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

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D5.2 Guidelines for designing persuasive strategies within the mobility context

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Abstract

In this deliverable we provide guidelines and recommendations for the design and implementation of persuasive systems in the context of personal mobility and trip planner systems. The guidelines are based on the work within the PEACOX project performed in different work packages between October 2011 and February 2015. The guidelines do address different design and technological aspects, and are based on the experiences and results of the development and evaluation of a 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.

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1. Introduction

This deliverable provides a collection of guidelines for designing persuasive strategies in the mobility context. These guidelines were developed as part of the PEACOX project, and reflect the experiences and findings made during the whole project duration starting from October 2011. The findings are specifically based on the experiences and findings made during the two field trials (for details see the deliverables *D7.4* and *D7.5*).

In order to enhance the readability of this document the identified guidelines for persuasive design are grouped into different categories and a unique identifier is used for each guideline in order to ensure easy referencing of the guidelines. The guidelines (in contrast to explanatory text) are furthermore highlighted by a gray background color in order to make them more visually prominent than the rest of the text.

2. Understanding mobility behavior

In order to understand persuasion in the mobility context it is first required to develop a detailed understanding and conceptual framework of mobility behavior in general and the different factors influencing travel behavior and trip mode decisions. Here we can relate to a strong body of prior research. For our work especially the analysis of the main factors influencing trip mode choices and a characterization of typical user groups are of high relevance. We therefore first very briefly discuss relevant results and knowledge on these factors, and then present the guidelines for persuasion within mobility we developed related to these aspects based on the experiences and findings from the project.

2.1 Factors influencing travel mode choices

First of all we want to look at available research focusing on the different factors influencing the travel mode choices of users. A detailed analysis of different models has already been provided in *D2.1 Description of user groups and travelling context*, here we only want to report a short summary and then elaborate on the consequences of the identified patterns for persuasive approaches in the context of mobility.

Travel mode choices often are not really conscious decisions but can be seen as habitual, in particular when traveling on familiar routes, e.g. to work. However, when behavior is executed less frequently different alternatives and factors are considered. These factors can include purpose-rational (e.g., travel time, user-friendliness, costs, comfort) and social-emotional decision factors (e.g., safety, status, past experiences, privacy) as well as weighting factors (e.g., trip purpose, time pressure). Conceptualizations that explain users' travel mode choices are presented in deliverable D2.1.

The understanding of behaviour and motivations for travel mode choice is an important basis for the work and research in the PEACOX project. Therefore, an online-study was conducted in order to extend existing travel mode choice models by factors concerning self-attribution of people and the inclusion of psychological determinants (affect and cognition) of environmental attitudes, values and behaviour. The costs of the travel mode, the total travel time and the frequency of public transport had a significant effect on the travel mode choice, as did the number of transfers, energy use, destination, and comfort of the travel mode (deliverable D2.1).

Deliverable *D2.2 Requirements document* summarizes further factors directly and indirectly connected to travel planning, such as travel time, availability, and reliability of transport modes (direct influence) as well as barriers for eco-friendly travel behavior (indirect influence).

In order to make an informed decision about their journey, users rated road information and public transport information as most important, parking information and points of interest were also identified as interesting (deliverable *D2.3 Stakeholder and technological requirements*).

Based on this overview of available work and the lessons learned in the project we extracted the following guidelines for persuasive design:

REC1:	Be sure to know what the main drivers are for travel mode decisions in your application domain.
REC2:	Have a good understanding of the composition of factor configurations depending on the area you are addressing (e.g. availability of public transport, etc.) as the composition might vary strongly, even over relatively small distances.
REC3:	If possible try to address more than one factor in persuasive design in order to increase effectiveness (i.e. do not only focus on low emission, but also address health aspect).
REC4:	Even if persuasion works on only one factor be sure to also consider the other factors important for making a trip decision in the design solution.
REC5:	Situational and contextual influences might have a strong effect on the actual travel mode choice and therefore should be considered in the design as thoroughly as possible.
REC6:	Purpose-rational factors might be more obvious when thinking of travel mode choices. However be sure to consider social-emotional factors and weighting factors as well, they can have a strong influence on the user's decision.
REC7:	Be sure to consider and address the main decision factors (typically time, cost and comfort) in your design solution even if your interventions are not targeted towards them.

REC8: ‚Soft' factors (comfort, exertion, sightseeing, etc.) influencing travel mode decisions seem to be more suited for persuasive approaches in the mobility context, as in contrast to 'hard' factors (e.g. travel time) they provide more possibilities to interpret and frame 'facts' in a persuasive manner.

REC9: Try to address travel mode decision factors that are not yet addressed in existing systems (e.g. include alternative criteria like the ones mentioned above)

REC10: Try to address the individual's composition of factors and question whether this is really serving the individual as a good starting point for persuasive measures.

REC11: Persuasive approaches should factor the social and general context in and address the potentials arising, as these aspects proofed to be very important for the weighting of the different factors influencing trip mode decisions.

REC12: Possibilities to question and reframe the reasoning also within one decisive factor influencing trip decision should be addressed. Often seemingly obvious calculations do not hold after a detailed look. For example, for calculating costs hidden factors are often not considered (e.g. basic costs for cars, time for parking cars, bringing to service, etc.), or made to look equal even if they are not (e.g. travel time: absolute travel time versus usable time available for other activities).

REC13: Persuasive interventions should be forgiving and allow for supporting special situations and exceptions (e.g. the need to transport stuff, going to holidays, etc.) with an 'objective' need for different travel solutions.

2.2 Mobility types

Our analysis and prior work did show that there is a vast variability on mobility types. In order to improve the efficiency of persuasive measures we think it is very important to understand and address these different mobility types. In the following section we first provide a summary of available work, and then summarize our recommendations of how to best address and utilize them in the context of design for sustainable mobility.

Deliverable D2.1 "Description of user groups and travelling context" lists a series of projects and studies that classify users into user groups and mobility types according to different criteria and variables. Table 1 in D2.1 gives an outline of the collected user groups.

A differentiation of user groups is typically based on socio-demographic variables, such as age, education, income, living area, and mental or physical impairment, as well as trip characteristics, such as purpose of the trip (school/education, work, shopping, leisure traffic, etc.), frequency and time of travelling, means of transport, and access to modes of transport. However, it is not sufficient to characterise travellers and their travel behaviour, as it lacks a deeper understanding of the travellers. Thus, there is effort to enhance this approach by also assessing latent variables including attitudes, norms, habits, preferences, and perceptions. Several typologies classify users into typologies including manifest as well as latent variables (see *D2.1 Description of User Groups and Travelling Context* for a detailed overview). Focus and scopes of the classifications and typologies differ widely. Some of the typologies focus on only a few socio-demographic variables, whereas others are very detailed and sophisticated and offer a large amount of information. Some typologies are based on person characteristics, others incorporate traffic behavior. All classifications were created on the basis of empirical data, however, both qualitative as well as quantitative research method were used for data collection.

For PEACOX, the following variables were considered as most important for the formation of PEACOX user groups: socio-demographic variables, environmental attitudes, environmental norms, habits, purposes, availability and accessibility of transport modes, financial aspects, and time.

In the following paragraphs we list recommendations for addressing these variables within personal mobility.

REC14: Persuasive design for sustainable mobility should consider and address different mobility types in order to increase the effectiveness of its outcomes.

REC15: Analyze your target and user group in terms of mobility types before starting design interventions.

REC16: Choose the most suitable set of mobility types to work with. Many classifications based on different approaches are available, and they vary in suitability for different contexts and application domains.

REC17: Identify which mobility types are most likely to respond to persuasive design interventions and have the most potential for achieving behavior change.

REC18: Taylor the persuasive design interventions towards the targeted mobility type(s), e.g. by aligning the type of rewards with the addressed mobility types. .

REC19: In case of mixed, unspecific or unknown user populations persuasive approaches supporting different motivations should be used in order to enhance the chance of creating good matches of intervention and user needs.

REC20: We recommend focusing on user groups and mobility types that are most likely to be influenced by persuasive measures and are more probable to adopt behavior changes.

REC21: The suggested routes must fit well with the mobility types as otherwise the likelihood of following the given recommendations and suggestions is very small.

REC22: The weighting of different route recommendations should reflect the different travel and mode use patterns of the users.

REC23: There might be important differentiations and sub-classes within one mobility type. For example, regarding persuasive purposes, bike users can be further discriminated into hardcore bikers, exercise bikers, short-distance bikers, etc.

REC24: Similarly also the main motivations within one user group may vary greatly. Whereas for some the factor of security is deciding, others are more interested in exercise aspects. These differentiations should be considered when addressing the users.

REC25: Such differences within one user group represent big design opportunities to increase the attractiveness of a travel mode. Already proven role models and practices exist that can help to convince others to follow the example.

2.3 Context Factors

Context factors are very important for making trip mode decisions, and therefore also need to be considered in persuasive approaches in the domain. In prior deliverables we already provided an overview the different relevant context factors for making trip decisions, and how they can be clustered and organized (see Deliverable D2.1 Description of User Groups and Travelling Context). Also, when talking about context for persuasion, we have to consider the context the user is in when he/she is interacting with the system and which aspects need to be considered with regard to this.

In this section we know focus on guidelines, how the different contextual aspects can and should be used in persuasive interventions.

Guidelines regarding general context factors:

REC26: Users make trip mode decisions considering a manifold of context variables such as time, cost, purpose, availability, accessibility, weather, reliability, safety, etc. Each of this context aspects might provide good possibilities for persuasion, therefore design should include as much of this aspects as possible and not be restricted to a single persuasive approach.

REC27: Weather seems to be an especially promising factor for persuasion for persuasive approaches towards increasing bike and walking shares.

REC28: Availability of parking spots and traffic jams form important possibilities to influence trip choice.

REC29: Consider time of time-of-day, weekday and season when making persuasive interventions.

Guidelines regarding the usage of situational context factors:

REC30: Persuasive measures should be adapted towards the current user context as much as possible.

REC31: The system should be aware whether the user is following/requesting a new route or a known routine route and adapt the persuasive measures accordingly.

REC32: Utilize the potential of interesting points-of-interest along the users' different route options as starting points for persuasive measures.

REC33: Identify situations where users are entering new and unknown situations, and carefully deploy persuasive measures as users seem to be more responsive to interventions in such circumstances.

REC34: Searching and accessing information for a new unknown route seems to be the most promising entry points for addressing behavior change. In these situations users do not have to unlearn behavior, but simply take slightly different decisions than they used to make.

Guidelines regarding the usage of context for the timing of persuasive measures

REC35: Context information should be used to optimize the impact of persuasive measures.

REC36: Context information should be used to identify whether the user is currently engaged in a main task, and based on this estimation derive whether potentially disruptive persuasive measures could be applied or not.

REC37: Use context and system information to identify 'quiet' times for presenting persuasive suggestions.

3. Technological Foundations

In this section we have a closer look on different technological aspects that were researched within PEACOX, and summarize our findings and recommendations regarding the usage of these technologies in a persuasive behavior change context.

3.1 Emission-aware routing

In emission-aware routing the (estimated) CO2-production associated with a given route is also considered in the routing process in addition to the commonly used variables (trip time, distance, etc.) for defining the optimal solution. In order to support ecological travel behavior direct consideration of CO2 in the routing process is an important possibility, however the following guidelines should be considered for its application:

REC38: Balancing the impact of CO2-emission and other optimization factors has to be done very carefully, as overdoing the weight of CO2 will result in unacceptable route suggestions for the users, and underdoing will not fully capitalize the possibilities for greener routing decisions.

REC39: Balancing of factors should be tailored towards the target group and individual user as good as possible.

REC40: The routing system should implement mechanisms that explain to the users the rational of the ranking, and allow him to develop a mental model of how the different factors influence the overall outcome.

3.2 Using Location Information

Using information regarding the current location of a user (provided by the smart phone) provides important design possibilities for persuasive systems. However, also many problem areas and design pit falls exist, and in the following guidelines we want to share our learnings from the PEACOX project:

REC41: Know the quality of the available location information and use it accordingly. GPS-tracking and GPS-based suggestions should only be used if well enough quality of location can be assured.

REC42: Implement measures in the system design that make it less prone for hard consequences when there is a location error.

REC43: Analyze which location accuracy can be achieved realistically for your target group and realistic application contexts, and design with this in mind.

REC44: Be aware for the required time-to-fix for GPS-location, and reflect accordingly in the system design.

REC45: Users frequently deactivate location tracking mainly due to battery and privacy issues. System design should therefore also provide value for the user and function smoothly even if no location information is available.

REC46: The system can provide much better value if current location information is available. Therefore design should foster activation of location functionality.

REC47: Many users have privacy concerns regarding tracking and disclosing of their location. Design measures that address these concerns should be implemented in the system.

REC48: Battery life is a crucial issue for many mobile phone users. Implementation of GPS-tracking is potentially very battery draining, therefore implementation should address the problem of minimizing battery drain in order to support acceptance by the users and willingness to keep the application running and use it constantly in everyday life.

REC49: The system should not rely solely on GPS for position tracking, as users frequently rely only on the more battery saving Wi-Fi or cell-ID-Identification. Also, time-to-fix can be long for GPS-positioning.

REC50: Usage of accelerometer data can be used to increase the accuracy of trip mode detection. However, logging and analyzing accelerometer data is very resource intensive, and therefore it should be analyzed in detail whether the achievable improvements in accuracy warrant the increased effort.

3.3 Trip mode detection

Trip mode detection identifies the used trip modality (e.g. car, bike, walking, public transport, etc.) based on the analysis of logged location data. This information then can be used to improve services and provide new functionalities to the users. For the practical application of such technology we propose to conform to the following guidelines:

REC51: Trip mode detection is never 100% correct. This fact needs to be communicated to the users in the system in order to not raise wrong expectations.

REC52: Design should be aware that underlying data might be wrong, and mitigate this issue in the interaction design.

REC53: A good possibility to deal with the uncertainty of the data might be to provide suggestions which offer a variety of possibilities (and not a single one), where the user then can choose the most appropriate one.

REC54: The design should explicitly reflect the different types of possible errors, and design for minimized impact of erroneous data.

REC55: The user should have the possibility to correct things if the system got it wrong. Optimally, this information should be used to improve the accuracy of the detection for the future.

REC56: Required accuracy levels (considering targeted user group and context) should be determined for the system (optimally based on empirical values and feedback from user studies).

REC57: If the uncertainty level of data is available show this uncertainty to the user, don't let the system behave as it was dead sure.

REC58: The system should be aware of the logging accuracy it produces, and considers this in the type of recommendations and suggestions it makes.

3.4 Trip purpose detection

Similarly to the trip mode detection also the trip purpose can be estimated based on logged trip itineraries and other information sources (maps, land-use-data, etc.). Accuracy for trip purpose data however is less good. Below we provide recommendations based on our experiences for the usage of such data for persuasive trip planners.

REC59: If trip purpose detection is applied it needs to be accurate enough to be useful for the user.

REC60: There should be a clear value for the end user for the consideration of trip purpose detection in trip planning.

REC61: Trip purpose detection needs to be near real-time in order to be used for trip planning and persuasive purposes.

REC62: Trip purpose is difficult to use for persuasive design as here the accuracy is much more important than for trip mode detection. Here interventions directly target individual situations and therefore correctness is extremely important because otherwise very awkward and strange recommendations can arise.

3.5 Emission modelling

The emissions related to a specific trip can be modelled and calculated in advanced. This information can be used to improve trip planner systems, and below you can find our recommendations for the design and implementation of such systems based on the findings during the PEACOX project:

REC63: Providing emission information is valuable information for users. When providing this information in the context of trip planning fast processing is more important than high accuracy. Users are only interested in the general relations (which are big between different modalities), and exactness doesn't add meaning.

REC64: Emission information should be provided in a way that is easy to understand and perceive to the users.

REC65: Emission Information should be provided in a way that allows users to understand the underlying numeric relations between the different values. This can be done by providing numeric values or graphic representations with an analogue representation of the numeric value.

REC66: Traffic light visualizations expressing semantic interpretations (good-average-bad) should only be used as additional means, not as only feedback for the emissions related with a trip.

REC67: The feedback/visualization of the emissions should support easy comparison between different means of transportation, other people, etc.

REC68: Care should be given that the impact of an individual person is clearly visible and not masked in the overall statistics.

REC69: Consequences for the environment could be made as tangible as possible in the feedback information in order to increase the impact.

3.6 Emission Exposure data

Similar to the calculation of emission data the exposure to defined emissions (e.g. particulate matter) can be modelled and calculated for each trip alternative. Again, this information might be used to support a targeted behavior change. Regarding practical usage we provide the following recommendations:

REC70: Emission exposure data is difficult to use for persuasive purposes, as this information can have counter-intended effects due to the association of emission exposure with preferred transportation means from an environmental viewpoint.

REC71: Also uncertainties related to the data basis should be made transparent to the user in order to not misinform them. It should be made clear that the actual exposure might significantly deviate from the prognosis due to very local conditions that cannot be considered in the exposure model and calculation.

3.7 Emerging technological possibilities for sustainable mobility

In this chapter we want to highlight two recent technological and urban-travel related developments, which – as we think – provide important possibilities for persuasive interventions in the context of trip planning systems:

REC72: Multimodal routing that also considers the possibilities of new and emerging mobility concepts such as car-sharing, city-bikes etc. should be integrated as this is a good possibility to increase the acceptance and usage of sustainable transportation, and standard routing systems do not address these possibilities yet.

REC73: Also E-cars should be considered and supported by trip planner systems in order to support users of this transportation mode and to help promote the opportunities of this possibility. E-Cars should not be treated as no-emission transportation, but realistic estimations related to the CO2-Cost of the electrical power production should be used.

4. Persuasive Strategies Research

In this section we report the guidelines for persuasion within mobility that we extracted with the main focus on the persuasive attempts itself. We first provide general process guidelines targeted at improving the processes and methods used to design and implement persuasive systems, and then focus of selected strategies and their implementations.

4.1 Process Guidelines

Based on our experiences and recommendations in the literature regarding the design of persuasive systems in general we derived the following set of guidelines, which we think can help to achieve a successful system when designing for behavior change within a mobility context.

REC74: The targeted user groups and their characteristics should be identified and specified as early as possible in the design process.

REC75: Clear behavior targets related to the target users (and strategies to achieve them) should be identified early in the design process.

REC76: Design should focus on a few targeted groups, and not try to address many distinct groups (and behaviors) at one time.

REC77: The design process should address the whole usage situation in all of its complexity and richness and not only focus on the technical solution. Also think about the social and societal processes that are needed in order to achieve the targeted goal, and how these processes can be supported (also as part of a technical solution).

REC78: When defining persuasive system, also consider societal change and do not only focus on behavior change. Important design possibilities might be missed if the focus is to narrow on behavior change.

REC79: The design process of the persuasive system aspects should be thoroughly integrated with the main functional development.

4.2 Guidelines for the design of specific persuasive system elements

Within this section of this report we provide recommendations for the design of typical functional elements that might be part of a mobile trip planner application. In detail we focus on the design of route related emission feedback, summary statistics, symbolic semantic feedback, and the use of challenges and social networks for persuasion.

4.2.1 CO2-Emission Feedback

A central element of many persuasive attempts within trip planner systems is to provide CO2-feedback on the proposed routes. Based on the empirical evaluation of our prototype implementation and an empirical study specifically designed to address this question we derived the following guidelines:

REC80: CO2-Feedback should be designed in a way, which allows users to understand the relative impact of different transportation means.

REC81: CO2-Feedback expressed in real-world concepts can help to make the information more tangible.

REC82: The feedback should be clearly related to a specific trip.

REC83: Feedback should be displayed unobtrusive und not cover-up other important information for making trip decisions.

REC84: If symbolic display of CO2 is used, a link to more detailed explanations and values should be provided.

REC85: For every CO2-value it should be possible to analyze its origin in detail, especially, which trip mode and segment contributes what to the overall score.

4.2.2 **Persuasive Messages**

Another frequently used possibility in persuasion is to provide short messages and nudges in the system. In travel planner applications these messages are typically related to specific trips. Also within PEACOX persuasive messages were used to promote more ecofriendly route alternatives, and the main findings are condensed in these guidelines:

REC86: Persuasive messages should not interrupt the main workflow of the user. They should never be implemented as a modal dialog, or require the user to actively take action to dismiss a suggestion.

REC87: Persuasive messages should be shown directly in the context of its associated main information element. For example, message related to a specific route should be shown in close location of the main route summary and information.

REC88: Care should be given regarding the temporal frequency of persuasive interventions. Messages should not be provided too often so that they annoy the user, but also not too rarely in order to not miss opportunities for persuasion.

REC89: Avoid repetition of persuasive suggestions. Providing the same messages and suggestions over and over again leads to disinterest and ignoring of messages by the users. Therefore a big enough sample of messages to draw from should be constructed and used.

REC90: Messages should be phrased in a positive, low key phrase, with a direct suggestion for an action.

REC91: Messages should be very short and to the point to foster fast perception with minimum distraction.

REC92: Messages should be adapted to the context and user as much as possible in order to increase the chance of adoption.

4.2.3 Guidelines for designing Challenges

Organizing challenges in which users can conform to a given goal and the extent to which they are achieving it also received considerable attention in the persuasive community. Within PEACOX we especially studied the consequences of individual versus collective challenges, and summarize our conclusion in the guidelines below:

REC93: Challenges should be achievable, clear and realistic.

REC94: Provide both individual and collective challenges, as different types of users prefer different settings.

REC95: Consider an appropriate time frame for your challenges based on the target users and application context. Achievements of challenges should not be too far off in time.

REC96: Provide feedback and information regarding the current progress of achieving a challenge.

REC97: If the achievement of challenges is measured by automatically collected/analyzed data (e.g. trip mode share), and the process is not 100 per cent error free, provide a possibility to report and correct errors for the users.

4.2.4 Guidelines based on HCI heuristics

Persuasive interventions in the context of interactive systems also need to follow general requirements derived from basic HCI principles as they need to be understood, accessible, etc. the same way as every other system part. Therefore in this section we provide basic guidelines for persuasive measures based on general HCI heuristics, but with a focus on the typical problems and implementation issues from the perspective of integrating persuasive measures into route planning systems. The guidelines are based on the classic Nielsen Heuristics[1], but analyzed as explained from a persuasive systems approach. In the following guidelines section we therefore first provide the original heuristic, and then extract recommendations specifically relevant for the context of persuasive interventions and designs in the context of mobility.

[1] http://www.nngroup.com/articles/ten-usability-heuristics

Visibility of system status: The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

REC98: When using persuasive interventions user should be made aware, what is objective information, and what is a persuasive suggestion.

REC99: If persuasive interventions or suggestions deviate from the users direct information request, this deviation should be made visible.

REC100: Availability of additional route suggestions should be made visible, so users can decide whether they want to access this information or not.

Match between system and the real world: The system should speak the user's language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

REC101: Persuasive messages should be framed and explained using concepts familiar to the user.

REC102: Persuasive Messages should provide examples that are relevant in the users 'Lebenswelt'.

REC103: Persuasive suggestions should match the actual potential for behavior change

REC104: Persuasive suggestions should provide realistic alternatives.

User control and freedom: Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

REC105: Do not force users to follow persuasive suggestions.

REC106: Even if the users requested more information on a suggestion always provide the possibility to return to the 'normal' routing routine.

REC107: Provide settings possibilities that support the user in specifying the right amount of persuasive interventions he is willing to accept.

Consistency and standards: Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

REC108: Persuasive interventions should be identifiable as such but also need to be consistent with the 'normal' system functionality.

REC109: If different persuasive strategies are used within one system, a common design element should be used to signify their relatedness.

Error prevention: Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

REC110: Avoid unintended following of persuasive suggestions by not hiding the character of such messages.

REC111: Support easy recovery by always providing the possibility to return to known system parts.

Recognition rather than recall: Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

REC112: Utilize recognition as persuasive means.

Flexibility and efficiency of use: Accelerators—unseen by the novice user—may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

REC113: Persuasive system aspects should not unnecessarily slow down expert interaction with the system.

REC114: However, persuasive systems should provide starting points for reflecting on usual practices, and provide possibilities to explore (route) alternatives.

Aesthetic and minimalist design: Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

REC115: Persuasive interventions should be designed in a way to not interrupt the main task (e.g. searching a route).

REC116: Persuasive interventions should not draw to much attention away from the main interface elements.

Help users recognize, diagnose, and recover from errors: Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

REC117: As with every system part, persuasive systems should help the user to avoid and deal with errors. In case of persuasive interventions for the design of these mechanisms it is important to design them integrated with the main functionality and not isolated.

REC118: Errors in the 'persuasive part' should not disable the main functionality of the system.

Help and documentation: Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

REC119: Provide information to the user what persuasive measures are taken, how they influence the routing results and system behavior, and what options the user has to change and modify this behavior.

4.2.5 **Guidelines based on PET-heuristics**

Ethical questions have been at the core of persuasive technology since its inception. Besides the questions regarding the ethic dimensions of persuasion per se also questions related to privacy need to be considered, as several persuasive strategies (e.g. sharing of trips or CO2-emissions) have also important consequences for data privacy. Below we provide high-level guidelines on how to address these questions. The guidelines are based on a set of guidelines developed for privacy-respecting systems in general, but tailored to the needs of persuasive technology.

REC120: Persuasive technologies should follow principles of informed consent, i.e. they should not try to hide the persuasive goals they follow, and make the implications and consequences of using the technology clear to the user.

REC121: Persuasive technologies should use privacy friendly defaults in order to protect the user's privacy.

5. Conclusions

In this deliverable we provided numerous recommendations and guidelines on how to apply and use persuasive technologies and approaches in system implementations within the context of influencing mobility behavior. This guidelines address different system aspects ranging from how and what factors to consider when designing persuasive systems (mobility types, factors influencing trip modes, context factors), through technological aspects in different areas (Emission-aware routing, GPS-Tracking, Trip mode and purpose detection, Emission and Exposure modelling), to findings on the application and design of different persuasive strategies. The guidelines condense our experiences within the PEACOX project. They should be understood as general guidelines (not as strict rules) that must be interpreted and understood in the concrete application example. When used this way we think these guidelines can help to avoid common mistakes and improve outcomes of persuasive systems.