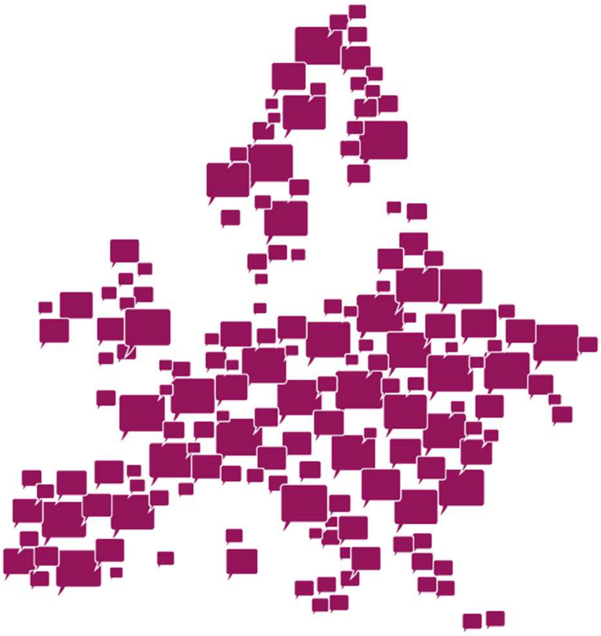
SocialCar

Open social transport network for urban approach to carpooling

D5.2 – Test Evaluation_1



Deliverable WP5 – D5.2
Dissemination level: public
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1. Introduction

1.1 Scene setter

WP5 is concerned with the testing and evaluation of the SocialCar system. Within WP5 the SocialCar project will run three different tests as follows:

- TEST A: Technical and functional testing of the SocialCar system for the system rollout (Test A);
- TEST B: Site specific simulated experiments based on traffic macro-simulation models (Test B);
- TEST C: On site real experiments based on real life testing in at least 3 sites (Test C).

Test A is not subject to impact evaluation because it will be focused on the technical and functional testing for the SocialCar prior to system rollout. This specific test is, in fact, aimed at testing the data interfaces, component functionality and robustness of the SocialCar system. It provides the final checks to ensure a fully working prototype is ready for use by end users (travellers).

Tests B and C provide the basis for the **impact evaluation.** D5.1 – 'Test plan and KPIs definition' provides a detailed plan for delivering these tests at the sites wherethey are to be applied.

Taking the results from the impact evaluation with end users (travellers) together with the results from the process evaluation surveys and feedback from consultation group meetings for both suppliers and exploiters of SocialCar, an appraisal of results/achievements against objectives and a SWOT analysis will be conducted. Lessons learnt, suggestions for improvement and good practice for enhanced engagement/transferability beyond the project timeframe will form the outputs from this analysis.

This Deliverable D5.2- 'Test Evaluation_1' establishes the set-up requirements for Test B and Test C.

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1.2 Executive summary

The focus of this report is specifically on ensuring the impact evaluatuion tests have sufficient and appropriate supply side input data to enable the tests to function adequately. Two distinct tests relating to impact evaluation are to be undertaken:

- Test B: City wide impact assessment of potential benefits from the SocialCar App based on different uptake scenarios, done using assignment models available at 5 sites (evaluating how effective the developed App could be in the future);
- Test C: Testing by actual travellers who utilise the developed SocialCar App, with evaluation done using user acceptance surveys and monitoring observed behaviour at 3 sites (evaluating how individuals use the App and how likely it is to change their behaviour).

The report begins by providing an introduction to the impact evaluation process.

- For each of the impact evaluation tests (TEST B and TEST C) the data requirements to be able to run the tests from a supply perspective are defined.
- The existing supply side data available for each site is described and assessed against the requirements for running each of the tests.
- Where supply data is missing, this is highlighted.
- If adjustments to the data are required, guidance on how to implement the adjustments is provided.

The outcome is production of a list of essential supply side set-up requirements that still need to be met in time for the delivery of Test B and Test C, both commencing in June 2017.

1.3 Scope of the document

D5.2 'Test evaluation_1' is the first of three Deliverables relating to the set-up requirements, test scenarios to be delivered and results analysis of the evaluation.

D5.2 is due at the end of November 2016 (M18), before any tests have been run and also prior to any 'before' data collection with end users has commenced. As such, its focus is on the set-up requirements, ensuring the tests (Test B and Test C), which form the basis of the impact evaluation, have sufficient and appropriate supply side input data to enable the tests to function adequately.

D5.3, the second evaluation deliverable due the end of May 2017 (M24), will define the different demand scenarios which will be tested at each of the SocialCar test sites in both Test B and Test C. i.e. the demand data matrices which will be run through the assignment models used in Test B, and the site specific SocialCar use case scenarios to be tested by end users in Test C. This will also detail the demand side user recruitment for Test C at each lightning site. Also contained in this Deliverable will be the findings and results from the Test A :Technical and functional testing of the SocialCar system for the system rollout.

Finally, D5.4, the final evaluation deliverable due end Nov 2017 (M30), will present the data generated in both Test B and Test C and provide a detailed analysis of this data including key performance indicator (KPI) impact assessment, system usability score (SUS) assessment. The findings from the process evaluation will also be presented including SWOT analysis, appraisal of results/achievements against objectives and providing guidance on improvements and lessons for transfer.

2. Introduction to the impact evaluation process

This section presents a general introduction to impact evaluation describing the two different approaches which are being undertaken:

- Test B: City wide impact assessment of potential benefits from the SocialCar App based on different uptake scenarios, done using assignment models available at 5 sites (evaluating how effective the developed App could be in the future);
- Test C: Testing by actual travellers who utilise the developed SocialCar App, with evaluation done using user acceptance surveys and by monitoring observed behaviour at 3 sites (evaluating how individuals use the App and how likely it is to change their behaviour).

2.1 Test B - overview

SocialCar is aimed at changing the travel environment by providing enhanced information on travel options via a mobile app. It has a particular focus on providing information on carpooling options and connected journeys to and from public transport (PT) services involving carpooling for the first and last miles of the journey.

As part of the evaluation (within TEST B) the project is undertaking city wide impact assessment of potential benefits from the SocialCar app based on different uptake scenarios. This will be done using mode choice / assignment models available at 5 sites (Edinburgh, Brussels, Canton Ticino, Torino and Zagreb) to evaluate how effective the developed App could be in the future at a city wide scale.

The testing process and schedule for running Test B is described in Section 3.2 of D5.1. Figure 1 summarises the tasks and timings relating to Test B. The left hand side of the figure presents the activities related to the demand side while the right hand side relates to the supply side.

The demand side activities are related to establishing the characteristics of different categories of people (e.g. income level, car ownership status etc.) and number of trips they make for different purposes. This will be reported on in the next evaluation Deliverable D5.3 'Evaluation Test_2' due the end of May 2017 (M24), while Section 3 of this Deliverable reports on the first 2 activities on the supply side in Figure 1.

The final outputs from running the models will provide a number of key performance indicators (KPI) relating to future year forecasts with SocialCar utilisation (low, medium, +high uptake scenarios derived from TAM intention to use analysis). These will be compared to base year outputs and 'business as usual' future year outputs. This will include both site specific assessment and cross site analysis. The full set of KPI are presented in Table 5 of D5.1 (for convenience, this is reproduced in Table 1 below). The expected minimum impact targets setout in the original Description of Work are reproduced in Table 2. For the 5 sites subject to TEST B the estimated impacts output from the modelling work (for low, medium and high uptake scenarios) will be compared with these target values. As the KPIs in table 1 will only be produced for those sites subject to Test B, it will be difficult to guage the potential impacts for the other 5 sites. The appropriateness of the target values and the transferability of the modelled impacts will be discussed with these sites during the analysis phase.

Following the actual demonstration with real users in TEST C the stated 'intention to use' will be validated against the actual use at the Edinburgh, Brussels and Ticino sites.

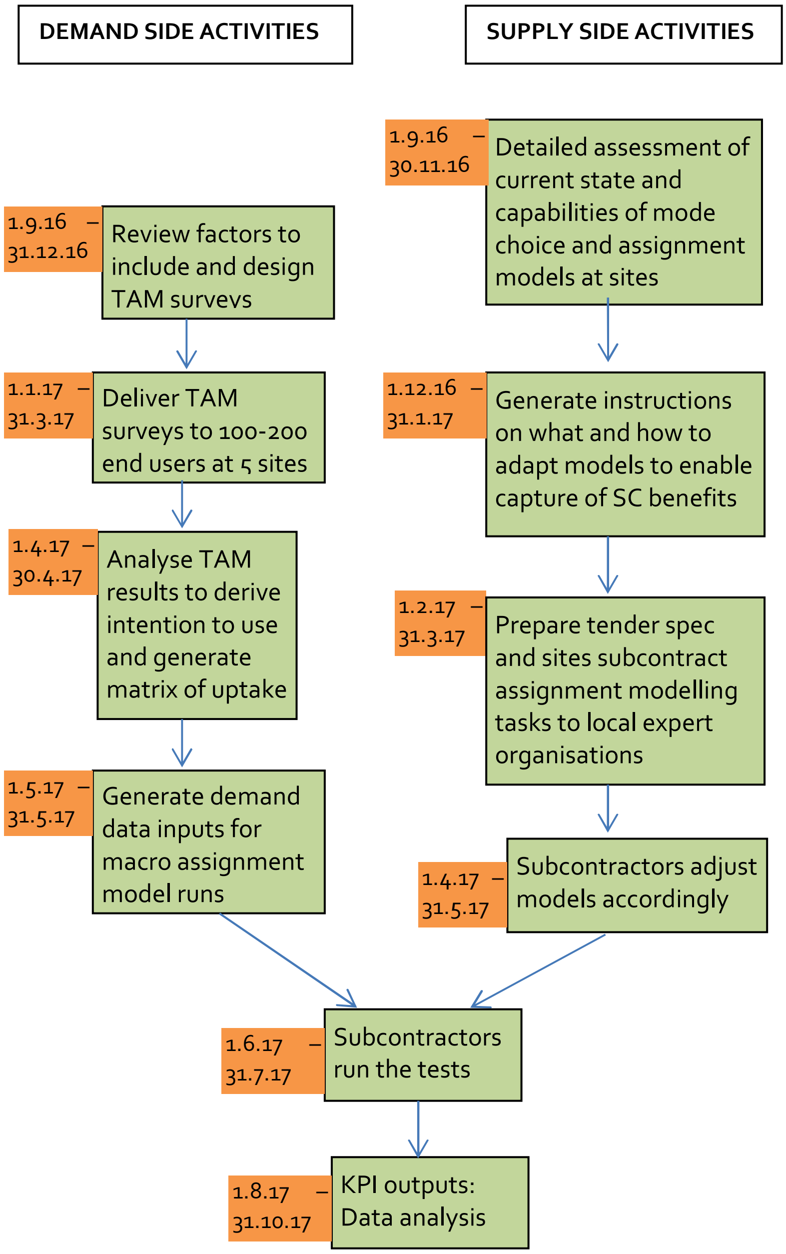

Figure 1 - Summary of the tasks and timings relating to TEST B

Table 1 - List of Key Performance Indicators for Test B

	KPI	UNITS
N°	**Transport**:	
1	reduction in car trips	total number of car trips
2	reduction in car-km	total vehicle-km by car
3	change in average vehicle occupancy	persons /vehicle
4	increase in PT users	total number of PT trips
5	increases in PT pass-km	total passenger-km by PT
6	change in average travel time	average OD travel time
7	change of average v/c ratio	∑ [link volume (veh/hour)/link capacity (veh/hour) x link length] / total network link length
	Environment:	
8	CO2 reduction based on car km reduction	kg CO2e
	Energy:	
9	Fuel consumption reduction based on car km reduction	Toe
	Economy:	
10	City-wide reduction in Veh-hrs delayed	Veh-hours
11	Individual journey costs reduction, based on car-km reduction and parking charges PT fares	EUROS
12	Increased revenue for PT operators	EUROS
	Society:	
13	Reduction in accident costs based on car-km reduction	EUROS

Table 2 - Target impacts as setout in the SocialCar proposal

Expected impact (minimun impact)	Transport			Environment	Economy	Society	Energy
	car occupancy increase	commuting trips reduction	n. of public transport users	C02 emission reduction	operating cost reduction per car owner	n. of accident reduction	fuel consumption decrease
Canton Ticino	between 1,5-2,5	>3%	>6%	>3%	50%	>0,5%	>3%
Skopje	between 1,5-2,5	>3%	> 6%	>10%	50%	>0,5%	>10%
Edinburgh	between 1,5-2,5	>3%	> 3%	>4%	50%	>0,5%	>4%
Lazio Region	between 1,5-2,5	>3%	> 6%	>7%	50%	>0,5%	>7%
Zagreb	between 1,5-2,5	>3%	> 3%	>9%	50%	>0,5%	>9%
Ljubljana	between 1,5-2,5	>3%	> 5%	>7%	50%	>0,5%	>7%
Luxembourg	between 1,5-2,5	>3%	> 3%	>3%	50%	>0,5%	>3%
Brussels	between 1,5-2,5	>3%	>6%	>3%	50%	>0,5%	>3%
Brescia	between 1,5-2,5	>3%	> 4%	>4%	50%	>0,5%	>4%
Turin	between 1,5-2,5	>3%	> 4%	>5%	50%	>0,5%	>5%

2.2 Test C - overview

Test C comprises of the use of the SocialCar App by actual travellers in their real travel environment at the three lightning sites (Brussels, Edinburgh and Canton Ticino) plus the potential inclusion of Ljubljana. The impact assessment involves the evaluation of the use of the App through a combination of monitoring observed behaviour during real life testing and conducting user acceptance surveys both before and after the real life testing.

The testing process and schedule for conducting TEST C is described in Section 3.3 of D5.1. Figure 2 summarises the tasks and timings relating to TEST C. The demand side activities relating to TEST C will be reported on in the next evaluation Deliverable D5.3 'Evaluation Test_2'due the end of May 2017 (M24), while Section 4 of this Deliverable provides an audit of the status on the first activity in Figure 2 on establishing the data to supply the SocialCar app.

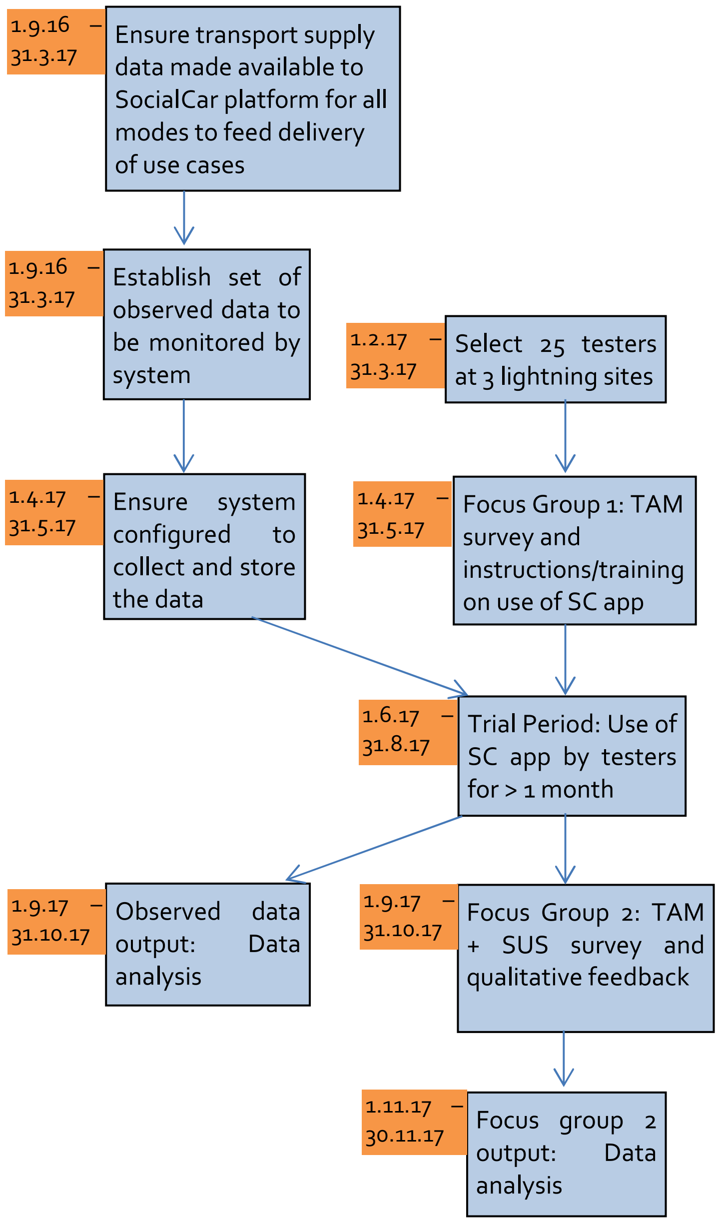

Figure 2 - Summary of the tasks and timings relating to TEST C

3. Test B: supply side data requirements

3.1 Model requirements to represent all transport supply options

SocialCar is aimed at changing the travel environment by providing enhanced information on travel options. It has a particular focus on providing information on carpooling options and connected journeys to and from PT services involving carpooling for the first and last miles of the journey. Other alternative mobility options such as ride sourcing are also considered where available.

In order that the modelling outputs can capture the potential impacts of the SocialCar App, the mode choice model and highway / public transport assignment models (within the macro assignment tools) need to be adapted in a number of ways. The transport network representations used in these tools must adequately reflect all the modes that the SocialCar App facilitates, as well as being able to model multi-modal journeys involving any possible combination of modes. Finally, perceived savings in wait times and reduced connection penalties for intermodal journeys need to be reflected. All of these considerations relate to the transport services and networks that travellers can use – otherwise known as the supply of transport.

Therefore, three key supply side requirements (in addition to standard modelling functions) of the mode choice/assignment models have been identified:

1) Adequate representation of the different modes of travel (which SocialCar provides information on) and the networks they use.
2) Capability for modelling intermodal trips.
3) Ability to adjust supply side variables to reflect the enhanced level of information available to travellers through SocialCar.

If these key requirements cannot be achieved then the ability for the models to capture impacts/benefits of SocialCar will be severely limited.

3.1.1 Representation of different modes of travel

The transport supply represented in the mode choice and assignment model needs to include the modes of travel for which SocialCar provides information on.

It is essential for car and PT to be represented in the mode choice model. This establishes seperate Origin-Destination demand matrices for these modes to be assigned to their respective road or public transport networks. The assignment estimates the routes through the network that the mode specific demand will choose and takes account of travel times and capacities on the network. The supply side characteristics of these modes (e.g. free flow av. speed, cost data, vehicle capacity) and the networks which these modes can travel on (link and node representations with link length and capacity) need to be available in the assignment model.

Walk and cycle are also usually considered as seperate modes within the mode choice model, although they are not always considered at the assignment stage; in which case no mode specific walk or cycle network representation is required.

Other modes such as carpooling, bike-sharing and taxi are not usually considered in the mode choice model or the assignment models. However, in some models, car occupancy levels specific to certain links in the network or to certain types of trip can be applied to the OD trip demand (derived from the mode choice model) as it is assigned to the road network to convert person based demand to vehicle assignment. This could be applied to account for varying levels of carpooling for end to end trips.

The other modes of travel which SocialCar potentially provides information on relate to bike-share, ridesourcing, and taxi. These are generally not considered as an option for end-to-end journeys within SocialCar, but possibly offer an option for first and last mile connections to/from PT services. Park-and-ride and carpool-and-ride also offer an option for first and last mile connections to/from PT services. As such, these modes are unlikely to require fully defined mode specific networks and supply data. Instead they are likely to be modelled using a set of dummy access links (one for each mode to each connection point) which can act as a proxy for travel from the origin to the point of connection with PT (or from PT disembarkation point to destination). The supply data required for these dummy links would include the travel time, distance, cost and capacity. This enables intermodal journeys involving connection to/from PT using these modes. This is described in more detail in Section 3.1.2.

3.1.2 Requirements to represent intermodal trips

The proportion of trips which involve more than one mode of travel is still very low; e.g. in the UK only 2% of car passenger trips and 1 % of car driver trips connect to or form another main mode (usually PT, train in particular) and 5% of cycle trips involve a connection to another main mode (NTS, 2014). Nevertheless, the emergence of new shared mobility services and accompanying smart phone technologies providing enhanced information of journey options, including intermodal journeys, is increasing the opportunities for, and attractiveness of, intermodal trips. As a result the development of new approaches and algorithms for modelling of intermodal trips is an emerging discipline (see Acierno et al 2011; Khani et al, 2014; Fonzone et al, 2016; Friedrich and Noekel, 2016). The basis for much of the recent work in this area is the development and adaptation of the supernetwork technique, whereby the route choice and mode choice modelling are integrated within a single assignment process to supernetworks which include several unimodal networks (e.g. bus, rail, walking) interconnected through transfer links to produce a single integrated multi-modal network. The attributes of these transfer links include times and costs (including those for parking vehicles) on the basis of which transfer disutilities can be derived (see Carlier et al, 2003; Zhang et al, 2011; Liao et al, 2012).

However, the mode choice and assignment modelling tools which are currently in use are largely based on the joint uni-modal approach. In this approach, allocation of OD demands to one of two main modes (car and PT) is undertaken in the mode choice mechanism based on relative costs of using each mode between the OD pairs. These costs are based on travel times and fares/operating costs. The allocated demand for each mode is then assigned to only pure uni-modal networks with no possibility for intermodal trips (although transfer between public transport sub-modes is possible in the PT assignment and access to the PT network is through 'dummy' walk access and egress links). The resultant link flows determine the link travel times which are fed back to the mode choice model for the next iteration – thereby introducing interdependency between the modes (e.g. congestion effects on the road network feed into the travel times of buses that use the road network).

The extended joint-unimodal approach introduces multi-modal alternatives as artificial modes in the mode choice model by pre-specifying fixed modal combinations (combined-mode trip alternatives) being combinations of the given main modes. For instance Park & Ride options are specified as a new separate modal alternative additional to the standard car and PT main modes. Although the added combined mode trip alternatives consist of two or more main modes, they are considered as an additional main mode, without specifying access or egress submodes. This has been used in several commercially available tools to model impacts of, and/or identify optimal locations for, Park and Ride sites. In all other aspects, the modelling follows exactly the same lines as the classical joint uni-modal approach and there is complete separation of the modal networks at the assignment stage.

Neither the joint uni-modal approach nor the extended uni-modal approach is adequate for capturing the potential intermodal journeys which SocialCar will facilitate. While the supernetwork approach would be suitable, this has not yet been developed into the commonly used commercial modelling software and so is therefore not available for the SocialCar testing.

A solution which is possible is a hypernetwork approach whereby access to the PT network is extended by adding a wider range of mode specific access and egress dummy links from the zone centroids. These new dummy links would be associated with each mode of transport being considered for first and last mile legs of the PT journey. This is an extension of the classical approach where only access and egress links are provided for walking. Including access and egress dummy links for car, carpool, bike, bikeshare (and possibly ridesourcing/taxi) has the effect of increasing and extending the number of zones where OD demand can access the PT network (from walking distance range to cycle and car range). So PT can be consided a more viable alternative, when compared to car use, for travel between many more OD pairs as the access/egress times are much lower for car and cycle than the walk time.

The complexity of this approach is that it introduces high levels of interdependency among the modes in trying to achieve a simultaneous equilibrium among all involved modes. Car, carpool, bike, and bikeshare access links all share the same road network links as each other and the main car mode. However, the flows from carpool, bike, bikeshare (and ridesourcing) dummy links are likely to be so low that the contribution to congestion on the road network will be minimal and can be ignored. The contribution to road network congestion from car dummy access/egress links is still likely to be low and so may also be ignored – but this should be assessed when running the models. Congestion from the main mode road network to these dummy link travel times should be fed back to the mode choice model for the next iteration – thereby introducing interdependency from the road network to the intermodal PT journeys.

The mode choice model therefore retains only the 2 main car and PT modes, but the cost of using the PT mode between OD pairs which are further from the PT network access points is greatly reduced due to the inclusion of intermodal (car/carpool/bike to PT) journeys costs rather than just walk to PT journey costs.

The advantages of extending the joint uni-modal classical approach to handle multi-modal trips in this way are numerous: practitioners can continue to utilise their existing models, datasets, and skills. Relatively small adjustments are required to the PT supply networks – adding in extra 'dummy' access and egress links. No changes are required to the mode choice models currently used. The definition of the characteristics of the new dummy links will need careful consideration to account for differing interchange activities (e.g. car dummy links will require parking related time/cost penalties while carpool dummy links may be 'kiss and ride' trips involving no need to find and pay for parking). Furthermore it may be necessary to limit the dummy links to access only certain PT nodes (e.g. not all bus nodes), or to limit the type of dummy link available to some PT nodes (e.g. bikeshare only whereit exists; ridesourcing only in central locations).

A second possible approach for the modelling of carpooling in the assignment stage is to represent all carpool offers as seperate bus services. This follows the same approach as proposed for the SocialCar journey finding algorithm. The start and end locations and time of departure are known for each carpool offer and are then converted into an equivalent bus route by identifying and allocating a time to a series of intermediate stops (many of which coincide with PT nodes) en-route. This approach involves more preparatory work in converting carpool offers to equivalent bus routes and then defining them in the assignment model. It has the advantage that end-to-end carpool trips could be represented as well as first and last mile connections to the PT network. This approach allows more control over the quantity and location of carpool service supply, which gives more realism for representing current carpool service provsion, but as the supply of carpool services is unknown in the forecast years assumed provision will be required.

3.2 Supply side data - current status

The current status of the models in use at each site has been elicited through a survey completed by modelling experts who manage/maintain/run the mode choice/assignment models on behalf of the respective cities/regions. Table 3 contains information on the software models used at each site, the geographic areas covered by the models and the organisation who is responsible for the upkeep and use of the models. Table 4 presents details on the base year for which the models have been created and calibrated and the future forecast years for which a 'business as usual' version of the model has been built.

Table 3- Summary of models being used at the Social Car TEST B sites (at Novemebr 2016)

SocialCar Demonstration site:	Geographical area covered by the model	Software Model used	Name of Model	Organisation who operate and maintain the model	Organisation who completed the survey
Edinburgh	Regional - Travel to Work area for Edinburgh	Cube Voyager	SESTRAN Regional Model 2012 (SRM12)	SYSTRA Ltd	SYSTRA Ltd
Canton Ticino	Regional – Canton Ticino	VISUM 15	Gesamtverkehrs modell Kanton Tessin (GVM TI)	TransOptima	TransOptima + SUPSI
Torino	Whole Piedmont Region	VISUM 11.5	SVR (Regional Traffic Supervisor) Model - Version: *piemonte_20140901*	5T	5T
Zagreb	Currently no model exists. Plan to model corridor between City of Samobor and City of Zagreb	Plan to use VISUM 14	Not avaialbe yet	To be identified	City of Zagreb, office for Strategic Planning and Development, & Faculty of Transport and Traffic Sciences, University of Zagreb
Brussels	Belgium: focus on Brussels Metro Area and high detail on Brussels-Capital Region.		Musti 2.3 (Modèle Multimodal Stratégique de la Région de Bruxelles-Capitale)	Bruxelles-Mobilité	Bruxelles-Mobilité

Table 4 - Base year and forecast years for which supply data is available and calibrated

Socialcar Demonstration site:	Calibrated Base year	Updated base year (reflecting interventions now in place)	Future forecast year1	Future forecast year2
Edinburgh	2012	2015	2024	2029
Canton Ticino	2013	Every 5 years	2030	
Torino	2014	2016	N/A	
Zagreb	**No Model Exists**	-------	(new model plan for 2020)	(new model plan for 2025)
Brussels	2011	2017	2025	2040

The forecast year models are intended as a "trend" scenario, i.e. new infrastructure is only included if its funding has been secured. Future estimated demand data is available for 'business as usual' scenarios for all forecast years.

Validation: The validation which has been undertaken for the base year includes:

- Edinburgh site
  - Road model is validated against observed traffic volumes, road journey time along routes, trip distribution plots and Census travel to work origin destination movements
  - Public Transport model is validated against observed public transport rail and bus passenger volumes and public transport timetables and Census travel to work origin destination movements
  - Park & Ride modelling is validated to observed car park occupancies
- Canton Ticino site
  - Both the car and PT models were calibrated using count data for the base year
- Brussels site
  - The car model has been calibrated using count data from 360 locations for the base year, while the PT model has been calibrated using count data from 547 locations for the base year
- Torino site
  - The model is validated by means of observed traffic volumes and Floating Car Data travel time along routes

Modes represented: The modes of transport which the models represent in the assignment models include:

- car via the highway network (road represented by links and junctions by nodes with capacities, link length, average free flow speeds, speed/flow functions, and any restrictions on use (e.g. time of day restictions). Operating costs per km based on fuel consumption and maintenance are specified.
- a combined public transport nework which includes all public transport submodes (lines and stops are included and either headways or schedules depending on whether a frequency or schedule based approach is used in the PT assignment). PT service capacities are sometimes included along with crowding curves/functions to capture effects and penalise overcrowding. Fare structures are

specified (the Torino model has no representation of public transport as it is aimed to provide only the current base traffic state to real-time systems).

- Full cycle networks are defned only for some models (Canton Ticono, Brussels)
- Full walk networks are defined only for some models (Canton Ticino, Brussels)
- Interchange walk links are included in PT network representation for all models
- Carpooling networks are not defined
- Taxi and ridesourcing networks are not defined

Access to the public transport network is provided from the zone centroids (where demand is assumed to eminate from, and be attracted to) through the use of 'dummy' walk links which reflect the distance from the zone centroid to the PT nodes within the zone (and hence travel time to reach the PT stops).

Parking: Parking considerations are often not included in assignment models, and often where it is included only a general area wide cost is used. However, for intermodal journeys where travellers change from car to PT mode, parking locations, capacities and costs become more important to model accurately.

- Edinburgh:
    - Parking charges are added to trips with a destination in relevant controlled zones. There is no attempt to model parking location choice or parking capacity constraints as standard within the city centre, though this functionality has recently been added to other similar models.
    - Parking costs and capacity is modelled at park and ride sites including rail stations. The model can be adapted to include a constraint within zones where parking is at capacity.
- Canton Ticino :
    - Parking is not included in the assignment. Proxies for availability / search time and costs are used in the destination and mode choice model, though.
- Zagreb:
    - Parking lots will be defined as part of Park&Ride systems.
    - The way that other parking costs and capacities are dealt for other car trips with has still to be decided.
- Brussels
    - For critical zones, 4 parking zones are modelled (Private Short Term, Private Long Term, Public on Street and Public Out of Street). A link with a speed flow curve (to model the search time) lead to each zone. The capacity of the link is the capacity of the parking. A cost is also included for each zone and for each demand segment. The time/cost included in the modal choice is the cost of the parking that bring the shortest time for each OD. After the modal choice, an iterative procedure determine the parking choice without exceeding capacity.
- Torino
    - No parking is included in the assignment model.

3.2.1 Modelling carpooling

None of the models treat carpooling as a seperate mode. In most cases there has been no attempt to model carpooling.

Most assignment models allow, as an input, specification of the average car occupancy for different types of trip. Table 5 gives illustration of the values recommended for use in UK assignment models. These are applied to the person based OD trip demands allocated to car mode trips following mode choice assignment. If SocialCar is likely to increase the level of formal carpooling then these parameter values could be adjusted accordingly to reflect the expected higher vehicle occupancies and hence lower number of vehicles on the road resulting from the trip assignment.

The level of increase in average car occupancy will need to be derived from the outcomes of the TAM surveys. This will be calculated from the proportion of respondents who state they would use SocialCar, and of those, the proportion who would make more of their end to end journeys as carpoolers. The questions need to elicit type of trip and number of these trips per week as well as total number of trips per week. Information about how they currently make these trips (e.g. solo driver etc.) is also required.

Table 5 – Car occupancy levels recommended for use in UK assignment models

Table A 1.3.3:	Car Occupancies (2010)						
	Weekday						
	7am – 10am	10am – 4pm	4pm – 7pm	7pm – 7am	Average Weekday	Weekend Average	All Week Average
Journey Purpose	Occupancy per Vehicle Kilometre travelled						
Work	1.13	1.16	1.15	1.17	1.15	1.31	1.16
Commuting	1.13	1.15	1.14	1.15	1.14	1.21	1.15
Other	1.71	1.82	1.79	1.79	1.79	2.12	1.91
Average Car	1.35	1.63	1.43	1.45	1.48	2.01	1.61
	Occupancy per Trip						
Work	1.20	1.19	1.17	1.18	1.19	1.26	1.20
Commuting	1.17	1.15	1.16	1.18	1.17	1.24	1.18
Other	1.68	1.65	1.71	1.66	1.67	1.90	1.73
Average Car	1.43	1.55	1.48	1.48	1.49	1.81	1.57

Source: Webtag: Tag Data Book Table 1.3.3 Car and Vehicle Occupancies (July 2016)
https://www.gov.uk/government/publications/webtag-tag-data-book-july-2016

In the Canton Ticino model this type of approach has been considered. Estimates on the occupancy rates of single vehicles on specific arcs of the network and/or for the individual trip purposes (commute, shopping, business, leisure) can be made, which will lead to the reduction of car flows during assignment – with the same level of demand. This can capture, to some extent, the impacts of carpooling for end-to-end journeys. This could possibly be used by SocialCar if the outputs from the TAM surveys include 'intention to use' the app and 'intention to use' carpooling for different trip purposes.

The Edinburgh model includes a High Occupancy Vehicle Choice module which allows trips to move between single occupancy vehicles and multiple occupancy cars. The Module works on the Home-based Work, Home-based Employers Business trips and Home-based Other trips for certain types of household. The occupancy choice takes the form of a logit model using different generalised costs for Single Occupancy and High Occupancy trips. The cost function includes different generalised cost for low and high occupancy and also incorporates a high occupancy penalty representing the additional travel and difficulty in arranging passengers. It should be investigated further whether this could be applied in some way to model impacts of end-to-end carpooling journeys.

The Brussels model deals with passenger and driver demands that are already separated prior to the assignment phase. However, this gives little scope for modelling car pooling.

3.3 Capability for modelling intermodal trips

This section describes the capability of the models (used at the 5 sites) to represent intermodal trips (including park and ride, carpool and ride, and possibly cycle and ride). This information has been acquired through surveys with the experts who run the mdels at the SocialCar TEST B cities.

3.3.1 Current status

Edinburgh: There is no standard way to model carpooling within the mode choice model. Park and ride is modelled as a separate mode within the mode choice model following the extended joint-unimodal approach described in Section 3.1.2. This predefines the locations of possible park and ride sites. These P&R locations include rail stations and specific bus P&R facilities. Driving to the edge of a parking controlled area and catching a bus from there is not modelled. Parking costs and capacity is modelled at the pre specified park and ride sites including rail stations. There is no previous application of access links to the PT network for any mode other than walking.

Canton Ticino: No modelling of P+R and no previous attempts to model other inetrmodal journeys.

Zagreb: The yet to be developed model intends to include both park-and-ride and carpooling as separate modes in the mode choice model. It is claimed that utility functions of different modes will be defined according to field surveys, although it is not clear how this will be achieved when carpooling does not exist in the area to be modelled. Mode choice will be conducted using Logit model in PTV Visum software.

Brussels: The P+R is a seperate mode in the modal choice. After the modal choice and parking choice, the P+R matrix is separated in two others (PrT and PT). These two matrices are assigned in their respective networks. No other attempts have been made to capture and model intermodal journeys.

Torino: The model considers only car trips and has no abaility to model public transport nor connections to public transport services. This makes it impossible, using the existing model, to capture the impacts and benefits from SocialCar use. In the next period it will be analysed how to improve the traffic simulator with PT features in order to meet the project requirements.

3.3.2 Possible approaches

As highlighted in section 3.1.2 there are two approaches which have been identified as potentially possible for modelling intermodal journeys involving carpooling for the first and last miles:

1. Use of carpool specific 'dummy' links to access PT network.
2. Convert carpool offers to equivalent bus services and add these to the PT network.

Relating to the first approach, as car driving distances may be significant, the number of 'dummy' links required could be very large as numerous zones will become within the catchment of a PT stop. The second approach will increase the complexity of the PT network and will involve considerable work to adapt the supply side of the assignment model to include the carpool options. This approach does provide capability to model end-to-end carpool trips as well as intermodal trips involving carpooling.

For either of the approaches highlighted above and from the perspective of modelling intermodal journeys in SocialCar, it is best that all public transport modes are treated simply as a single PT mode within the mode choice and then assigned to a combined PT network containing rail, bus, tram etc. Within this combined PT network interchange between different PT modes is possible (including carpool if represented as equivalent bus services). It also reduces the amount of work to create additional mode specific dummy access and egress links to connect the demand to a single PT network rather than multiple PT networks. Table 6 shows that it is the case that all the mode choice models treat PT as a combined mode.

Table 6 - Transport modes explicitly represented in the mode choice model used at each site

SocialCar Demonstration site:	Car	Cycle	Walk	Taxi	Public Transport (all types combined)	Public Transport (each mode seperately)
Edinburgh	✓				✓	
Canton Ticino	✓	✓	✓		✓	
Torino	✓					
Zagreb	(✓)		(✓)		(✓)	
Brussels	✓	✓	✓		✓	

Accommodating the interdependency between the seperate modal networks is an important issue in mode choice/assignment modelling. This is particularly relevant when there is congestion on the road network as this then also impacts on the travel times of buses which utilise the road network. If the carpool offers are represented as equivalent bus services in the model then this becomes particularly important.

- The model used in Edinburgh offer a feedback between the highway assigned link travel to update the scheduled bus travel times.
- The Canton Ticino and Brussels models provide no feedback between the car and public transport networks. The assignments for both modes are carried out in separate network models. Bus travel times are thus fixed, and it is assumed that they run according to the schedule. When this is the case it becomes more important that suitable penalty weightings are applied to different PT submodes where road congestion may delay their operation.
- In Zagreb it is unclear how the yet to be developed new model will deal with interdependency.
- The Torino model has no representation of any mode other than private car.

3.3.3 Components of Generalised Cost

Generalised costs are used in the calculation of the utility of paths as perceived by travellers and therefore in determining the assignment of passenger flows to the paths. It is a combination of a number of different attributes of a path with each attribute being given its own weight or coefficient. The coefficients convert components to common units (time or monetary) and are chosen to ensure that the relative importance of each component for passengers is reflected. These attributes will normally be a subset of the following list:

- Access time (from trip origin to PT stop);

- Egress time (from PT stop to trip destination);
- Transfer time (between PT stops);
- Origin wait time (time spent waiting for first service on path);
- Transfer wait time (time spent waiting for subsequent services);
- In vehicle time (weighting may vary by mode/vehicle type);
- Fare;
- Transfer penalty (based on number of transfers, a fixed penalty, possibly differentiating between different transfer types);
- Distance (for car travel in order to calculate cost of fuel and maintenance);
- Overcrowding;
- Quality of service and facilities at interchanges.

Ideally a model would have the capability to model and build each of these measurements into the generalised cost function. However, this is not always the case and commercial software differs widely in the extent to which these are incorporated.

Table 7 summarises the capabilities of the software at each of the TEST B SC sites. This shows there is good representation of the attributes which need to be included in the generalised cost calculations for intermodal routes. This is crucial since it is the adjustment to the values of these attributes which enables the model to capture benefits from use of SocialCar (See section 2.4).

Table 7 – Components included in Generalised Cost in the models as each TEST B site

Attribute included in generalised cost calculation	Edinburgh	Canton Ticino	Torino	Zagreb	Brussels
Access time (from trip origin to PT stop)	✓	✓	✗	(✓)	✓
Egress time (from PT stop to trip destination)	✓	✓	✗	(✓)	✓
Transfer time (between PT stops)	✓	✓	✗	(✓)	✓
Origin wait time (time spent waiting for first service on path)	✓	✓	✗	(✓)	✓ (possible to include)
Boarding times	✗	✗	✗	(✓)	✓ (see Table 9)
Transfer wait time (time spent waiting for subsequent services)	✓	✓	✗	(✓)	✓
In vehicle time	✓	✓	✗	(✓)	✓
Fare	✓	✓	✗	To be discussed	✓ (possible to include)
Distance	✓ (for cars)	✓ (for cars)	✓ (for cars)	(✓ for cars)	✓ (for cars)
Overcrowding	✓	✗	✗	(✗)	✓ (possible to include)

Quality of service and facilities at interchanges	✓ (possible to include)	✗	✗	(✗)	✗

3.4 Parameter adjustments required

Reliable customised information, such as that provided by SocialCar, will help the trip maker adapt their travel behaviour by making them more aware of the rich set of opportunities that are available. These behaviour changes can occur en-route (if real-time information is provided), pre-trip (when advance journey planning is used) and ultimately contibuting to changes in their habits.

Section 3.1.2 identified two potentially feasible approaches for allowing assignment of demand matrices to intermodal routes which include carpooling for the first and/or last miles of the journey. This enables the representation within the models of the wider, rich, range of intermodal journeys which SocialCar provides information on.

The enhanced information that SocialCar provides, including real-time network/service status information, reduces the disutility of making these intermodal connected journeys. To capture these benefits that SocialCar can offer (and hence influence the mode choice and assignment outputs) requires adjustments to the values used in the models relating to PT wait times, interchange penalties, as well as in cases where these exist: weightings associated with finding car parking, penalties representing the additional travel and difficulty in arranging passengers.

This section presents an overview, from the literature, on the level of changes to these supply side variables which can reflect the enhanced level of information available to travellers through SocialCar.

The value of real-time information:

Table 3.5 in Gentile and Noekel (2016) features a number of ITS solutions and identifies the assignment input variables which they have an impact on and outlines the output benefits thay offer. This highlights that for real-time information while waiting for a service, the value of time changes and reliability increases. This can be captured by reducing the weighting associated with wait time and the interchange penalty in Table 9.

Real-time information does not directly affect the operation of the transport system, but rather provides knowledge about its current state and expected performance to the passengers. The aim of such systems is to make transit more attractive to users through provision of higher service quality (Gentile and Noekel, 2016). If service quality parameters are represented in the assignment model then adjustments to this parameter could also be made to capture the benefits.

According to Fries et al (2011) the most significant benefit of real-time transit information was reducing the utility of rider wait time at a stop. Specifically, reducing the anxiety level of waiting passengers was found to be the largest category of benefits to riders. Transit information provided over the Internet or via mobile devices can save riders waiting time at a transit stop, and the information provided to riders at a bus stop reduces the utility of that wait time. These two tools complement each other, first, possibly by saving travellers time at the stop, and next by making the true time at the stop more useful and less inopportune. Real-time information can also be very valuable in facilitating trip recovery after disruption.

A study in London found that real-time travel information at stops reduced the perception of wait time by 26% (Schweiger 2003). Dziekan and Kottenhoff (2007) find that adding real-time arrival information signs to bus stops reduced perceived waiting times by more than 20% based on a longitudinal, before/after survey of passengers. These findings are backed up by Watkins, et al (2011) using at-stop, in person surveys in King County, Washington.

Wardman et al.(2001) report that passengers value real-time information at interchange terminals as equal to 1.4 minutes in-vehicle-time. Of course expected wait times are a function of the frequency and reliability of the transit service (Furth et al., 2006). Watkins et al (2011) developed a model to take into account these factors and found that the addition of real-time information decreases the perceived wait time by 0.7 min (about 13%). This is equivalent to 1.4 minutes of in-veh time reported by Wardman et al. (2001) if a weighting of 2 is applied to wait time. The Watkins study also found that mobile real-time information reduces not only the perceived wait time, but also the actual wait time experienced by customers. Real-time information users in the study wait almost 2 min less than those arriving using traditional schedule information. This 2 minutes reduction in actual wait time resulting from providing mobile real-time information (RTI) is confirmed by Brakewood et al. (2014). They also found that RTI users had significant decreases in levels of anxiety and frustration when waiting for the bus compared to the control group. Similarly, they had significant increases in levels of satisfaction with the time they spend waiting for the bus and how often the bus arrives at the stop on time. Table 8 presents the recommended values for use in UK assignment models for real-time information provided at stops and for simplified ticketing initiatives (Robson, 2009).

Table 8 Value of time savings from real time information provided at bus stops

Table M 3.2.1: Segmented values of soft bus interventions (generalised minutes)			
Soft Measure	**Bus Users**	**Car Users**	**Overall**
RTPI (at bus stops)	1.47	1.74	1.69
Simplified Ticketing	0.84	2.06	1.43

Source: Webtag: Tag Data Book Table M3.2.1 (July 2016)
https://www.gov.uk/government/publications/webtag-tag-data-book-july-2016

The calculation of the mean wait time is usually based on half the headway. This assumes that passengers arrive randomly at the stop and that the service is reliable. When services are irregular (either planned or a result of poor punctuality), half the mean headway may actually be an underestimate of the mean waiting time. In this situation it is worth considering using wait curves where the waiting time is greater than half the headway. In schedule-based assignment systems it is possible to calculate intermediate waiting times exactly, due to knowledge of the timetable. At the SocialCar sites, both Edinburgh and Zagreb models use a frequency (headway) based approach to the PT assignment while the Canton Ticino site uses a schedule based approach (the model has the HAFAS timetable containing all PT submodes for the entire region).

Based on the academic research cited above, if SocialCar is offering enhanced real-time information then the mean wait time could be reduced by 2 minutes. Furthermore the weighting associated with wait time could be reduced by 20% since providing real-time updates on arrivals while at a stop allows the passenger to make use of the wait time in a productive manner; e.g. visit the shop, go to the toilet, buy a coffee.

In summary,

– reductions in perceived wait time from real-time information while waiting is approximately 20%. This can be applied directly to the value of 'wait-time' weighting.

- reduction in actual wait time from real-time information provision via mobile apps is on average 2 minutes. This can be applied directly to the value of 'mean wait time' determined from the headway or from wait time curves. Also it can be applied to the 'Interchange penalty'.
- reduction in anxiety faced by travellers has not been quantified but is significant. It is possible that the quality of service parameter could be reduced to reflect this. However, there appears to be limited use of this parameter within the models across the sites (see Table 7) and a lack of research evidence to quantify the value of anxiety reduction.

The values for these 'wait-time' weighting and 'interchange penalty' parameters currently applied in the models used at the SocialCar sites is presented in Table 9.

Table 9 Summary of parameter values associated with PT interchange used by the site models

Socialcar Demonstration site:	Wait time weighting applied (to in-veh time)	Interchange penalty	In-veh time weighting for				
			train	metro	tram	Inter-urban bus	Urban bus
Edinburgh	Wait-time curve to turn headways into perceived wait time	5 minutes	1.0	N/A	1.0	1.2	1.4
Canton Ticino	2.5	11 minutes	1.0	N/A	N/A	1.25	1.25
Torino	----	----	----	----	----	----	----
Zagreb	TBC	TBC	N/A	N/A	TBC	TBC	N/A
Brussels	1.51	4 + 15 (if operator change) + x (vary between PT modes)	Penalties applied to boarding rather than in-vehicle time: Metro = 0; Bus = 10 or 20 (function of the operator); Tramway = 3.4; Train = 7.5				

4. Test C: supply side data status

Test C will involve actual travellers who utilise the developed SocialCar App at the three lightning sites (Brussels, Edinburgh and Canton Ticino) plus the potential inclusion of Ljubljana. Their use of the app will be monitored through the SocialCar system. In addition a subset of the travellers will provide feedback through on-line user acceptance/usability surveys and focus groups.

A pre-requisite for establishing a working app to use in the testing, is that there is sufficient data available to the SocialCar system in order to deliver information which is of value to the traveller. This data relates to the different transport modes and is required to feed the SocialCar journey planning and matching algorithms in order to provide the user experiences / use cases for the SocialCar product identified in D1.1 'The SocialCar Arena'.

This section reports on the status of the transport services data provision at each of the lightning sites (including Ljubljana) – and highlights where there are still gaps in the data required to realise the use cases. Table 10 provides an overview of the data which is currently (Nov 2016) available for each mode of transport at each site.

The detailed results of the data audit conducted for each site are contained Table 11 for Brussels; Table 12 for Canton Tivino; Table 13 for Edinburgh and Table 14 for Ljubljana. The data which the audit is based on is uploaded in the data repository that is currently contained at the following link: http://46.101.128.4/index.php/s/65ZeDatPENezPt5.

Table 10 - Overview of currently available data for each site

Modes	*Brussels*	*Canton Ticino*	*Edinburgh*	*Ljubljana*
Bus	*Yes*	*Yes*	*Yes*	*Yes*
Tram	*Yes*	*No*	*Yes*	*No*
Metro	*Yes*	*No*	*No*	*No*
Train	*Yes*	*Yes*	*Yes*	*Yes*
Real-time PT	*No*	*Partly*	*No*	*Yes*
Car pooling	*Yes*	*Not yet*	*Not yet*	*Yes*
Car sharing	*Yes*	*Yes*	*No*	*No*
Bike sharing	*Yes*	*Yes*	*No*	*Yes*
Taxi	*Yes*	*No*	*No*	*Yes*
Open Street Map cut-out	*Yes*	*Yes*	*Yes*	*Yes*
Real-time traffic	*Yes/ no*	*Yes/ no*	*Not yet*	*Yes*

In general the following items can be concluded:

- Availability of modes per site is very diverse. This means that not all SocialCar use-cases can be tested in each single site, therefore a suitable subset of use-cases needs to be selected per site.
- Real-time data is very limited. Only Ljubljana has real-time data available for both PT and traffic. In other sites this data is either unavailable (red) or needs to be acquired (yellow).
- The quality of the data is not officially reviewed yet. Current expectations are:
    - Bus, tram, metro, train: quality of the GTFS-data is expected to be very high. This data is already used for Google Transit, so it is 'automatically reviewed' constantly.

  - Real-time PT: only Ljubljana can already provide a feed with a full GTFS-format. So that seems to be of high quality. The feed from Canton Ticino is only about bus, so this is not covering PT in full.
  - Car-pooling: data quality is not clear yet. Brussels (TaxiStop) is expected to produce feeds of high quality. The feeds from others still need to be developed and/ or tested.
  - Car sharing, bike sharing, taxi: data quality is expected to be high since content is rather simple (mainly name, address and GPS-coordinates per location)
  - OSM cut-out: data is expected to be of high quality since it is all extracted from OSM. Risk is that also irrelevant regions are uploaded or that relevant regions are missing.
  - Real-time traffic: this data is available, but in many cases it needs to be bought. So this can only be tested when SocialCar or these sites purchase the necessary data (budget is available within the project for this form of data acquisition).
- In various cases the upload of data has taken place more than 4 to 6 months ago. Especially in case of public transport, the risk of changes in such a period is high. So data can be out-dated. It is essential that sites upload a new data-set when the current data is out-dated.

Table 11 - Data uploaded to SocialCar repository for Brussels (Status 03.11.2016)

Modes	Loaded	Source	Date	Format	Explanation	Size	Type
Bus	Yes	TEC	04-05-16	GTFS	agency.txt, calendar_dates.txt, feed_info.txt, routes.txt, shapes.txt, stop_times.txt, stops.txt, trips.txt	779 routes	Static
		De Lijn	08-05-16	GTFS	agency.txt, calendar_dates.txt, routes.txt, stop_times.txt, stops.txt, trips.txt	1159 routes	Static
Tram	Yes	TEC	04-05-16	GTFS	Together with TEC-bus in one file. So Tram is part of the bus-file mentioned in row 1		Static
Metro	Yes	MIVB	07-05-16	GTFS	agency.txt, calendar_dates.txt, calendar.txt, routes.txt, shapes.txt, stop_times.txt, stops.txt, translations.txt, trips.txt	88 routes	Static
Train	Yes	NMBS	12-08-16	GTFS	agency.txt, calendar_dates.txt, calendar.txt, routes.txt, stop_times.txt, stops.txt, transfers.txt, translations.txt, trips.txt	487 routes	Static
Real-time PT	No				Real-time data is processed, but not available for SocialCar. PT operators do not want to share it.		
Car pooling	Yes	Taxistop	16-08-16	API	API description		Dynamic
Car sharing	Yes	Cambio	12-05-16	XLS	Name, address, GPS, closest PT routes	121 locations	Static
Bike sharing	Yes	Villo	12-05-16	XLS	Name, address, GPS, availability	352 locations	Dynamic
Taxi	Yes	Collecto	20-06-16	XLS	Name, address, GPS	205 locations	Static
	Yes	Taxis	20-06-16	XLS	Name, address, GPS, number places per stand	147 locations	Static
OSM cut-out	Yes	OSM	07-10-16	none	OSM cut-out	499,8 MB	Static
Real-time traffic	Yes/ no				Data can be made available, but it will have to be acquired. Content is still unknown.		Dynamic

Table 12 - Data uploaded to SocialCar repository for Canton Ticino (Status 03.11.2016)

Modes	Loaded	Source	Date	Format	Explanation	Size	Type
Bus	Yes	SBB	07-07-16	GTFS	agency.txt, calendar_dates.txt, calendar.txt, feed_info.txt, frequencies.txt, routes.txt, stop_times.txt, stops.txt, transfers.txt, trips.txt	393329 routes	Static
Tram	No						
Metro	No						
Train	Yes	SBB	07-07-16	GTFS	agency.txt, calendar_dates.txt, calendar.txt, feed_info.txt, frequencies.txt, routes.txt, stop_times.txt, stops.txt, transfers.txt, trips.txt	31398 routes	Static
Real-time PT	Yes/ no	FFS		API	Free feed is available with actual position of trains, but without the position of other PT modes		Dynamic
Car pooling	Not yet						Dynamic
Car sharing	Yes	Mobility Car-Sharing	07-07-16	TXT	agency.txt, calendar.txt, stops.txt - name, GPS	12 locations	Static
Bike sharing	Yes	PubliBike	07-07-16	TXT	agency.txt, calendar.txt, stops.txt - name, GPS	28 locations	Static
Taxi	No						
OSM cut-out	Yes	OSM	23-09-16	XML	OSM cut-out	410,3 MB	Static
Real-time traffic	Yes/ no	ViaSuisse		API	Current traffic situation: incidents, roads closures, traffic jams. Service is not free: 1000 CHF / month		Dynamic

Table 13 - Data uploaded to SocialCar repository for Edinburgh (Status 03.11.2016)

Modes	Loaded	Source	Date	Format	Explanation	Size	Type
Bus	Yes	TLS	06-07-16	GTFS	agency.txt, calendar_dates.txt, calendar.txt, feed_info.txt, routes.txt, stop_times.txt, stops.txt, trips.txt	4467 routes	Static
Tram	Yes	TLS	06-07-16	GTFS	Tram is uploaded in one PT file, see Bus. So Tram is part of the file mentioned in row 1		Static
Metro	No						
Train	Yes	TLS	06-07-16	GTFS	Train is uploaded in one PT file, see Bus. So Train is part of the file mentioned in row 1		Static
Real-time PT	No						
Car pooling	Not yet	Liftshare		API	Liftshare is in contact with WP3 to develop a suitable feed, also TaxiStop is involved		
Car sharing	No						
Bike sharing	No						
Taxi	No						
OSM cut-out	Yes	OSM	07-10-16	none	OSM cut-out	418,1 MB	Static
Real-time traffic	Not yet	Traffic Scotland	NA	NA	Traffic Scotland publishes: unplanned events, roadwork, future roadworks, traffic status data, traffic status sites, VMS settings, VMS locations, travel time data, travel time sites – costs are still unknown		Dynamic

Table 14 - Data uploaded to SocialCar repository for Ljubljana (Status 03.11.2016)

Modes	Loaded	Source	Date	Forma t	Explanation	Size	Type
Bus	Yes	JPP	11-10-16	GTFS	agency.txt, calendar_dates.txt, caledar.txt, routes.txt, shapes.txt, stop_times.txt, stops.txt, trips.txt	1717 routes	Static
Tram	No						
Metro	No						
Train	Yes	JPP	11-10-16	GTFS	Train is uploaded in one PT file, see Bus. So Train is part of the file mentioned in row 1		Static
Real-time PT	Yes	JPP	26-08-16	API	http://194.33.12.25/bus/api/arrival/1938; last parameter is the station ID	NA	Dynamic
Car pooling	Not yet		16-08-16	API	API development under construction. API is discussed with TaxiStop.	NA	Dynamic
Car sharing	No						
Bike sharing	Yes	BicikeLJ	26-08-16	XLS/ API	Name, GPS & feed for availability per station	38 locations	Static
Taxi	Yes		13-09-16	CSV	Name, closest address, number of places [what are the extra DBF-, SHP- and SHX-files?]	41 locations	Static
OSM cut-out	Yes	OSM	14-10-16	TXT	TXT-file with link and password to OSM-file		Static
Real-time traffic	Yes	Promet			Data on delays, works, traffic report, etc. via – for instance - http://www.promet.si/portal/en/etd.aspx		Dynamic

5. Next steps

5.1 Summary of supply inputs requirements and overview of the next tasks in supply side set-up

This section presents a list of incomplete tasks relating to the supply side and gaps in data collection. These need to be completed within the next 6 months to ensure the essential requirements will be met in time for the delivery of Test B and Test C, both commencing in June 2017.

5.1.1 TEST B

1. The mode choice / assignment models in use at each site have varying states of readiness for SocialCar use.

   Tasks to do:

   a. A working group of modelling experts should be formed to exchange ideas/techniques and good practices in model development especially in relation to carpooling and modelling intermodal journeys.

2. The Torino site has a very basic model which only assigns demand to the road network and no consideration of public transport is included in the model. This is completely unsuitable for the impact assessment required in TestB.
   Tasks to do:

   b. SocialCar project team to establish if Torino can play any further role in the Test B impact assessment.

3. The Zagreb site does not have any existing model which can be used. There is a proposal to build a new model using VISUM 14 software for the corridor between City of Samobor and City of Zagreb.

   Tasks to do:

   c. Zagreb need to provide a detailed plan (by end Dec 2016) with timescales for delivering on this to ensure a suitablemodel is available, validated and capable of modelling intermodal journeys involving carpooling, by May 2017

4. The models which exist at Edinburgh and Canton Ticino sites are well described and validated and have suitable base year and future year networks and data which SocialCar can utilise. Therefore the adaptations which are required in order to capture SocialCar impacts are related to the way in which carpooling is represented and the manner in which first and last mile connections from car, carpool and bike to PT are included.

   Tasks to do (applies to all 5 sites):

   d. Through consultation with the modelling experts at the sites, a decision needs to be arrived at on which approach to modelling of carpooling is to be adopted in these models. This is needed by end Feb 2017.

5. The sites need to prepare tender specifications and subcontract the assignment modelling tasks to local expert organisations.
    a. A detailed set of instructions on what is required to adjust the models in order to capture SocialCar impacts will be produced by end February 2017.
    b. The sites then need to prepare their tender specifications and award the work by the end of March 2017.
    c. The subcontracted modelling experts then need to adjust models accordingly so they are ready to commence running the tests in June 2017.

5.1.2 TEST C

1. **Advance planning of multi-modal trips:** It appears that data required for multi-modal trip planning (including connections to public transport from carpooling) in advance of travel will be available in time for the testing.
    - Static PT stop and schedule data is widely available.
    - The protocols (type, content and frequency of data excange) and agreements for obtaining the necessary carpool data are well developed (see Section 4.3 of D6.1).
    - Static car park location data for park and ride sites and bikeshare location data is available to enable car-to-PT and PT (train)-to-bike intermodal journey plan options to be possible.
    - Costs and fare data is not available for all modes at all sites.

    Tasks to do:

    a. Finalise the protocols and agreements for obtaining the necessary carpool data (by end Dec 2016)
    b. SocialCar needs to develop a data conversion tool to transform the data received from the carpool providers into the GTFS equivalent format required by the SocialCar route finding algorithm - also likely to be required for the TESTB definition of carpooling in the assignment models (by end Jan 2017).
    c. Modest enhancement is required to the SC journey finding algorithm to enable park and ride and bike and ride journey options to be included in results (by end Jan 2017).
    d. Where cost or fare data is unavailable for a particular mode or for a leg of a journey, then SocialCar must provide an estimate of the cost of use. Methodologies for estimating these costs (in the absense of accurate data) need to be developed for each mode (by end Feb 2017).
    e. Thorough checks need to be conducted on the quality and completeness of the static data to be used in feeding multi-modal journey planning solutions (by end April 2017).

2. **Real-time journey planning updates:** Real-time data does not appear to be available to SocialCar with network coverage or for all modes. This makes re-planning journeys based on real-time data difficult to achieve with any reliability.
    - Real-time public transport data from official sources is unlikely to become available for most PT services at most sites.
    - Real-time traffic data is unlikely to become available with extensive network coverage at most sites without payment of a fee.

    Tasks to do:

    f. SocialCar needs to decide if it is to pursue the objective of providing instant journey planning based on real-time data. If it is, then the limitations/conditions under which this will be delivered need to be specified and the real-time data required needs to be identified and obtained (by end Jan 2017).

3. **Real-time travel status information:** Real-time status information is likely to be available to SocialCar for a range of modes if users are willing to utilise the SC tracking function.
   - Some real-time PT data is available from official sources
   - Real-time information on PT service status could be provided by SC users through GPS tracking.
   - Real-time information on carpool service status could be provided by SC users and carpool drivers through GPS tracking.
   - Real-time data on bike-share availability is available at most sites.
   - Real-time carpark space availability at P+R connections is available for some sites.
   - Real-time event and incident data on highway network is possibly available from official sources.
   - Unstructured real-time information on events and incidents potentially available from official and unofficial social media tweets.

   Tasks to do:

   g. SocialCar needs to complete development of its GPS tracking feature. It needs to develop a strategy to ensure that this is utilised by as many SocialCar travellers as well as Carpool drivers as possible. An incentive scheme should be offered and concerns related to battery life and privacy need to be dealt with (by end Mar 2017).
   h. SocialCar needs to decide the form in which real-time information is to be presented to users and how it will incorporate social media content (e.g. tweets) (by end April 2017).

5.2 Demand side considerations

This Deliverable has focussed attention on the set-up of the supply-side data and network representations for running the TEST B macro assignment modelling and TEST C real life use of the SocialCar app.

The other side of the set-up is establishing the demand inputs to the tests: for TEST B this involves generating OD matrices of demand for different types of trip by different user classes at different times of day. Usually, at least three different trip purposes are defined, often home-based work trips (HBW), home-based other (or non-work) trips (HBO), and non-home-based trips (NHB). Normally the user classes differentiate between levels of car availability. For SocialCar it will also be necessary to define another sub-class related to access to the SocialCar app. Through the delivery of Technology Acceptance Model (TAM) surveys to between 100 and 200 respondents at each site, the factors which influence traveller's intention to use the SocialCar App will be identified, revealing if there are any differences in factors influencing traveller's intention to use SocialCar by gender, age, car ownership, mode of travel, purpose of trip etc. The output from analysis of the TAM survey data will enable the generation of a set of demand matrix inputs for the future year forecast runs of the mode choice / assignment models where SocialCar is available. The timetable for delivery of this is detailed on the left hand side of Figure 1.

This process of TAM survey design, delivery and analysis will be described in detail in the next evaluation Deliverable (D5.3) due the end of May 2017 (M24). This will produce as an output the set of demand data matrices which will be run through the assignment models used in Test B, and the site specific SocialCar use case scenarios to be tested by end users in Test C. This will also detail the demand side user recruitment for completing TAM surveys at each lightning site and Torino and Zagreb in Test B and for recruiting real testers of the SocialCar app at each lightning site and Ljubljana in Test C.

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