies and user interface concepts, b) implementing a second iteration of the functioning prototype that integrates the modules developed by the different partners and e) evaluating the developed concepts, algorithms and prototypes in extensive field trials in Vienna and Dublin, and f) document and report the findings in order to ensure accessibility and impact of results after the official project end.

With regard to the description of work within the third period of the project the following main objectives of PEACOX were targeted:

- **Objective 1:** Develop advanced methods for automated travel mode and trip purpose detection targeted to the travel context using readily available and unobtrusive input sensors.

- **Objective 2:** Develop advanced carbon footprint models that consider situational variables and allow for a more specific and realistic computation of CO2-consumption.

- **Objective 3:** Develop personalized persuasive strategies tailored to influence mode choice as well as driving behaviour.

- **Objective 4:** Develop user interfaces and interaction methods that communicate energy saving opportunities in an optimized way i.e. providing situated and proactive suggestions without being intrusive, annoying or privacy disrespecting.

- **Objective 5:** Develop and evaluate a fully functional prototype system in selected example regions that allows researching the developed concepts in detail.

The first objective was addressed within work package 4, Automated Travel Mode and Trip Purpose Detection. In the third period work focused on the improvement of the routines
developed in the prior project years, and especially on developing and improving the trip purpose detection.

Input for objective 2 was provided by work package 3, Behavioural Analysis and Environmental Impact Modelling. The third period of the project for work package 3 saw the evaluation of the developed models based on data collected during the trials.

Objective 3 and 4 were both addressed by work package 5, Development of Persuasive Strategies for Green Mobility. Based on the comprehensive research and collection of persuasive strategies done in the prior project years, work in the third project period focused on further refining and evaluating the persuasive mechanisms, especially targeting the strategies of feedback, challenges and social comparisons. In close cooperation with work package 7, Evaluation the detailed functionalities of the prototype with regard to persuasion were developed and tested in the second field trials.

The development aspect of objective 5 was addressed within work package 6, System Design and Implementation. Based on the design work in work package 5 a functional prototype has been developed and tested, that implements key concepts and functionalities of the system, and integrates the components provided by the different partners.

In the framework of work package 7 Evaluation), activities addressing objective 5 were performed. The main goal of objective 5 was to evaluate the PEACOX system in detail. Based on the initial evaluation plan (D7.1 Evaluation Plan) the detailed processes and methods used for the evaluation were specified. On-going evaluation of usability and user experience and the evaluation of persuasive strategies were done in order to achieve the evaluation objectives. Usability evaluations of the developed prototype concepts were performed using expert-based and user-based approaches. Also an extensive field trial in Vienna and Dublin lasting for two months was organized within the third project year. The following concepts were evaluated in this field trial: the user interface, the human computer interaction and adaption mechanisms, user acceptance of using recommendations, automated location detection and success of the trip purpose mechanism, the emission models, impact and effectiveness of different persuasive strategies.

### 2.2 Addressing the Commission’s Recommendations

Within this section we provide information on how the Project addressed and implemented the recommendations based on the interim review in Brussels on July 4, 2014.
2.2.1 Recommendations regarding the project management

An amendment for postponing the ending date of the project is found at this stage necessary, and is to be submitted by the project coordinator;

A project extension was requested and was granted.

However, the delay of 6 months planned may be just sufficient to finalize the project, and perhaps not leave enough time for the field trial data analysis part to reach solid findings and mature conclusions. It is therefore recommended to constantly monitor the progress by the project coordinator and all WP leaders;

The trials were finished in the beginning of October 2014, so sufficient time to analyse the data was available until the project end.

The management report is lacking a list of scientific publications (if any) since last review. It is recommended to include a section for a list of scientific publications in the management report, even if the list is empty.

Such a list was included in the management report.

2.2.2 Recommendations regarding the second field trial

It is very important that proper care is taken to the fact that it was run during the holiday season;

Comments from trial participants and analysis of data did not show any effects of having done the trials during the holiday season.

It is recommended to more widely recruit “secondary users “ for the second field trial, as this can be a good dissemination activity and also provide input a wider range of users at a low cost. For example, secondary users can be invited through press releases, transit authority homepages etc;

More secondary users were recruited after the finalisation of the main trials. During the trials we decided to not include secondary users due to two reasons: First, for the Dublin router only a limited number of route requests were available from the Google-API, therefore including additional users would have introduced the risk of overspending the available contingent. Second, the PEACOX infrastructure was not designed for managing big numbers of concurrent users, therefore having secondary users at the same time with the main trials might have introduced problems.
In the online questionnaire (Field trials planning, appendix C), the project should consider if the age of the children should be asked. It is likely that having 2 year old children or 18 year old “children” at home can have different impact on the travel behaviour.

This question was added to the trial questionnaire.

A check on the preliminary analysis and findings from the field trial should be provided by the end of the year; this will give a clearer indication of the quality that can be achieved and the effective time needed to conclude the project, expectedly within the first three months of 2015.

By the end of 2014 we conducted an analysis of the field trial data and concluded, that the remaining project time is sufficient for analysing the trial data.

2.2.3 Recommendations regarding the deliverables:

The dissemination and exploitation plans were presented at the review meeting but not sufficiently elaborated in the reports submitted before the meeting. This should be done. In particular stronger involvement of stakeholders and potential users should be achieved; the links with other projects and programmes should get enhanced; in the exploitation plan, the industrial stakeholders and the end-users should also be considered; the contribution to the standardisation should be enhanced.

An updated version of the exploitation plan is provided by exploitation lead partner TMX.

It is noted that the deliverables still not completely follow the common template, even though this has been commented on in previous review reports. Care should be taken to follow the same template. Care should also be taken to proofread the deliverables before submission to avoid page breaks in the middle of tables, page break in between the figure and the figure caption captions etc. that is occurring in some current reports.

Procedures ensuring the conformity to templates and correctness have been implemented.

When submitting deliverables, it should be made clear if the report is in a draft, final version, submitted for comments or any other status. It is suggested to add a track list of versions of the reports;

Only final versions of Deliverables are submitted to the final review, therefore no disambiguates regarding their status should be possible.
For the next reviews, a letter of response to the reviewers should be provided, which lists all the changes made to the deliverables. An alternative solution can be the provision of the resubmitted deliverables in the form of track changes;

After the pre-review in June 2014 modified deliverables with track-changes have been delivered. A similar procedure is planned to take place for the final review.

As commented in the previous review report, there are several cases of repetitions between the reports. The recommendation from the last review is repeated that excessive repetition should be avoided;

Repetitions have been removed from prior Deliverables.

The final review meeting should be held in Dublin to allow for a demonstration of the application in a test site.

The final review meeting has been organized for May 22nd, 2015 in Dublin.

2.3 Work Package 2 – Requirements for Eco-Travel Information Systems

Work package 2 has already been successfully finished as planned in the first project year, and therefore no more activities were planned in the following years.

2.4 Work Package 3 – Behavioural Analysis and Environmental Impact Modelling

The third year of the project saw the completion of the second set of field trials in both Dublin and Vienna. Trinity College were active in assisting CURE/AIT in both recruiting application users and the running of the Dublin workshops.

During the third and final year of the PEACOX project the final deliverables due in WP 3 were completed. The second iteration of D 3.4 “Validating the door-to-door emission model and behaviour model” was completed. The behavioural model was constructed using the multinomial logit and mixed logit models described in both D 3.3 and D 3.4 Part 2. These models produced poor R2 values, and can be considered to have done a poor job of explaining the data observed, however, following the issues encountered in the first trial Trinity College incorporated a number of ancillary data collection methods within the second field trial. Results of workshop questionnaires indicate that in many cases users only
assessed the travel time information provided by the application and did not consider emissions information. Post-trial surveys conducted as part of the Dublin field trials indicate that, while the majority of users found the application to be both interesting and informative, other factors than carbon dioxide emissions were the primary drivers of their transport choices.

Trinity College published a journal paper assessing individuals’ abilities to assess transport related emissions information: Brazil, W., Caulfield., B., Testing individuals’ ability to compare emissions from public transport and driving trips, Journal of Public Transportation, 17, (2), 2014

2.4.1 Progress towards Objectives WP3

<table>
<thead>
<tr>
<th>WP 3</th>
<th>Work performed, status and achievements per task</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task 3.1</strong> Door to Door emission Model</td>
<td>Work on this task was already finished before start of the third period.</td>
</tr>
<tr>
<td><strong>Task 3.2</strong> Validation of Emission Model</td>
<td>The second iteration of this task involved the validation of the simple emissions model that had been selected for the second PEACOX trial. Due to computational run time and issues arising from the complexity of the initial emissions model, a simplified model was developed based upon an emissions factors by link length configuration. The results of this task are contained in the second iteration of D3.4</td>
</tr>
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</table>


<table>
<thead>
<tr>
<th>Task 3.3</th>
<th>Work on this task was already finished before start of the third period.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eco-driving</td>
<td></td>
</tr>
<tr>
<td>model</td>
<td></td>
</tr>
<tr>
<td>Task 3.4</td>
<td>Work on this task was already finished before start of the third period.</td>
</tr>
<tr>
<td>Exposure Model</td>
<td></td>
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<tr>
<td>Task 3.5</td>
<td>Work on this task was already finished before start of the third period.</td>
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<tr>
<td>Developement</td>
<td></td>
</tr>
<tr>
<td>of Behavioural</td>
<td></td>
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<tr>
<td>Model</td>
<td></td>
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</tbody>
</table>
### Task 3.6 Evaluation of Behavioural Model

Validation of the behaviour model. This task was completed based upon the data collected as part of the second PEACOX trial in Vienna and Dublin. Modelling methods were successfully applied thanks to data collection changes recommended by TCD following the first Vienna trial. Model fit was found to be poor; however ancillary methods were used to examine the role of emissions information in mode choice.

### 2.4.2 Highlights WP3

The highlights of this work package are the completion of the final deliverables. Furthermore work in this work package in the final year resulted in another journal paper, in addition to the three previously published.

### 2.4.3 Deviations and remedial actions WP3

The overall delays encountered by the project resulted in knock on impacts upon WP3. As the second field trial was moved from early 2014 to late summer and early autumn, the delivery of the second iteration of D 3.4 was delayed accordingly, however, this deliverable was provided on time in line with the updated time line.
2.4.4 Use of Resources WP3

Figure 3 provides an overview over the planned and actual resources that have been invested in this work package in year 3.

![Figure 3: WP3 Planned and Actual Resources in Person Months for Whole Project](image)

The figure shows the distribution of planned and actual person months used in work package three. TCD had a significant overspending of resources. As already outlined in the prior reports the discrepancy is mainly caused by the employment of less experienced personnel than originally foreseen when planning the project and so the cost per month is greatly reduced, but the required person months to fulfil the tasks successfully are bigger.

2.5 Work Package 4 – Automated Travel Mode and Trip Purpose Detection

The objective of WP 4 is to provide highly accurate and reliable travel mode and purpose detection for GPS observations and derive participants’ individual travel patterns. Complementing GPS data with accelerometer measurements, which are available on most dedicated GPS devices and also in most smart phones, increases the stability and reliability of the routines. The machine learning approach used for trip purpose detection was successfully applied to mode detection and the effect of learning strategies was analysed. Further the routines were adapted to work in different parts of the world by using the UTM (Universal Transverse Mercator) coordinate system. And finally, they were tested in the real world as part of the PEACOX application.
2.5.1 Progress towards Objectives WP4

<table>
<thead>
<tr>
<th>WP4</th>
<th>Work performed, status and achievements per task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 4.1</td>
<td>Extending the mode detection to account for additional modes and the logical order of the resulting mode chains</td>
</tr>
<tr>
<td></td>
<td>Majority of the work of Task 4.1 was finished as scheduled in the first year of the project. As trip purpose detection was done using random forests, this methodology was also tested for mode detection. Accuracies of around 85% were reached using mode- and stage-specific input features which is only slightly better compared to the optimised fuzzy rules system (up to 83%). Interestingly, the public transport map-matching score which was developed in the first year, did not improve prediction quality. Including personal mode shares on the other hand, has a positive effect (accuracy increase to around 88%). Personal mode shares can be obtained in surveys with longer time periods. To do so corrections of participants in the first days or weeks are important.</td>
</tr>
<tr>
<td>Task 4.2</td>
<td>Validation of the trip and mode detection and calibration of the parameters for the study area</td>
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<tr>
<td></td>
<td>Analysis of the corrections done by participants during the second field trial showed very different patterns. For some participants only around 30% of transport mode predictions were correct, others did not change anything. Unexpectedly, less corrections were done for trip purposes (only around 20%, similar for all participants).</td>
</tr>
<tr>
<td>Task 4.3</td>
<td>Development and implementation of a trip purpose imputation</td>
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<td></td>
<td>Developing a trip purpose detection module was the major task of the second project year. A random forest was used which is a machine learning method where, based on training data, different decision trees are learned. Each tree in this random forest has one vote for classification. After successful testing of the method using Matlab and data from a one-week GPS survey in Zurich, in the third year, the trip purpose imputation module was implemented in Java for Field Trial II. The processing methods in general were refactored to handle input data from different parts in the world using the UTM coordinate system. The trip detection module distinguishes the following classes: “home”,</td>
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“work and education”, “shopping and services”, “recreation”, “pick someone up or drop someone off”, “business”, “other” and “mode transfer”.

<table>
<thead>
<tr>
<th>Task 4.4</th>
<th>Design, implementation and testing of the prompted-recall survey to obtain user feedback regarding the processing results</th>
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<tr>
<td></td>
<td>The goal of the prompted-recall survey is to obtain a user corrected travel diary. For the first field trial a paper-and-pen diary in A6 format was used. Even though it was easy to understand and most participants filled it in reliably, this procedure caused some problems as matching the recorded GPS data to the paper-and-pen diary was not straightforward. Therefore, for the second field trial a smartphone application was implemented that directly accessed the pre-processed diary data on the central survey database. The consortium decided to implement a prompted-recall smartphone application, as all participants needed to have a smartphone in any case for the PEACOX journey planner. The “Trip diary” application was kept as simple as possible, it consisted of the main menu where the date could be chosen, and a map where GPS tracks were shown with a list below where color-coded transport mode and icon-coded activity types were listed in chronological order. Both transport mode and activity type could be corrected by participants and were again directly saved in the central database.</td>
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<table>
<thead>
<tr>
<th>Task 4.5</th>
<th>Development and implementation of learning routines for the mode and trip purpose detection</th>
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<tr>
<td></td>
<td>First steps were taken into customizing detection results. For trip purpose detection the data of the paper-and-pen travel diaries was used to generate a personalized random forest. This was then combined with the more general forest learned on the Zürich data set by weighting the scores of both random forests equally. Results are promising and will be further investigated. For the mode detection, which is based on fuzzy rules, a genetic algorithm was developed to automatically improve the parameter set given some training data. The downside of both approaches is that a reasonable amount of user corrected data is needed for personalization. Therefore, it will be</td>
</tr>
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investigated if e.g. combination of the same trip on different days can be used to improve mode and trip purpose detection.

2.5.2 Highlights WP4

For the second version of the PEACOX mobile application trip purpose detection was personalised by learning the home and work address within the first week, adding diary data corrected by participants to the classifier that was relearned every day and for mode detection self-reported mode shares were included. Further, the routines were adapted to handle coordinates from different places in the world, to do so the UTM coordinate system was used. The complete Position Data Processing package (PosDaP) is available open source on sourceforge.net.

The paper-and-pen diary of the first field trial was replaced by a prompted-recall smartphone application the “Trip diary”. This allowed participants to observe their trips and to correct transport mode and activity type whenever needed. Even though the app was easy to use, many participants forgot to use it or only corrected their diary after several days, when recall of trips already gets challenging.

Logging of GPS data with smartphones worked well during Field Trial II. A comparison of the amount of logging between smartphone GPS and GPS of dedicated devices suggests that still a little more movement is detected by the dedicated devices, even though it is often argued that dedicated devices are forgotten at home.

2.5.3 Deviations and remedial actions WP4

Logging of accelerometer data worked well during Field Trial II. Unfortunately some of the data was lost, as it had to be deleted from the database on a daily basis, due to their huge amount. Still, enough data is available for analysis especially as data was also logged with dedicated GPS devices.
2.5.4 Use of Resources WP4

Figure 4 provides an overview of the planned and actual resources that have been invested in this work package.

![Figure 4: WP4 Planned and Actual Resources in Person Months for the Whole Project](image)

The efforts in the work package reflect to a large extent the planned efforts for the whole project duration, with ETHZ, ICCS and TMX as main contributors. Whereas after the second period there was a notable differences of planned versus spend resources occur for TMX and ETHZ, resource usage could be successfully compensated in the last project year.

2.6 Work Package 5 – Development of persuasive strategies for green mobility

The main objective of this work package was to identify existing strategies, as well as to develop new ones to persuade users to change their attitudes as well as their travelling behaviour towards an economical friendly one. The focus was on the identification, creation, implementation as well as evaluation of persuasive strategies and design principles. A combination of methods was used to identify and develop these ideas and approaches. As an outcome of this WP, informed decisions about strategies that should be implemented were made.
2.6.1 Progress towards Objectives WP5

| Task 5.1. Collection of persuasive technologies within the mobility context | This task was already successfully completed in year one. A detailed report about the research strategies can be found in Deliverable D5.1 Persuasive Strategies Report. |
| Task 5.2. Designing and evaluating persuasive strategies for eco-feedback technologies | In period 3 – based on the results from the prior project periods – work on designing and improving selected persuasive strategies was continued, and different strategies and approaches were evaluated with regard to their usefulness and applicability in the PEACOX project as part of the second field trials. Work in this task focused on the following aspects and strategies  
   a) Persuasive Messages tailored to specific route requests.  
   b) Improving CO2 Feedback used in behaviour statistics  
   c) Improving the algorithms for semantic summary feedback (implemented as a tree)  
   Results informed the work in Task 5.4 and are summarized in D5.2 Guidelines for designing persuasive strategies within the mobility context. |
| Task 5.3. Exploration of Further Persuasion Strategies for Eco-navigation | The main goal of this task is to explore the possibilities of persuasive approaches besides the a-priory defined foci of personalization and eco-feedback, that are already addressed in Task 5.2. Based on the analysis of related work, the project focused in its third reporting period on the strategy of using challenges to motivate people. Here a framework for proposing challenges to users was defined considering both, individual and group challenges. Different areas of target behaviour for challenges were defined, and detailed challenges and messages to be used were specified.  
   Results informed the work in Task 5.4 and are summarized in D5.2 Guidelines for designing persuasive strategies within the mobility context. |
### Task 5.4 Detailed Design of personalised eco-feedback

Within this task we developed the conceptual design of the second PEACOX application, based on the selected persuasive strategies and the learnings from the first trial.

Starting point of the development of the PEACOX user interface was the system design of the first prototype iteration, and based on the feedback from the users the interface design was modified and improved for the second prototype. Furthermore new system elements implementing additional strategies were designed in close cooperation with the implementation partners, especially FLU and ICCS. The final interface design was implemented in the second prototype and tested in the field trials.

### Task 5.4 Decision making support

We established a choice architecture approach for facilitating informed decisions in everyday transportation conditions. The approach considers choice aspects that affect user decisions including defaults, structuring of complex choices and information filtering. Moreover our approach is coupled with Multi Attribute Utility Theory methods and specifically with the ordered weighted averaging operator. Decision criteria, which we considered are route characteristics, contextual information and users' preferences, provided through the PEACOX application settings that users set.

### 2.6.2 Highlights WP5

Highlights of WP5 are the development and inclusion of new strategies (challenges, tailored persuasive messages) within the PEACOX system and the evaluation of these strategies and concepts as part of the second field trials.

We furthermore condensed the main findings on using different strategies and concepts in persuasive systems in a guideline document (*D5.2 Guidelines for designing persuasive strategies within the mobility context*).
2.6.3 Deviations and remedial actions WP5

Due to the delay of the development work in WP6 and the second field trials, also work on the evaluation of persuasive strategies (which partly was performed in conjunction with the trials) had to be postponed accordingly. Due to the requested and granted project extension this did not result in negative effects.

2.6.4 Use of Resources WP5

Figure 5 provides an overview over the planned and actual resources that have been invested in this work package.

![Figure 5: WP5 Planned and Actual Resources in Person Months for Whole Project Duration](image)

The amount of work spent during the third project year generally was in line with the planned efforts, relevant deviations were only present for partners FLU, TCD, and CURE. The deviation for CURE and FLU can be explained by appointing less senior (and cheaper) personnel. Partner TCD also significantly contributed to WP5 (especially by studying optimized ways for CO2 Feedback), but accounted work mainly in WP3 (in conjunction with which work was performed), which also contributes to the overspending of TCD there.
2.7 Work Package 6 – System Design and Implementation

The specification phase of the overall system for the second prototype was finalised, including the features as well as the technical aspects. Within this phase all server as well as client components were defined, and the interfaces between the individual components and the most important system processes were specified. Furthermore, the use cases for both applications (journey planner and navigation application) were finalised.

The recommendation component was developed further including several improvements during the development phase. The second version now includes functionalities that rank the suggested routes according to user preferences inferred from the analysis logs that detect the users’ trip mode and functionalities that generate persuasive messages aiming to nudge users towards routes with low emissions.

With respect to the implementation, work was required both on the server as well as on the client side. Fluidtime integrated successfully all partner components within the main PEACOX server and every project partner used the central PEACOX database.

In the implementation phase, two applications were developed – the journey planner application and the navigation client. During the development phase, several versions of the application were released and both clients were ready for the second trial.

2.7.1 Progress towards Objectives WP6

<table>
<thead>
<tr>
<th>WP 6</th>
<th>Work performed, status and achievements per task</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task 6.1</strong>&lt;br&gt;Use case Specification</td>
<td>The use cases for the final PEACOX applications (journey planner and navigation client) and the corresponding technological requirements were defined. Furthermore the final use cases and the corresponding feature set were finalized.</td>
</tr>
<tr>
<td><strong>Task 6.2</strong>&lt;br&gt;Recommendation Component</td>
<td>The recommender was adopted, based on the lessons learned from the first trial. New functionalities that rank the suggested routes according to user preferences inferred from the analysis logs that detect the users’ trip mode and functionalities that generate persuasive messages aiming to nudge users towards following routes with low emissions were implemented.</td>
</tr>
<tr>
<td><strong>Task 6.3</strong></td>
<td>The final system architecture was adapted, based on the changes from the</td>
</tr>
<tr>
<td>System Design</td>
<td>Previous trial. The system design now includes all server and client elements, their functionality and interface protocols, leading to a widely applicable and scalable service concept. The changes were documented within deliverable D6.3.2 Updated System.</td>
</tr>
<tr>
<td>---------------</td>
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</tr>
<tr>
<td><strong>Task 6.4</strong> Definition of Data Interfaces and Interface Design</td>
<td>Within this task the interaction design was adapted, based on the results from the first trial and the screens for the second trial features were created including the visual design.</td>
</tr>
<tr>
<td><strong>Task 6.5</strong> Routing Server and Model-Integration</td>
<td>Within this task FLU connected the routing engine (Google routing engine) for the second trial (Dublin) in order to enable a routing within the journey planner application. Furthermore the partner components where integrated in the route process. For the navigation client a slightly different architecture was realized, where a multimodal route is calculated in two steps. First the user’s request is forwarded through the TMX server to the FLU server, where multimodal routes are calculated. Their descriptions including important waypoints are sent to the navigation client, where the second step of route calculation is handled. For car and on-foot navigation the route is calculated using map data stored in the phone’s internal flash memory. Then all parts of calculated routes are displayed and the user is asked for choosing one of them.</td>
</tr>
<tr>
<td><strong>Task 6.6</strong> Web, Mobile Interface Development</td>
<td>Two PEACOX applications – the journey planner application and the navigation client - were developed and finalised within this task. The logging component (GPS &amp; accelerometer) was developed in an iterative process and intensively tested with the project partners. The journey planner application was developed, based on predefined use cases and features for the second and final trials. The key features are statistics, challenges and the recommendation as well the routing in Dublin. For the challenges a web interface was created in order to enable the PEACOX admin to send specific challenges to specific user. The development of the navigation client was focused on the implementation</td>
</tr>
</tbody>
</table>
of multimodal navigation and two-steps route searching (as is described in Task 6.5). TMX has also implemented new parts of GUI beside this route searching internal functionality. These parts of GUI will be used for second part of navigation client development. Furthermore, the deliverable D6.5 Second Prototype was finalised.

2.7.2 Highlights WP6

Based on the defined system architecture the partner components were successfully integrated into the PEACOX server. The routing engines for both trial cities were integrated within the overall system.

The journey planner application was further developed for the second field trial. Therefore, new features and several improvements from the first field trial were considered. Additionally, the challenges web interface and the logging component were successfully developed. Also, the final version of the recommendation component was successfully completed.

The navigation application was extended by multimodal functionalities, where multimodal route is calculated in two steps process. End user can use navigation client as common car navigation support or as a multimodal navigation using public transport together with walk mode.

2.7.3 Deviations and remedial actions WP6

Due to unexpected complications and insecurity regarding the availability of the routing infrastructure, the integration of the different components towards the second prototype in WP6 took longer than planned. The consortium discussed this issue, and a project extension was asked for in order to ensure a successful completion of the PEACOX project.
2.7.4 Use of Resources WP6

Figure 6 provides an overview over the planned and actual resources that have been invested in this work package.

![WP6 Planned and Actual Resources in Person Months for Whole Project Duration]

The reported resources generally are in good alignment with the planned ones. Only for partner FLU there is a significant deviation. Reason for the deviation between actual and planned person-month for the partner Fluidtime (FLU) are as follows: The FLU Peacox team members engage in WP6 who actually worked in the project do have a lower hourly rate compared to the average rate used by FLU in the Proposal / Description of Work.

2.8 Work Package 7 – Evaluation

The objective of this work package was to evaluate the developed concepts, components and prototypes with regard to all relevant criteria. Special focus was on the involvement of real users in realistic settings in the evaluation to provide valid results. The outcomes of the work package were used to inform further system development and to base critical design and implementation decisions on empirical data from real users.
## 2.8.1 Progress towards Objectives WP7

<table>
<thead>
<tr>
<th>WP 7</th>
<th>Work performed, status and achievements per task</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task 7.1</strong> Evaluation Planning &amp; Preparation</td>
<td>In this task, a comprehensive testing and assessment plan for the PEACOX-project was developed. Deliverable 7.1 Evaluation Plan was already submitted in the first project year and provides an overview on the planned evaluation phases. Based on this general outline a detailed specification of the methods and procedures to be used during the second field trials was developed and agreed upon the project partners.</td>
</tr>
<tr>
<td><strong>Task 7.2</strong> Ongoing Usability and User Experience Feedback</td>
<td>Within this task on-going usability feedback on the developed concepts and components was provided. The main activities (user group definition, usability test) already took place in the first two project years. Activities within the concurrent period of this task focused on monitoring the implementation of the user interfaces and on performing expert reviews and providing suggestions for improvements. Activities addressed all user interfaces developed in the project, i.e. the trip planner, the turn-by-turn-navigation and the prompted recall tool.</td>
</tr>
<tr>
<td><strong>Task 7.3</strong> Persuasive Strategies Evaluation</td>
<td>The evaluation of the persuasive strategies was designed to be done in a twofold manner. First, as part of the field trials and on-going evaluation activities the effects of the different persuasive actions on the end users were measured, discussed and analysed. Second, dedicated studies and experiments were designed to study the impact of different approaches in more controlled settings. In the third period the evaluation of strategies focused on the second field trials, and on the aspects of challenges and integration with social networks.</td>
</tr>
<tr>
<td><strong>Task 7.4</strong> Field Trials I</td>
<td>The first field trial was already conducted during the second reporting period. Results of this task were reported in D7.4. These informed the design and development process for the second prototype iteration, especially in WP5 and WP6.</td>
</tr>
<tr>
<td><strong>Task 7.5</strong> Field Trials II</td>
<td>In the third period the second trials in Vienna and Dublin were successfully planned, organized, run and analysed.</td>
</tr>
</tbody>
</table>
2.8.2 Highlights WP7

The second field trials were successfully conducted during summer of 2014, and results were analysed and the major findings were compiled into recommendations and guidelines for persuasive systems. An important aspect of the trial was furthermore accepted for publication in the Persuasive Technology 2015 conference.

2.8.3 Deviations and remedial actions WP7

As mentioned above, due to delays in several other WPs, also the trial had to be postponed compared to the original planning. An updated work plan was submitted to the commission and approved.

2.8.4 Use of Resources WP7

Figure 7 provides an overview over the planned and actual resources that were invested in this work package.

![Figure 7: WP7 Planned and Actual Resources in Person Months for Whole Project Duration](image)

The reported resources are on track with respect to the objectives of this work package and are in relation with the work plan to a large extent. There were no major deviations to the planning within work package 7.
2.9 Work Package 8 – Project Dissemination and Exploitation

Dissemination of the project results to the wide public, industrial stakeholders and scientific audience was provided using different communication channels, supported by means like posters, white papers, multimedia material or scientific papers. An important pillar was the project web site, serving at the same time as a means for internal communication purposes. Both the web site and all materials are based on a uniform graphic layout.

As part of the dissemination activities of PEACOX, the consortium handed in and published scientific papers at different conferences. These publications reported results from different aspects of the project, such as e.g. the collection and analysis of GPS data, the impact of collective versus individual challenges in persuasion or the design of recommender systems.

An exploitation plan was prepared, which describes the PEACOX’s consortium members’ expectation for using and exploiting the project results. The last part of WP8 was the preparation of a recruitment strategy for recruiting test users for testing of the prototype of the PEACOX system in Vienna and Dublin.

2.9.1 Progress towards Objectives WP8

<table>
<thead>
<tr>
<th>WP 8</th>
<th>Work performed, status and achievements per task</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task 8.1</strong>&lt;br&gt;PEACOX Project Website</td>
<td>The PEACOX Project Website was developed in Year 1 and it is continually used for dissemination activities, as well as for collaboration within the consortium. The PEACOX project website is available at <a href="http://www.project-PEACOX.eu">http://www.project-PEACOX.eu</a>. The project website is continuously maintained and updated, and news regarding the project’s progress were distributed regularly by means of a news section on the site.</td>
</tr>
<tr>
<td><strong>Task 8.2</strong>&lt;br&gt;Public and Scientific Dissemination Activities</td>
<td>The aim of this task was to carry out public and scientific dissemination activities. Consortium members organized several project dissemination activities and also collected feedback to the performed work. Detailed activities were reported in D8.2.3.</td>
</tr>
<tr>
<td><strong>Task 8.3</strong>&lt;br&gt;Motivating End-users for Participating in</td>
<td>This task was performed successfully for the second round of testing of the PEACOX system in Vienna and Dublin during Summer 2014. Enough users could be motivated to participate in the second trials, and finally 37 participated throughout the whole trial period.</td>
</tr>
</tbody>
</table>
Upon wider discussion within the consortium members and based on the feedback from the pre-review, the exploitation plan was updated. It is based on the initial version, which was further developed and adapted after the second trials were finished.

2.9.2 Highlights WP8

Almost all planned activities for WP8 were successfully achieved. Michael Kieslinger (Fluidtime) presented the PEACOX project and the PEACOX journey planner application within the Economic Forum in Dublin. Furthermore several publications in scientific journals presenting important project results were achieved.

2.9.3 Deviations and remedial actions WP8

No major deviations from the WP project plan occurred within this WP.

2.9.4 Use of Resources WP8

Figure 8 provides an overview over the planned and actual resources that were invested in this work package.

![Figure 8: WP8 Planned and Actual Resources in Person Months for Whole Project Duration](image-url)
Most resources spendings were in line with the original planning, with exceptions for Partners FLU and CURE. Due to the intense publication and dissemination activities and long travels (Australia, Kanada), CURE used more resources than planned in WP8. The overspending of FLU was related to both using less senior personal than planned as well as intensified dissemination activities.

2.10 Project Management during the period

The objectives of related to consortium management were to ensure the realization of all project objectives as defined in this document. This contains the monitoring of the achievement of milestones and the timely finalization of the deliverables; defining and monitoring quality standards, risk management, conflict resolution and ensuring that results are achieved within budget.

With regards to management Figure 9 gives an overview of the management efforts that were realized so far in relation to the effort planned for this reporting period.

![Figure 9: Overview of planned vs. actual PM in WP1 (Project Management) for the whole project](chart)

The spent efforts in work package 1 reflect to a large extent the planned efforts for the second period, no major deviations have occurred.
2.10.1 Communication

With regards to internal communication the following infrastructure was set up and is used regularly:

- On the PEACOX website an internal password-protected area for the project partners was set up and used to manage documents. With this infrastructure, working documents, minutes, deliverables etc. could be uploaded and are shared among all partners.

- A mailing list ([peacox-all@lehar.cure-vienna.org](mailto:peacox-all@lehar.cure-vienna.org)) containing all involved project partners was available since the beginning of the project and regularly updated in case of changes of involved personal thereby making it easy to communicate to the whole consortium.

- In the internal area of the project website, contact information (email contact) to all members of the consortium was available.

- Regular telephone conferences were held with participation of representatives of all partners. Frequency of the phone conferences is adapted according to the project needs.

- All partners could be reached by email or via Skype on short term.

Communication within the project was good and all partners participate as expected in internal communication.

2.10.2 Meetings

The following major meetings took place or are still planned in the third and final project period:

- Consortium Meeting: 3 and 4 October 2013, Zurich
- 2nd Advisory Board Meeting, 11 October, Vienna
- Technical Meeting, 27 and 28 November 2013, Vienna
- Consortium Meeting, 5 to 7 February 2014, Dublin
- Consortium Meeting: 3 June 2014, Brussels
- PreReview Meeting: 4 June 2014, EC, Brussels
- PEACOX Consortium Meeting, 21-22 October 2014, Athens
- Peacox Final Review Meeting, 22 May 2015, Dublin
Furthermore regular, telephone conferences with all partners were set up to keep all partners informed about the status of the project and work of all partners. Representatives from all partners took part in these regular telephone conferences.

Regularly scheduled telephone conferences took place on work package level, with only a subset of partners working on the specific topics taking part. The telephone conferences were mainly used to discuss on-going tasks, common work and to do’s of the partners.

2.10.3 Reporting
All partners delivered project management reports for their organization for the third project periods (Oct 2013 – Mar 2015), which were summarized in this management report. Each work package leader provided regular reports on the activities within his work package. The combination of these activity reports has led to the compilation of this periodic report.

2.10.4 PEACOX Advisory Board
In the framework of the project an Advisory Board for expert discussion, evaluation, advice and exchange of views about the project PEACOX was built up.

For PEACOX it is important to get different perspectives and viewpoints, so various experts and scientists from several disciplines and fields (engineers, social scientists, managers and transport planners) were invited to take part in the Advisory Board. 6 experts from Germany, Italy, Austria, and Ireland were invited to participate and all of them have agreed. The Advisory Board consisted of the following members:

- Ralf Risser (FACTUM – Austria)
- David King (RPA Railway Procurement Agency – Ireland)
- Peter Cranny (NTA National Transport Authority – Ireland)
- Luciano Gamberini (UNIPD University of Padova – Italy)
- Fritz Busch (TUM Technical University of Munich – Germany)
- Jakob Puchinger (AIT Austrian Institute of Technology – Austria)

At the beginning of the third period of the project the second Advisory Board Meeting took place in Vienna on 11 October 2013. Unfortunately not all advisors could physically participate in this meeting, so some of them provided feedback and guidance based on the materials of the project sent to them. During the meeting the status of work of all work
packages of the PEACOX project was presented by various project partners. Consistently positive feedback was received for the work conducted until the respective meetings. The outcomes of the board meeting was documented in form of meeting minutes, and informed the future work and direction of the project.

2.10.5 Project Planning, Status and Quality

The efforts spent in the project are summarized in Figure 10 below. On an overview level the resources invested in the third project period are in line with the planning. Only in WP 3 and WP6 there were significant differences between planned and actual usage of resources. The related reasons are explained in detail in the regarding work package sections.

![Figure 10: Overview of Planned vs. Actual Efforts per WP](image.png)

14 deliverables and one milestone (MS3) were due in the third period of the project. An internal QA procedure was defined to ensure high quality of all internal and external deliverables. The internal reviewing process worked well for all external deliverables in the period and is planned to continue in the same way for all deliverables of the project. A detailed overview of the deliverables which were due in the third period and their status is provided in section 3.
2.10.6 Organisational changes, Modification of Work Plan and Re-Scheduling of Tasks

Transfer from CURE to AIT. In the third project period the original consortium leader CURE transferred its role within PEACOX including the project coordination to the Business Unit Technology Experience within the Austrian Institute of Technology (AIT). This business unit was newly formed recently by Prof Tscheligi and is also headed by him. The transfer did not entail any changes of the planned work, only organisational and administrative changes were required. Also, the personnel working at the project stayed the same, as the involved people (mainly Manfred Tscheligi, Johann Schrammel and Sebastian Prost) also moved from CURE to AIT thereby ensuring maximum continuity of the project work. All project partners were informed of this change in advance and asked for their opinion on the change. All partners expressed positive feedback on it, and no partner stated any opposition against this transfer.

Project Extension. At the last review the project had a delay of approximately 3 months, and the original plan was to catch up this delay by increased parallelisation of work. Unfortunately due to unforeseen developments we were not able to do so, and therefore a request for a project extension and a modified planning of the remaining project work was submitted and granted. Mainly two developments were responsible for the continued delay of the project which required the extension:

- At the beginning of the year 2014 it became questionable whether ITS will still be able to provide the routing services using the same technology as in the first trial. This was caused by a changed general strategy regarding the usage of routing services within ITS. Until this issue could be solved (which took about two months) development was stopped in order to not base it on wrong assumptions.
- Secondly, during the first half of 2014 the discussion and management activities regarding the accession of AIT to the project were done, which also took longer than expected.

As a result a project extension of 6 months was applied for and the timing of tasks and deliverables was adapted accordingly, and an updated Description of Work has been submitted to the EC.

2.10.7 Development of the Project Website

The website of the PEACOX project can be found at www.project-PEACOX.eu.
During the first period the basic website infrastructure already had been set up. The website was being updated with information about the current progress of the project regularly, and the public deliverables of the project were uploaded. Additionally, the published newsletters are achieved on the website and accessible to the public.
3. Deliverables and milestones tables

3.1 Deliverables

This list shows all deliverables that had to be submitted in the third project period.

<table>
<thead>
<tr>
<th>Del no.</th>
<th>Deliverable name</th>
<th>Version</th>
<th>WP no.</th>
<th>Lead beneficiary</th>
<th>Nature</th>
<th>Nature</th>
<th>Dissemination level</th>
<th>Delivery date from Annex I (proj month)</th>
<th>Actual/Forecast delivery date</th>
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<tbody>
<tr>
<td>D3.5</td>
<td>Evaluation of developed models</td>
<td>3</td>
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<td>Implementation and pretest of the trip purpose detection</td>
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<td>D5.5</td>
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<td>Updated System Design and Interface Definition</td>
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</tbody>
</table>
4 Dissemination Level:

**PU** = Public

**PP** = Restricted to other programme participants (including the Commission Services).

**RE** = Restricted to a group specified by the consortium (including the Commission Services).

**CO** = Confidential, only for members of the consortium (including the Commission Services).

*Make sure that you are using the correct following label when your project has classified deliverables.*

**EU restricted** = Classified with the mention of the classification level restricted "EU Restricted"

**EU confidential** = Classified with the mention of the classification level confidential " EU Confidential "

**EU secret** = Classified with the mention of the classification level secret "EU Secret 

<table>
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<tr>
<th>Report Code</th>
<th>Report Title</th>
<th>Dissemination Level</th>
<th>Project Code</th>
<th>Start Date</th>
<th>Submitted</th>
<th>Approved</th>
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<tr>
<td>D7.5</td>
<td>Field Trials II Report</td>
<td>PU</td>
<td>41</td>
<td>31.03.2015</td>
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<td>D8.2.2</td>
<td>Periodical Dissemination Report 2</td>
<td>PU</td>
<td>24</td>
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<td>D8.2.3</td>
<td>Periodical Dissemination Report 3</td>
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<td>D8.4.2</td>
<td>Recruiting Strategies Report 2</td>
<td>PU</td>
<td>33</td>
<td>27.06.2014</td>
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<td>D8.5</td>
<td>Final Exploitation Plan</td>
<td>PU</td>
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<td>30.04.2015</td>
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</table>
3.2 Milestones

Please complete this table if milestones are specified in Annex I to the Grant Agreement. Milestones will be assessed against the specific criteria and performance indicators as defined in Annex I.

This table is cumulative, which means that it should always show all milestones from the beginning of the project.

<table>
<thead>
<tr>
<th>Milestone no.</th>
<th>Milestone name</th>
<th>Work package no</th>
<th>Lead beneficiary</th>
<th>Delivery date from Annex I dd.mm.yyyy</th>
<th>Achieved Yes/No</th>
<th>Actual / Forecast achievement date dd.mm.yyyy</th>
<th>Comments</th>
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<tr>
<td>MS1</td>
<td>Requirements Definition Finished</td>
<td>WP2, WP5</td>
<td>FLU</td>
<td>30.06.2012</td>
<td>Yes</td>
<td>30.06.2012</td>
<td>D2.1 – D2.3 and D5.1: These are prerequisites for the further development</td>
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<tr>
<td>MS3</td>
<td>Second Prototype Evaluation Finished</td>
<td>WP6, WP7</td>
<td>CURE</td>
<td>30.06.2014</td>
<td>Yes</td>
<td>31.03.2015</td>
<td>D6.5 Second Prototype, D7.5 Evaluation Report Field Trials II</td>
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</table>
4. Explanation of the use of resources

The explanations of the use of resources have been uploaded in the NEF system for some of the project partners. However, due to delays in accounting procedures the final data is not available for all project partners yet.