PROJECT FINAL REPORT

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1. Final publishable summary report

Executive summary

Ecological issues in traffic become more and more pressing, as personal transportation is one of the greatest contributors of CO2 emissions. Means to help people reducing their ecological impact are urgently needed. To answer this need, the project provides travellers with personalized multi-modal navigation tools that allow, help and persuade them to travel and drive ecological friendlier. To convince users in making more sustainable travel choices, it will enrich navigation systems with innovative approaches and features:

The EU-funded project PEACOX, which was conducted from April 2012 until March 2015, aimed at integrating automated travel mode detection based on real-time GPS data into the trip planning and thereby minimizing the need for explicit user input. The system developed within the PEACOX project has the capability to automatically detect users' trip purpose through the analysis of behavioral patterns, allowing tailoring trip suggestions to these purposes. PEACOX builds on dynamic user models for personalizing recommendations based on prior trip choices and individual preferences. Advanced door-to-door emission models were developed that provide accurate feedback on the ecological carbon footprint and exposure levels in planning as well as during traveling and car driving activities. Furthermore, PEACOX utilized and extended persuasive interface strategies to give feedback about the ecological impact of individual behavior as well as to make the ecologically friendliest behavioral pattern visible and attractive.

Figure 1 illustrates the high-level system approach of PEACOX:

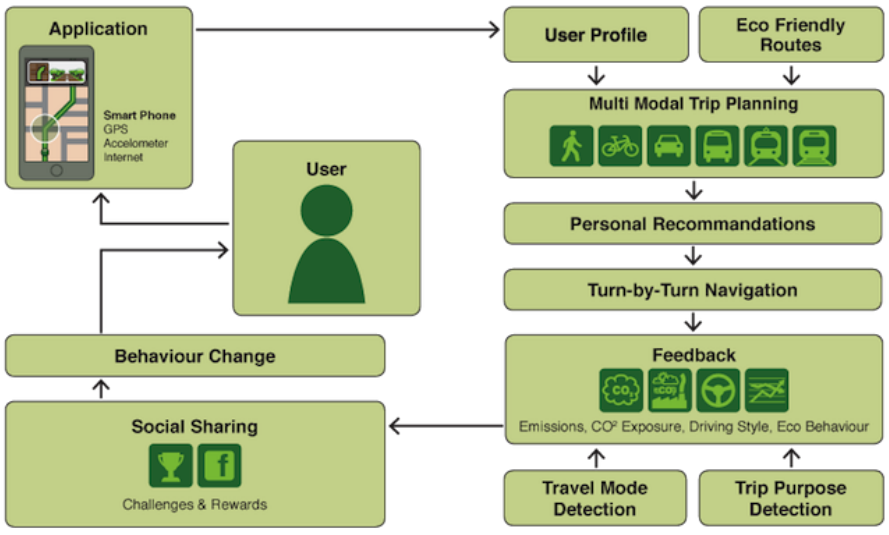

Figure 1: High-level approach of PEACOX

The system was developed in two iterations, following user-centred and agile design approaches, and extensive field trials in Vienna and Dublin were conducted to ensure high quality and impact of the developed system. The PEACOX project enabled a comprehensive view from navigation systems, transportation sciences, environmental modelling, artificial intelligence, persuasive technology, human-computer interaction to software development.

Project context and objectives

Ecological issues in environments have become more and more pressing, and means to reduce the ecological impact of inhabitants are needed urgently. A substantial part of emissions is related to traffic and mobility, and as work and leisure life becomes more and more geographically distributed, it has become even more important to support and guide users to behave pro-environmentally with regard to their traveling behavior and decisions.
To answer this need, the main approach of PEACOX was to provide travellers with personalized mobile and web tools that allow, help and persuade them to plan their trip in accordance with environmentally friendliest travel modes. To support the users in making this decision without feeling restricted, the developed PEACOX system considers their situational and individual range of acceptable travel choices. PEACOX furthermore facilitates eco-friendly driving behavior by providing real-time feedback and instructions about driving. In this way, PEACOX is expected to contribute to a significant reduction of the ecological/carbon footprint without reducing quality of life and comfort of travellers.

The overall goals of PEACOX were as follows:

- To investigate possibilities for influencing travel and driving behavior of users by means of targeted persuasive strategies, providing situated and personalized feedback and use of advanced travel information systems.
- To implement an integrated prototype system and infrastructure bringing developed approaches to the real world.

These goals were broken down into the following more specific project objectives:

- 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 behavior.
- 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.

PEACOX has implemented two main interfaces for the end user that can be used in different traveling contexts. Firstly, a mobile interface was planned that allows using the trip planning and suggestions functionality on the move. This interface can also be used in the car, by additionally giving feedback about the ecological issues associated to the different driving behaviors. Secondly, a web-interface supports users within their decision-making process before and after traveling. Implementation of those technologies was mainly building on existing knowledge and technology platforms provided by the industrial partners.

The PEACOX system concept defined already at project start is illustrated in Figure 2:

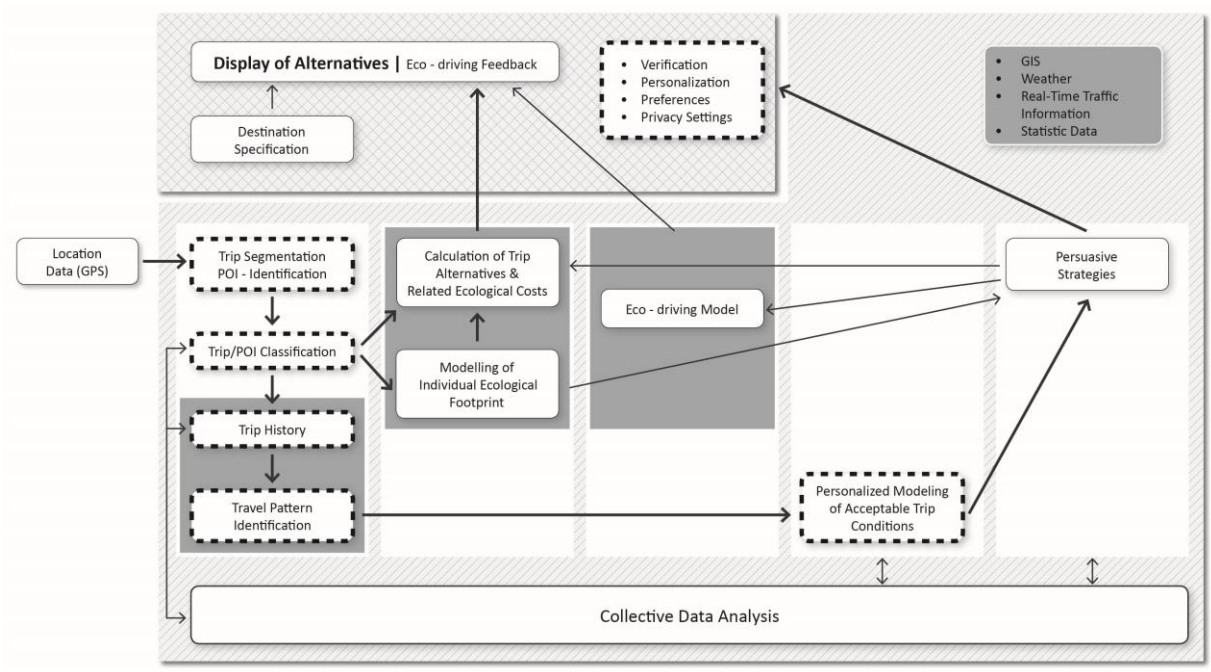

Figure 2: Core components of *PEACOX*

The image shows a distinction between the frontend system (on the top left side of the visualization) and the backend system. In the frontend, the user specifies his/her destination (*PEACOX* provides already destination suggestions based on trip history) and the system then calculates and displays recommendations of different travel mode alternatives.
These recommendations are based on a process in the backend system. With the aid of GPS, dynamically updated location data from usage is collected. After identifying trip segments and points of interest (POIs), PEACOX classifies this data and subsequently creates a trip history for each individual user. With this information about previous travel behavior PEACOX identifies travel patterns e.g. one user always uses public transport on the way to work. Those travel patterns include information about traffic mode, time and duration, preferences and location. PEACOX uses this data to personalize the recommendations for travel behavior to the individual users, so users are only presented recommendations that are within reasonable limits for the given user.
With the information of the trip classification, PEACOX models the individual ecological footprint and calculates trip alternatives and related ecological costs. This information is used to evaluate the environmental impact of different trip alternatives, and also to collect information about actual impact of a user's travels and her possible savings. Besides this ecological model, an eco-driving model incorporating different real-time data variables was developed. To visualize values of those models, user interfaces were enriched by persuasive strategies.
Trip history, travel pattern identification, modeling the environmental footprint and calculating trip alternatives get information values from GPS, weather, real-time traffic and statistical data. To increase accuracy and privacy, the user has the possibility (but is not required) to verify the outcome of the detection process and to specify preferences and privacy settings, which helps to increase the accuracy and supportiveness of the system.

To achieve the objectives and system concept, the PEACOX workplan (see Figure 3) started with a detailed look on the requirements from different relevant perspectives in WP2. Next, in WP3 and WP4 the technical foundations for implementing the *PEACOX* concepts were researched and developed. WP 5 developed strategies on how to best utilize the developed technological

possibilities with regard to the end user, and it systematically explored possibilities to enhance impact on behavior change. In WP 6, the developed concepts and approaches were implemented, and feedback from ongoing evaluation activities (WP 7) informed the development. The outcome of WP 6 was a multi-channel (Web and mobile-access) prototype of an individualised travel and navigation system.

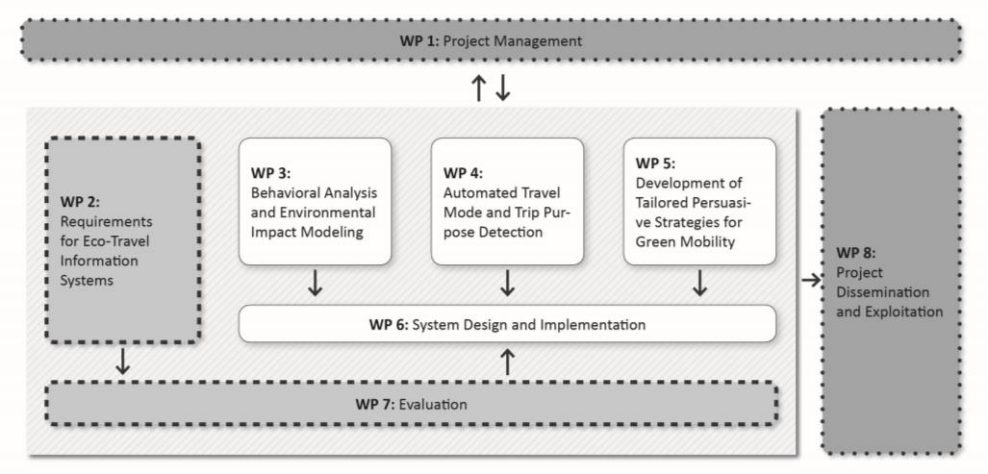

Figure 3: PEACOX workplan overview

Main S&T results/foregrounds

The project has achieved all the scientific and technological results that were defined in the DoW. In the following, these will be documented, following the list of expected results defined in the DoW:

1. Integrated system that supports end-users in engaging in sustainable travel behavior. The system will provide and integrate all the mechanisms and information needed to achieve the required behavior and attitude change.
2. An automated model for analyzing and predicting movement patterns, and transportationmeans and trip purposes by use of available location and spatial (e.g. GPS) data.
3. An advanced model for the planning and prediction of ecological costs and exposures of traveling and driving also taking into account dynamic data like traffic situation, weather, etc.
4. New and innovative persuasive strategies and interfaces/interface components targeted to the needs of ecological trip planning and selection.
5. Guidelines for the implementation and application of persuasive strategies targeted on behavior change in the transportation context.

In the following sections we provide a summary of the main outcomes related to this distinct areas of research:

Result 1: Development of an integrated system

Technical architecture

Within PEACOX, an overall integrated system has been developed. The integrated PEACOX solution adopts a client/server approach. Scalability, loosely coupling, and heterogeneity are part of the main requirements of modern software architecture. PEACOX maintains those requirements by adopting *Service Oriented Architecture (SOA)*. Figure 4 depicts the system architecture of PEACOX.

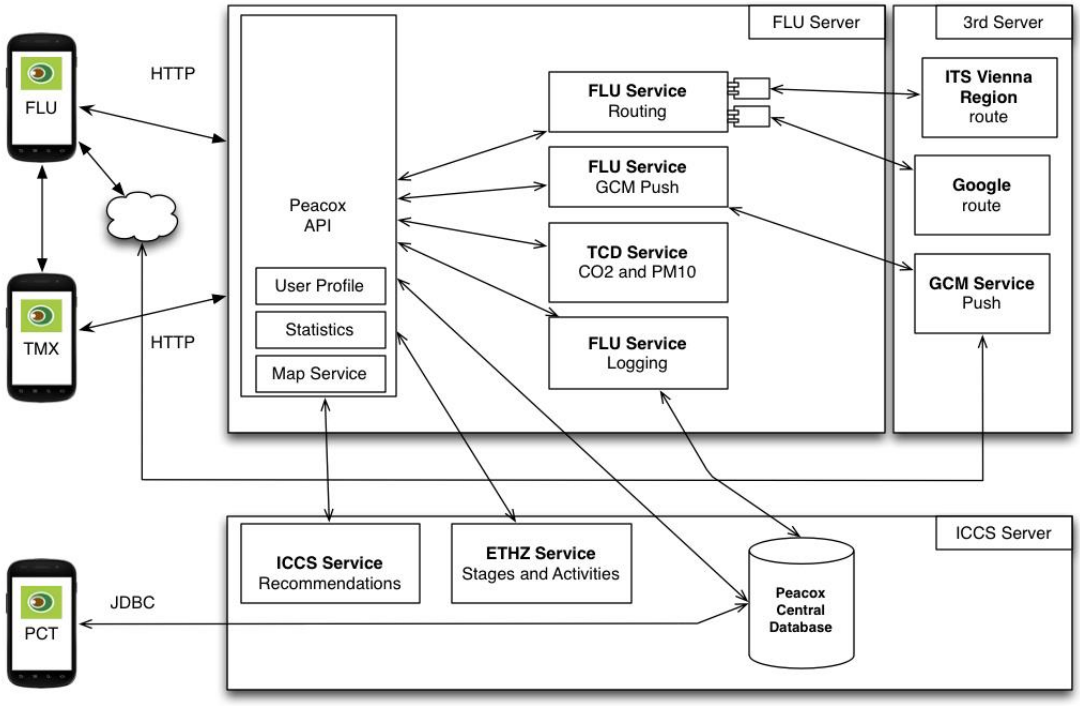

Figure 4: PEACOX system architecture

We next describe the core services enabling the PEACOX system:

GPS and Sensor Data Logging Service. The logging of GPS and sensor data is an important service that PEACOX provides. This service ensures a reliable and efficient data logging service. The collected data are used in one of the main processes of the PEACOX system, the 'Create Activities' and 'Stages Service'.

User Profile Service. This service enables the user to register to the PEACOX system. After having successfully registered, the user can use his registration information to log into the system at any given point in time. Furthermore, the user profile service ensures the privacy of user related data.

Routing Service. This service provides the users with multimodal routes. Since PEACOX trials run in two different cities, it is an important requirement for this service to be designed in way that routes can be acquired from different route providers. The routes for Vienna are provided by ITS Vienna region, where Google Maps API provides the routes in Dublin.

Statistics Service. The statistics service provides the user with an overview as well as detailed information about the CO2 and PM10 values related to the route of the user. There are two levels of CO2 and PM10 statistics, the first one is the information extracted from the routes the user requested from the routing engine. However, it is not necessary that users use the routing engine for all their movements, that is why, in the second level of the statistics service we use the information that were extracted by other two PEACOX services, which are namely the "Create Activities and Stages Service" and "Transport Modality Detection Service".

Push Service. The Push service provides the administrators of PEACOX with a facility to send push messages to the users. A secured web page for this purpose has been implemented. After a

successful login, the administrator can select the type of the message she wants to send, the recipients, and can enter additional free text. The information entered in the push form is then sent to the push API of PEACOX. The Push API provides an implementation of a push service specified by Google Cloud Messaging (GCM). Thereby, the PEACOX administrator can send different types of push messages.

Recommendation Service. The aim of the service is to personalize and contextualize route requests and route results received from the routing engine, while considering nudge factors in order to urge users to follow environmentally friendly routes.
In more details, route requests are contextualized according to current weather information. For example, when too cold or too hot conditions are met, long bicycle and walking routes are filtered out. Moreover, user settings with respect to transportation options are overridden in order to get as many route results as possible from the routing engine. This means that if for example a user omits the walking option, the recommendation service will activate it in order to allow the routing engine to calculate walking results. Note that in the next step the results are filtered according to user preferences, so the system decides whether the route will be presented or not.

Tree Service. The tree service calculates a per user score in a range of 0 – 100 based on the CO2 emissions of past trips which are recorded and stored in the database. The service takes as input the user id and subsequently retrieves all the trips of the specific user. Each trip is comprised of one or more segments and each segment concerns a detected transportation mode. Using the simplified emission model, we calculate the emissions of the all trips and calculate the user tree score. Decreasing emissions lead to a higher score, while increasing emissions lead to a lower score.

CO2 and PM10 Calculation Service. This service uses the emission model provided by TCD to calculate the CO2 and PM10 values for the routes of the users.

Create Activities and Stages Service. The activities and stages of user trips are detected based on the logged data, i.e. GPS and sensor data.

Transport Modality Detection Service. This service detects the transportation modalities the users used for their trips; the data uses the GPS and sensor data.

Client interface

Based on this underlying technological architecture, we developed a user interface client that allows users to access the different functionalities using their smart phones.

The user interface of the PEACOX journey planner application aims to support its users on their daily trips, providing personalized and ecological information before, during and after the trip. In the following sections we provide a description of the different main system parts:

Route planning. Each person chooses one available travel-route over another by considering different criteria. Users select start and end destinations, starting time and means of transportation (see Figure 5).

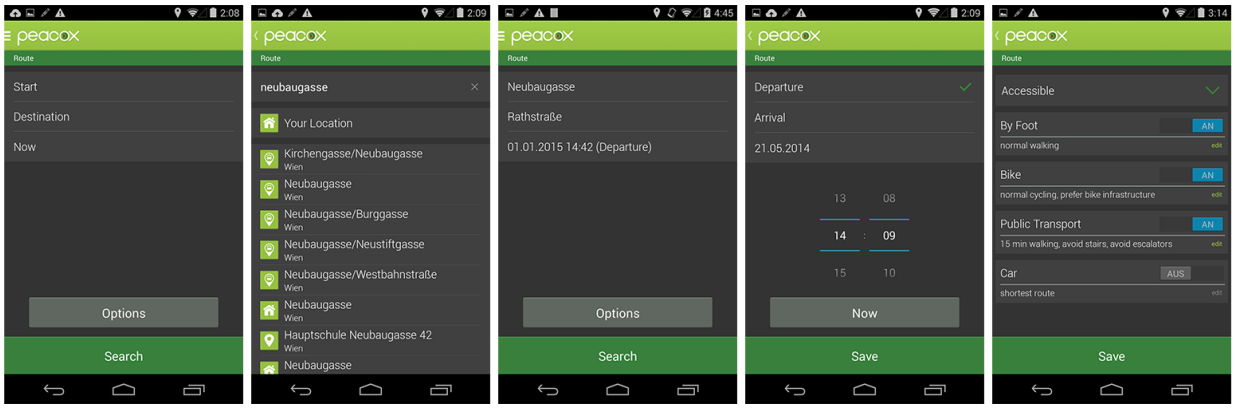

Figure 5: Screenshots route planning

Route overview and route detail with focus on eco-friendly routes. The route overview informs users of available routes for their chosen criteria (see Figure 6). It allows users to compare all available routes based on simple information including time frame and means of transportation. To nudge the user to an ecological decision, the PEACOX journey planner application also shows the CO2 footprint. The "Route Detail" screen displays all available information on one specific route. The "Step-by-Step" view provides the user with a simple stepwise navigation. If users don't need turn-by-turn navigation they can stay in this view, navigating between segments by swiping or pressing the arrows for next or previous segments. The map then focuses on the chosen segment.

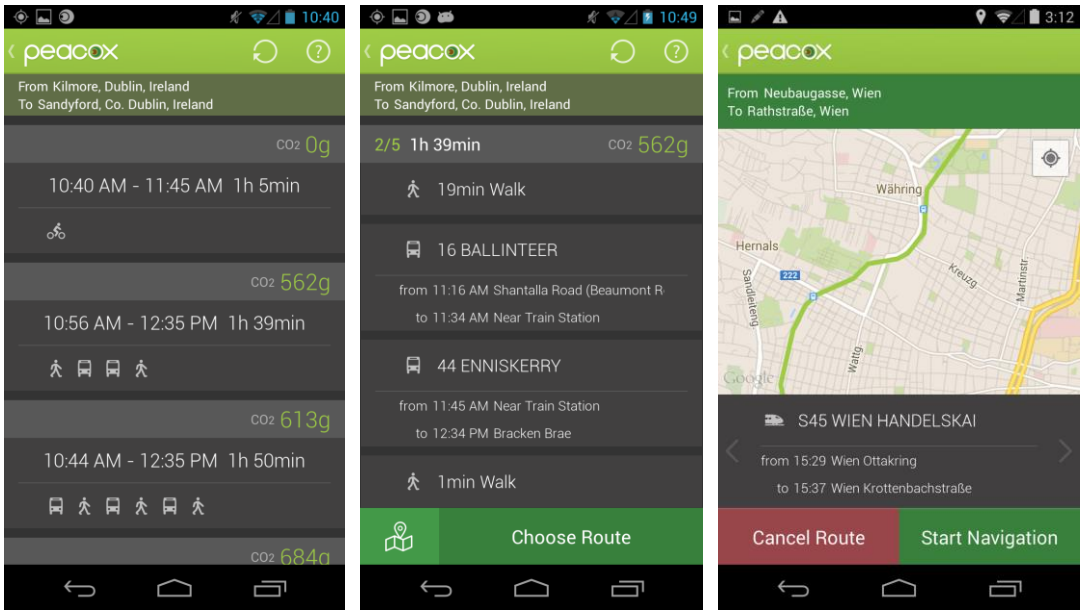

Figure 6: Route overview, route detail, step-by-step screen

Statistics. On the start screen of the statistics section of the application, a user's overall ecological performance is visualized by the means of a tree, and users furthermore have the possibility to track their CO2 consumption on a daily, weekly and monthly basis (see Figure 7).

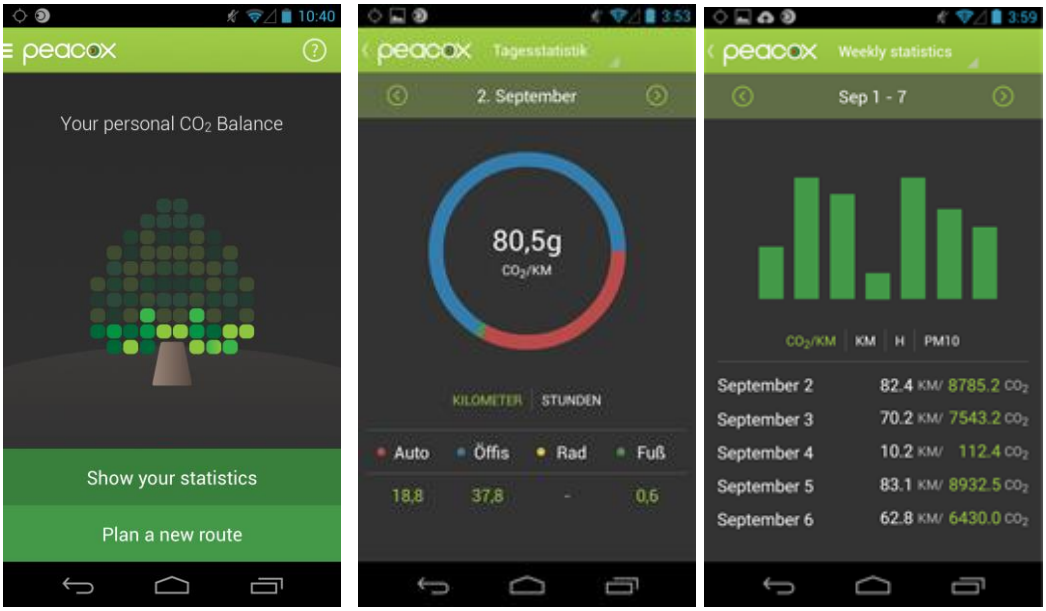

Figure 7: Visualization of ecological performance

Challenges and Recommendation. The main purpose of the challenges and achievements section is to motivate users to increasingly use the application and switch to more ecological means of transportation by providing them with specific targets and rewarding them by displaying achievements in form of badges.

Result 2: Analyzing and predicting movement patterns

Trip mode detection

In this area of research, we worked on improving trip mode detection methods based on existing mode identification algorithms. Improvement was achieved by implementing an automatic optimization of the fuzzy logic rules using a genetic algorithm and by differentiating between different public transport modes through map-matching. We worked on the extraction of clear mode transition rules for the majority of mode transitions. Progress was achieved regarding the introduction of metro as a new mode by using accelerometer data. However, further development is necessary to improve the performance of this approach.
The second main task was the validation of the trip and mode detection and the calibration of their parameters for the study area. With the genetic algorithm for optimizing the fuzzy logic rules, an important step was made to achieve the calibration as quickly as possible once initial field data sets are available.

Trip purpose imputation

Within PEACOX we developed trip purpose identification using random forests, a machine-learning approach based on decision trees. The method was developed using GPS and accelerometer data collected by 156 participants, taking part in a one-week travel survey in Switzerland completed in 2012. The analysis of the performance shows that random forests provide robust trip purpose classification. For ensemble runs, a share of correct predictions between 80 and 85% was achieved. Different setups of the classifier are possible, and sometimes required by the

application context. The classifier's training set and its input variables (feature set) are defined in various ways.

Result 3: Ecological costs

Emission model:
To calculate and predict emission as accurately as possible in the given mobile device context with existing knowledge on emission factors, the following general methodology (Figure 8) has been developed, which is applicable for both, the real time and the prediction model. To ensure accuracy, the model will account for all possible factors mentioned in the PEACOX description of work. For instance, the model will take account of the effect of the cold start emissions which is dependent upon the weather data, particularly temperature. Wind flow and wind direction effects are difficult to incorporate for individual vehicles due to lack of data and are thus omitted. Real time speed (from prediction based on real-time traffic or instantaneous speed from GPS) of the vehicles will be a surrogate for congestion, using for modal models (i.e. considering instantaneous second by second vehicle trajectories speed and acceleration), which are capable of taking congestion into account.

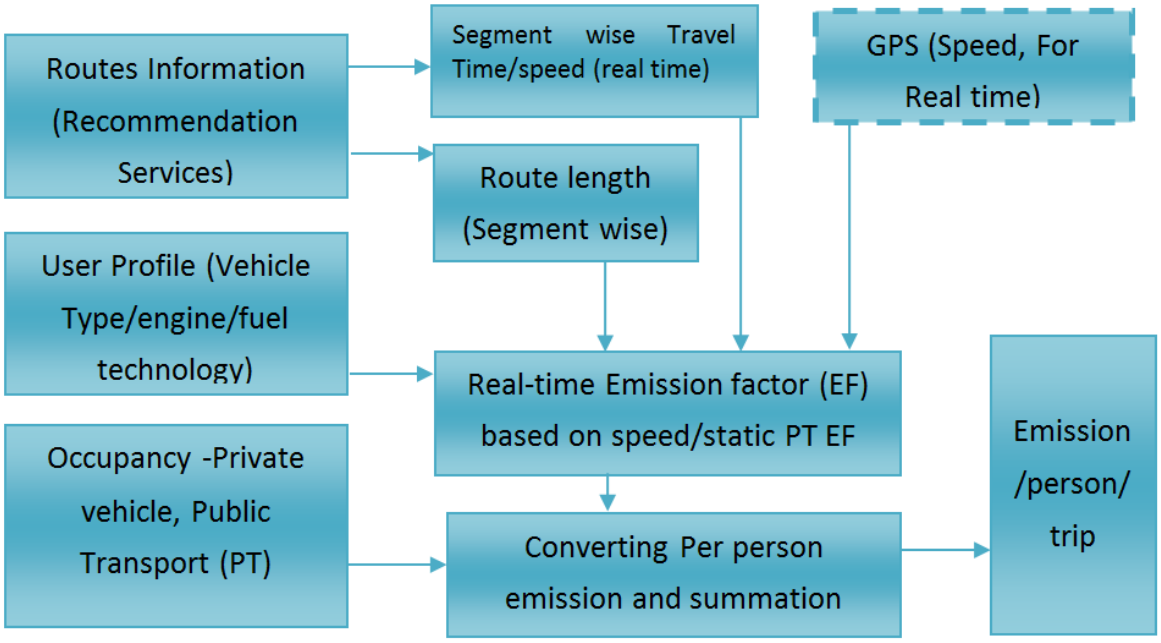

Figure 8: Basic Emission Modelling Methodology

The model accounts for a general classification of modes for public transport, but more precise classification of private vehicles based on fuel type, emission standard, and catalytic converter is included. However, it was not possible to include the effect of vehicle age or state of repair on emission for the individual trip level. To provide individual carbon footprint data, it is necessary to convert all emissions output for a person's trip. Thus, occupancy for all the vehicles has been taken into account.

Exposure Model
The PEACOX project has set grounds for managing eco-friendly driving issues more efficiently along with their other set targets. One of the aims is to provide information to travellers about safer routes in terms of exposure. Studies showed that a reduction in exposure to particulate matter (PM10) could reduce premature deaths significantly and, could also offer a healthy environment for traveling. Thus, PM10 has been chosen as a generic pollutant whose concentration level indicates

the level of exposure in the routes. In order to estimate exposure concentrations, exposure models were built.
To carry out the task, PM10 concentration has been estimated for Dublin and Vienna using a land-use regression model approach. Routine monitoring PM10 data has been used for building models where explanatory variables included weather, land use, topographic and demographic information. After model validation, a neural network was also used to obtain the best fit model, optimising the relationship between response and explanatory variables. This was necessary to offset the limitation of using the small number of PM10 monitors available. Fourteen emissions maps for different days of the week over the summer and winter seasons were predicted for each city. PM10 concentrations were then transferred to the road network level to highlight the best route in terms of exposure level, or dose for trips.

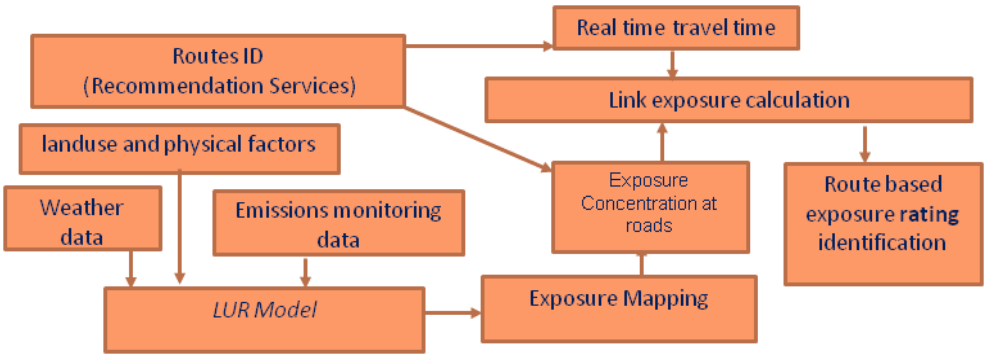

Figure 9: Exposure Model

According to the developed methodology (see Figure 9), two different steps are involved in the exposure models predictions. For the first level of analysis, it is necessary to estimate the exposure concentration for every road link. For defining exposure concentration, land-use regression (LUR) can be used among the candidate models, which utilises the monitored levels of the pollutant of interest as the dependent variable, and variables such as traffic, topography, and other geographic variables are considered as independent variables in a multivariate regression model.

Result 4: New and innovative persuasive strategies and interfaces/interface components

In this area of work within PEACOX, several approaches to persuasion were analysed, studied, implemented and evaluated. Specifically work focused on the following aspects:

CO2-Feedback. Providing feedback on CO2 emissions associated with different route options has been studied since a long time, and a substantial amount of knowledge on how to use and display it is available. CO2 Feedback has become a standard feature, and results from other studies as well as our experiences within PEACOX show that this type of feedback helps users to understand the proportions of associated emissions between different trip modes. Feedback on its own does seem to have a general educating effect on users, might raise awareness, but also does not seem to be very effective on its own when it comes to behavior change.

Behavior Statistics. These statistics summarize the past travel behavior or the user, and allow them to analyse different aspects of their behavior. The statistics typically show information on the used trip modalities and associated CO2-emissions, and provide possibilities to compare the own behavior and emission production of other users. Providing such statistics proved to be a suitable approach in our project.

Semantic Feedback. With semantic feedback we refer to the approach of evaluating CO2-emissions and of providing overall feedback on how well one is doing or not compared to the specified target behavior. In PEACOX we made use of an evolving metaphor, specifically a tree growing to provide semantic feedback to the users. This semantic feedback proved to be motivating at least for some users.

Persuasive messages. Persuasive messages are short texts intended to nudge the users towards modifying their routine behavior or introducing reflections questioning their common practice. In PEACOX these messages are tailored to a specific route suggestion. Due to the restricted screen real estate, messages are designed short and to the point. The messages were applied within PEACOX directly integrated into the route results display, and were perceived well by most of the trial participants. However, no direct behavior change was visible in the data that can be directly attributed towards the persuasive messages in the system.

Challenges. Challenges have been successfully used to promote more eco-friendly travel behavior, and also have been integrated into trip planner systems. Within PEACOX the usage of challenges for persuasive systems has been studied specifically with a focus on individual versus collaborative challenges. During the second field trial empirical data on the usage, acceptance and impact of this approach were collected, and also qualitative date to better understand the quantitative results was gathered. Results showed that challenges seem to be an appropriate means to sustain interest in persuasive systems. Furthermore we found that only a specific subset of users can be motivated for behavior change by challenges.

Social network integration. A commonly suggested and successfully applied feature for persuasion is to use the power of social relationships for influencing behavior. By making commitments visible to the social environment and by harnessing the power and spirit of social cooperation, approaches integrated into social networks provide important possibilities for influencing behavior and attitudes. Within PEACOX social network integration focused on promoting and publicizing individual and collaborative challenges users could subscribe to. The chosen direct integration with the most commonly used social network (Facebook) proved to be a good choice, and interesting findings (see D7.5) and also questions, ideas and approaches for future directions of work could be identified.

Result 5: Guidelines for the implementation and application of persuasive strategies

Based on the results of extensive field trials of the developed prototypes, we collected a set of guidelines for the design and implementation of persuasive systems in the context of personal mobility and trip planner systems. The guidelines do address different design and technological aspects, and are based on the experiences and results of the development and evaluation of the PEACOX prototype system with two main iterations. The guidelines address general factors to consider for designing persuasive systems (mobility types, factors influencing trip modes, context factors), technological aspects in different areas (emission-aware routing, GPS-Tracking, trip mode and purpose detection, Emission and Exposure modelling), and findings on the application and design of different persuasive strategies.

Potential impact and exploitation of results

At present, mobility and pro-environmental behavior are very pressing issues. There is necessity to obtain information about pro-environmental ways to efficiently get from one point to another. In developing innovative strategies and for minimizing the costs of the user, the project focussed on travel mode detection, trip purpose, real-time traffic information, personalized systems, calculating ecological emission as well as an exposure model, persuasive strategies and human-computer interaction.

Potential impact

PEACOX results are expected to **improve efficiency of mobility and transport in Europe**. The project provides a permissive approach to traffic management, delegated to mobile end-users for optimal energy-efficient behavior without restricting citizen freedom of choice. The technology gives real-time information about traffic issues like traffic jam or delays in public transport, which improves the efficiency of individual wayfinding. Automated local detection of trip purpose strengthens this impact.
Furthermore, by convincing users to take alternate and greener ways of transport, the project was designed to increase door-to-door public transport facilities usage. Additionally – as PEACOX provides multi-modal travel advice – car drivers are motivated to use the public transport if it is possible and beneficial (e.g. in case of jam) for them.
Especially the highly user-centered approach that integrated different user groups as well as different contexts and situations within the developing process, resulted in a system that can be widely used by different target groups. Additionally, the inclusion of different user groups from the beginning of the project (requirements) resulted in highly acceptable systems that can be used by different user groups. Field trials in Dublin and Vienna gave insight into the effect and possible behavioural change in different cities in Europe for different user groups.
Additionally PEACOX contributes to the target of reducing emissions in transportation by 25%, mainly through the exploitation activities. The PEACOX consortium consists of an important industry group which actually provides navigation software and travel information systems for individual users, the aviation sector, for logistics as well as the car industry. Existing products in these fields are widely used, and consequently there is a high potential to reach a large crowd of users and companies.

PEACOX contributes to the **extension of market opportunities for new ICT-based mobility and transports services** by two main activities. Results were shared with stakeholders and experts of the research, public and industry area. The PEACOX consortium itself consisted of interdisciplinary research partners as well as of different stakeholders from industry and public. Therefore this project brought together different perspectives to work on the same problem. Additionally international experts were invited to develop new innovative product ideas with the project team. By this integrative approach, ideas were gathered that paved the way towards new innovative, widely used technologies.
Furthermore, PEACOX influenced the development of new products by the involved industry partners, and thus on the one hand allowed consumers to play a novel role in the management of their energy consumption, while on the other hand integrating an ecological component in navigation systems and trip advisors. Through the focus on the user, the project had the possibility to research user role and privacy and acceptance as well as possibilities and limitations to change behavioral patterns.

Scientific and commercial exploitation

The main goal of dissemination was to raise awareness of the PEACOX project, from the concept to the final results. Dissemination of the project results was targeted to the wide public, industrial stakeholders and the scientific audience. This was accomplished through different channels, supported by means like posters, white papers, multimedia material or scientific papers. One important and constant pillar was and is continuing to be the project web site, which also served as a means for internal communication purposes. Both the web site and all materials were based on a uniform graphic layout.

The scientific partners within PEACOX were and remain to be active in dissemination. The key achievements include the following:

- PEACOX results and achievements are submitted to award competitions. For example, the PEACOX application won the gold medal at the IIID (International Institute for Information Design) competition within the category sustainability. For more details please visit the homepage http://www.iiidaward.net/index.php and http://www.iiid.eu.
- Scientific results were disseminated within so far 30 publications at conferences, such as the renowned ACM CHI and MobileHCI conference, and journals, including the TRB journal series, see a complete overview in the table below.
- Online dissemination via the project homepage (www.project-peacox.eu), promo videos, and press articles.
- Individual dissemination by partners via specialized events, such as the presentation of the PEACOX journey planner to Austria's president Heinz Fischer within the Economic forum in Dublin

The main aim for scientific exploitation is to use project results as input for next R&D projects or as a basis for consultancy activities. Commercial use of project results would be focused on the extension of functionality of currently operated navigation and journey planner services. Consortium members expect also consultancy activities besides these two main products.

2. Use and dissemination of foreground

This section includes an overview in tabular form on the collection of all scientific (peer reviewed) publications relating to the foreground of the project and the exploitable foreground.

Section A (public)

TEMPLATE A: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[1] (if available)	Is/will open access[2] provided to this publication?
1	Recommender systems for lifestyle and behavioural changes	Ludwig, B., Ricci, F., Yumak, Z.	ACM Recommender Systems 2012, 1st Workshop on Recommendation Technologies for Lifestyle Change	n/a	ACM	Dublin, Ireland	13/09/2012	n/a	doi>10.1145/2365952.2366045	
2	Preparations for estimating public transport connection choice from GPS observations	Rieser-Schüssler, N., Montini, L., Axhausen, K.	13th International Conference on Travel Behaviour Research IATBR	n/a	IATBR	Toronto, CAN	July 2012	n/a	n/a	
3	Emissions model and behavioural model	Caulfield, B. et al.	Irish Transport Research Network 2012	n/a	ITRN	Dublin, Ireland	August 2012	n/a	n/a	
4	Personalized Persuasive Technology – Development and	Busch, M., Schrammel, J., Tscheligi, M.	8th International Conference on Persuasive	Vol. 7822	Persuasive Technology	Sydney, Australia	April 2013	33-38	10.1007/978-3-642-37157-8_6	

[1] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).
[2] Open Access is defined as free of charge access for anyone via the internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

	Validation of Scales for Measuring Persuadability		Technology						
5	PEACOX – Persuasive Advisor for CO2-Reducing Cross-modal Trip Planning	Schrammel, J., Busch, M., Tscheligi, M.	1st International Workshop on Behavior Change Support Systems (BCSS)	n/a	BCSS 13	Sydney, Australia	April 2013	n/a	http://ceur-ws.org/Vol-973/bcss5.pdf
6	Contextualise! Personalise! Persuade! A mobile HCI framework for behaviour change support systems	Prost, S., Schrammel, J., Röderer, K., Tscheligi, M.	15th international conference on Human-computer interaction with mobile devices and services (MobileHCI)	n/a	ACM Mobile HCI'13	Munich, Germany	September 2013	510-515	doi>10.1145/2493190.2494434
7	Smart and sustainable travel mode choices – implications for sustainable technology development	Röderer, K., Schrammel, J., Busch, M., Tscheligi, M. S.	10th Biennial Conference in Environmental Psychology	n/a	10th Biennial Conference in Environmental Psychology	Magdeburg, Germany	September 2013	n/a	http://www.envpsycon.ovgu.de/envpsycon_media/Downloads/Interactive+conference+program.pdf
8	Presentation of Carbon Dioxide Emissions Information for Smartphone Application	Brazil, W., Caulfield, B., Rieser-Schüssler, N.	92nd Annual Meeting of the Transportation Research Board, Conference Paper	n/a	TRB	Washington, USA	2013	n/a	n/a
9	Impact of emissions information on mode choices in Dublin: A Stated Preference experiment	Brazil, W., Caulfield, B.	ITRN Conference 2013	n/a	Proceedings of the ITRN	Dublin, Ireland	2013	n/a	http://www.itrn.ie/uploads/Brazil%20and%20Caulfield%20B.pdf

10	Public Awareness of Carbon Emissions: Do you know your carbon footprint	Brazil, W., Caulfield, B.	ITRN Conference	n/a	Proceedings of the ITRN	Dublin, Ireland	2013	n/a	http://www.itrn.ie/uploads/Brazil%20and%20Caulfield%20A.pdf
11	Factors affecting the use of transport related smartphone applications	Brazil, W., Caulfield, B.	9th ITS European Congress, Conference Paper	n/a	ITS Conference	Dublin, Ireland	2013	n/a	n/a
12	Using real-time emissions data to encourage sustainable mobility: PEACOX	Caulfield, B.	9th ITS European Congress, Invited Talk	n/a	ITS Conference	Dublin, Ireland	2013	n/a	n/a
13	Eco-Driving Policy & Technology: A Review of Benefits & Limitations in CO2 Emissions Reduction	Alam, S., McNabola, A.	9th ITS European Congress, Conference Paper	n/a	ITS Conference	Dublin, Ireland	2013	1-11	n/a
14	An assessment of a new determinant for smarter route choice	Alam, S., McNabola, A.	Proceedings of the Irish Transport Research Network	n/a	Proceedings of the ITRN	Dublin, Ireland	2013	n/a	http://www.itrn.ie/uploads/Alam%20and%20McNabola.pdf
15	Testing individuals' ability to compare emissions from public transport and driving trips	Brazil, W.,Caulfield, B.	Journal of Public Transportation	Vol. 17, No. 2	Journal of Public Transportation	n/a	2014	27-43	http://www.nctr.usf.edu/wp-content/uploads/2014/07/JPT17.2.pdf#page=32
16	Understanding Carbon: Making Emissions Information Relevant	Brazil, W.,Caulfield, B., Rieser-Schüssler, N.	Transportation Research	Vol. 19	Transportation Research Part D: Transport and Environment	n/a	2013	28-33	doi:10.1016/j.trd.2012.12.002

17	The potential role of smart phone technology in transport behaviour	Brazil, W., Caulfield, B.,	potential role of smart phone technology in transport behaviour	Vol. 37	Transportation Research Part C: Emerging Technologies	n/a	2013	93-101	http://hdl.handle.net/2262/68122
18	Identifying chosen public transport connections from GPS observations	Rieser-Schüssler, N., Axhausen, K.	TRB Conference 92nd Annual Meeting	n/a	TRB Conference 92nd Annual Meeting	Washingt on DC	2013	n/a	http://trid.trb.org/view.aspx?id=1240566
19	Choice architecture for environmentally sustainable urban mobility'	Bothos, E., Apostolou, D., Mentzas, G.	ACM SIGCHI Conference on Human Factors in Computing Systems	n/a	ACM	NY, USA	2013	1503 - 1508	doi>10.1145/2468356.2468624
20	An Ecologically-aware Approach for Mobile Travel Recommender Systems	Bothos, E., Apostolou, D., Mentzas, G.	eChallenges e-2012 Conference	n/a	Conference Proceedings	Lisbon, Portugal	2013	n/a	n/a
21	Presentation of multimodal navigation in context of public transport data available in the Czech rep	Tvrzský, T.	IDS conference	n/a	Conference Proceedings	Praha, Czech republic	2013	n/a	n/a
22	'Sometimes it's the weather's fault': sustainable HCI & political activism	Prost, S., Schrammel, J., Tscheligi, M.	ACM SIGCHI Conference on Human Factors in Computing Systems	n/a	ACM	NY, USA	2014	2005 - 2010	doi>10.1145/2559206.2581358
23	Persuasive Strategies and Choice Architecture for Sustainable Decisions in Urban Mobility	Bothos, E., Prost, S., Schrammel, J., Röderer, K., Mentzas, G.	Persuasive Conference 2014	Vol. 12, No. 3	PsychNology Journal	Padua, Italy	2014	107-126	http://www.psychnology.org/File/PNJ12(3)/PSYCHNOLOGY_JOURNAL_12_3_BOTHOS.pdf

24	Trip Purpose Identification from GPS Tracks	Montini, L., Rieser-Schüssler, N., Horni, A., Ahausen, K.	93rd Annual Meeting of the Transportation Research Board	No. 2405	Journal of the Transportation Research Board	Washingt on DC	2014	16-23	DOI 10.3141/2405-03
25	Trip Purpose Identification from GPS Tracks	Montini, L., Rieser-Schüssler, N., Horni, A., Ahausen, K.	Transportation Research Record	No. 2405	Journal of the Transportation Research Board	Washingt on DC	2014	16-23	DOI 10.3141/2405-03
26	Personalisation in multi-day GPS and accelerometer data processing	Montini, L., Rieser-Schüssler, N., Axhausen, K. W.	14th Swiss Transport Research Conference	n/a	14th Swiss Transport Research Conference	Ascona, Switzerlan d	2014	n/a	http://www.strc.ch/conferences/2014/Montini_EtAl.pdf
27	Comparison of Travel Diaries Generated from Smartphone Data and Dedicated GPS Devices	Montini, L., Prost, S., Schrammel, J., Rieser-Schüssler, N., Axhausen, K. W.	10th International Conference on Transport Survey	n/a		Leura, Australia	2014	n/a	https://jschrammel.files.wordpress.com/2010/10/isctsc10_montini etal.pdf
28	Recommender systems for nudging commuters towards eco-friendly decisions	Efthimios, B., Dimitris, A., Gregoris, M.	Intelligent Decision Technologies (IDT), special issue on Advances in Recommender Systems	n/a	Intelligent Decision Technologies	n/a	2015	n/a	DOI: 10.3233/IDT-140223
29	Watch your Emissions: Persuasive Strategies and Choice Architecture for Sustainable Decisions in Urban Mobility	Bothos, E., Prost, S., Schrammel, J., Röderer, K., Mentzas, G.	Psychnology	Vol. 12, No. 3	PsychNology Journal	n/a	2014	107-126	http://www.psychnology.org/File/PNJ12(3)/PSYCHNOLOGY_JOURNAL_12_3_BOTHOS.pdf

Section B (confidential)

TEMPLATE B1: LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, ETC.			
Type of IP Rights: Patents, Trademarks, Registered designs, Utility models, etc.	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant (s) (as on the application)
n/a	n/a	n/a	n/a

TEMPLATE B2: OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND					
Exploitable Foreground (description)	**Exploitable product(s) or measure(s)**	**Sector(s) of application**	**Timetable, commercial use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiary(s) involved**
Persuasive interface concepts for trip planner systems	*Persuasive interface concepts*	*Transportation, Software Design*	*2015-17*	*-*	*FLU, TMX, AIT*
Improved trip mode detection	*Trip mode detection algorithm*	*Transportation, GIS*	*2015-17*	*-*	*ETHZ, FLU, TMX, TT*
Improved trip purpose identification	*Algorithms and methods for trip purpose identification*	*Transportation, GIS*	*2015-17*	*-*	*ETHZ, FLU, TMX, TT*
Emission model	*Emission model*	*Transportation*	*2015-17*	*-*	*TCD*
Exposure model	*Exposure model*	*Transportation*	*2015-17*	*-*	*TCD*

TEMPLATE B2: OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND					
Exploitable Foreground (description)	**Exploitable product(s) or measure(s)**	**Sector(s) of application**	**Timetable, commercial use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiary(s) involved**
Detailed Knowledge on the design and application of persuasive strategies	*Design knowledge*	*Software Design*	*2015-18*	*-*	*AIT*
New approaches for tailoring recommendations	*Recommender Technology*	*Software Design*	*2015-17*	*-*	*ICCS (Owner), AIT*
Tool for the improved validation and correction of GPS-Data	*Prompted Recall Tool*	*GIS*	*2015-18*	*-*	*ETHZ, TMX, AIT*

Turn-by-turn navigation concepts for in-car system	*Turn-by-turn navigation*	*Software Design*	*2015-17*	*-*	*TMX*

4.1 Report on societal implications

Replies to the following questions will assist the European Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

A General Information *(completed automatically when **Grant Agreement number** is entered.*	
Grant Agreement Number:	288466
Title of Project:	PEACOX - Persuasive Advisor for CO2-reducing cross-modal trip
Name and Title of Coordinator:	Prof. Dr. Manfred Tscheligi

B Ethics		
1. Did you have ethicists or others with specific experience of ethical issues involved in the project?	x	**Yes** **No**
2. Please indicate whether your project involved any of the following issues (tick box) :	***YES***	
INFORMED CONSENT		
• Did the project involve children?		
• Did the project involve patients or persons not able to give consent?		
• Did the project involve adult healthy volunteers?	X	
• Did the project involve Human Genetic Material?		
• Did the project involve Human biological samples?		
• Did the project involve Human data collection?		
RESEARCH ON HUMAN EMBRYO/FOETUS		
• Did the project involve Human Embryos?		
• Did the project involve Human Foetal Tissue / Cells?		
• Did the project involve Human Embryonic Stem Cells?		
PRIVACY		
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)		

• Did the project involve tracking the location or observation of people?	X
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	
• Were those animals transgenic small laboratory animals?	
• Were those animals transgenic farm animals?	
• Were those animals cloning farm animals?	
• Were those animals non-human primates?	
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Use of local resources (genetic, animal, plant etc)	
• Benefit to local community (capacity building ie access to healthcare, education etc)	
DUAL USE	
• Research having potential military / terrorist application	

C Workforce Statistics

3 Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator		1
Work package leader	2	3
Experienced researcher (i.e. PhD holders)	1	7
PhD Students	1	4
Other	15	10

4 How many additional researchers (in companies and universities) were recruited specifically for this project?	
Of which, indicate the number of men:	4
Of which, indicate the number of women:	1

D Gender Aspects

5	**Did you carry out specific Gender Equality Actions under the project** ?	○ X	Yes No

6 Which of the following actions did you carry out and how effective were they?

		Not at all effective				Very effective
❑	Design and implement an equal opportunity policy	○	○	○	○	○
❑	Set targets to achieve a gender balance in the workforce	○	○	○	○	○
❑	Organise conferences and workshops on gender	○	○	○	○	○
❑	Actions to improve work-life balance	○	○	○	○	○
X	Other:	The project activities did not address the gender issue in the direct way, however the equal opportunity policy is implemented on the company level by each partner				

7 Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

X Yes- please specify: Users in user trials

○ No

E Synergies with Science Education

8 Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

○ Yes- please specify

X No

9 Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

○ Yes- please specify

X No

F Interdisciplinarity

10 Which disciplines (see list below) are involved in your project?

○	Main discipline[3]: 1.1		
○	Associated discipline**Fehler! Textmarke nicht definiert.**:5.4	○	Associated discipline**Fehler! Textmarke nicht definiert.**:1.4

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*	X ○	Yes No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

- X No
- ○ Yes- in determining what research should be performed
- ○ Yes - in implementing the research
- ○ Yes, in communicating /disseminating / using the results of the project

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	○ X	Yes No

12 Did you engage with government / public bodies or policy makers (including international organisations)

- ○ No
- ○ Yes- in framing the research agenda
- ○ Yes - in implementing the research agenda
- X Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

- ○ Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
- X Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
- ○ No

13b If Yes, in which fields?

[3] Insert number from list below (Frascati Manual)

Agriculture Audiovisual and Media Budget Competition **Consumers** Culture Customs Development Economic and Monetary Affairs Education, Training, Youth Employment and Social Affairs	X	**Energy** Enlargement Enterprise Environment External Relations External Trade Fisheries and Maritime Affairs Food Safety Foreign and Security Policy Fraud Humanitarian aid	X	Human rights **Information Society** Institutional affairs Internal Market Justice, freedom and security Public Health Regional Policy Research and Innovation Space Taxation Transport	X

13c If Yes, at which level?

- ○ Local / regional levels
- ○ National level
- ○ European level
- X International level

H Use and dissemination

14 How many Articles were published/accepted for publication in peer-reviewed journals and conferences?		**29**
To how many of these is open access[4] provided?		**0**
How many of these are published in open access journals?		
How many of these are published in open repositories?		
To how many of these is open access not provided?		
Please check all applicable reasons for not providing open access:		
❑ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other: ……		
15 How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*		**0**
16 Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	**0**
	Registered design	**0**
	Other	**0**
17 How many spin-off companies were created / are planned as a direct result of the project?		**0**
Indicate the approximate number of additional jobs in these companies:		

[4] Open Access is defined as free of charge access for anyone via the internet.

18	**Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:**		
❑	Increase in employment, or	❑	In small & medium-sized enterprises
❑	Safeguard employment, or	❑	In large companies
❑	Decrease in employment,	❑	None of the above / not relevant to the project
X	Difficult to estimate / not possible to quantify	❑	

19 For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:*
Difficult to estimate / not possible to quantify	X

I Media and Communication to the general public

20 As part of the project, were any of the beneficiaries professionals in communication or media relations?

○ Yes X No

21 As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes X No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

X	Press Release	X	Coverage in specialist press
X	Media briefing	X	Coverage in general (non-specialist) press
❑	TV coverage / report	X	Coverage in national press
❑	Radio coverage / report	❑	Coverage in international press
X	Brochures /posters / flyers	X	Website for the general public / internet
X	DVD /Film /Multimedia	X	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

X	Language of the coordinator	X	English
❑	Other language(s)		

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES

1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]

1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)

1.3 Chemical sciences (chemistry, other allied subjects)

1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)
1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY
2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)
2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]
2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES
3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)
3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)
3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES
4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)
4.2 Veterinary medicine

5. SOCIAL SCIENCES
5.1 Psychology
5.2 Economics
5.3 Educational sciences (education and training and other allied subjects)
5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES
6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)
6.2 Languages and literature (ancient and modern)
6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group] .