ADVANCED REAL-TIME MULTIMODAL INFORMATION SYSTEM FOR COPENHAGEN TRAFFIC MANAGEMENT ENHANCEMENT
PPI ITS PROJECT - COPENHAGEN

ADVANCED REAL-TIME MULTIMODAL INFORMATION SYSTEM FOR COPENHAGEN TRAFFIC MANAGEMENT ENHANCEMENT

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1. INTRODUCTION

1.1 Purpose of the document

The purpose of this document is to prepare the final report of the project named Advanced Real Time Multimodal Public Transport Information System for Copenhagen City, prepared by the Team n.7 within the PPI ITS framework project signed with representative of Copenhagen City.

1.2 Content of the document

The document includes the following main sections / chapters:

1. A summary of the functional description of the proposed concept solution;
2. The main innovation focus of the concept, and benefits for the city of Copenhagen and value for the citizens
3. The business case of the concept, with market potential, scalability, scale of investment, risk in the concept.
4. The main test results, considering the test sessions with the municipality and the citizens
5. Recommendation and next steps suggested
3. FUNCTIONAL DESCRIPTION OF THE SYSTEM

3.1 General description of the concept

The concept of the solution is to integrate on one platform Copenhagen multi modal transport offer such as car, public transport, bicycle, walking, using real time information for each mode; forecast data is based in addition on real time and forecast traffic data, including accident events.

The concept is based on the use and integration of the already existing application such as Rejsplanen and to use its display adding some new features so as to stay in the logic of mutualisation.

Thus, the system provides :

- For the end-user: multimodal customized information about their trip (on car, public transport, bicycle, walking) using a web / mobile application and on parking terminals
- For the City of Copenhagen : public transport, traffic and pollution monitoring and forecast information, on the back office governance module, and also possibility to implement traffic management rules to reduce pollution, etc.

Thus, the advanced real-time multimodal application with parking data is made of 3 main modules :

1. The RTI (Real-Time Information) module giving the real-time data in the relevant format and appropriate transfer protocol from Bus Operator, Train Operator, and all the systems that have to be integrated

2. The multimodal travel planner, from Point A to Point B, integrating all transport modes (car, bicycle, taxi, ferry and PT) in real-time, displayed on a mobile/Parking terminal/Website application for users with functionalities for itinerary search, schedule search, city services, etc.

3. The governance Back office system, a tools for operators and for the City of Copenhagen enabling:
• Interfaces, data publication, and network mapping management
• Public transport, traffic and pollution monitoring, including CO2 emissions tool calculating CO2 level for each trip

The following picture provides an overview of the concept solution.

3.2 The RTI module functionalities

The main functionalities of the RTI module are:

• To integrate and translate in the relevant format the data (real-time and/or forecast if available) given by the different operators
To integrate according to the adequate protocol on one platform Copenhagen multi modal transport (personal and public) using real time information for each; forecast data is based in addition on real time and forecast traffic data, including accidents

To integrate according to the adequate protocol car and bicycle parking data in the travel planner (position, parking spot availability, bike availability), and remote booking

The RTI module is integrated with the multimodal travel planner application and the Governance back-office module providing the required information.

3.3 The multimodal travel planner application functionalities

The multimodal travel planner functionalities on the applications are:

- To provide searching tools for itinerary with two or multiple points
- To order the results display according to the duration time, price and CO2 level
- To display the loyalty program bonus points for each suggested itinerary
- To detail information on a chosen result
- To guide with a vocal system when driving
- To book and pay parking spaces in advance
- To book and pay available bicycle
- To provide registration option to create a customize account on the application with the preferred travel plans
- To send pop-up alert in case of perturbations on a preferred registered travel plan and to suggest convenient alternative
- To enable registration to a loyalty program, “the more environmental-friendly itinerary you take, the more bonus points you earn” to win free parking or free transport tickets
- To provide free parking coupon of free tickets coupon (through tags) according to the points on the loyalty program
So, all those functionalities are accessible through:

1. The web application
2. The mobile and iPad/tablet application
3. The parking terminal
4. The IVR (Interactive Voice system)
3.4 The governance back office module functionalities

The main functionality of the Back office governance system is to monitor the public transport, the pollution level and the traffic, and make corrective actions to regulate the traffic according to the current needs.

The governance system includes several information required by the City of Copenhagen:

- An air quality management module with real time data from traffic information, weather data, sensors; an advanced model allows to extend pollution data to other areas, information is sent to the Multimodal travel planner;

- a multimodal/multiuser public transport management module, providing an integrated monitoring of all the public transport operators;

- A car traffic management module;

- A weather monitoring system;

- An interface with the end-user application to provide info mobility information;
An integrated simulation tool allowing analysis of scenario based on real time data and forecast.

3.5 The overall system technical architecture and interfaces

The concept system proposed can be based on the following components:

- **A Copenhagen OCC** (Copenhagen Operational Control Centre) data center room, hosting the control center hardware and base software, including the following required software applications:
  - The RTI module functionality, for system integration and pre-processing
  - The multimodal travel planner application
  - The governance back office module, including
    - An air quality management module
    - Multimodal/multiuser public transport management module
    - Car traffic management module
    - Weather monitoring system
    - A simulation tool (of traffic, air quality, public transport) based on forecast data

- **A Copenhagen MOC operational room**, hosting all the workstations for the Copenhagen operators and used to manage the service (suggested WS with double monitors each); other users from other locations can be connected from other municipalities and operators to provide the same information, even if with different access priorities.

- **All the 3rd Party Systems**, connected to the OCC data center room, for live mono or bidirectional data exchange, including:
  - Rejsplanen system, providing data on the public transport operators
  - The existing traffic management system
  - The existing air pollution system
The existing meteo system

The existing parking system

Other future systems

The proposed parking machines, to be installed in parking areas or other strategic areas

The users, able to get information using mobile phones, on web, and using the parking machines.

In case external systems cannot be connected, the concept solution is open to allow integration of specific sensors (on traffic for instance, or meteo) to be installed to provide the required information.

The following picture shows the overall general scheme and system architecture.
4. INNOVATION FOCUS MAKING THE CONCEPT UNIQUE

4.1 Targeted needs of the solution

The solution aims to facilitate every day’s life for the Citizens and for the City mainly by :

1. **Reducing traffic congestion and accidents level through :**
   - Focus on bikes displaying information about CO2 and calories that will encourage people to use it more when the travel time is quite similar than using the car
   - Opportunity of registering to a loyalty program : “ The more sustainable itinerary you chose, the more points you get”
   - Give information about all transport modes and combination will show people that several itineraries are possible and it will help them reconsider their transport habits

2. **Giving relevant real-time information to the user :**
   - Use of an easy and efficient tool such as the application will help people find alternative in real-time in case of unexpected perturbations
   - Customize the door to door itinerary and send updates in case of works or other perturbations in the user’s preferred trips
   - Give information about calorie performances, CO2 level, available seats for the travel comfort, etc. will convince the user to use more soft modes than its car

3. **Involving the City in the traffic management through the system: **
   - Overall view of urban resources (traffic, pollution, works, etc.) to have on one screen all the needed information
   - Facilitate understanding of decisions impacts with simulation of rules implementation impact
   - Regulate public transport traffic in real-time according to the needs. For example, if one train station is closed, increase the frequency of some buses to avoid delays and people concentration at a point.
• Send corrective actions in real-time. For example according to Copenhagen policy, if the pollution level in Copenhagen is too high on a day, the City of Copenhagen can decide to close the traffic to the car in one area for that day, and it can be decided on advance based on real-time and forecast data.

4.2 Main innovation tracks of the concept solution

For citizens:

- Real-Time Multimodal Information
- Customized display for passengers (based on their typical route, on time, price, etc.)
- Includes all transport modes, not only Public Transport (including car and bicycle)
- Parking information and payment integration
- Integration of CO2 emissions data
- Integration with existing systems (known by the user)
- Vocal guidance
- Loyalty program based on environmental factor
- Bicycle and parking real-time availability and advance booking possibilities

For operators of the city of Copenhagen, the availability of a customized integrated Governance back-office system on transport, in details:

- Overall view of urban resources (traffic, public transport, pollution)
  - Real time Monitoring of the overall public transport services provided by the transport operators, to provide a continuous monitoring of the performance and the service (same data and view can be made available to the transport operators)
  - Real time Monitoring of the road traffic in Copenhagen
- Real time Monitoring of the pollution level in Copenhagen (CO2, PMxx, Noise, etc)
- Forecast information
- Management from the city of the traffic rules
  - Real time implementation of corrective actions by the City to regulate the traffic according to the current needs and to the city environmental policies
  - Tool for a better management and understanding of decision impacts

### 4.3 Added value for the City of Copenhagen

*How a real-time multimodal application could give the City of Copenhagen the possibility to manage the traffic and the pollution level in back office?*

The main added values for the City rep are:

- Owning a part of the application and being able to control and influence the transport services it according to the City environmental policies
- Possibility to integrate on the back office module other operators and others systems to monitor other indicators: interoperability and mutualization
- Customization of the application for the end-user
- End-user sensibilization about environmental-friendly attitude with the loyalty program
- The parking terminal in the City displaying the application for all (especially those who do not have smartphones)

### 4.4 Added value for the Citizens

*How to create a better transportation experience for the users?*

The four added value axes for the end-user are the following:

**BE BETTER – The user should think that he is honoring his inner values / principles:**

- By choosing other transportation than car
• By being on time
• By paying less
• By making healthier choice

DO BETTER – The user wants to increase its skills :
• By choosing its transport modes according to the time, weather, price, bonus points etc.
• By being faster and more efficient during its travel time
• By choosing cheaper option, benefit
• By being at the basis of its City CO2 level reduction

FEEL BETTER – The user wants to feel that the solution is made for him :
• By getting customized information about its preferred trips
• By getting cost information for each suggested trip
• By getting unexpected pop-ups with suggested solutions when there is an issue
• By being rewarded for his eco-friendly behavior
• By being less stressed
• By monitoring its performance (number of calories)

LOOK BETTER – The user wants to gain social recognition using the app :
• By arriving on time
• By being able to share the trips information
• By sharing the CO2 saved on social media

So, for the end-user, the main added value of the application is :
• Real-time information to give him more reliability
• Customized information (about time, price, preferred transport) to give him more confidence in his choice and more trust in the transport system
• The loyalty program to give him more social recognition and economic benefit about his eco-friendly attitude
• The advance booking of parking spots and bikes to reduce his stress
5. BUSINESS CASE OF THE CONCEPT

5.1 Market potential

5.1.1 Unmet needs

The main unmet needs are:

- For passengers
  - Integrated interconnection between modes, including bicycle, car, public transport, trains, metro; actually is limited to some of them
  - Integration with parking information, at present not available
  - Data integrated on real time traffic information, to check for the real travel plan and evaluate the use of other sustainable modes

- For the municipality
  - Real time and forecast global view of urban transport resources combined and integrated with the pollution level
  - The possibility to inform directly the population
  - The possibility to monitor directly the transport services and improve the service with direct actions
  - Facilitate understanding of decisions impacts

5.1.2 Target groups

The main target groups are:

- **car and PT passengers**: we expect an increase of the use of the public transport users based on integration of the transport modes
• **the city of Copenhagen**: the system will allow to manage in more efficient way the transport with the goal to reduce the pollution level

• **Local merchants**: potential benefits are expected from this pushing for parkers or travelers.

### 5.2 Scalability

• The solution is based on a modular approach from the functional point of view, and is scalable, can be adapted according to configuration and geographical area of application

• The concept is scalable from the geographical point of view, and can be extended to other municipalities with similar needs

• The concept is scalable from the modes point of view

• The concept is scalable in terms of number of public transport operators, being multi operator and multimodal

• Scalability is applied to applications (for instance for different media) and to system configuration (n. of devises to be installed in the field, such as kiosk, displays, etc)

• The system is open to integration with sensors directly incase data from existing application are not available.

### 5.3 Risk in the concept

The main risks expected in the implementation of the concept are the following

• Existing system (but not owned by the city of Copenhagen) updated to comply some missing requirements

• Data are not available

• Data are available but not in a standard way

• Information are not reliable

• Operators not ready with standard interface
6. TESTS RESULTS

6.1 Tests sessions description

In March, Team7 went to Copenhagen in order to prepare the test sessions.

Indeed, we planned to organize two types of test sessions: one with the City rep and one with Copenhagen citizens in order to get their feedbacks as users on the back-office governance system for the City and on the front-end application for the users.

So on the 17\textsuperscript{th}, Team7 prepared with Maria the test sessions.

6.2 The Municipality test session

Where: In Copenhagen

When: March, 18th 2014, one 2-hour-sessions with about 15 people from different departments of the Municipality (ITS, Parking, Traffic) and other PPI participants, invited by the City

Who is in charge of the sessions:

- The Team7, in cooperation with the project manager of the Municipality of Copenhagen

How many Municipality rep:

- One group of Transport / traffic planner operators
- Other operators, from the traffic department
**What is done:**

- **Tools at hand:**
  - The presentation of the general concept and detailed use case 1-3 (mobile app)
  - Live applications: on iPad, iPhone, laptops and Parkéon parking terminals video
  - Questionnaire about the key information needed to improve further the solution

- **Open discussion** with the participants.

**Municipality test session main objectives:**

The main objectives was to share the proposed concept, to demonstrate the solution using a demo system, to receive a feedback about the main benefits and functionalities of the solution and to provide the City of Copenhagen with input on how to continue the development of the solution.

The following insights were detailed:

- The description of the concept solution, and the main use cases,
  - Use case 1 - Web based multimodal journey planner
  - Use case 2 - Multimodal information provided by advanced parking totem
  - Use case 3 - Governance back office system

- **description of the main scenarios**
  - car user commuting from home to office
  - pollution level is increasing due to high traffic
application testing for the municipality of Copenhagen on live stations on:
  o mobile multimodal applications
  o multi-service parking terminal
  o integrated public transport monitoring system

evaluation through questionnaires about the solution and its various functionalities
which features and benefits can potentially create the most value
Which potentially new features could increase the solution’s value to the citizens.

6.3 The Citizen test session

Where: In Copenhagen

When: March, 24th 2014, two 2-hour-sessions with 10 citizens each

Who is in charge of the sessions:
  o Kris Østergaard, Partner & Chief Philosophy Officer of DARE2, Transport Management Consultancy company, Expert in the field of mobility systems and behavior analysis

How many City rep:
  o One group of 10 citizens with high frequency car users (drive to work every day)
  o One group of 10 citizens with flexible car users (also choose other means of transportation)

What is done:
  o Open discussion with the participants
  o Tools at hand:
    o Screenshots of the mobile application illustrating a car driver using the app
    o The presentation of the general concept and detailed use case 1-3 (mobile app)
    o Live applications: on iPad, iPhone, laptops and Parkéon parking terminals video
Questions about the key information needed to improve further the solution

Citizen test session main objectives:

Provide the City of Copenhagen with input on how to continue development of the solution and obtain the following insights:

- The potential target groups’ openness towards the solution
- Motives and barriers towards the solution and its various functionalities
- Which features and benefits can potentially create the most value
- Which potentially new features could increase the solution’s value to the citizens.

Main focus for this session was on the following use cases:

- Use case 1 - Web based multimodal journey planner
- Use case 2 - Multimodal information provided by advanced parking totem

6.4 The main conclusions

Positive feedbacks were received during both sessions.

About the municipality session, main focus was on the UC3- Governance back office system.

The overall solution was positively appreciated and was considered an improvement by most of the attendees.

Main comments are the following:

1. The availability of the Governance system is rated positive, and, considering the feedback received, the solution:
   a. reduce the pollution level and traffic
   b. Increase the use of the public transport and sustainable transport services
   c. Introduce a more efficient coordination between different transport modes
1. Support the setup of new traffic rules for reducing the pollution level
2. Decrease the overall time spent in the urban transport network

2. Integration of information about traffic, public transport and pollution is needed

3. Other comments received was the following:
   a. Include the noise pollution in the concept
   b. Include the weather forecast
   c. To setup a level of service / limit value for the monitored information (pollution, traffic, public transport service), to allow an effective use of the solution
   d. To integrate for bikes the air pollution level
   e. To integrate the parking for bikes, and integration with IBILUCPH.DK
   f. To provide in addition information for drivers on TRAFFIC ROADSIGNS or NAVIGATION SYSTEMS

After that user test session, the main comments about the users feedbacks are the following:

1. There is openness towards the solution that holds the potential of affecting the citizens’ transportation habits – but obviously under certain conditions.
2. The solution’s uniqueness and strong selling propositions was not necessarily clear, and required clarification to be understood.
3. Mental barriers from car users towards public transportation must be considered.
4. The customization of the solution to the user’s individual needs was really welcome.
5. The greatest potential benefit – and reason to use - is if the solution is hyperconvenient.
6. Key features with potential uniqueness: Time, costs, real-time & parking.
7. Creating a better transportation experience for the citizen, should be the solution’s main customer focused purpose.
So, to sum up, the solution was well-appreciated by the users that would like to have such an application to have an optimized use of the transport network. The main benefits that the citizens like about the solutions are:

- Better transportation experience reliability
- Customized service to focus on the user’s individual needs
- More social recognition with loyalty program
- Reduced stress with advance park and bike booking
- Feel healthier with performance monitoring