SUNSET

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Summary

The main purpose of this deliverable is to investigate the feasibility of the potential and effective incentives as identified in D3.3 with respect to 1) user cases; 2) system goals 3) system services and 4) innovative & technical aspects. Details of each of the analysis are described in this deliverable. Understanding the relationships between the incentives and the aforementioned SUNSET criteria aforementioned allows the relative rating of individual incentives to be defined. This has helped prioritising efforts, resources and release planning within SUNSET. The resulting feasibility matrix can be found in the table below.

For easy reference, the numbering of incentive categories is repeated here:

1. Real-time travel information provided by the system
2. Social networks for peer-to-peer travel information (messages)
3. Feedback based on self-monitoring of own travel behaviour
4. Feedback based on setting targets
5. Challenges (using points without an exchange value)
6. Challenges (using points with an exchange value)
7. Social networks for sharing location and/or mobility profile
8. Social networks for finding a buddy
9. Social networks for treasure hunt

Criteria	**Real-time travel info**		**Feedback and self-monitoring**		**Rewards and points**		**Social networks**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
User cases	Med	Low	High	High	Med	Med	Med	Low	Low
System goals	Med	Low	High	High	Med	High	Med	Low	Low
System services	Low	Low	Med	Med	High	High	Low	Low	Med
Innovative aspects	Low	Low	High	High	Med	Med	High	Med	High
Technical easiness	Low	High	Med	Med	Med	Med	High	High	Med
Overall rating	**Low**	**Low**	**High**	**High**	**Med**	**High**	**High**	**Low**	**Low**

Table 1-1 Feasibility matrix with relative rating of individual incentives against the criteria used for comparisons.

Finally, given the feasibility matrix, this deliverable also describes the incentives framework that has been made available within the SUNSET system tripzoom.

Incentive	**Status**	**Availability**
1. Real-time travel information provided by the system	This incentive has an overall rating of low rating. A previous deliverable D1.2 has already identified that the infrastructures of real-time road systems that are available to SUNSET are limited in the context that real-time information poses high requirements to timeliness and accuracy of the information. Moreover, there are already some applications (like Google traffic) that provide real time type of information to users and which do better than we can with our limited resources. Therefore we have decided in sunset to focus on new innovative functionality like personal mobility profiles and social networking.	Will not be implemented.

Incentive	Status	Availability
2. Social networks for peer-to-peer travel information (messages)	This incentive has a low overall rating of rating. Key challenges related to this incentive include the real-time information delivery mentioned in incentive 1. The way SUNSET provides user interaction is via the Portal incorporating Facebook and elgg. Instant peer-to-peer communication is not supported. Details related to the Portal can be found in D5.2.	Will not be implemented.
3. Feedback based on self-monitoring of own travel behaviour	This incentive is provided to users by presenting them with their personal mobility profile. A mobility profile can be viewed on one's mobile device. The mobility profile includes a list of recent trips, the route, modality, objective, sojourn time, distance, cost, and CO_2 emission of each trip.	Implemented.
4. Feedback based on setting targets.	This incentive is high in rating and it is a variant of incentives 3, 5 and 6 – these all refer to the mobility profiles. This incentive builds on incentive 3 and aims to allow users to set their own personal targets. Incentives 5 and 6 allow the system to set shared targets in the form of challenges. With respect to the social networking character of the project we decided to put emphasis on achieving shared targets rather than personal targets.	Will not be implemented, only variants of this incentive are implemented, see incentive 3, 5 and 6.
5. Challenges (using points without an exchange value)	This is rated as a high rating. This incentive is made available through the Incentive Market Place. With reference to a user mobility profile and preferences, challenges are set in an optimal way so as to achieve maximum effectiveness with respect to achieving the system goals and attractiveness from the user's perspective. Users who shares one or more common characteristics such as travel on the same route, similar time, are assigned into a specific target group and an incentive will be sent to all the users in the group. A challenge is often a suggestion of an alternative route and/or modality and/or time of travel. Users are awarded points upon completion of a challenge. The amount of point associated with a challenge is pre-defined by the system, the living lab controller to be specific, and it is presented to the users when a challenge is offered. When a user has completed a challenge, he/she will be awarded with the points. Information about the latest points and the accumulated points of users are available for viewing on the user's profile.	Implemented.

Incentive	Status	Availability
6. Challenges (using points with an exchange value)	This is an extension of incentive 5 with the addition of an exchange value, and has a medium rating. While the challenge and point system is in place, there is not the redemption available within tripzoom as it adds a considerable amount of complexity to the project.	Will not be implemented, only the version stated in incentive 5 is implemented. Redemption of points will not be implemented.
7. Social networks for sharing location and/or mobility profile	This incentive has a high rating. Through the app and the web portal, users have the option to share their mobility profile with their friends. Sharing your mobility profile is a social mechanism to get influenced in behaviour as one can see how well one is doing with respect to the community.	Implemented.
8. Social networks for finding a buddy	This incentive has a low rating. Through the web portal, users have the option to share their mobility profile with their friends.	Implemented.
9. Social networks for treasure hunt	This incentive has a low rating. The final implementation of this incentive has been adopted in the form of a "lucky dip" approach and users do not need to get treasure by social networking. Instead of presenting users with a challenge, they are offered an opportunity to win a "treasure" in the form of extra points. The way a user can obtain the treasure is to follow the route/modality specific by the system, and users have one in ten chances to win the treasure. The implementation of this incentive is based upon incentives 5 and 6.	Will not be implemented, only a variant of this incentive is implemented.

Table 1-2 Incentives in tripzoom.

Document Information

Authors

Name	Partner	Email
Stefan Poslad	QMUL	Stefan@eecs.qmul.ac.uk
Athen Ma	QMUL	athen.ma@eecs.qmul.ac.uk
Zhenchen Wang	QMUL	zhenchen.wang@eecs.qmul.ac.uk
Haibo Mei	QMUL	haibo.mei@eecs.qmul.ac.uk
Frances Hodgson	UNIVLEEDS	F.C.Hodgson@its.leeds.ac.uk
Susan Grant-Muller	UNIVLEEDS	S.M.Grant-Muller@its.leeds.ac.uk
Eric van Berkum	UTWENTE	E.C.vanBerkum@utwente.nl
Jing Bie	UTWENTE	J.Bie@utwente.nl
Diana Kusumastuti	UTWENTE	d.kusumastuti@utwente.nl

Main Author

Name	Stefan Poslad
Partner	QMUL
Address	School of Electronic Engineering & Computer Science (EECS), Queen Mary, University of London, UK
Phone	+44 2078823754
Fax	
Email	Stefan@eecs.qmul.ac.uk

History

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V1.1.2	12-06-2013	Reviewed the relation of D3.4 to D4.3 and drafted content of key sections.
V1.1.3	21-06-2013	Updated summary, section 1, section 4 and conclusions.
v.1.1.4	24-06-2013	Section 4 updated. Conclusions added.
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v.1.1.6	15-07-2013	Updates with respect to WP3 Leader comments
v.1.1.7	15-07-2013	**Final revised version**

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15-07-2013	Project Officer	Stefanos.GOUVRAS@ec.europa.eu
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1. Introduction

A main aim of SUNSET is to attain more efficient and sustainable urban road travel by offering individual travellers the right kind of incentives. An effective incentive is one that motivates individual travellers to change their travel behaviours so as to achieve the overall SUNSET system goals, i.e., to reduce car use during peak commute times, to protect the environment through reducing CO_2 emissions, to promote well-being through using more human-powered mobility during urban travel and to facilitate personal safety.

D3.3 defines a total of 4 categories of incentives which include **real-time travel information, feedback and self-monitoring, rewards and points and social networks**. Further investigations were carried out to better understand how these categories of incentives can be translated into well-defined functions, and this has led to translating these conceptual ideas into technical specifications. During the M11 workshop which took place in Leeds, UK, the topic of an incentive was discussed in detail with reference to the SUNSET team's knowledge and expertise on transport studies, social science, technical background, available and potentially available resources. A list of 9 individual incentives has been defined as candidate incentives to be included in the tripzoom system based on the 4 incentive categories. These are:

For "Real-time travel information"

1. Real-time travel information provided by the system
2. Social networks for peer-to-peer travel information (messages)

For "Feedback and self-monitoring"

3. Feedback based on self-monitoring of own travel behaviour
4. Feedback based on setting targets.

For "Rewards and points"

5. Challenges (using points without an exchange value)
6. Challenges (using points with an exchange value)

For "Social networks"

7. Social networks for sharing location and/or mobility profile
8. Social networks for finding a buddy
9. Social networks for treasure hunt

Since the workshop in Leeds, the 9 incentives have been examined in great depth with respect to their relevance to the defined user cases in D1.2, the overall system's goals and system services.

There are several key challenges in developing a practical and feasible system to support the use of travel incentives. First, the concept of a travel incentive is a very rich high-level concept. It can refer to better informing travellers so that they are provided with quality information about their mobility which helps them to change their behaviour. It can include support for marketing, i.e., towards improved travel demand management (TDM). It can include motivational support for urban travellers. It can assert influence to commuters at a personal, social and social level. Second, it seems quite impractical to specify and develop a single sub-system that supports an operational time-critical computation model of incentives to support such a rich high-level concept. Third, the design of such a system likely needs to be highly participatory in terms of supporting different stakeholders to set and receive incentives and requires multi-shot feedback

from stakeholders in order to evaluate and improve the operation and effect of incentives. Finally, the incentive sub-system needs to be integrated as part of a larger system that help service the rich set of inputs and outputs required as part of an incentive service.

This deliverable provides a summary on the feasibility studies carried out on the 9 incentives and provides an overview on the incentives that are available in the final tripzoom system.

1.1 Goals

The objectives of the Incentive services and goal management Work Package (WP3) are to:

- Research the relationship between individual and system objectives
- Investigate the key factors that influence the use of information message
- Develop a set of feasible and productive incentives to change mobility.

Task 3.3 contributes to the above objectives through the accomplishment of the following tasks:

- To investigate the feasibility of the potential and effective incentives identified with respect to user cases;
- To investigate the feasibility of the potential and effective incentives identified with respect to system goals;
- To investigate the feasibility of the potential and effective incentives identified with respect to system services;
- Discuss and report the results.

1.2 Main Results and Innovations

The main results of this document are 1) recommendations on the most feasible incentives based on their relevance to user cases and system services, 2) identification of the most effective incentives with reference to system goals and impact and 3) a summary of the incentives that are available in the final tripzoom system.

Table 1-1 explains how the results of this deliverable contribute to the project's main innovations. In this table, N/A" in the right column indicates that this deliverable does not contribute to a particular project innovation,

SUNSET innovations	Contribution of this deliverable
Social mobility services that motivate people to travel more sustainably in urban areas	D3.4 defines 9 incentives with reference to user cases, system goals and system services and highlight the incentives that are most likely to be successful in motivating people to travel more sustainable in urban areas.
Intelligent distribution of incentives to balance system and personal goals	D3.4 analyses the potential impact of each incentive and examine their effectiveness in achieving the system goals.
Algorithms for calculating personal mobility patterns using info from mobile and infrastructure sensors	N/A
Test methodologies and impact analysis based on living lab tests	N/A

Table 1-1 Contributions of this deliverable to SUNSET innovations

1.3 Approach

Deliverable D3.3 and related empirical studies have provided the basis on why the 9 incentives have been chosen, however, the feasibility of providing them within SUNSET requires the understanding their relationships to the objectives of SUNSET, their potential impacts and the subsequent demands made on technical specifications. This deliverable examines the feasibility of the incentives qualitatively by referring to SUNSET user cases, system goals and system services. The main aim is to evaluate how the individual incentives related to these pre-defined requirements in previous assessments within SUNSET from the user, system and technical perspectives. Results obtained from the analysis are extrapolated to define the relative rating of each incentive, demonstrating how the current incentive framework in the operating tripzoom system is derived.

1.4 Document Structure

The remainder of this deliverable is structured as follows: in section 2, a short summary of the incentive categories and the subsequent incentives identified will be presented to provide the basic information for the understanding of the rest of the deliverable. The relationships between the defined incentives and the user cases defined for the system will also be presented. This is then followed by a qualitative analysis on the incentives with respect to the overall system goals and their likely impacts in section 3. An overview on the linkage between the incentives and system services is provided in section 4. In the same section, assessments on innovative and technical aspects of the incentives are also provided, together with the list of the incentives in the final tripzoom system. The final section concludes with the main findings of this deliverables.

2. Potential Types of Incentives

SUNSET Deliverable D3.3 by Kusumastuti et al. (2012) identifies potential effective incentives based on literature reviews. They are categorised into 4 groups: real-time travel information, feedback and self-monitoring, rewards and points and social networks. The same deliverable also provides an insight into the extent these categories of incentives found in existing transport-related schemes and applications as well as the way users have perceived them. In addition, abstract descriptions of these incentives have been derived and users' perceptions on these incentives in the three living lab locations have been examined qualitatively via surveying focus groups. From these works, we are able to gain an understanding on users' attitude towards the notion of an incentive and their willingness to take up the different kinds of incentives. In the assessment of *feasible and potentially successful incentives*, information about these kinds of incentives is, undoubtedly, important evaluation criteria; as well as contributing towards the incentive service design process.

We will first recap of the 4 categories of incentives by focusing their main objectives and key finding in D3.3. It is not the intention here to repeat the bulk of the text in D3.3, but stating the key points at this stage will provide the necessary information that help us to understand the incentive feasibility assessment described in this deliverable.

2.1 Categories of Incentives

2.1.1 Real-time Travel Information

This main aim of this category of incentives is to provide users with real-time information on the conditions of the transport network such as delays information, planned or emergency road works, park availability and traffic alerts and hazards (e.g. a road accident or a train cancellation). Information on these conditions can be coupled with personal habitual travel patterns to deliver information that are personalised to individual users. In addition, real-time road conditions can be applied to generate intelligent travel suggestions, such as an alternative route and/or modality in the event one's usual way to work is found to be currently congested. Other information, such as weather, is found to be also relevant, as weather which affects the way people travel greatly.

The responses from the numerous focus groups have indicated the true usefulness and attractiveness of this feature, and opinions vary from one location of the living lab to another. Reliability or trustworthiness of the information has been emphasised as the key to this type of incentive. The source of information should be authenticated by transport system authorities. Much attention should be paid to the delivery of the information as it can delay sensitive information. This is particularly the case with news on traffic accidents that users need to be informed very shortly after the accident has taken place. The distribution of information should also be well managed so as to avoid users experiencing an information overload. Finally, there is a concern about the conflict between road users and use of mobile devices; the application should be designed in such a way that it should not disturb road users while they are actually on the road e.g. driving or cycling, and allow users to opt in as it suits them.

2.1.2 Feedback and Self-Monitoring

Providing personalised feedback on individual travel behaviours aims to provide travellers with tangible evidence in a comprehensive manner, so as to raise their awareness on impact caused

by the way they travel. Metrics used are often relatively simple, such as cost, time, calories, distance and carbon footprint, and this aims to help users to identify an area (or areas) for improvement. This functionality, in other words, provide a way for users to monitoring their own behaviour. Recommendations can also be suggested to users based on their performance and by identifying suitable alternatives.

The overall response towards this type of incentive is positive as it provides a tool to allow users to check their behaviour and progress by simply referring to their mobile device. However, it has been raised that while self-monitoring provides a means to see and understand one's travel habit, such a function on its own may not be adequate in changing people's behaviour in anyway. It is perhaps effective for the most motivated individuals who are keen to change their behaviour in the first place. As for SUNSET, it has been suggested self-monitoring should be combined with other types of information, such as environmental or financial feedback or social influence so as to achieve the system's goals. The choice of metrics should be selected with care, for instance, people would are only interested in cutting their carbon footprints should be presented with measurements related to the environment such as CO_2 emission; presenting them with a cost breakdown may not be useful and effective. Nevertheless, accuracy must be maintained to the highest level. Timing of notifications, either in the form of rewards or feedback, can also be key to the successful use of this type of incentive.

2.1.3 Rewards and Points

There is a large number of computer and smartphone games that use a points based system to motivate players to stay "online". The rationale of using points as a form of reward can be explained by Fogg's work (2010). He argues that an activity that is easy to do (such as playing games) will require only a low motivation for a person to finally commit to it. Thus, triggers such as points, may be enough for driving him/her to play a game. However, when an activity is hard to do, it will require much stronger triggers. Changing people's travel behaviour can be a difficult task especially when there are many factors which influence one's behaviour, such as constraints in daily activity scheduling. Therefore, linking bonus points to different awards may be a necessary step so as to provide the extra 'push' required.

Rewards can be in many forms, ranging from simple recognition of achievement within the community or tangible ones with a monetary value. The notion of points provides a common currency which may help motivate user participation. It can also mimic the operation of a reward scheme in which users can "spend" their points. Combinational and accumulative incentives can be coupled with target or challenge settings in the design of a scheme or game framework.

2.1.4 Social Networks

The key incentive of social networks to users is to provide them with a means to communicate, share their experience and information with each other. There is strong evidence that allowing users to share their performance is a way to: boost their achievement and trigger competition; help promote group behaviour; increase trust among users and reduce social ambiguity. Thus, providing such an incentives-based platform allows users to interact with each other to help promote peer influence as well as loyalty to the system, which in turn helps attract more users.

Privacy is a main concern for social networks and affects the way in which data are stored and for what period of time. Anonymity and disclosure of data must be treated with the greatest care.

2.2 Refined List of Incentives

The examination of the 4 categories on incentives has led numerous possibilities with which how they can be offered in tripzoom. A substantial effort has been put in place within SUNSET to define specific incentives that would be the basis of offering incentives in tripzoom. With reference to the users responses as discussed in the previous section, existing literature, latest trends in smartphone application development, gaming and social networking and end-user surveys carried out within SUNSET, 9 specific incentives have been defined: (also see Table 2-1).

Under the category of Real-time travel information:

1. **Real-time travel information provided by the system**

This refers to the information provided by transport system infrastructures and/or authorities on a city's transport status using different types of sensors and instruments such as traffic camera, loop detectors, GPS on buses, and more. It is envisioned that users can get informed in a more timely manner to avoid congestion.

2. **Social networks for peer-to-peer travel information (messages)**

This is another type of information dissemination approach discussed in D3.3. The idea is to let mobile users report the road traffic status on a peer-to-peer basis. This incentive makes end users both an incentive producer and an incentive consumer. Theoretically, this incentive is more like customized short message service where the content of the message is restricted to traffic information of location, time and road congestion status. When a user is an incentive producer, he/she has to rely both on the real road situation in-situ so that a 'correct' derived. However, the judgement can be incorrect in some cases as the lifetime of the information itself can be relatively short. For example, a road accident may cause immediate disruption top traffic in the immediate area but once the scene has been dealt with cleared, the road condition would return to its normal flow shortly. As a result, such notification would only be relevant to users who are within a certain distance but not necessary those who are relatively quite far away.

Under the category of feedback and self-monitoring:

3. **Feedback based on self-monitoring of own travel behaviour**

Travel statistics can be summarised and visualised in different forms so that users get better knowledge of their travel behaviours. This incentive is intended for those who are interested in their own travel behaviour and is aimed at motivating travellers to achieve a better travel behaviour through overviewing the travel data produced by them.

4. **Feedback based on setting targets**

A further step for motivating better travel behaviour is to let users set their own personal travel targets. This can be done by allowing users to set the objectives of those trips. The benefits are twofold. First, users can keep a record of their own targeted trips. Second, it helps improve the system's detection quality as the system is able to automatically detect a user's trip objective by default once a trip is ended.

Under the category of rewards and points:

5. **Challenges (using points without an exchange value)**

This allows the system to actively suggest a "challenge" to users. This can be a specific way to change their travel behaviour. For example, a challenge can be a suggestion for an alternative route and/or modality to work; an earlier or later department time or an accumulation of

walking/cycling distance for a given period of time. Including the notion of points provides a means to recognise and celebrate one's achievement, which has been an effective way in motivating participation in other studies as mentioned in section 2.1.3.

6. Challenges (using points with an exchange value)

This is closely related to incentive 5. The notion of an exchange value originates from many loyalty schemes in which users can collect points and if one's amount of points is above a predefined threshold, one can redeem a gift. In SUNSET, a similar idea applies where users can collect points by completing different challenges, and if they have collected adequate points, they could use their points to redeem prizes.

Under the category of social networks:

7. Social networks for sharing location and/or mobility profile

In a social network, users can make friends with each other. Each user can share his/her location or his/her mobility profile (How well am I doing with respect to the community in terms of mobility costs, CO_2 emissions, points earned and calories burned) with his/her friends.

8. Social networks for finding a buddy

Users can find friends by searching their names. If the corresponding buddy accepts the request then both users can be friends. This feature allows users to find travel companies or to join groups with comparable mobility behaviour or motivations.

9. Social networks for treasure hunt

This is a fun incentive where a user can get extra points once a challenge is done. A limited number of extra points are assigned to a challenge and it can be rewarded to a limited number of users who first finished a challenge.

Type of incentive (From D3.3)	Description of incentive	Characteristics of incentive
Real-time travel information		
1. Real-time travel information provided by the system	• The system gives information about the most recent conditions on the road networks. • The system gives alerts to users whenever there is a relevant event (either expected or unexpected) that may influence their travel behaviours. In addition: a) Users should be able to enable/disable the incentive; b) When enabled, alerts can only be given based on regular activity-travel patterns (i.e. related to the spatial parameter). Therefore, when a traveller uses a new route for the first time, alerts related to that route will not be available.	• Duration of incentive: It should be made available 24/7. • Time and frequency to offer/remind user about the incentive: a) Regarding the real-time information on a map, users should be able to set the reminder manually. b) Regarding alerts on expected sporadic events (e.g. road works), an alert should be given to users 1-2 days before the event. Users should be able set manually how often they want to be reminded. c) Regarding alerts on unexpected events (e.g. traffic congestion & accidents), an alert should be sent immediately whenever the event occurs.

2. Social networks for peer-to-peer travel information/messages	The system provides an infrastructure for users to exchange messages among each other. In general, there are two types of messages: • Alerts related to the conditions on the road or infrastructure • Tips/advice on travel	• Duration of incentive: It should be made available 24/7. This means users can post messages at any time and can read old posted messages. • Time and frequency to offer/remind the user about the incentive: a) Alerts related to the conditions on the road or infrastructure should be given to users who may be affected by a message. Based on the results of the empirical work in D3.3, users prefer only relevant information. Therefore, the user should specify the spatial and temporal parameters and the category of the information to share (i.e. alerts on road condition and tips/advice) in every message. This way, massages containing alerts can be sent to users who are likely to be affected by the information. b) Tips/advice on travel should be offered to all users whenever a message containing new tips/advice appears.
Feedback and self-monitoring		
3. Feedback based on self-monitoring of own travel behaviour	The system records users' daily activity-travel patterns and present the recorded information to users. This is the basic incentive and feature of tripzoom app.	• Duration of incentive: It should be made available 24/7. • Time and frequency to offer/remind the user about the incentive: Users should be able set manually how often they want to be reminded to check their recorded patterns.
4. Feedback based on setting targets	The system allows users to set their own travel targets.	• Duration of incentive: Users should be able to set their targets for a definite time period (e.g. 1 week). • Time and frequency to offer/remind user about the incentive: When a target is set, the user can get a daily reminder in the morning of their performance in relation to their target.
Rewards and points		
5. Challenges (using points without an exchange value)	Every user who exhibits certain travel behaviours (e.g. cycling or walking) will be awarded points. This can be related to a competition with other users based on points (akin to on-line games)	• Duration of incentive: It should be made available 24/7. • Time and frequency to offer/remind user about the incentive: Not applicable. User should be able to find the information related to how points can be collected in the help menu.
6. Challenges (using points with an exchange value)	This category is related to: • Challenges set by the system or by the 3rd parties. • Periodic offers akin to a loyalty card. For instance, once a user reaches 100 points, he or she can redeem the points to a tangible reward.	• Duration of incentive: a) A challenge should last for a period of time (e.g. 1 week). b) The loyalty scheme should be offered for a longer period (e.g. 6 months or 1 year). • Time and frequency to offer/remind user about the incentive: a) Users should get news about a new challenge whenever it is introduced.

		Users should be able set manually how often they want to be reminded. b) The loyalty scheme should be offered for a longer period (e.g. during the whole LL period). Users should be able set manually how often they want to be reminded.
Social networks		
7. Social networks for sharing location and/or mobility profile	Every user can share their current location to selected users.	• Duration of incentive: Depending on users: users should be able to choose to turn on/off their location sharing. • Time and frequency to offer/remind user about the incentive: Not applicable.
8. Social networks for finding a buddy	Every user can use find a buddy to find a travel companion.	• Duration of incentive: Depending on users: users should be able to choose to turn on/off find a buddy. • Time and frequency to offer/remind user about the incentive: Not applicable.
9. Social networks for treasure hunt	This is also another type of challenges. For example, treasure (in the form of points) can be hidden in a specific coordinate and can only be unlocked whenever users cycle pass the coordinate.	• Duration of incentive: Depending on users: users should be able to choose to turn on/off treasure hunts. When it is enabled, users should be able to detect treasures within his or her proximity. • Time and frequency to offer/remind user about the incentive: Not applicable.

Table 2-2 Possible incentives for tripzoom derived from D3.3.

2.3 Relation between Incentives and Use Cases

SUNSET project deliverable D1.2 provides a refined list of operational use cases and user requirements initially defined in D1.1. With the substantial development work that has been already carried out, together with formative evaluation of the system, D1.2 highlights the status of individual user requirements as well as their order of priority. This section will examine the relationships between these user requirements and their relevance to the 9 aforementioned incentives so as to investigate the suitability and feasibility of these incentives, see Table 2-3. The list of user requirements is obtained directly from D1.2; the status and priority of the individual requirements have also been provided here for completion. Next the relationships between each of the user requirements against the 9 incentives are examined. Please note that D1.2 and about other technical deliverables in WP2, WP4 and WP5 have already defined detailed descriptions on the technical requirements and constraints in great depth. It is not the intention of this deliverable to repeat all the analytical and technical details again here. The aim here is to systemically extrapolate results from the empirical, qualitative and technical aspects so as to report the process of identifying the feasible incentives selected for the tripzoom system.

Recalling the user cases listed in D1.2, Table 2-3 summarises the relationships between the individual user cases and the incentives identified, a "Yes" indicates that the given user case is *related* to the given incentive. For each incentive, we count the number of user cases it is associated with. The bottom of the tables provides a summary of all the counts of the number of associated user cases. It can be easily seen that all incentives are related to at least two or more user cases. Both incentives under the "feedback and self-monitoring" category have the high counts of 11 out of the total 22 use cases, suggesting that providing these two incentives tripzoom would able to cover 50% of all the user cases. The "rewards and points" category offers two incentives that have the next highest count of 6. However, all the user cases found are common to those identified in the previous category and no additional user cases are addressed. Under the real-time travel information category, the incentive "Real-time travel information provided by the system" has a count of 4 and these user cases are different from the ones identified in previous categories. Note that the availability of suitable sources of data and resources for US8 to US11 have already been discussed in D1.2 and as indicated in Table 2-3 that these user cases are not applicable in tripzoom. The incentive on "Social networks for peer-to-peer travel information (messages)" within the same category has the lowest count of 2. Other incentives related to social networks also consistently have the lowest counts of related user cases.

User requirement		Real-time travel info		Feedback and self-monitoring		Rewards and points		Social networks		
		1	2	3	4	5	6	7	8	9
US1	Mobility App registration &Download									
US2	Social Network Reuse		Yes					Yes	Yes	Yes
US3	Mobility Pattern Analysis & View			Yes	Yes	Yes	Yes			
US4	Improved Mobility Pattern Analysis			Yes	Yes					
US5	Trip-based Pattern Analysis & Recommender			Yes	Yes	Yes	Yes			
US6	Trip Recommender Acceptance & Feedback			Yes	Yes	Yes	Yes			
US7	Real-Time Trip, Historical Trip, Transport choice, Info.			Yes	Yes	Yes	Yes			
US8	Planned Real-time Trip Info and Recommender	Yes								
US9	Real-time Trip Info. Confirmation using individual mobility monitoring and traffic sensors	Yes								
US10	Trip Degradation Confirmation using Traffic cameras	Yes								
US11	Trip change based upon Traffic cameras	Yes								
US12	Group-based aggregated Views of multiple individual Trips							Yes	Yes	Yes
US13	Trip Change Incentives			Yes	Yes	Yes	Yes			
US14	Ad hoc Location-specific Mobility Offers			Yes	Yes					
US15	Ad hoc group Travel Offers			Yes	Yes					
US16	Public transport recognition:			Yes	Yes					
US17	Experience sampling									
US18	Sharing Mobility Status Updates		Yes							
US19	User-centred monitoring and visualisation of Mobility patterns.			Yes	Yes					
US20	Reuse of SUNSET Widgets in External Applications									
US21	Analysis of Mobility Patterns and Proposals for Mobility Improvement			Yes	Yes	Yes	Yes			
US22	Users can offer each other travel tips									
	Total no. of related user requirements	**4**	**2**	**11**	**11**	**6**	**6**	**2**	**2**	**2**

Table 2-3 Relationships between use cases and the incentives defined in D3.3.

3. Feasibility of Incentives from a System's Perspective

The aim of this section is to investigate the likely impact of individual incentives on the system level (e.g. congestion, emissions). This is done through a qualitative approach by analysing the impact of incentives on individual behaviour (based on D3.3) and the impact of individual behaviour on system performances (based on D3.2). As the results derived from the above approach are indicative rather than conclusive.

3.1 Qualitative Analysis

The 9 incentives are being investigated. The following subsections will focus on the impact of these incentives on individual behaviour and, subsequently, on system performance of the traffic and transport network.

3.1.1 Impact of Incentives on Behaviour

Incentives can influence the behaviour of individual travellers. This concerns both the planning/scheduling behaviour and the en-route behaviour (D3.2). For the planning/scheduling behaviour, the following aspects are being considered:

- **Trip decision**: Take a trip or not (e.g. home working, teleconferencing); destination choice (e.g. shopping in the city centre instead of own neighbourhood);
- **Timing choice**, especially in relation to congestion avoidance: departure time choice to avoid peak hour, or strategic break-ups of the trip (e.g. an intermediate stop at a petrol station) to avoid congestion;
- **Mode choice**: car, public transport (PT), or alternative modes (e.g. cycling & walking); combination of modes (e.g. P+R);
- **Route choice**: the route between origin and destination, especially for the car mode as the road network is denser than PT networks.

For the en-route behaviour, the following aspects are being considered:

- **Driver status**: workload (e.g. physical activities & mental stress); concentration (e.g. focus on the driving task), correlated to workload;
- **Longitudinal control**: speed profile (within speed limit), car following behaviour;
- **Lateral control**: lane keeping/departure; lane change (e.g. gap acceptance) & overtaking;
- **Compliance with traffic rules** (if not included above): red light violation; priority rules.

The SUNSET incentives are expected to mainly affect the planning/scheduling behaviour of travellers, and only have minor effects on en-route behaviour. Therefore the analysis in this section will only focus the behavioural aspects related to trip planning/scheduling. Based on D3.3 and D3.2, the impact of the SUNSET incentives is identified and listed **Table 3-1**.

Incentives	Type of impact and their significance			
	Trip decision	Timing choice	Mode choice	Route choice
1. Real-time travel information provided by the system	Medium	Major	Medium	Major
	Trip cancellation immediately before departure, in case of severe congestions on the road and/or disruptions on public transport.	Choice of departure time immediately before departure, and the sojourn of a trip en route and taking up other activities in order to avoid congestion and disruptions.	Choice of mode immediately before departure in order to avoid congestion and disruptions.	Route diversions in order to avoid congestion and disruptions.
2. Social networks for peer-to-peer travel information (messages)	Medium	Minor/Medium	Major	Major
	Trip planning and engagement in other activities.	Medium impact on the sojourn of a trip en route and taking up other activities; minor impact on the choice of departure time immediately before departure.	Choice of mode, due to the experience of peers.	Route diversions in order to avoid congestion and disruptions
3. Feedback based on self-monitoring of own travel behaviour	Major	Medium	Major	Medium
	Amount of trips: by raising awareness of personal goals that are dependent on the amount of trips.	Choice of departure time, by raising awareness of personal goals that are correlated to departure time of trips (e.g. congestion related).	Choice of mode as most of the personal goals heavily depend on the chosen mode.	Route diversions, by raising awareness of personal goals that are correlated to the route of a trip (e.g. congestion related).

4. Feedback based on setting targets	Medium	Minor	Major	Minor
	Amount of trips in order to reach personal targets that are dependent on the amount of trips.	Choice of departure time, in order to reach personal targets that are correlated to departure time of trips (e.g. congestion related)	Choice of mode, as most of the personal targets heavily depend on the chosen mode.	Route diversions, in order to reach personal targets that are correlated to route of a trip (e.g. congestion related).
5. Challenges (using points without an exchange value)	Minor	Minor	Medium	Medium
	Amount of trips, in order to earn points.	Choice of departure time, in order to earn points.	Choice of mode, in order to earn points.	Route diversions, in order to earn points.
6. Challenges (using points with an exchange value)	Medium	Medium	Major	Major
	Amount of trips, in order to earn points.	Choice of departure time, in order to earn points.	Choice of mode, in order to earn points.	Route diversions, in order to earn points.
7. Social networks for sharing location and/or mobility profile	Major	Minor	Major	Major
	Amount of trips, in order to meet friends.	Choice of departure time, in order to meet friends.	Choice of mode, in order to meet friends.	Route diversions, in order to meet friends.
8. Social networks for finding a buddy	Minor	Medium	Medium	Medium
	Amount of trips, in synergy with buddies.	Choice of departure time, in synergy with buddies.	Choice of mode, in synergy with buddies.	Route choices, in synergy with buddies.
9. Social networks for treasure hunt	Medium	Minor	Medium	Major
	Amount of trips, in order to hunt treasure.	Choice of departure time, in order to hunt treasure.	Choice of mode, in order to hunt treasure.	Route choices, in order to hunt treasure.

Table 3-1 Impacts of incentives and their grades on individual behavioural aspects

3.1.2 Impact of Behaviour on System Performance

Individual behaviour affects the performance of the network. This concerns the system performance regarding both **efficiency** and **externalities** (D3.1 and D3.2). Efficiency related system performance measurements include:

- **Accessibility**, including the performance level of the transport infrastructure & the accessibility to spatially distributed activities;
- **Congestion**, measured by e.g. car kilometres in congestion, travel time, waiting time, schedule delay, throughput, or capacity.

Externality related system performance measurements include:

- **Safety & security**, measured by the reduced exposure to risks, including: avoidance of cyclists for car drivers, awareness of local road and weather conditions, awareness of unusual conditions, avoidance of waiting times on dark and silent (railway) stations, reduced risk of getting robbed;
- **Environment** protection, namely: reduced CO2 emissions, improved air quality, reduced noise pollution;
- **Personal wellbeing** of citizen, including: disturbance from traffic noise, personal health and being fit, being able to set and monitor personal objectives.

Based on D3.2, the impact of individual behaviour on the system performance is identified and listed in Table 3-2.

Behaviour	**Strength of impact on**				
	Accessibility	Congestion	Safety	Environment	Wellbeing
Trip decision	—	Major/Minor	Medium	Medium	Medium
	Negligible.	Major impact when high demand leads to heavier congestion; minor impact when longer trips also increase congestion.	High demand leads to more exposure to accidents.	High car traffic demand leads to more pollution.	Longer trips also increase emission.
Timing choice	Medium	Medium	Minor	Minor	Minor
	Peak hour avoidance may improve/degrade accessibility if the traveller is time rich/poor.	Less car traffic during peak hours leads to a significant reduction of congestions.	Less car traffic during peak hours reduces the accident risk due to congestion.	Less car traffic during peak hours reduces the amount of emissions due to congestion.	Peak hour noise decreases due to peak avoidance.

Mode choice	Medium	Major	Medium	Major	Medium
	Choosing a non-car mode generally decreases accessibility.	Choosing a non-car mode significantly reduces congestions on the road network.	Less car traffic means less exposure to road accidents.	Less car traffic reduces emission.	Choosing a non-car mode reduces noise and choosing an active mode e.g. walking, cycling, improves personal health.
Route choice	—	Medium	Medium	Minor	Minor
	Negligible.	More traffic on local roads leads to more local congestion.	More traffic on local roads increases accident risk.	More traffic on local roads reduces local air quality.	More traffic on local roads generates more noise disturbance.

Table 3-2 Strength of impact of individual behavioural on system performance

3.1.3 Impact of Incentives on System Performance

Based on the results in sections 3.1.1 and 3.1.2, it is then straightforward to derive the main impacts of incentives on the system performance. The detailed results are listed in with a summarised version on the strength of impact Table 3-3 (with all Major impacts highlighted). The overall strength of impact is determined by the rules given in Table 3-4.

Incentives	Accessibility	Congestion	Safety	Environment	Wellbeing
1. Real-time travel information provided by the system	Minor Changes in timing and mode choice.	Medium Changes in timing, mode and route choice.	Medium Changes in mode and route choice.	Medium Changes in mode choice.	Minor Changes in mode choice.
2. Social networks for peer-to-peer travel information (messages)	Medium Changes in timing and mode choice.	Major Changes in mode choice and medium impact due to changes in trip decision, timing and route choice.	Medium Changes in trip decision, mode and route choice.	Major Changes in mode choice and minor impact due to changes in trip decision.	Medium Changes in trip decision and mode choice.
3. Feedback based on self-monitoring of own travel behaviour	Medium Changes in timing and mode choice.	Major Changes in trip decision and mode choice, and minor impact due to changes in timing and route choice.	Medium Changes in trip decision, mode and route choice.	Major Changes in mode choice and minor impact due to changes in trip decision.	Medium Changes in trip decision and mode choice.
4. Feedback based on setting targets	Minor Changes in mode choice.	Major Changes in mode choice and medium impact due to changes in trip decision and mode choice.	Medium Changes in trip decision and mode choice.	Major Changes in mode choice and minor impact due to changes in trip decision.	Medium Changes in trip decision and mode choice.

5. Challenges (using points without an exchange value)	Minor Changes in mode choice.	Medium Changes in mode and route choice.	Medium Changes in mode and route choice.	Medium Changes in mode choice.	Minor Changes in mode choice.
6. Challenges (using points with an exchange value)	Medium Changes in timing and mode choice.	Major Changes in mode choice and medium impact due to changes in trip decision, timing and route choice.	Medium Changes in trip decision, mode and route choice.	Major Changes in mode choice and minor impact due to changes in trip decision.	Medium Changes in trip decision and mode choice.
7. Social networks for sharing location and/or mobility profile	Minor Changes in mode choice.	Major Changes in trip decision and medium impact due to changes in mode and route choice.	Medium Changes in trip decision, mode and route choice.	Major Changes in trip decision and mode choice induced by community-effects.(others travel more sustainable than I do or vice versa)	Minor Changes in trip decision and mode choice induced by community-effects. (others are travelling more healthy than I do or vice versa)
8. Social networks for finding a buddy	Medium Changes in timing and mode choice.	Medium Changes in timing, mode and route choice.	Medium Changes in mode and route choice.	Medium Changes in mode choice.	Minor Changes in mode choice.
9. Social networks for treasure hunt	Minor Changes in mode choice.	Medium Changes in trip decision, mode and route choice.	Medium Changes in trip decision, mode and route choice.	Medium Changes in trip decision and mode choice.	Medium Changes in trip decision and mode choice.

Table 3-3 Strength of impact of incentives on system performance

The overall strength of impact of incentives on system performance is determined as …, if:	Given the strength of impact of incentives on behaviour is …, and	Given the strength of impact of behaviour on system performance is ….
Major	Major	Major
Medium	Major	Medium
	Medium	Major
	Medium	Medium
Minor	All other combinations	

Table 3-4 Adopted rules for determination of strength of impact

3.2 Tuning the Incentives for Living Lab Operation

For SUNSET, a set of incentives will be enabled through the tripzoom app and tested in three Living Labs (Enschede, Gothenburg, Leeds). This section discusses which incentives are expected to be most effective in achieving the system objectives, and how the detailed design of each incentive can be fine-tuned during the Living Lab operations.

3.2.1 Potentially Successful Incentives Based on Expected Impacts

Based on the results of the impact analysis in the preceding sections, we can select the most effective incentives for each of the five policy goals.

Accessibility
Accessibility is considered to be a long term measurement of the infrastructure. That means, short term changes in behaviour, such as those caused by incentives, are unlikely to cause a major impact on accessibility. However, if incentives contribute to long term habit forming, and/or changes in household possession (such as the purchase of a bicycle, or hybrid car), they can have a long term effect (even if the offering of incentives may be temporary). It is postulated here that the accessibility can be improved by incentives that raise awareness, such as feedback and challenges.

Congestion
Congestion can be effectively reduced by providing travellers with information and feedback. In other words, the incentives help the traveller to avoid congestion, through rerouting and through the change of mode. On the other hand, the incentive of social networks for sharing location may have the unintended consequence of travellers making more trips to meet up friends, leading to heavier congestion.

Safety & security
Most incentives have indirect consequences on safety, mainly by reducing exposure. This is realised by providing travellers with information on dangerous situations (accidents, road conditions, etc.) and with challenges that motivate them to take a safer route/mode/departure time.

Environment
Environmental protection is achieved by raising the awareness of travellers on their carbon footprint. Feedback and challenge based incentives are most effective for this objective.

Personal wellbeing
Some incentives have indirect consequences on the personal wellbeing of citizens. This is mainly due to the impact of mode choice on social wellbeing. Incentives that motivate a mode shift to public transport and/or active modes (walking, cycling) are believed to improve social wellbeing.

Based on the above discussions, the recommended incentives are listed in Table 3-5. For easy reference, the numbering of incentives is repeated here:

1. Real-time travel information provided by the system
2. Social networks for peer-to-peer travel information (messages)
3. Feedback based on self-monitoring of own travel behaviour
4. Feedback based on setting targets
5. Challenges (using points without an exchange value)
6. Challenges (using points with an exchange value)
7. Social networks for sharing location and/or mobility profile
8. Social networks for finding a buddy
9. Social networks for treasure hunt

System objectives	Recommended incentives								
	1	2	3	4	5	6	7	8	9
Accessibility			✓						
Congestion	✓	✓	✓	✓		✓			
Safety	✓					✓			
Environment			✓	✓	✓	✓	✓		
Wellbeing			✓	✓	✓	✓	✓	✓	

Table 3-5 Recommended incentives per system objective

3.2.2 Using System Performance Metrics as Incentive Parameters during the Living Lab Operations

For the recommended incentives, the detailed design of each is to be made during the Living Lab operations. Experience sampling questions (ESQ) can be asked to collect data on the type of desired incentives. Some of the fine-tuning activities are also related to the evaluation methodologies; they should be conducted in accordance with the recommendations of SUNSET deliverables D6.1 and D6.2.

1. Real-time travel information provided by the system
This incentive mainly targets congestion and safety. The analysis in the previous sections does not show a major impact of this incentive on congestion. This is mainly due to the fact that real-time information, despite its name, is latent and less effective than predictive information. Nevertheless, it is interesting to see the impact of such information on congestion.

It is recommended to adopt the opt-in approach in sending out congestion information, so as not to disturb the user (too much). Fine tuning can be made via ESQ in testing:

- The spatial scope from where travellers want information;
- The temporal frequency at which travellers want to be updated.

However, incident/safety information should adopt the opt-out approach, so that travellers are always informed (unless they opt out).

2. Social networks for peer-to-peer travel information (messages)
This incentive should be provided in free form so that travellers can write/send messages in the way they want. Fine-tuning of this incentive relates to the way recipients are informed, namely:

- The difference between public messages (broadcast) and private messages (friends only, or with specified recipients);
- The timing of messages/notifications: immediate, delayed, or periodic digests (e.g. daily);
- The maximum amount of messages/notifications that a traveller should receive per day.

3. Feedback based on self-monitoring of own travel behaviour
This incentive provides travellers with their mobility profile, which includes not only their mobility pattern, but also the impact of their mobility (e.g. on emission).

Fine-tuning of the incentive relates to the presentation of feedback. For an effective incentive, it is necessary to highlight the over-time changes over time in the mobility profile, so that travellers experience a sense of progress. Graphics are usually welcomed by end users.

4. Feedback based on setting targets
This incentive is similar to incentive #3 (see above), with the inclusion of personal targets in the comparison with progress in mobility profile.

5. Challenges (using points without an exchange value)
This incentive is less powerful than the incentive with an exchange value (incentive #6, see below). It is useful mainly for the externally related system objectives, as both have to do with image and self-recognition.

This incentive will be tested in combination with incentive #6. Research questions to be asked (cf. D6.1 on the effectiveness of incentives) include:

- How effective are points without an exchange value (therefore only the non-material image and recognition) in motivating people to change their behaviour?
- How does this compare to points with an exchange value (incentive #6)?

6. Challenges (using points with an exchange value)
This incentive has the potential of motivating people in changing their behaviour in every aspect. Major attention should be paid to mode and route choices, while trip decision and timing choice should also be tested.

Fine tuning of the incentive involves the amount of points that is needed in order for travellers to change their current behaviour. It is therefore recommended to start from a low amount of points and gradually increase the amount. Research questions to be answered (cf. D6.1) are:

- What are the thresholds needed for behavioural change (per aspect, also in combination with traveller groups)?
- Above the threshold, what is the relationship between the amount of points and the extent of behavioural change?

7. Social networks for sharing location and/or mobility profile
The analysis in this section indicates this incentive as effective in achieving system objectives in the area of sustainability and health.

8. Social networks for finding a buddy
The main impact of this incentive is to facilitate travellers to travel together, hopefully on car share, public transport, or a move active mode such as walking and cycling.

This incentive should be designed by taking into account the similarity of two travellers in terms of:

- Their social economic background;
- Their geographical association;
- Their mobility pattern.

Results from the Living Lab will help answer the research questions (cf. D6.1):

- What motivate buddies to travel together?
- What thresholds have to be met to make it likely for buddies to travel together?
- When buddies travel together, what are the chosen modes/routes? How are they chosen?

9. Social networks for treasure hunt
The analysis in this section indicates this incentive is ineffective in achieving each of the system objectives. It is still relevant for the Living lab operations to test and confirm/reject this judgment.

4. Operation of Incentives

From the empirical work, SUNSET has gained an insight into the possibilities of what potential incentives may be and an early indication on how users might perceive them. Incentives, however, are expressed in a descriptive and conceptual way in the empirical study. We also need to understand the degrees of innovation of the candidate incentives. Translating these incentives into technical specifications for the design and implementation of the final tripzoom system requires careful interpretation. It also requires a critical analysis of the system requirements for the different incentives and dependencies in the system design and suitable supporting technologies and methodologies.

4.1 Relation of System Services to Incentives

The definitions of the 9 incentives can be found in section 2.2. This section analyses the relationships between the defined incentives and system services and a summary can be found in Table 4-2.

4.1.1 Real-Time Travel Information Provided by The System

Real-time travel information requires a function to track a user's journeys and makes available information about the travel and the transport system.

The specification of this incentive can be divided into two main areas: providing real-time information from the road system and tracking mobility for providing personalised information.

Providing real-time information of a road system ranges from road conditions obtained via traffic camera, loop detectors and real-time arrival and departure requires the availability of suitable data to the accepted level of reliability, interoperability between systems, mechanisms and resources to process and interpret the data. Again, this required substantial demand both on the system as well as resources to implement this function. Furthermore, SUNSET has three living labs in three different countries which would present degrees of difficulties in each case, making this functionality extremely difficult to implement in practice. In the final implementation, the Global Traffic Resources Search was integrated with the tripzoom city dashboard so as to provide links that allow city moderators access public traffic resources, such as online road cameras, bus schedules in city of Leeds, Enschede and Gothenburg. All these public traffic resources have been defined in D1.2.

Tracking mobility is one of the fundamental function that tripzoom offers. While such function is available in the design and implementation of the system, offering *real-time tracking* both in terms of route and modality leads to an extra level of complexity. Existing GPS tracking system provides accurate real-time route tracking and SUNSET exploits this technology to track routes. Identifying the modality of a user, however, requires an addition analysis of the mobility patterns and a comparison with priori information. This makes this impossible to be carried out on the mobile device itself. It is not scalable to carry out this process in real-time for all active users. In addition, the GPS tracking system is based on mobile devices that have limited power and network support. GPS signals are not always available due to a variety of environment conditions, such as travelling inside tunnels. All these factors bring difficulties in carrying out real-time route tracking.

4.1.2 Social Networks for Peer-To-Peer Travel Information (Messages)

The main aim of this incentive is to allow users to exchange real-time information based on their current travel experience and it is related to the following system services:

SUNSET aims to reuse existing social network infrastructures, such as Facebook[1], to support interactions among users. In addition, SUNSET employs an open source social networking engine, namely elgg[2] within the project to incorporate social networking which is embedded in tripzoom which allow users to use the same user account. This incentive allows users who travel on similar routes to share their current travel experience, otherwise, it would be just another instant messaging tool. This means that individual users would impose a requirement on processing, collating, distributing real-time individual trip information on the system.

4.1.3 Feedback Based on Self-Monitoring of Own Travel Behaviour

Travel behaviour monitoring requires a user to be able to:

TSS1 Travellers can get info about their own travel data on the LL
TSS2 Travellers can embark on a the LL via a desktop or a mobile device.
TSS5 Travellers can dis-embark from a LL
TSS3 Travellers can get help from a helpdesk / user forum
TMS8 Travellers can compare their actual behaviour with city level goals

This incentive is closely related to the tracking mobility function described in section 4.1.1. The key difference here is that there is not a requirement to provide information on mobility in real-time. The system is therefore able to schedules the collection and processing of data and the identification of route and modality at other times so as to ease the demand on the server.

The travel data can be further defined by a set of properties (see Table 4-1) which give users an accurate picture of how they travel, where they have travelled; what their inter-city and intra-city travel profiles are; whether they use more than one transport mode and the effect this has on their trip purposes. SUNSET offers users a personal dashboard that visualises historical trips. Trips are profiled in terms of origin, destination, route, trip purpose, transport mode and distance.

Trip Properties	Description
Total Distance	Total distance of a trip in meters
Trip Modality	Modality used during trip: none, foot, bike, car, bus and others"
Total Cost	Total cost of a trip in euros
Total Emission	Emissions of the trip

Table 4-1 Trip Properties currently defined in SUNSET

4.1.4 Feedback based on Setting Targets

The incentive described in 4.1.3 allows travellers to view their mobility information including trip objective, route, modality as well as other metrics such as emission. The incentive on "Feedback

[1] See https://www.facebook.com/
[2] See http://community.elgg.org/

based on setting targets" is an extension of section 4.1.3 which provides users with a comprehensive summary of their mobility profile by showing their historical trips and related statistics with reference to metrics aforementioned, so that they can set targets in a realistic and achievement manner.

System services related to these incentives include:
TMS2 Travellers can get overviews of their trips
TMS3 Travellers can zoom in on their trip details
TMS15 Travellers can receive an incentive when they are at a specific place or area at a specific time(period)
CMMS1 The city moderator can get overviews of mobility profiles
CMMS2 The city moderator can see the consequences of mobility profiles

4.1.5 Challenges (Using Points without an Exchange Value)

Monitoring a user's mobility profile allow the system to better understand one's habitual travel behaviour, together with the support of other complementary function such as the Experience Sampling, the system can gain an insight into a user's preference. SUNSET runs a city dashboard that enable these kinds of information to be retrieved and visualised and therefore, it is then possible to couple the two findings to set a target that is both effective and attractive to users.

Challenges include a set of trip requirements which can be used to constrain the whole journey. These requirements include:

- Objective
- Modality
- Emission
- Cost
- Distance
- Departure time

The combination of these requirements allows a living lab coordinator to create useful challenges in order to achieve a city level goal. This incentive requires:

CMMS6 The city moderator can issue tips and travel alternatives on how to reach personal goals
CMMS8 City moderator can issue incentives at a specific place or area at a specific time(period)
CMMS9 City moderator can manage the lifecycle of a SUNSET user challenge

On the traveller's side

TMS13 Travellers can receive notifications
TMS16 Travellers can receive an incentive when they meet a SUNSET challenge.
TMS17 Travellers can see what challenges are 'open'

Travellers are also allowed to voice their view on the incentive by

TMS19 Travellers can rate incentives they liked

4.1.6 Challenges (Using Points with an Exchange Value)

The basis of this incentive is identical to that of section 4.1.5 with the addition of an exchange value so that users could use their collected points to redeem a reward in a physical form or with a financial value. The notion of 'points' is used in the system to demonstrate conceptually that rewards can be of any size, and a fully operating system can be designed in such as way that

users can use their collected point to redeem a gift or voucher with a cash value. The tripzoom app, as a proof-of-concept prototype, does not have any commercial sponsor at present and therefore, the point exchanging feature is not currently available.

4.1.7 Social Networks for Sharing Location and/or Mobility Profile

Location sharing allows a traveller's friends to see his/her current location. In the discussion on the design and implementation of this incentive, there is concern about the handling of privacy preferences and profile, as well as issues about personal safety arising by sharing one's location. The system services that are related to this incentive is:

TMS1 Travellers can change their privacy preferences and profile
TMS8 Travellers can compare their actual behaviour with city level goals
TMS10 Travellers can compare their mobility pattern with patterns from others

4.1.8 Social Networks for Finding A Buddy

This can be designed to operate either "on-trip" or "off-trip". The former is related to a number of incentives aforementioned such as sections 4.1.1, 4.1.2 and 4.1.7, requiring information of associated users to be shared instantly. Issues related to technical complexity, privacy and personal safety remains the key challenges. Alternatively, the system can offer this incentive off-trip through the system web page where users can be provided with great control about the type and amount of information they wish to share. The system service that is related to this incentive is:

TMS1 Travellers can change their privacy preferences and profile

4.1.9 Social Networks for Treasure Hunt

This is intended to provide a gaming element in the system as it has been suggested that it can be an effective way to motivate users and help retention. It can be seen as a variant of that in section 4.1.6 in which the presentation of a challenge is crafted in such a way that users are presented with a route or location where he/she may be able to find a "treasure". Again, similar to that in sections 4.1.5 and 4.1.6, the city dashboard available within SUNSET allows effective and attractive suggestions to be made and a "treasure" can be in a variety of forms, ranging from extra points to other physical rewards. Related system services are:

TMS13 Travellers can receive notifications
TMS15 Travellers can receive an incentive when they are at a specific place or area at a specific time(period)
TMS16 Travellers can receive an incentive when they meet a SUNSET challenge.

Identifier: tripzoom service as specified in Leeds M11 Meeting	**Real-time travel info**		**Feedback and self-monitoring**		**Rewards and points**		**Social networks**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
TSS1 Travellers can get info on the LL			Yes						
TSS2 Travellers can embark to the LL			Yes						
TSS3 Travellers can get help from a helpdesk / user forum			Yes						
TSS4 Travellers can give feedback on LL									
TSS5 Travellers can dis-embark from the LL			Yes						
TMS1 Travellers can change their privacy preferences and profile							Yes	Yes	
TMS2 Travellers can get overviews of their trips				Yes					
TMS3 Travellers can zoom in on their trip details				Yes					
TMS5 Travellers can see the consequences of their mobility pattern									
TMS8 Travellers can compare their actual behaviour with city level goals			Yes				Yes		
TMS10 Travellers can compare their mobility pattern with patterns from others							Yes		
TMS13 Travellers can receive notifications					Yes	Yes			Yes
TMS14 Travellers can receive an incentive when they show compliance in actual travel behaviour with city level goals									
TMS15 Travellers can receive an incentive when they are at a specific place or area at a specific				Yes					Yes

time(period)									
TMS16 Travellers can receive an incentive when they meet a SUNSET challenge.					Yes	Yes			Yes
TMS17 Travellers can see what challenges are 'open'					Yes	Yes			
TMS18 Travellers can publish some personal mobility facts on social media (share with friends)									
TMS19 Travellers can rate incentives they liked					Yes	Yes			
CMMS1 The city moderator can get overviews of mobility profiles				Yes					
CMMS2 The city moderator can see the consequences of mobility profiles				Yes					
CMMS6 The city moderator can issue tips and travel alternatives on how to reach personal goals					Yes	Yes			
CMMS8 City moderator can issue incentives at a specific place or area at a specific time(period)					Yes	Yes			
CMMS9 City moderator can manage the lifecycle of a SUNSET user challenge					Yes	Yes			
CMMS10 City moderator can issue experience sampling questions									
CMMS11 City moderator can analyse the response to the experience sampling questions									
Total no. of related services:	**0**	**0**	**4**	**5**	**7**	**7**	**1**	**1**	**3**

Table 4-2 tripzoom services that are supported (this an update of information in Table 3 in D1.2) in relation to the incentives

4.2 Innovative and Technical Aspects of Incentives

In the assessment of the candidate incentives, we investigated the degree of innovation each of the incentives to ensure that tripzoom provides cutting-edge services to its users. The level of technical easiness of each incentive has also been assessed so as to ensure that incentives chosen for the final tripzoom system are achievable within the time frame and resource constraints of the project. A full summary of the assessment can be found in Table 4-3, with ratings and justifications provided.

Incentives	Degree of innovation	Technical easiness
1. Real-time travel information provided by the system	Low There are existing applications online that provide real-time traffic information, examples include Google[3] and TOMTOM[4].	Low If an existing service was to be re-used by tripzoom, this could be achieved by incorporating the appropriate APIs into the overall design and architecture. This would present significant amount of technical challenges and put an additional demand on the overall development. An alternative approach is for SUNSET to development its own version of the service. Again, there is simply inadequate time and resources within the project to achieve this.
2. Social networks for peer-to-peer travel information/messages	Low There are existing applications available on mobile devices that enable users to communicate instantaneously. Most of these applications are already popular and often free of charge.	High This would simply require the appropriate APIs to be integrated with the system, and APIs of this type are often relatively simple to exploit.
3. Feedback based on self-monitoring of own travel behaviour	High Providing personalised mobility information is a key innovation of SUNSET. There are existing applications that tracking one's route based on GPS, while detection of both route and modality using smartphones presents a high degree of innovation.	Medium The SUNSET team has experience and expertise in this area which has made the tracking of personal mobility available in tripzoom at an early stage. Much effort has been in place to improve the overall accuracy on route and modality detections. There are many factors that affect the accuracy of detection, including disruption of signals, poor signals, localised movements of users, location in which a mobile device is placed.
4. Feedback based on setting targets	High Providing personalised mobility information is a key innovation of SUNSET. See incentive 3 for more details. We deviate from the	Medium Please refer to incentive 3 above.

[3] www.google.com
[4] www.tomtom.com/livetraffic/

	original idea on setting personal targets as it has been decided we should emphasize on supporting a social networking environment which allows users to share information.	
5. Challenges (using points without an exchange value)	Medium Our background research on both the literature and existing trends in mobile application show that it is common and effective to give recognition to users, and this is useful in particular to promote loyalty. SUNSET introduces this idea to the tripzoom app so as to provide a means to acknowledge any behaviour change from users regardless of the magnitude.	Medium A framework is required within the system to manage the operation of this incentive. Key challenges related to this incentive are 1) providing a means in the system to define challenges and this includes the start and end dates, target users, description of task and associated conditions; 2) management of challenges within the system; and 3) communications to users.
6. Challenges (using points with an exchange value)	Medium This introduces an idea that is commonly used in other loyalty schemes in which users can use their accumulated points to redeem gifts. Our literature review has indicated that providing such scheme with the aim to influence the way people travel is relatively novel in the field of transport.	Medium The basic framework follows what has been described in incentive 5. An additional management system is needed to account for all the transactions between the users and the system as well as any third parties (e.g. providers) involved. Issuing of gifts also need further investigation in terms of validity, authentication, format and presentation, particularly when third party providers are involved.
7. Social networks for sharing location and/or mobility profile	High This incentive lies in the heart of the original idea of SUNSET which supports a social networking environment to enable users to interact with each other, and in turn aims to create a 'culture' of sustainable travel among them.	High This is facilitated by existing social networking technologies and SUNSET has adopted the open source social networking engine, elgg, to enable this.
8. Social networks for finding a buddy	Medium Collecting personal mobility profiles from users means that users not only get gain a better insight into how one travels, but via the social networking facility, one can also find a 'travel buddy'. While there are similar schemes which are currently available and they are mostly associated with car pooling, the novelty here comes from the fact that tripzoom extends the idea to offer multi-modal, providing the extra flexibility to	High See incentive 7.

	users.	
9. Social networks for treasure hunt	High Background literature and existing trends in mobile applications suggest that this is an innovative way to attract users and maintain user loyalty.	Medium This incentive will require the highest precision on the route and modality for it to be run successfully, as any inaccuracy in the detention results would result in users not being able to find the "treasure". Also, see the technical challenges related to incentive 3.

Table 4-4 Assessment on the degrees of innovation and technical difficulty of candidate incentive.

4.3 Incentives in tripzoom

This deliverable has addressed the feasibility of 9 candidate incentives with respect to user cases, system goals and system services. From the previous analysis, we see that the incentives identified demonstrate gradients of compatibility with users cases and system goals. In addition, they present a variety of technical difficulties with respect the system services. Table 4-5 provides an overview on the relative rating of each incentive against each criterion used for the feasibility analysis in the previous sections. We assign an overall 'high' rating to an incentive if two or more criteria have been ranked as 'high' and the ranking of the rest of the incentives are determined be the majority of the ranks.

SUNSET has gone through different releases in the implementation of tripzoom, and the 9 incentives have been built, adopted, modified and re-evaluated through the cycle of development. A summary of the incentives that are available in tripzoom is provided in Table 4-6. For easy reference, the numbering of incentives is repeated here:

1. Real-time travel information provided by the system
2. Social networks for peer-to-peer travel information (messages)
3. Feedback based on self-monitoring of own travel behaviour
4. Feedback based on setting targets
5. Challenges (using points without an exchange value)
6. Challenges (using points with an exchange value)
7. Social networks for sharing location and/or mobility profile
8. Social networks for finding a buddy
9. Social networks for treasure hunt

Criteria	**Real-time travel info**		**Feedback and self-monitoring**		**Rewards and points**		**Social networks**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
User cases	Med	Low	High	High	Med	Med	Med	Low	Low
System goals	Med	Low	High	High	Med	High	Med	Low	Low
System services	Low	Low	Med	Med	High	High	Low	Low	Med
Innovative aspects	Low	Low	High	High	Med	Med	High	Med	High
Technical easiness	Low	High	Med	Med	Med	Med	High	High	Med
Overall rating	**Low**	**Low**	**High**	**High**	**Med**	**High**	**High**	**Low**	**Low**

Table 4-5 Relative rating of individual incentives against the criteria used for comparisons.

Incentive	Status	Availability
10. Real-time travel information provided by the system	This incentive has an overall rating of low rating. A previous deliverable D1.2 has already identified that the infrastructures of real-time road systems that are available to SUNSET are limited in the context that real-time information poses high requirements to timeliness and accuracy of the information. Moreover, there are already some applications (like Google traffic) that provide real time type of information to users and which do better than we can with our limited resources. Therefore we have decided in sunset to focus on new functionality like personal mobility profiles and social networking.	Will not be implemented.
11. Social networks for peer-to-peer travel information (messages)	This incentive has a low overall rating of rating. Key challenges related to this incentive include the real-time information delivery mentioned in incentive 1. The way SUNSET provides user interaction is via the Portal incorporating Facebook and elgg, instant peer-to-peer communication is not supported. Details related to the Portal can be found in D5.2.	Will not be implemented.
12. Feedback based on self-monitoring of own travel behaviour	This incentive is provided to users by presenting them with their personal mobility profile. A mobility profile can be viewed on one's mobile device. The mobility profile includes a list of recent trips, the route, modality, objective, sojourn time, distance, cost, and CO_2 emission of each trip.	Implemented.
13. Feedback based on setting targets.	This incentive is high in rating and it is a variant of incentives 3, 5 and 6 – these all refer to the mobility profiles. This incentive builds on incentive 3 and aims to allow users to set their own personal targets. Incentives 5 and 6 allow the system to set shared targets in the form of challenges. With respect to the social networking character of the project we decided to put emphasis on achieving shared targets rather then personal targets.	Will not be implemented, only variants of this incentive are implemented, see incentive 3, 5 and 6.

Incentive	Status	Availability
14. Challenges (using points without an exchange value)	This is rated as a high rating. This incentive is made available through the Incentive Market Place. With reference to a user mobility profile and preferences, challenges are set in an optimal way so as to achieve maximum effectiveness with respect to achieving the system goals and attractiveness from the user's perspective. Users who shares one or more common characteristics such as travel on the same route, similar time, are assigned into a specific target group and an incentive will be sent to all the users in the group. A challenge is often a suggestion of an alternative route and/or modality and/or time of travel. Users are awarded points upon completion of a challenge. The amount of point associated with a challenge is pre-defined by the system, the living lab controller to be specific, and it is presented to the users when a challenge is offered. When a user has completed a challenge, he/she will be awarded with the points. Information about the latest points and the accumulated points of users are available for viewing on the user's profile.	Implemented.
15. Challenges (using points with an exchange value)	This is an extension of incentive 5 with the addition of an exchange value, and has a medium rating. While the challenge and point system is in place, there is not the redemption available within tripzoom as it adds a considerable amount of complexity to the project.	Will not be implemented, only the version stated in incentive 5 is implemented. Redemption of points will not be implemented.
16. Social networks for sharing location and/or mobility profile	This incentive has a high rating. Through the app and the web portal, users have the option to share their mobility profile with their friends. Sharing your mobility profile is a social mechanism to get influenced in behaviour as one can see how well one is doing with respect to the community.	Implemented.
17. Social networks for finding a buddy	This incentive has a low rating. Through the web portal, users have the option to share their mobility profile with their friends.	Implemented.

Incentive	Status	Availability
18. Social networks for treasure hunt	This incentive has a low rating. The final implementation of this incentive has been adopted in the form of a "lucky dip" approach and users do not need to get treasure by social networking. Instead of presenting users with a challenge, they are offered an opportunity to win a "treasure" in the form of extra points. The way a user can obtain the treasure is to follow the route/modality specific by the system, and users have one in ten chances to win the treasure. The implementation of this incentive is based upon incentives 5 and 6.	Will not be implemented, only a variant of this incentive is implemented.

Table 4-6 Incentives in tripzoom.

5. Conclusions

In this deliverable, we examine the feasibility of the 9 incentives identified in SUNSET deliverable D3.3 by referring to their relationships with the user cases, system goals, system services, innovative aspects and technical easiness. Recalling the 9 incentives:

1. Real-time travel information provided by the system
2. Social networks for peer-to-peer travel information (messages)
3. Feedback based on self-monitoring of own travel behaviour
4. Feedback based on setting targets
5. Challenges (using points without an exchange value)
6. Challenges (using points with an exchange value)
7. Social networks for sharing location and/or mobility profile
8. Social networks for finding a buddy
9. Social networks for treasure hunt

Assessments on these incentives against the criteria aforementioned are summarised in Table 5-1.

Criteria	**Real-time travel info**		**Feedback and self-monitoring**		**Rewards and points**		**Social networks**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
User cases	Med	Low	High	High	Med	Med	Med	Low	Low
System goals	Med	Low	High	High	Med	High	Med	Low	Low
System services	Low	Low	Med	Med	High	High	Low	Low	Med
Innovative aspects	Low	Low	High	High	Med	Med	High	Med	High
Technical easiness	Low	High	Med	Med	Med	Med	High	High	Med
Overall rating	**Low**	**Low**	**High**	**High**	**Med**	**High**	**High**	**Low**	**Low**

Table 5-2 Relative rating of individual incentives against the criteria used for comparisons (Table 4-5).

Our analysis shows that the incentives are among the highly ranked with respect to the overall success of SUNSET are Incentive 3 (Feedback based on self-monitoring of own travel behaviour), Incentive 4 (Feedback based on setting targets), incentive 5 (Challenges (using points without an exchange value)), Incentive 6 (Challenges (using points with an exchange value)) and Incentive 7 (Social networks for sharing location and/or mobility profile). Majority of these incentives are implemented in the tripzoom system and available to living lab users. The reason why incentive 6 is not implemented in tripzoom has already been discussed in previous sections of this deliverable. The exception of incentive 4 is because a main aim of SUNSET is to provide a social environment to offer sustainable social networking services for transport, allowing users to set their personal targets seems somewhat disjunction from this project aim. We therefore have decided to put emphasis on achieving shared targets rather than personal targets.

6. References

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