Original

AECOM

STUDY ON

KEY PERFORMANCE INDICATORS FOR INTELLIGENT TRANSPORT SYSTEMS

Final Report

IN SUPPORT OF THE IMPLEMENTATION OF THE EU LEGISLATIVE FRAMEWORK ON ITS (DIRECTIVE 2010/40/EU)

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Executive Summary

Introduction

This study was commissioned by DG MOVE to establish a set of common Key Performance Indicators (KPIs) for road transport Intelligent Transport Systems (ITS), with supporting guidance on their application, presentation and reporting. Interim objectives of the study included undertaking a state of the art review of KPIs relating to ITS, with a particular focus on the type, method of calculation, terminology used and approaches and how these vary between Member States.

Approach Used

The study process commenced with a state of the art review of current degree of application of KPIs within the EU, as well as reviewing examples of good practices through a review of publically available data sets. The findings from this process were augmented through a stakeholder questionnaire, which identified additional KPIs currently in use within the EU, as well as adding valuable insight into the data sources used, terminologies and the key barriers currently limiting the benchmarking of ITS within the EU.

These stages of the project facilitated the identification of an emerging long list of KPIs covering the range of ITS in use within the EU. This list was consulted on as part of a stakeholder workshop and a 'homework pack' for those unable to attend the workshop in person. This provided valuable feedback from European ITS experts on the emerging long list of indicators, which informed the development of a recommended shortlist.

Study Findings

The initial state of the art review identified 228 indicators in use within the EU related to ITS, although the quality of these was varied and a number were considered to fall short of true KPIs. These KPIs were categorised into either deployment; relating to the implementation of ITS, or benefits; relating to the impacts of ITS. It also identified significant variations in the level of KPI use between different EU Member States, highlighting the challenge in establishing KPIs suitable for all Member States.

The stakeholder questionnaire identified valuable information about the data sources currently in use, including the availability and use of system generated data, which offers the opportunity for easy and cheap access to viable data to inform future KPIs.

As part of the questionnaire views were also provided on the barriers currently preventing the measurement of ITS performance and benchmarking, with harmonised KPIs considered an important solution to allow performance assessment.

The state of the art review and stakeholder questionnaire findings were used by a panel of AECOM experts in informing an emerging long list of 38 KPIs which were presented to stakeholders at a workshop and as part of an associated homework exercise for those unable to attend in person. These events provided useful insight into the views of ITS experts on the emerging long list and a voting exercise was undertaken to establish preferences. A final analysis process was then undertaken to prioritise and modify KPIs using the above findings and consultation feedback to inform the development of a shortlist.

The identified KPI shortlist of 15 KPIs achieves a relatively even balance between benefit (7 KPIs) and deployment (8 KPIs). The recommended list also seeks to achieve an appropriate balance between the different ITS priority areas of the ITS Action Plan[1] and ITS Directive and wider EU policy goals.

The Shortlist

The recommended KPI shortlist is presented below:

Recommended Deployment KPIs

- Length and % of transport / road network covered by websites/over-the-air services offering traffic and travel information. Report separately:

  1) Travel information
  2) Traffic information
  3) Integrated traffic and travel information
  3) Freight specific information

  Report separately by road type or area where possible

[1] http://ec.europa.eu/transport/themes/its/road/action_plan/

- Number and % of urban public transport stops for which dynamic traveller information is made available to the public. Report separately by public transport mode where possible.
- Length and % of road network covered by the following. Report separately:

  1) Information gathering infrastructures
  2) Traffic information services
  3) Traffic management plan(s) incl. cross border TMP
  4) Traffic management and control measures / equipment
  5) Infrastructure or equipment on the network to enable Cooperative-ITS
  6) Intelligent safety services for disabled and vulnerable road users

  Report separately by road type or area where possible.
- Number and % of signal controlled road intersections using adaptive traffic control or prioritisation. Report separately by road type or area where possible.
- Length and % of road network covered by incident detection and incident management. Report separately by road type or area where possible.
- Length and % of road network covered by automated speed detection. Report separately by road type or area where possible.
- Provision of intelligent services on the TENT-T core and comprehensive networks that are compliant with the Delegated Regulations of the ITS Directive:

  1) Length and % of TEN-T network covered by real-time traffic information services that are compliant with the requirements of Delegated Regulation xx/2015
  2) Length and % of TEN-T network covered by road safety related traffic information services available free of charge to users that are compliant with the requirements of Delegated Regulation 886/2013
  3) Length and % of TEN-T network covered by information services for safe and secure parking places for trucks and commercial vehicles that are compliant with the requirements of Delegated Regulation 885/2013.
- Number and % of new vehicles including the following intelligent vehicle features:

  1) Safety readiness
  2) Automated operation
  3) Cooperative systems
  4) Public (112) systems
  5) Private eCall systems

Report separately by vehicle types where possible

Recommended Benefit KPIs

- % change in peak hour journey time along routes where ITS has been implemented. Report by vehicle type where possible.
- % change in peak hour traffic flow along routes where ITS has been implemented. Report by vehicle type where possible.
- % change in journey time variability on routes where ITS has been implemented -as measured by coefficient of variation. Report by vehicle type where possible.
- % change in mode share on corridors where ITS has been implemented. Report percentage mode share separately for each mode.
- % change in number of reported accidents along routes where ITS has been implemented. Report by accident severity where possible.
- % change in annual CO2 emissions (Tons) on routes where ITS has been implemented.
- Time taken between initiation of public (112) eCall to the presentation of the content of MSD in an intelligible way at the operator's desk in the Public Safety Answering Point.

Synthèse

Introduction

Cette étude a été commandée par la Direction Générale Mobilité et Transports (DG MOVE) afin d'établir un ensemble d'Indicateurs communs de Performance (KPI) appliqués au transport routier. Cette étude proposera également des recommandations sur l'application, le suivi et la présentation de ces indicateurs. L'étude s'est appuyée sur un état de l'art des indicateurs relatifs aux Systèmes de Transport Intelligents (STI), avec un accent particulier sur le type d'indicateurs, leur méthode de calcul, la terminologie associée, les approches utilisées et leurs variations entre les États membres de l'Union Européenne (UE).

Approche

L'étude a commencé par un état de l'art du degré actuel d'application des KPI au sein de l'UE et une analyse des exemples de bonnes pratiques à travers l'examen des documents et données accessibles au public. Les résultats de ce processus ont été complétés par un questionnaire soumis aux parties prenantes. Le questionnaire a permis d'identifier des KPI supplémentaires actuellement utilisés au sein de l'UE et de collecter des renseignements précieux sur les sources de données utilisées, les terminologies associées et les principaux obstacles qui, à l'heure actuelle, limitent l'analyse comparative des STI et de leur impact au sein de l'UE.

Ces étapes du projet ont permis l'identification d'une longue liste d'indicateurs de performance couvrant la gamme des STI déployés au sein de l'UE. Les parties prenantes ont été consultées sur cette liste lors d'un atelier et par écrit pour ceux n'ayant pu assister à l'atelier. La consultation des experts européens a fourni de précieux commentaires sur cette longue liste d'indicateurs et ainsi permis de développer une liste réduite d'indicateurs recommandés.

Conclusions de l'étude

L'état de l'art initial a permis d'identifier 228 indicateurs liés aux STI au sein de l'UE. Cependant, la qualité de ces indicateurs est variable et certains d'entre eux ne correspondent pas à de véritables indicateurs de performance. Ces KPI ont été classés en deux catégories selon qu'il s'agissait d'indicateurs de déploiement des STI, ou d'indicateurs relatifs aux impacts des STI. L'analyse a également fait émerger des variations importantes dans le niveau d'utilisation des KPI entre les différents États membres de l'UE. Ceci souligne la difficulté de définir des indicateurs communs de performances appropriés pour l'ensemble des États membres.

Le questionnaire soumis aux parties prenantes a permis de collecter des informations précieuses sur les sources de données utiles à l'établissement et au calcul des KPI; par exemple la disponibilité et l'utilisation de données directement générées par les systèmes intelligents, permettant ainsi une collecte facile et peu coûteuse de données pouvant contribuer au développement de futurs KPI.

Dans le cadre du questionnaire, les opinions sur les obstacles à la mesure de la performance et l'analyse comparative des STI ont également été fournies, indiquant que l'harmonisation des KPI est considérée comme une solution pouvant permettre l'évaluation de la performance des STI.

Les résultats de l'état de l'art et l'analyse des réponses au questionnaire ont été utilisés par AECOM pour développer une liste réduite de 38 indicateurs communs de performance ensuite soumise pour discussion et avis aux parties prenantes lors d'un atelier et via une consultation écrite pour les experts ne pouvant participer à l'atelier. Ces activités ont fourni un aperçu utile des opinions des experts STI sur la liste émergente et leurs préférences ont été établies grâce à un vote. Une analyse finale a ensuite été entreprise afin d'établir des priorités et modifier les KPI sur la base des conclusions du processus ci-dessus. Une liste réduite d'indicateurs recommandés a finalement été produite.

Les 15 KPI retenus dans cette liste réduite présentent un équilibre entre les indicateurs d'impacts (7 KPI) et les indicateurs de déploiement (8 KPI). La liste d'indicateurs recommandés vise également à atteindre un équilibre entre les différents domaines et actions prioritaires du Plan d'Action européen sur les STI et de la Directive Européenne pour le

déploiement des STI d'une part[2], et les objectifs politiques européens d'autre part.

La liste des KPI recommandés

La liste des KPI recommandés est présentée ci-dessous:

KPI de déploiement:

- Longueur et % du réseau de transport / réseau routier couvert par les sites Web / technologies mobiles offrant des services d'information sur le trafic routier et sur les déplacements (à renseigner séparément):

  1) Services d'information sur les déplacements
  2) Services d'information sur le trafic routier
  3) Services d'information intégrés sur le trafic routier et les déplacements
  4) Services d'information spécifiques pour le transport de marchandises

  Dans la mesure du possible, renseigner chacun séparément par type de route ou zone géographique.

- Nombre et % d'arrêts de transport public urbain pour lesquels l'information dynamique des voyageurs est accessible au public. Dans la mesure du possible, renseigner séparément chaque mode de transport public.

- Longueur et % du réseau routier couvert par les services suivants (à renseigner séparément) :

  1) Infrastructures de collecte de données
  2) Services d'information sur le trafic routier
  3) Plan(s) de gestion de la circulation (y compris plans de gestion de la circulation transfrontalière)
  4) Mesures et équipements de gestion et de contrôle du trafic routier
  5) Infrastructures ou équipements permettant la communication entre les véhicules et l'infrastructure
  6) Services de sécurité intelligents pour usagers vulnérables

  Dans la mesure du possible, renseigner chacun séparément par type de route ou zone géographique.

- Nombre et % d'intersections routières contrôlées à l'aide de signalisation utilisant des systèmes adaptatifs de régulation ou priorisation du trafic. À signaler séparément par type de route ou de zone, là où possible.

- Longueur et % du réseau routier couvert par des systèmes de détection des incidents et de gestion des incidents. À renseigner séparément par type de route ou zone géographique, dans la mesure du possible.

- Longueur et % du réseau routier couvert par des systèmes de détection automatique de vitesse. À renseigner séparément par type de route ou zone géographique, dans la mesure du possible. Fourniture de services STI sur le réseau de transport transeuropéen (RTE-T) conformément aux dispositions des règlements délégués de la Directive STI :

  1) Longueur et % du réseau RTE-T couvert par des services d'information sur le trafic routier en temps réel conformes aux exigences du règlement délégué xx/2015.
  2) Longueur et % du réseau RTE-T couvert par des services d'information sur la circulation liés à la sécurité routière, disponibles gratuitement aux usages de la route et conformes aux exigences du règlement délégué 886/2013.
  3) Longueur et % du réseau RTE-T couvert par des services d'information sur les zones de stationnement sûres et sécurisées pour les camions et les véhicules commerciaux, conformes aux exigences du règlement délégué 885/2013.

- Nombre et % des nouveaux véhicules, dotés des équipements suivants:

2 http://ec.europa.eu/transport/themes/its/road/action_plan/

1) Systèmes de sécurité et d'aide à la conduite
2) Systèmes d'automatisation de la conduite
3) Systèmes coopératifs
4) Systèmes d'appel d'urgence publics (eCall 112)
5) Systèmes d'appel d'urgence privés (TPS-eCall)

À renseigner séparément par catégorie de véhicule, dans la mesure du possible.

KPI d'impact:

- Variation en % du temps de parcours, en heure de pointe, le long des itinéraires où des STI ont été mis en place. À renseigner par catégorie de véhicule si possible.
- Variation en % du flux de trafic, en heure de pointe, le long des itinéraires où des STI ont été mis en place. À renseigner par catégorie de véhicule si possible.
- Variation en % de la variabilité du temps de parcours (coefficient de variation) le long des itinéraires où des STI ont été mis en place. À renseigner par catégorie de véhicule si possible.
- Variation en % de part modale le long des corridors où des STI ont été mis en place. À renseigner par séparément pour chaque mode de transport.
- Variation en % du nombre d'accidents signalés le long des itinéraires où des STI ont été mis en place. À renseigner par gravité de l'accident, si possible.
- Variation en % des émissions annuelles de CO_2 (tonnes) le long des itinéraires où des STI ont été mis en place.
- Temps nécessaire entre l'émission d'un appel d'urgence public (eCall 112) et la réception du set minimal de données par l'opérateur du centre de réception des appels d'urgence.

1 Introduction

1 Introduction

1.1 Introduction

Directorate General for Mobility and Transport (DG MOVE) of the European Commission engaged AECOM to carry out a Study on Key Performance Indicators (KPIs) for Intelligent Transport Systems (ITS). This Final Report outlines the process that AECOM has utilised to establish current levels of KPI use, consult with industry experts and establish a set of recommended KPIs for implementation within and across the EU. The objectives of the study as a whole were:

- To undertake a state of the art review of KPIs relating to Intelligent Transport Systems, with particular focus on the type, method of calculation, terminology used and approaches and how these vary between Member States; and
- To define/recommend a set of common KPIs for road transport, with supporting guidance on their application, presentation and reporting.

As defined in the study Terms of Reference, the work is to provide the Commission with a recommended set of KPIs that can be adopted across the European Union. It is recognised that significant investment has been made into ITS, although the approaches developed for monitoring have remained fragmented, with little pan-European consolidation. As such, this study has built upon this existing evidence base, incorporating a review and assessment of the scope, rigor and relevance of indicators already adopted.

In developing a set of common KPIs consideration was given to achieving a balance between KPIs to deliver a minimum standard and KPIs to support future investment and deployment. Consideration has also been given to the future developments in ITS, ensuring that the recommended KPIs remain relevant for the foreseeable future.

The primary focus of this study is ITS for road transport. However, it is recognised that many ITS incorporate elements of multi-modality, for example the provision of public transport information to promote modal integration. Multi-modal KPIs have therefore been considered where relevant.

1.2 Study Overview

An Inception Report was produced in June 2014 which outlined the revised methodology for the study following the study kick off meeting on the 10th June. This document provided an initial gap analysis of the state of the art review as well as confirming the taxonomy of ITS that would be used in the study to classify ITS and the developing KPIs. The proposed structure for stakeholder consultation activities was also presented.

Following completion of the inception phase of the study a state of the art review has been completed utilising publically available datasets to gain insight into current levels of KPIs for ITS within the EU.

To gain a wider understanding of the current state of the art within the EU a stakeholder survey was undertaken in July 2014. The results of the survey and state of the art review were reported as part of the Interim Report produced in November 2014.

A stakeholder workshop was also undertaken in November 2014, gaining greater insight into the barriers currently limiting KPI use within the EU. An emerging long list of KPIs was presented and discussed at this event and detailed feedback received. This exercise was augmented by way of a 'homework pack' containing the workshop exercises for completion by key stakeholders unable to attend the workshop in person.

The findings from the above stakeholder survey, workshop and homework pack exercises were summarised as part of the Consultation Report produced in January 2015.

The findings from the above work were used in the detailed analysis of the long list of candidate KPIs, informing the recommended shortlist of KPIs presented herein.

1.3 Structure of Final Report

This report contains four sections and is structured as follows:

- Section 1: Introduction;
- Section 2: Approach and Methodology;
- Section 3: Study Findings; and
- Section 4: Recommended KPIs.

2. Approach and Methodology

2 Approach and Methodology

2.1 Introduction

This section outlines the approach and methods adopted on this study to establish a suitable short list of recommended KPIs for adoption within the EU. As outlined in the invitation to tender the approach utilised consisted of five tasks:

- Task 1: A **State of the Art review** of current KPI use within the EU and beyond, based upon publically available data sources.
- Task 2: A **questionnaire survey** undertaken with Member States and key industry experts to ascertain existing levels of KPI use and views on the issues surrounding development of appropriate ITS KPIs.
- Task 3: The above activities allowed the **establishment of an emerging long list of KPIs** upon which consultation could be undertaken.
- Task 4: A **stakeholder workshop** was undertaken to gain views on the emerging long list of KPIs and to provide additional qualitative detail around the key trends identified in the questionnaire survey. This exercise was augmented by way of a comparable '**homework pack' exercise** for completion by those unable to attend the workshop in person.
- Task 5: The findings from the above tasks were fed into an **analysis process** which determined a recommended shortlist of KPIs. A set of pro-forma were produced for these KPIs to provide the detail needed to allow Member States to implement the recommendations.

The methodology adopted for each of the above study tasks is presented below.

2.2 Task 1: State of the Art Review

A state of the art review was undertaken to provide a comprehensive and robust statement of the ITS KPIs currently being utilised across the 28 EU Member States. Where sufficient data was available it also considered the differing methods of calculation, terminology and approaches used to the development and implementation of KPIs between Member States.

The 2008 ITS Action Plan[3] and 2010 ITS Directive[4] established a clear framework for the technological development and deployment of road transport ITS. The focus of the review was on the deployment and effects (benefits) of ITS; the development of ITS is not directly within the scope of this work. The review also considered multi-modal ITS deployment and benefits.

The objectives of the State of the Art Review are to:

- Identify the use of KPIs on deployment and effects of ITS across the EU28
- Identify the use of KPIs on deployment and effects of ITS across the 6 priority areas of the ITS Action Plan
- Identify existing data sources used in generating KPIs
- Identify any ownership and privacy issues associated with data sources
- Identify the potential cost of data collection/collation

Our methodology for the state of the art review consisted of three sub-tasks:

- Task 1.1: Confirming and agreeing the taxonomy of ITS;
- Task 1.2: Systematic evidence search;
- Task 1.3: Synthesis of findings.

Each of these sub-tasks is presented in turn below.

[3] European Commission (2008) *ITS Action Plan*

[4] European Commission (2010) *Directive 2010/40/EU on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport*

Task 1.1: Define ITS Taxonomy

Defining an agreed (hierarchical) taxonomy of ITS was central to complete an efficient and effective state of the art review. We utilised the 2DECIDE[5] ITS services structure as the starting point of our classification.

Following a review of the 2DECIDE ITS services structure, utilising our professional judgement and knowledge of ITS deployment within the EU28 and feedback from DG MOVE, we identified a modified taxonomy (Table 2.1 overleaf).

This table maps the 2DECIDE categories against the four ITS Directive priority areas and is also in line with PIARC ITS handbook[6]. As with the 2DECIDE structure a number of levels are also identified which classify ITS services with increasing levels of detail, from level 0, representing the ITS Directive priority areas, through to level 4. For the purposes of defining where each KPI sits within this taxonomy we have recorded the Level 2 system within the state of the art database. This allowed for both an aggregation to Level 1 and 0 within the analysis, and the consideration of Level 3 and 4 systems. Mapping the defined KPIs against Level 2 of the taxonomy allowed an assessment of ITS coverage to be undertaken. A central challenge in defining common KPIs was ensuring sufficient and proportionate coverage across the ITS deployment areas.

The taxonomy as set out in Table 2.1 provided a level of detail suitable for the collection and collation of the state of the art database of existing KPIs.

A classification of Member States was also required to ensure that the review considered a representative sample of ITS. AECOM's experience from the Easyway[7] evaluation expert group was that evidence on ITS performance management was heavily skewed towards Northern and Western Europe. Particular consideration was therefore given to obtaining data from the more Southern and Eastern Member States.

A classification of EU Member States was therefore developed to consider the geographic location of each Member State within the EU, as well as how recently it joined; separating out the original EU15 countries, the EU25 countries and the EU28 Member States which joined subsequent to this (Table 2.2). This approach also reflected the working assumption that ITS maturity may be more advanced in the EU15 than in more recent members.

Table 2.2: Classification of EU Member States

	EU Status	Area
Austria	EU15	Central
Belgium	EU15	Western
Bulgaria	EU28	Eastern
Croatia	EU28	Southern
Cyprus	EU25	Southern
Czech Republic	EU25	Central
Denmark	EU15	Northern
Estonia	EU25	Northern
Finland	EU15	Northern
France	EU15	Western
Germany	EU15	Central
Greece	EU15	Southern
Hungary	EU25	Central
Ireland	EU15	Western
Italy	EU15	Southern
Latvia	EU25	Northern
Lithuania	EU25	Northern
Luxembourg	EU15	Western
Malta	EU25	Southern
Netherlands	EU15	Western
Poland	EU25	Central
Portugal	EU15	Southern
Romania	EU28	Eastern
Slovakia	EU25	Central
Slovenia	EU25	Central
Spain	EU15	Southern
Sweden	EU15	Northern
United Kingdom	EU15	Western

[5] http://www.2decide.eu/

[6] PIARC (2011) *Handbook on Intelligent Transport Systems*

[7] http://www.easyway-its.eu/

Table 2.1: Taxonomy of ITS

Level 0	Level 1	Level 2	Level 3	Level 4
Optimal Use of road traffic and travel data	Public Transport services	Public Transport Management		
		Demand Responsive and Shared Transport		
		Public Transport (Integrated) Electronic Payment		Smart card
		Communication Systems		
	Traveller Information Services	Pre-trip traffic & travel Information	Internet Journey Planning and phone line	Trip Planning Support / Journey assistance
			Smart phones based Journey Planning	
			TV/Radio	
			Kiosks pages	
			Social Media / Social Data functions	
		On-Trip traffic & travel Information	Mobile Internet/Wireless page	
			Radio	
			Roadside variable Message Signs	
			Public transport & multi-modal information displays	
			In-vehicle Systems / navigation and route guidance	
			Social Media / Social Data functions	
Continuity of traffic and freight management ITS Services	Freight Transport Management	Commercial Vehicle Pre-Clearance		
		Commercial Vehicle Administrative Services		
		Management of Dangerous Freight		
	Transport-related Electronic Payment services / Tolling	Transport-related Electronic Financial Transactions		
		Integration of Transport Related Electronic Payment Services		
	Traffic Management and Operations Services	Traffic Management and Control	Traffic Flow Control	Dynamic lane management
				Ramp metering
				Travel guidance using variable message signs (VMS)
				Co-ordinated traffic management
				Traffic management for specific vehicles (dangerous, wide loads)
			Adaptive Traffic Control at Intersections	
			Parking Facilities management	
		Information Infrastructures	Traffic monitoring	
			Weather monitoring	

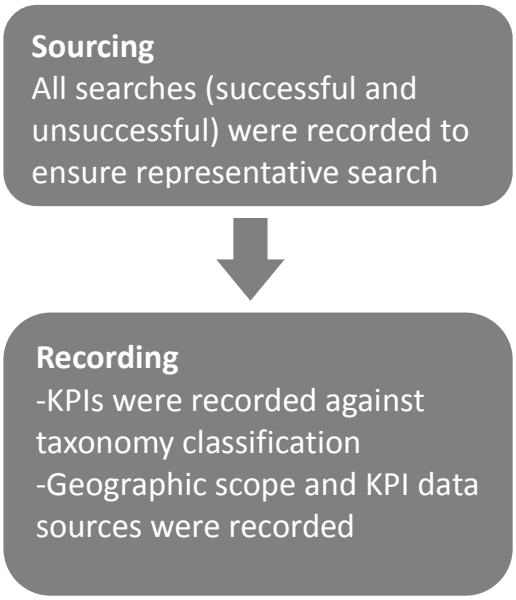
Level 0	Level 1	Level 2	Level 3	Level 4
			Environmental Conditions Monitoring	
			Traffic Information centres	(Real Time) Traffic Information Services
			Traffic Control Centres (TCC)	
			Planning and forecasting traffic conditions	
		Incident Management		
		Demand Management		
		Transport Infrastructure Maintenance Management		
		Policing/Enforcement		Weigh in Motion
				Speed Enforcement
ITS road safety and security applications	Emergency Services	Transport Related Emergency Notification and Personal Security	eCall	
		Emergency Vehicle Management		
		Hazardous Materials and Incident Notification		
	Road Transport Related Personal & Freight Transport Safety	Public Travel Security		
		Safety Enhancements for Vulnerable Road Users		
		Safety Enhancements for Disabled Road Users		
		Safety Provisions for Pedestrians Using Intelligent Junctions and Links		
		Commercial Vehicles Secure parking (Information & Reservations)		
		Road Safety Related Traffic Information		
	Disaster Response Management and Coordination Services	Disaster Data Management		
		Disaster Response Management		
		Coordination with Emergency Agencies		
	Driver Assistance & Vehicle Control	Safety Readiness	Driver impairment	Alcohol Interlock
			Intelligent vehicle safety systems or eSafety systems	Adaptive Headlights
				Local Danger Warnings
				Collision avoidance
				Lane keeping
			Vision Enhancement	Blind spot monitoring
			Speed control (including ISA, Intelligent Speed Adaptation)	
Linking the vehicle with the transport infrastructure	Intelligent Vehicle Services	Automated Vehicle Operation	Platooning	
		Co-operative Systems	Vehicle 2 Vehicle	
			Vehicle 2 Infrastructure	
			Vehicle 2 X	
			Value-Added services	

Task 1.2: Systematic Review

Identification of KPIs

To ensure our approach to the sourcing, recording and processing of KPI information across the EU Member States was of suitable breadth and depth to capture the range of KPI information required we utilised a structured process for recording our activities and decision making processes. Figure 2.1 indicates the key stages of this process, with these detailed further in subsequent paragraphs.

Figure 2.1: KPI Identification Process



Sourcing Information

We utilised a combination of electronic, print and 'grey' (non-published) literature sources of information to ensure that as comprehensive as possible a review was completed. We used a combination of the following review approaches:

- Electronic database searching;
- Searching of specialist ITS websites (EASYWAY, QUANTIS, 2DECIDE etc); and
- Using general search engines on the internet such as 'Google' and 'Google scholar'.

The review also considered examples of best practice from international documents where monitoring of ITS deployment and benefits is well developed, such as the United States.

To ensure our sample of source information was as representative as possible we maintained a log of our search criteria, whether these resulted in the identification of an appropriate KPI source or not (see Table 2.3). This log contains information on the key words used in the search and the type of search undertaken (see types in above bullets). Using this log we monitored the number of searches being made by ITS taxonomy class (as shown in Table 2.1) to ensure we achieved a sample which was as representative as possible. This log also acted as an input document register to record all documents reviewed, their contents, relevance and location of the saved or filed document.

Table 2.3: Search Log

Database column	Description
Search Method	The method used (e.g. google search)
Search Terms	The terms used within the search
Source within scope?	Whether the above search identified a source suitable for this study
URL of results	The URL of the search results (if appropriate)
Report Title	The title of the identified source report
Comments	General information about the search results
Country	The country or countries to which the results relate

It was identified that the EASYWAY initiative[8], a European Commission project with the core objective of fostering the deployment of interoperable Europe-wide ITS core services, was a particularly rich source of KPI information. A significant number of projects were funded by the EU as part of this initiative, with

[8] http://www.easyway-its.eu/

evaluation reports produced for each project as a mandatory part of the EU scheme funding. Due to the scale of information available a systematic approach was used to the review of these evaluation documents:

- First, a stratified sample was taken to ensure a representative review of reports from each geographic area of Europe; and
- Secondly, the differing quality of KPI information across comparable EASYWAY projects was assessed. In this instance the most prevalent type of ITS funded by EASYWAY was identified as Dynamic Lane Management/Hard Shoulder Running. A sample of projects relating to this ITS category was reviewed to identify differences in KPI type and quality.

Task 1.3: Synthesis of Findings

Recording Information

A data collection template was used to record the relevant taxonomy service, Member State and detailed KPI (plus supporting indicators/data, see Table 2.4) for each KPI. All sources of evidence and data relating to ITS KPIs were coded to record how and why each source will be used as part of this study. This included the nature of the ITS being reported, the characteristics and purpose of the study/report used and a commentary on the type and robustness of research method adopted.

Supplementary Information

To supplement the KPI information obtained through publically available data sources the results of the questionnaire survey (discussed later in this methodology) were analysed for additional sources of information that could augment the state of the art review. This analysis consisted of two key tasks:

- The identification of KPI information within the provided survey responses; and
- The identification of additional sources of information as part of survey responses that could be interrogated to identify additional KPI information.

The findings from the state of the art review are discussed in Section 3 of this report.

Table 2.4: KPI Log

Database Column	Description
ITS Taxonomy Definition	Which classification from the taxonomy does the KPI relate to
Country	The EU28 Member States that the KPI relates to
KPI Description	A detailed description of the identified KPI
KPI Type	Does the KPI relate to the deployment or benefits of ITS?
KPI: Supporting indicators	Any additional indicators that are required to build up the KPI, e.g. Km of network in a given Member State or km covered by sensors.
Method of Calculation	Details of how the KPI is calculated
Data Requirements	The data required to develop each KPI
Data Ownership	Who owns the data required to calculate the KPI?
Data Privacy	Are there any privacy issues associated with the required data?
Geographic Scope	Is the KPI applicable nationwide? Key cities or locations? Trunk roads or urban? Etc.

2.3 Task 2: Stakeholder Questionnaire

This section presents an overview of the first stage of stakeholder consultation undertaken as part of this study utilising an on-line questionnaire survey.

Stakeholder engagement and consultation is essential to the successful outcome of this study, in order to:

- Ensure that the best possible view of the current state of the art is captured by the study to support the analysis;
- Enable stakeholders to provide input to the KPI development process, in particular where they have existing experience of ITS KPIs and indicators that can be used in developing the study; and
- Provide a mechanism for stakeholders to engage with the proposed approach to take the KPIs forward into use.

The following objectives were defined for the stakeholder questionnaire:

- Identify the use of KPIs across the EU28
- Identify the use of KPIs across the range of stakeholder groups/types
- Identify the use of KPIs across the 6 Priority Areas of the ITS Action Plan
- Identify existing data sources used in generating KPIs
- Identify gaps in KPIs and data sources
- Identify the perceived adequacy/scope/rigor of KPIs
- Identify constraints/barriers to the adoption of KPIs
- Identify issues of cross border cooperation and integration
- Request information on KPIs and performance assessment/data that are not in the public domain
- Identify new technologies that are being/will be deployed that could support data collection and performance measurement

The key tasks undertaken as part of the questionnaire task included:

- Task 2.1: Questionnaire Design;
- Task 2.2: Stakeholder List;
- Task 2.3: Questionnaire Distribution; and
- Task 2.4: Data Cleaning and Checking.

The methodology used for each of these tasks is detailed below.

Task 2.1: Questionnaire Design

Given the importance of the stakeholder questionnaire in ensuring a comprehensive consultation is achieved, an initial activity during the inception period was the definition of a draft outline questionnaire structure. The questionnaire was based on addressing the objectives defined above, and undertaken in parallel to defining data collection tools for the state of the art review. This structure was agreed with the client as part of the Inception Report and ensured that the questionnaire design would appropriately complement the state of the art.

Following the completion of the initial high level state of the art review, the questions and structure of the questionnaire were prepared by AECOM in close consultation with DG MOVE.

Each question and section was reviewed by the Project Manager, a member of the ITS team and our Social and Market Research leader, to assess the wording, flow and structure. Question routing, instructions for completion of different question types and the language used were reviewed to ensure that the survey was easy to complete for stakeholders from across the EU28.

Table 2.5 provides an outline of the questionnaire structure and the question topics within it. The full questionnaire can be found in Appendix A of this Final Report.

Table 2.5: Outline Questionnaire Structure

Theme Area	Question Topics
About you/your organization	Type of organization represented
	Country(ies) of operation
	Type of network ITS activities are focused on
	Types of ITS involved/interested in
Data collection	Information (data/metrics/indicators) used to monitor the extent of ITS deployment
	Information (data/metrics/indicators) used to monitor the extent of ITS performance
	Usefulness of information and rationale
	Purpose of information
	Datasets and sources used
	Collection frequency of data
	How long is data kept
	Is data published
	Privacy issues preventing publication
	Types of performance monitoring published
	Benchmarking against other EU Member States
	Benchmarking against other ITS service providers
	Rating of different facets of data (e.g quality, coverage, consistency)
Evolution of ITS performance monitoring	Importance of monitoring different aspects of performance
	Aspirations for additional monitoring
	Barriers to additional monitoring
	Ways to overcome barriers
	Value of consistent metrics/indicators across Europe

On-line Survey Tool

The survey was published with an online tool, SNAP. SNAP offers a wide functionality to customise the questionnaire and to make it look attractive; both were key features in achieving a good response rate. SNAP also facilitated good survey 'routing' allowing respondents to answer the questions relevant to them, again promoting a high response rate. Another advantage of using SNAP was that the data was available for analysis immediately.

Task 2.2: Stakeholder List

Approximately 1500 European experts in the field of ITS based upon a series of contact lists held by DG MOVE were sent the finalised questionnaire, including the Member State Task Force and contacts from other European Commission services.

Task 2.3: Questionnaire Distribution

It was agreed at the Kick-off meeting that DG MOVE would distribute a link to the online survey to the ITS mailing list and other DG MOVE contacts.

In preparation for this, AECOM developed a covering email inviting participation in the survey, including information on the process to be undertaken and deadline for survey completion. This covered the following:

- The provision of information describing the context, scope and objectives of the consultation;
- A clear and concise description of the ITS issues for discussion;
- The contact details of an AECOM team member; and
- The deadline for submission of the questionnaire.

The survey was approved for use by AECOM and DG MOVE on the 31st July and distributed by DG MOVE on the 18th August, with a deadline for survey responses by the 30th September (approx. 6 weeks). During early September, a reminder was issued to encourage the completion of the questionnaire.

A PDF version of the questionnaire was also made available upon request to allow stakeholders to complete offline or circulate internally to formulate responses. The response rate and key findings from

the questionnaire are discussed in Section 3 of this report.

Task 2.4: Data Cleaning and Checking

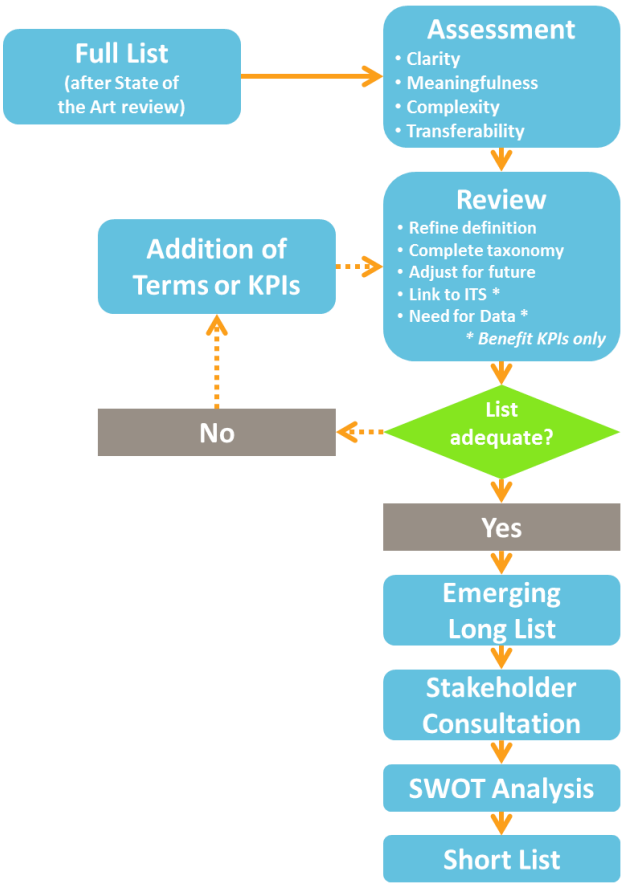
A data cleaning and checking process was carried out in accordance with AECOMs quality assurance procedures, meeting the requirements of the UK Market Research Society (MRS) rules and standards. To avoid errors at the point of data entry a number of routing, range and logic checks were built into the online survey programme. Open ended questions were inspected and coded according to an agreed coding frame. Further consistency checks were conducted as part of the production of frequency counts and basic tabulations for each question to check for any extreme values or potential logic errors.

2.4 Task 3: Development of Emerging Long List

Following the state of the art review and stakeholder questionnaire a process was developed to use the findings from these activities in the development of an emerging long list of KPIs, to be presented to the stakeholder workshop in Brussels (discussed later in this methodology).

Figure 2.2 provides a schematic representation of the methodology used in the development of this emerging long list and the subsequent short list.

Figure 2.2: Short-listing Methodology Summary



Once the full KPI list was finalised as part of the state of the art review, an assessment exercise was undertaken. All KPIs were given a score – between 1 (poor) and 5 (good) – against the following criteria:

- Clarity, defined as the ability to easily understand the KPI;
- Meaningfulness, focusing on whether the KPI can be clearly interpreted into appropriate actions by decision makers;
- Complexity, referring to the easiness in undertaking the relevant calculations to estimate the KPI; and
- Transferability, judging the availability of the data required to calculate the KPI across Member States.

Examples of the scoring methodology against the above criteria for a high and a low scoring KPI are provided in Tables 2.6 and 2.7.

Table 2.6: High scoring KPI example

Number of websites and portals for Traveller information	
Clarity	Very clearly defined; not allowing contradicting interpretations
Meaningfulness	Very easy to compare performance and very clear on further actions needed to improve it if underperforming against benchmark (i.e. need to install more counting stations)
Complexity	Very easy to calculate; a simple count of sites/portals
Transferability	Easy to transfer across member-states as they are expected to be able to provide supporting data
1	2 3 4 5

The total score for each KPI was the sum of the scores across the individual criteria. KPIs were subsequently ranked based on their scoring performance and mapped against Level 2 of the taxonomy (please consult Table 2.1 for taxonomy definition).

The next step in the process of deriving the KPI long list involved an exercise of removing duplicate KPIs and merging functionally similar ones into a single indicator. Following this process, a qualitative review by a panel of AECOM experts was undertaken. This review focused on:

- Refining the definition of the KPIs to avoid ambiguities and potential misinterpretations across projects or Member States;
- Checking the KPIs against the corresponding taxonomy and identifying additional KPIs to fill gaps in the taxonomy; and
- Pre-empting advances in technology that could render the KPIs impractical or redundant in the future.

At the same time, the panel was aware of the challenges in linking the KPIs with ITS equipment and services as well as associated policies and objectives, and the data required to estimate each KPI, especially for benefit KPIs. In an effort to make realistic and adoptable recommendations the process was iterative, each time adding either terms or new KPIs so as to meet the criteria above.

The identified KPI long list is discussed in Section 3 of this report.

Table 2.7: Low scoring KPI example

Reliability index*	
Clarity	Not clearly defined; allowing different opinions in interpretation
Meaningfulness	Very easy to compare performance but not clear on further actions to be taken to improve it, if underperforming against benchmark
Complexity	Very complex to calculate; including large operator summations across matrices
Transferability	Difficult to transfer across Members States as extensive data is required and not all Member States are expected to be able to provide them
1	2 3 4 5

* An index designed to assess delays, waiting times, number of stops, interchanges, missed connections, red light times

2.5 Task 4: Stakeholder Workshop

The purpose of the stakeholder workshop was to gain greater insight into the views of key stakeholders on the above discussed emerging long list of proposed KPIs.

The following objectives of the stakeholder workshop were defined during AECOMs initial internal briefing discussions:

- Provide an overview of the study activities and findings to date;
- Present the emerging common KPIs;
- Identify any additional KPIs that have not been defined during either the state of the art or stakeholder consultation;
- Discuss the barriers and constraints to the application of common KPIs; and
- Support the mapping of common KPIs, and supporting indicators, including refinement of terminology.

Task 4.1: Workshop Attendance

DG MOVE prepared a list of key stakeholders to target for attendance at the workshop and subsequently distributed invitations to the agreed list of stakeholders. The workshop took place on the 5th of November 2014 at the European Commission premises in Brussels. The event was attended by 21 delegates representing different Member States, ITS service providers and individual experts within the field of ITS, plus European Commission members of staff.

Task 4.2: Workshop Structure

The event consisted of an initial presentation outlining the purpose of the study. The agenda and full presentation given at the workshop are shown in Appendix C. It was followed by an open discussion of the role of KPIs with respect to ITS policy framework, at which attendees discussed their experiences to date in the application of KPIs within the field of ITS.

The main focus of the day subsequently consisted of two facilitated breakout discussions. These breakout discussions allowed delegates to consider the strengths and weaknesses of a subsection of the emerging long list of KPIs, identify gaps within the coverage of KPIs or amendments that could be made to improve the identified KPIs. The discussions also included the barriers and challenges to the adoption of common KPIs.

Following the individual breakout sessions a voting exercise was undertaken. Delegates were given time to consider the full emerging long list of KPIs, as well as the comments provided by breakout groups and any additional KPIs identified. Each workshop delegate was then given 10 voting stickers to 'spend' on any of the emerging long list KPIs, or additional KPIs identified during the course of the day. These stickers could be placed all on one KPI or across a range of KPIs at their discretion. This provided useful insight into the views of delegates as to the type of KPIs most suitable for recommendation, taking account of the strength, weakness and barriers discussions held earlier in the day.

A plenary session then followed, summarising the findings from the breakout sessions and the emerging key patterns identified in the voting. The day was concluded with a brief overview of the next steps in the study process.

Task 4.3: Homework Pack

In addition to the stakeholder workshop a 'homework pack' exercise was undertaken to gain further insight from experts within the field of ITS. The homework pack contained the same exercises as those undertaken at the workshop and was sent out to the organisations/individuals who could not attend the stakeholder workshop in Brussels in person.

The homework pack included the presentation given at the workshop event as well as additional slides summarising the findings from the workshop and providing instructions on the tasks required, see Appendix F. Participants also received a spreadsheet whereby they could vote on their preferred KPIs, comment on the strengths and weaknesses of identified KPIs and identify additional KPIs. These comments are outlined in Appendix G.

2.6 Task 5: Analysis Process

The workshop and homework pack provided a significant amount of feedback on the emerging long list of KPIs including amendments to KPIs, additional KPI suggestions and comments on the strengths and weaknesses of the KPIs identified. This information, as well as the combined scores from the workshop and homework pack voting exercises were aggregated together into a spreadsheet and used initially to refine the identified KPIs based upon the feedback received. The comments received and KPIs scores were also used in informing which KPIs should be shortlisted. This process identified a series of KPIs which appeared viable and well received by stakeholders. An assessment was made of how this list corresponded against the taxonomy and ITS Priority areas, helping to ensure good coverage was achieved across the taxonomy classifications and policy goals.

A SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis was also undertaken to further refine and optimise the list of KPI recommendations to maximise the strengths of the KPIs, utilising opportunities where possible, whilst limiting the weaknesses and threats presented by the KPIs. This process helped to ensure that the recommended KPI shortlist was substantiated.

All of this information was used in informing which KPIs to recommend for inclusion in the shortlist, outlined in Section 4 of this report. Details of the information used in informing the short listing process are outline in Appendix H.

A series of pro-formas was then developed to provide practitioners with a suitable level of details to allow them to implement the recommended KPIs. Table 2.9 provides an overview of the criteria contained within this pro-forma.

Table 2.9: Shortlist KPI Pro-forma Template

KPI Details	
Reference Number	
Short Name	
Long Name	
Definition	
Calculation	
Presentation	
SWOT Analysis	
Strengths	
Weaknesses	
Opportunities	
Threats	
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	
Constraints in aggregation to EU level	
Road Type	
Data Requirements	
Source	
Ownership	
Frequency	

2.7 Methodology Summary

This section has outlined the data collection and analysis processes utilised in establishing a short list of KPIs recommended for implementation. This was based upon existing levels of KPI use within the field of ITS, as established during the state of the art review and stakeholder questionnaire, views expressed during the stakeholder questionnaire and workshop and the comments received on the emerging long list of KPIs during the stakeholder workshop and homework pack. The key findings from each of these exercises are discussed in Section 3, with the recommended shortlist of KPIs presented in Section 4 of the report.

3. Study Findings

3 Study Findings

3.1 Introduction

Section 2 of this report outlined the methodology used throughout this study to bring together the evidence to inform the recommendation of a short list of KPIs for implementation within the EU. This section outlines the key findings from the activities described previously, providing the evidence that has been used to define the recommendations outlined in section 4 of the report. This section considers the key findings from each stage of the process, considering in turn:

Task 1: The State of the Art Review

Task 2: The Questionnaire Survey

Task 3: The Emerging Long List

Task 4: The Stakeholder Workshop and Homework Pack Exercise

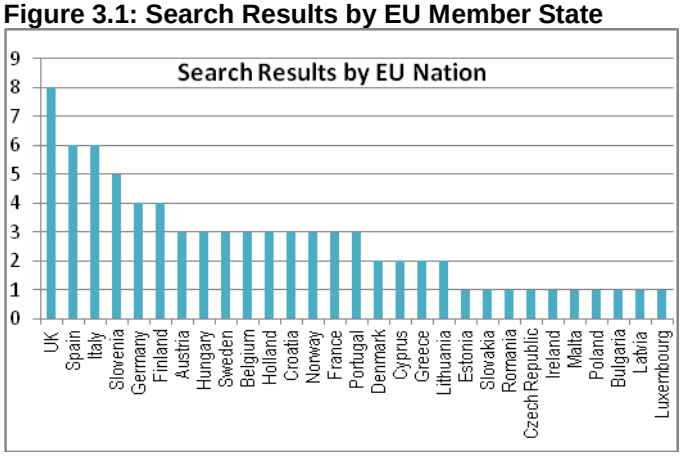
Task 5: The Analysis Process

3.2 Task 1: The State of the Art Review

Searches

An initial task was to ensure that the searches undertaken to identify KPIs were done in a systematic way, to ensure a representative sample of information from across the EU. Figure 3.1 shows the number of search results achieved by EU nations. The number of searches totals to 78 and shows that the highest level of search results was achieved for the UK, Spain and Italy.

Figure 3.1: Search Results by EU Member State



NB – this excludes non country specific searches which brought up a number of the identified KPIs

Search results were achieved for all EU Member States, however not all of these searches identified viable KPI information.

Table 3.1 categorises the search results based upon when countries joined the EU, as well as the geographic area the country is located within. The analysis shows that the largest overall number of search results was achieved for EU15, with Southern, Western and Central European countries bringing up the largest number of results. When these values are factored to take account of the number of countries within each classification it shows that EU15 brought up the most search results per country, with Southern Europe exceeding the search results of Western Europe, and with Eastern Europe having the lowest level of results. It is important to take account of these skews in the search results when considering the wider state of the art conclusions.

Table 3.1: Search results by EU Status and Geographic Area

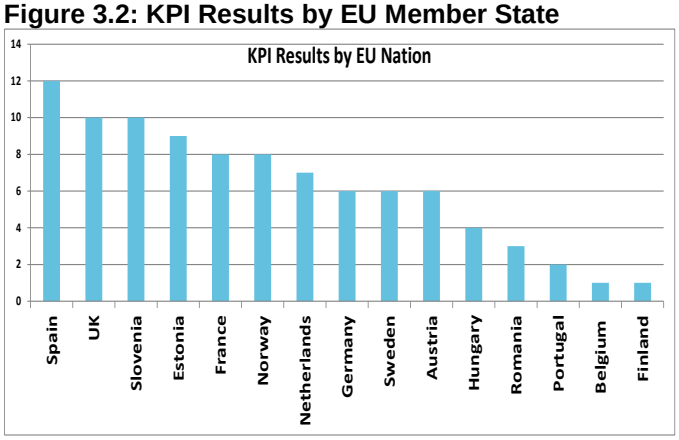
EU Status /Area	Countries in classification	Search results	No. per country
EU15	15	52	3.5
EU25	10	18	1.8
EU28	3	5	1.7
Western	6	19	3.2
Eastern	2	2	1.0
Southern	7	23	3.3
Central	8	19	2.4
Northern	7	16	2.3

NB – this excludes non country specific searches which brought up a number of the identified KPIs – results also include Norway.

KPI Coverage

The methodology as outlined in Section 2 identified 228 KPIs. Further analysis was undertaken to establish the coverage of the sample of KPIs identified. Figure 3.2 indicates the number of KPIs identified by EU Member State. It indicates that Spain, the UK and Slovenia had the highest number of KPIs, with a number of countries having no publically available KPI information in English. Other EU28 countries that are not shown within the graph recorded zero KPIs.

Figure 3.2: KPI Results by EU Member State



NB – this excludes non country specific searches which brought up a number of the identified KPIs – results also include Norway.

Figure 3.3 presents this information graphically and highlights the geographic split in KPI results towards the west of Europe.

Figure 3.3: KPI Results by EU Member State

Further analysis was undertaken to establish the number of KPIs identified by geographic area within Europe and when each country joined the EU. This showed that the EU15 Member States contained the largest number of KPIs, followed by the EU25 (Table 3.2). Geographically, Western Europe had the most KPIs followed by Central Europe. When these results were adjusted to take account of the number of countries within each classification the EU15 and Western Europe had significantly higher levels of KPIs per country than other parts of Europe.

Table 3.2: KPI results by EU Status and Geographic Area

EU Status /Area	No. Countries in classification	No. KPIs identified	No. per country	No. per country per search result
EU15	15	56	3.7	1.1
EU25	10	25	2.5	1.4
EU28	3	6	2.0	1.2
Western	5	28	5.6	1.6
Eastern	2	6	3.0	3.0
Southern	7	14	2.0	0.6
Central	8	26	3.3	1.4
Northern	6	13	2.2	0.9

NB – this excludes non country specific searches which brought up a number of the identified KPIs – results also include Norway.

The results were then compared against the number of search results that they stem from, which identified that the EU25 and Eastern European countries were most highly represented considering the number of searches identified. Southern Europe and the EU15 Member States were least well represented by this metric. This indicates that whilst the EU15 and Western European countries may have the most KPIs identified this may be a result of higher levels of publication of this information. It is important to bear these considerations in mind when considering the wider findings of the state of the art review.

KPIs by Type

Analysis was undertaken to establish the types of KPIs identified as part of the state of the art review. An initial assessment was undertaken of the breakdown of the identified 228 KPIs based on whether they related to the deployment of ITS (i.e. the number or scale of ITS implementation) or the benefits (such as journey time reliability or increased safety) resulting from that ITS implementation. Table 3.3 shows that the number of benefit related KPIs exceeded deployment related ones, accounting for 61% of the identified KPIs.

Table 3.3: Identified KPIs by KPI Type

KPI Type	Total	%
Benefit	139	61%
Deployment	89	39%
Grand Total	228	

The identified KPIs were broken down further to consider how they relate to the ITS Directive Priorities in Table 3.4.

Table 3.4: KPI results by ITS Directive Priority Area

Directive Priority areas	Total	%
Optimal Use of road traffic and travel data	32	14%
Continuity of traffic and freight management ITS Services	131	57%
ITS road safety and security applications	19	8%
Linking the vehicle with the transport infrastructure	19	8%
Others	27	12%
Grand Total	228	

Table 3.4 indicates that continuity of traffic and freight management ITS Services make up the majority of the identified KPIs (131), followed by optimal use of road traffic and travel data (32). Fewer KPIs (19) were identified relating to each of the road safety and security application and linking the vehicle with the transport infrastructure priority areas.

The identified KPIs were also classified against the ITS Taxonomy (previously presented in Table 2.1), as shown in Table 3.5. This classification was focused around Level 2 of the taxonomy, but for certain KPIs it was necessary to classify using Level 1.

Table 3.5: KPIs by Taxonomy Level 2 Grouping

ITS Taxonomy Definition	Total	%
Traffic Management and Control	59	25.9%
Information Infrastructures	47	20.6%
Co-operative Systems	19	8.3%
Various	13	5.7%
Travel Services Information	10	4.4%
Public Transport Management	9	3.9%
On-Trip traffic & travel Information	8	3.5%
Public Travel Security	8	3.5%
Disaster Response Management	7	3.1%
Freight Transport Management	7	3.1%
Policing/Enforcement	7	3.1%
Road Transport Related Personal & Freight Transport Safety (from Taxonomy Level 1)	6	2.6%
Incident Management	5	2.2%
Transport Infrastructure Maintenance Management	4	1.8%
Transport-related Electronic Financial Transactions	4	1.8%
Pre-Trip traffic & travel Information	4	1.8%
Management of Dangerous Freight	3	1.3%
Intelligent Truck Parking	2	0.9%
Emergency Vehicle Management	2	0.9%
Safety Readiness	2	0.9%
Intelligent Vehicle Services (from Taxonomy Level 1)	1	0.4%
Demand Responsive and Shared Transport	1	0.4%
Grand Total	228	

It shows that Traffic Management and Control represented the largest category of the identified KPIs, representing 22% of the total identified KPIs. No KPIs were identified for instance for Coordination with Emergency Agencies, Automated Vehicle Operation and Public Transport Electronic Payment.

Data Sources Used in Generating KPIs

As part of the recording of KPIs we also reviewed information regarding the data sources used in generating the KPIs. Generally the source documents used in ascertaining KPI information contained very little or no information on the precise data sources required to calculate the KPI values. Table 3.6 indicates the key data sources where this could be identified. It indicates that traffic counts, either automated or manual represented the largest source of data used in generating KPIs. Surveys of users of the system were also highly prevalent, followed by data generated by the ITS systems themselves.

Table 3.6: Identified KPIs by Data Source

Data Source	Total
Traffic Counts	14
User Surveys	9
Systems data	7
Accident Data	3
Investment Costs	2
Police Records	2
Journey Time Data	2
Incident Logs	1
Tachographs	1
ANPR Cameras	1
Sales data	1
Hospital Records	1

NB – In most instances no information on data sources was provided.

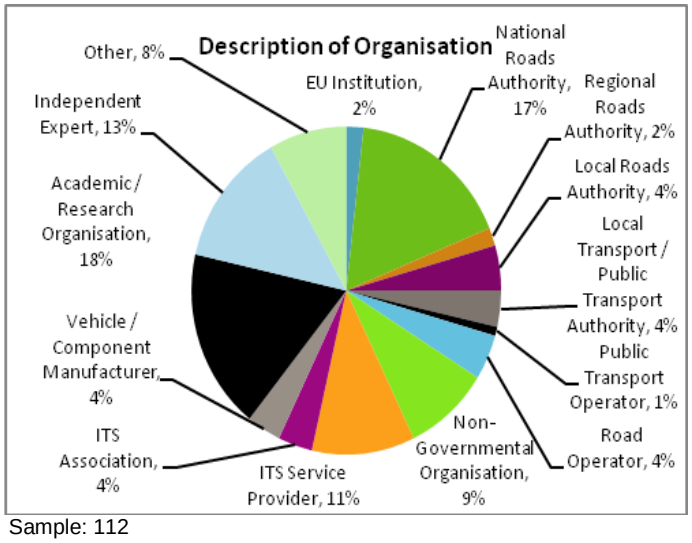
State of the Art Summary

Through the state of the art review the study team identified 228 indicators. Of this number, 39% were focusing on deployment and 61% on the impacts of ITS. Analysis of country specific KPIs suggested that 64% were referring to the older EU Member States (EU15), whilst 36% to the newer (EU28). In terms of data sources, incompleteness of the information available did not permit a thorough assessment exercise, however the questionnaire survey discussed overleaf adds additional details in this area.

3.3 The Stakeholder Questionnaire

The methodology adopted for the stakeholder questionnaire is outlined in Section 2 of this report. In total 110 responses to the questionnaire were received. Initial analysis was undertaken to establish whether a representative sample had been achieved. Figure 3.4 shows a categorisation of respondent organisations. The best represented groups were Academic/Research Organisations (18%) and National Roads Authorities (17%), with Independent Experts (13%) and ITS Service Providers (11%) also well represented. Lower levels of response were received from organisations such as public transport operators (1%) and vehicle/component manufacturers (4%).

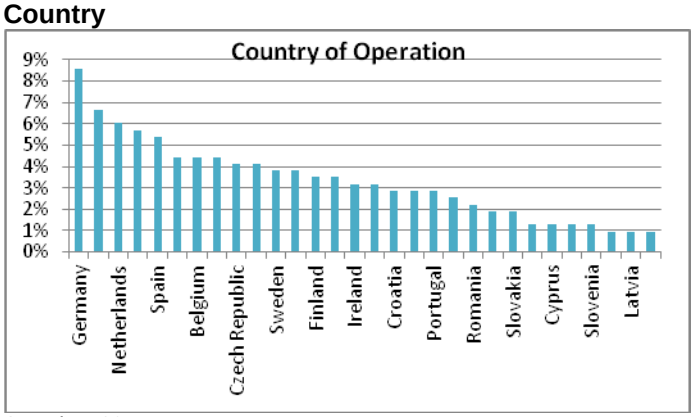
Figure 3.4: Description of Organisation



Sample: 112

Figure 3.5 shows the percentage of responses from across the EU28 countries in descending order. Germany, United Kingdom, Netherlands, France and Spain were the most highly represented countries, making up approximately 32% of the EU total. Meanwhile, Luxembourg, Latvia and Estonia were the least well represented, totalling less than 3%. Figure 3.6 shows this information in map format[9]. It is shown in the mapped results and highlights a west/east divide in levels of responses from Member States. It mirrors the findings from the state of the art review, indicating an east/west split in both levels of KPI use and ITS use in general.

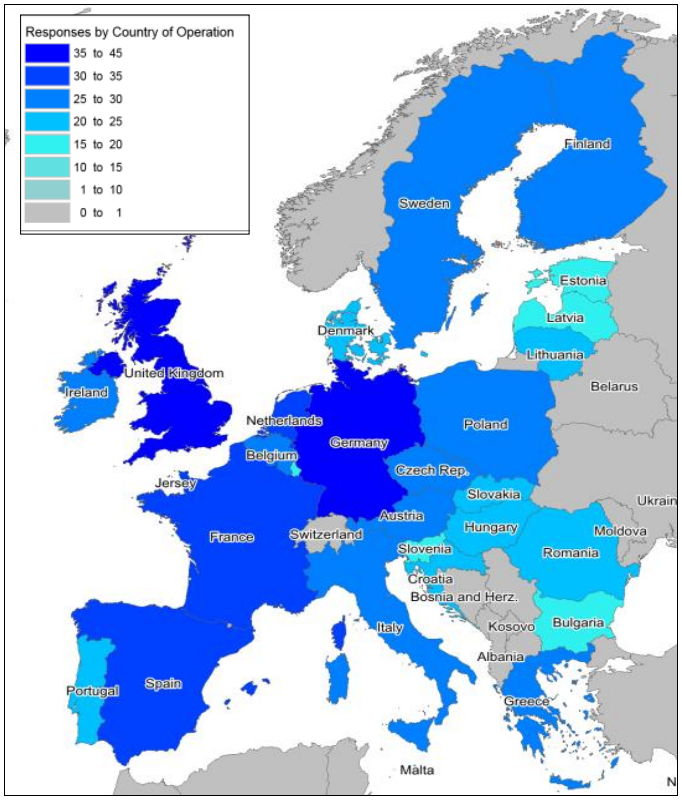
Figure 3.5: Percentage of responses from each Country



Sample: 109

[9] Please note that it was possible for respondents to select more than one country of operation, including selecting all EU countries.

Figure 3.6: Number of respondents operating in Each Country



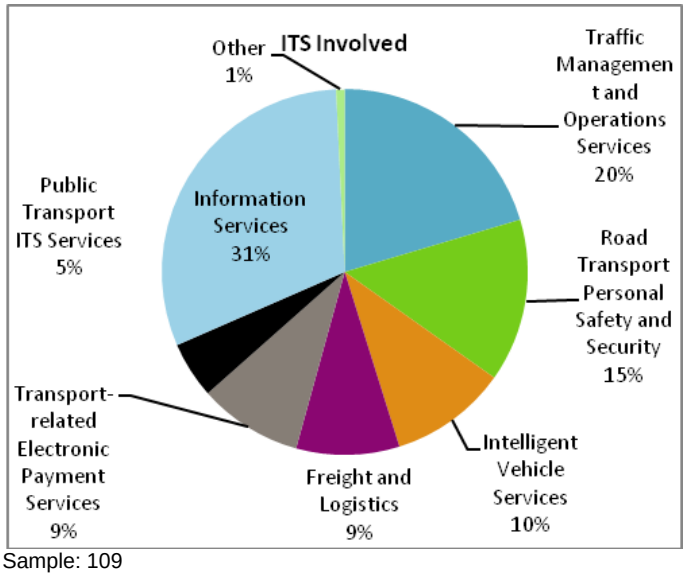
Questionnaire Findings

The following section outlines the key findings from the survey. Please refer to Appendix A for a blank copy of the questionnaire and Appendix B for a summary of results for each question.

ITS Involvement

Figure 3.7 shows the areas of ITS in which respondents indicated an involvement. The question used allowed multiple answers to be selected. The most common area of ITS was Information Services, with 31% of respondents involved in this area of ITS. Traffic Management and Operations (20%) was the next most prevalent, followed by Road Transport Personal Safety and Security (15%). This is well aligned with the findings from the state of the art review, where Traffic Management and Control and Information Infrastructures were the most prevalent groupings of KPIs identified.

Figure 3.7: ITS Involvement

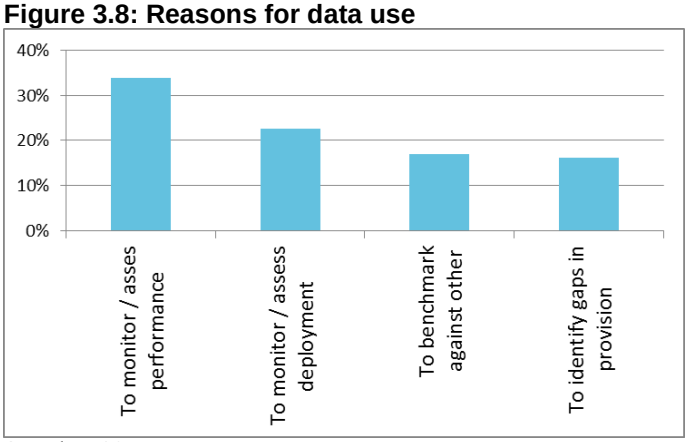


Sample: 109

Reasons for monitoring ITS

Respondents were asked why they undertook data collection. Figure 3.8 indicates that the most prevalent reason was to monitor or assess performance. The deployment of ITS was considered less important, with benchmarking against others and identification of gaps in provision being also important considerations. The bias towards benefits, rather than deployment of ITS mirrors the findings from the state of the art review, where benefit KPIs were more prevalent than deployment ones.

Figure 3.8: Reasons for data use

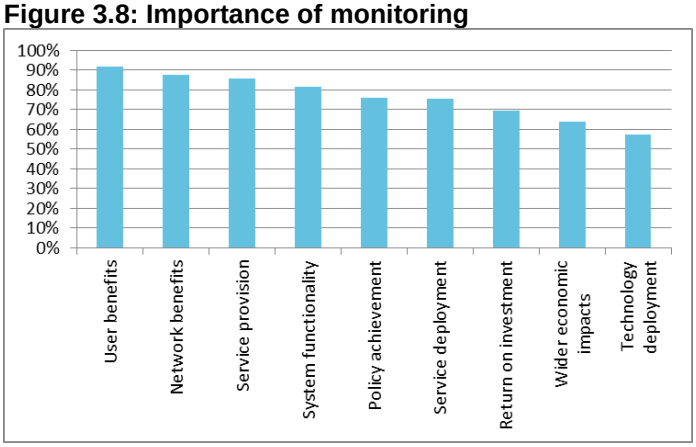


Sample: 106

Importance of and barriers to monitoring ITS

Figure 3.8 outlines the views of respondents on the importance of monitoring different aspects of ITS. Respondents indicated that user and network benefits were considered the most important areas for monitoring, with technology deployment and wider economic benefits the least important aspects, although all facets included within the question were considered important by more than 50% of respondents.

Figure 3.8: Importance of monitoring

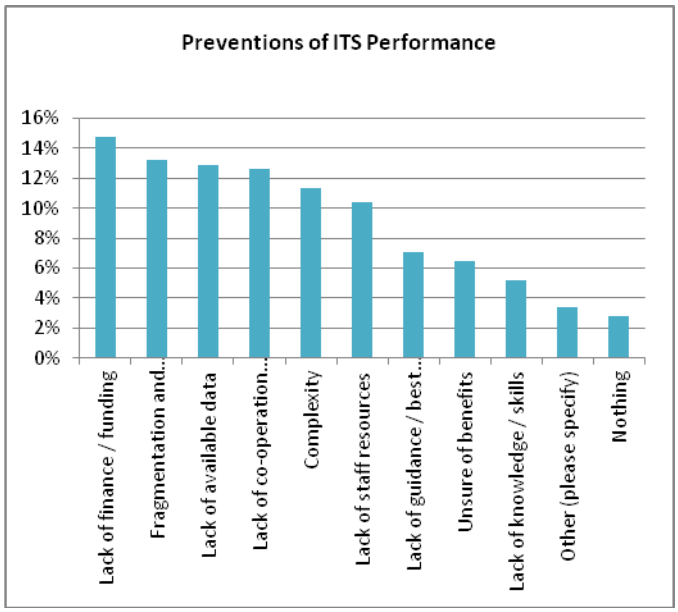


Sample: 103

These results provide an indication that benefit KPIs may be more important than deployment KPIs for those surveyed.

A follow on question asked respondents to indicate what the barriers were to the monitoring of ITS performance, benefits and deployment. Figure 3.9 highlights the main barriers to the measurement of ITS as being the lack of finance and funding along with the fragmentation and incompatibility of data, lack of available data and lack of cooperation with other stakeholders.

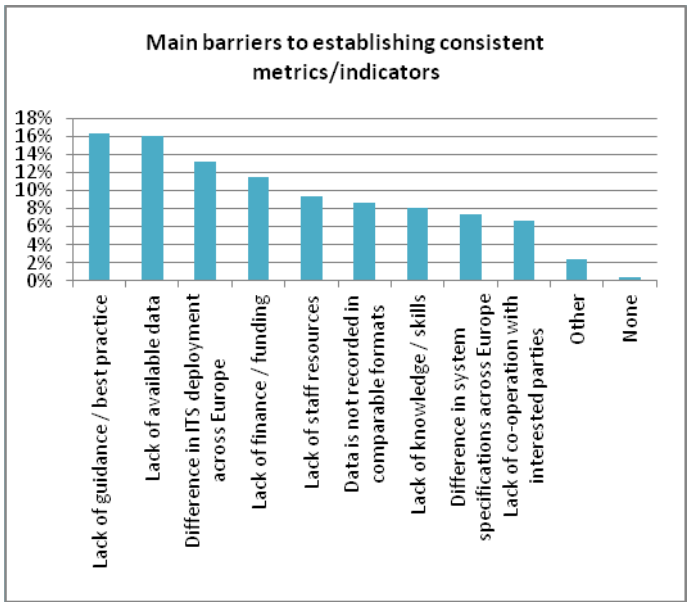
Figure 3.9: Preventions of measuring ITS Performance



Sample: 105

Figure 3.10 highlights the main factors preventing the establishment of consistent metrics/indicators. The top two barriers were noted to be a lack of guidance/best practice and lack of available data. The findings from this study should assist with providing additional guidance and evidence of best practice in this respect.

Figure 3.10: Main barriers to establishing consistent metrics/indicators



Sample: 104

Sources of Data

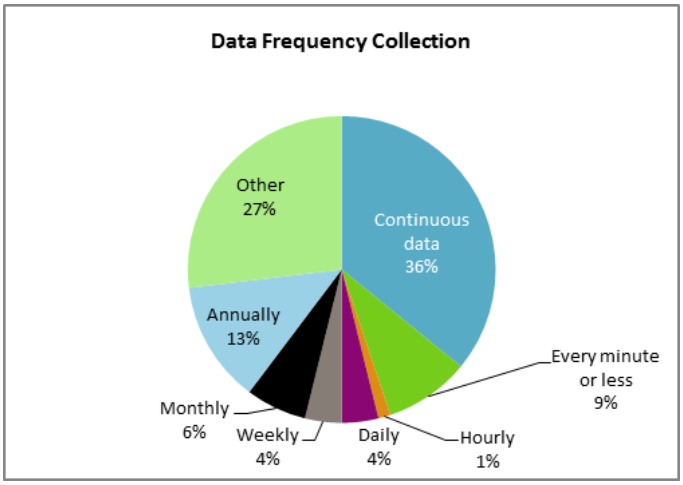
Table 3.7 summarises the sources of data that respondents use/require in adopting KPIs. A large proportion of respondents use data collected directly through ITS systems (29%), with traffic counts (17%) and journey time data (15%) also common. Very few respondents indicated that they use data sources such as Police records, investment costs and sales data (1-2%). The reported use of cooperative systems and social media data was also low, although it is recognised that the former is widely adopted. The latter data source may increase significantly as the associated technologies increase in prevalence, therefore these types of data should not be discounted in considerations of future means of data collection. The data sources indicated by questionnaire respondents closely matched those inferred from the state of the art review and highlight the focus identified towards monitoring the benefits of ITS, rather than its deployment.

Table 3.7: Data Sources of the KPIs

Data Source	Frequency	%
Systems Data	57	29%
Traffic Counts	33	17%
Journey Time Data	29	15%
User Surveys	18	9%
Tachographs	16	8%
Accident Data	14	7%
Incident Logs	9	5%
Automatic Number Plate Recognition Cameras	6	3%
Passenger/People Counts	4	2%
Police Records	3	2%
Sales data	2	1%
Cooperative systems / social media	2	1%
Investment Costs	1	1%
Hospital Records	1	1%

Figure 3.11 shows how frequently the data used in monitoring ITS deployment or benefits is collected, excluding the 24 respondents who stated it was KPI dependant. 36% of respondents stated that they collect data on a continuous basis, indicating that time series trend analysis may be possible. Only 4% collect data daily or weekly and 6% monthly.

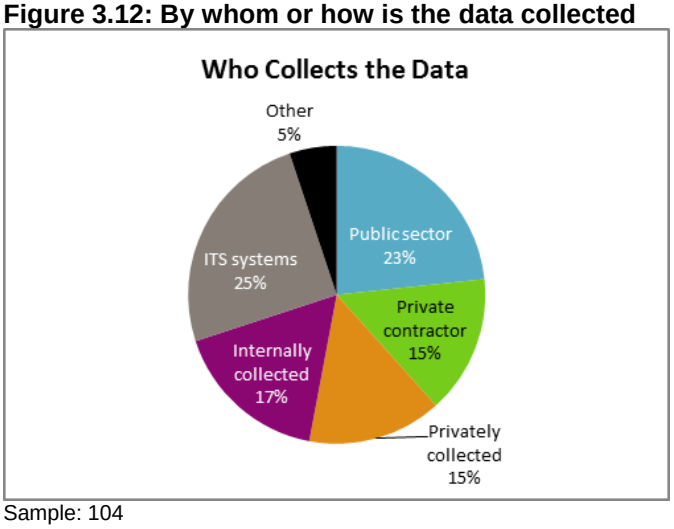
Figure 3.11: Frequency of Data Collection



Sample: 102

Figure 3.12 shows that across all respondents, there was a relatively even distribution of the types of organisation responsible for collecting the data. The largest amount of data is sourced directly from ITS systems (25%). As this information is system-generated it should be available directly at no additional cost to the system operator. Some additional costs are likely to be incurred through the storage, analysis and transmission of ITS generated data. The costs and availability of data may also be dependent upon whether the data was owned by the public or private sector. 30% of the identified data was collected by a private organisation or contractor, indicating possible issues in accessing this information for the public sector.

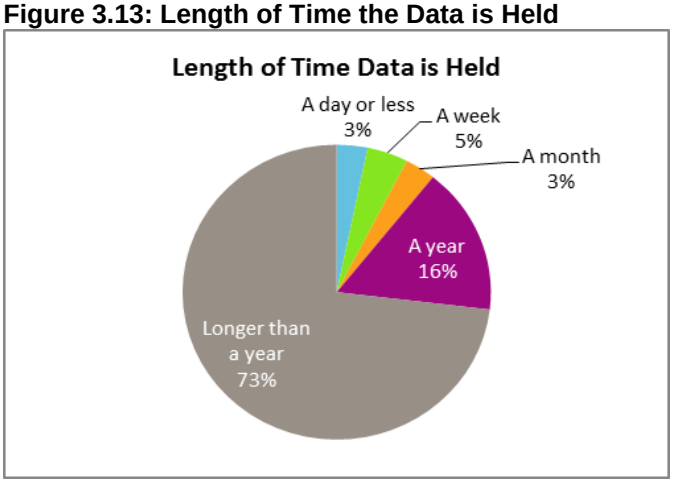
Figure 3.12: By whom or how is the data collected



Sample: 104

Figure 3.13 shows the reported length of time that data is held for. Almost three quarters (73%) of respondents stated that they kept the data collected for in excess of a year; whilst only 3% kept their data for a day or less. This indicates that data is mainly kept for a long enough period to allow annual monitoring of trends to be undertaken. The short retention time for some data may be a reflection of privacy policies or requirements.

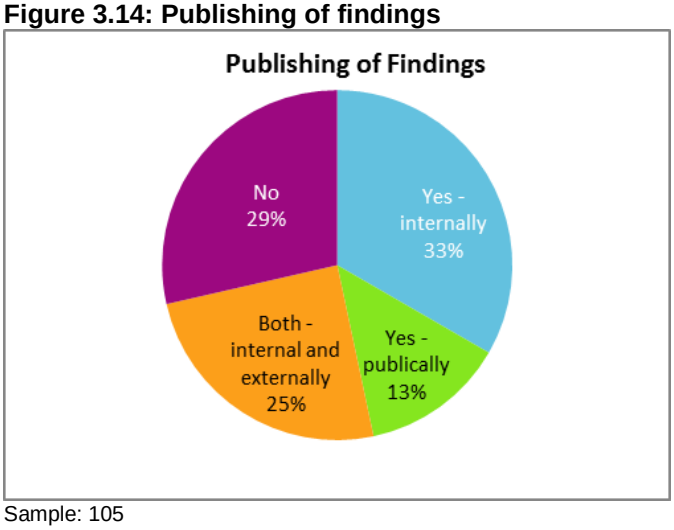
Figure 3.13: Length of Time the Data is Held



Sample: 93

Figure 3.14 highlights whether respondents reported and published the findings of their monitoring of ITS. Currently, 29% of data does not get published with a further 33% only being published internally. Only 38% of the information used to monitor ITS deployment and benefits is available in the public domain. These 38% represent the information that have been identified as part of the state of the art review and highlights the importance of this questionnaire and further stakeholder engagement in ascertaining a wider understanding of KPI use based upon information that currently sits outside of the public domain.

Figure 3.14: Publishing of findings

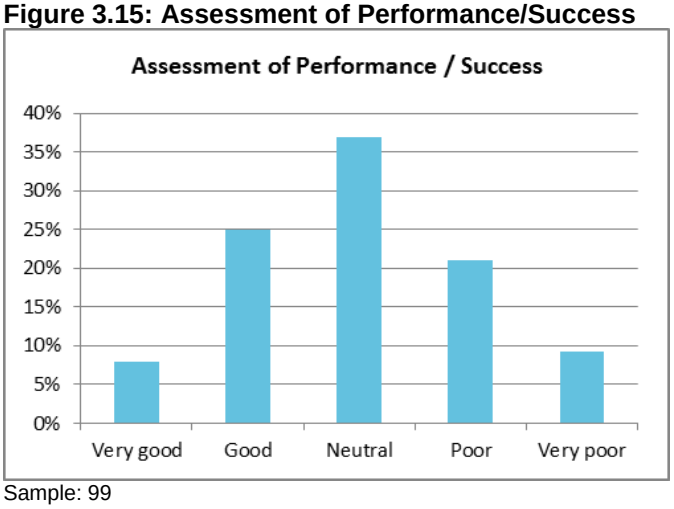


Sample: 105

Data Usage

Figure 3.15 shows how respondents viewed the ability to assess the performance/success of ITS, excluding 23 respondents who stated they did not know. Over 35% rated this as neutral, with only a third feeling that their ability to assess the performance or benefits of ITS was currently good or very good.

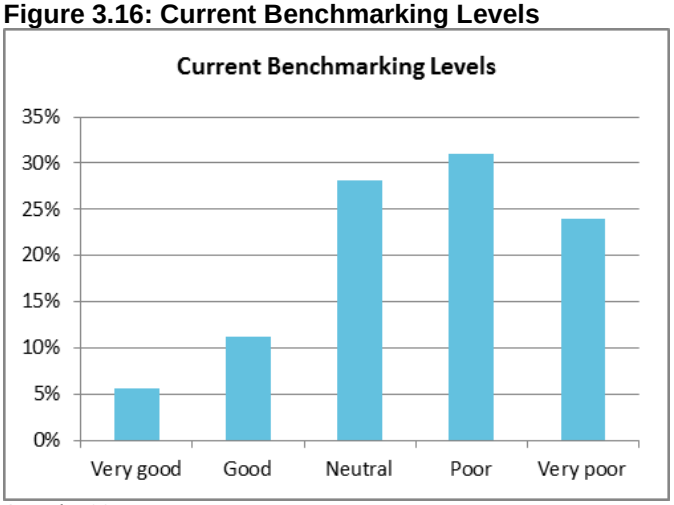
Figure 3.15: Assessment of Performance/Success



Sample: 99

Figure 3.16 shows the ability to benchmark the performance of ITS excluding 27 respondents who did not know. From the skew to the right that is shown in the results, it is clear that the majority of the organisations felt that the ability to benchmark was poor or very poor. This was despite a higher proportion initially considering the quality of their data to be good.

Figure 3.16: Current Benchmarking Levels



Sample: 98

46% of respondents stated that they did benchmark against other Member States, whilst 36% benchmarked against other ITS service providers. This may be a reflection of the data being of a good quality, but not being 'harmonised' across Europe using consistent formats and definitions to allow benchmarking.

Ways to Overcome Barriers

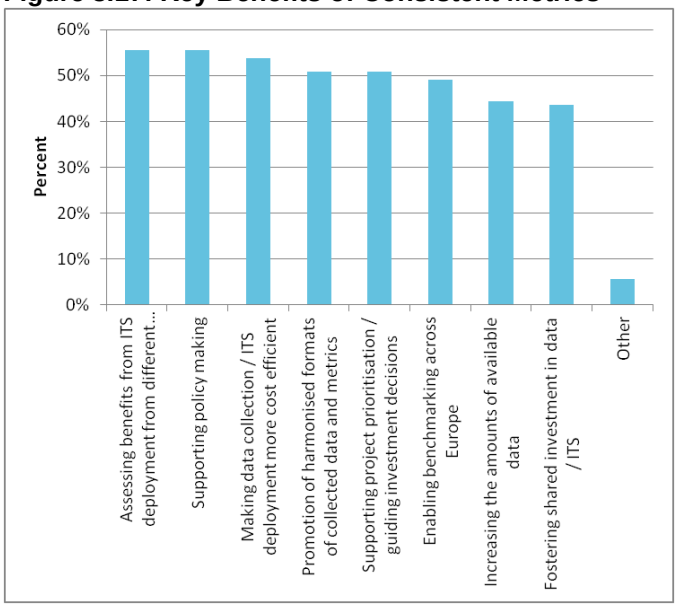
Respondents were asked to provide their own thoughts as to how the barriers to consistent metrics across the EU identified above could be overcome. These responses have been categorised as indicated in table 3.8 below. EU harmonisation was considered to be the most important means of overcoming barriers followed by improved collaboration between organisations involved in ITS. Improved staff resources, shared management and open systems were considered less suitable ways of overcoming the identified barriers.

Table 3.8: Ways to overcome barriers

Ways to overcome Barriers	Frequency
EU Harmonisation	33
Improved Collaboration	16
EU Financial Support	12
Other	11
Common KPIs	9
Development of a National Data Warehouse	7
Higher Engagement	7
Incentives	5
Nothing	3
Market Openness	2
Support in Deployment of New Technologies	2
Unified Coding	1
Advanced Business Models	1
Open Systems	1
Shared Management	1
Improved Staff Resources	1

Figure 3.17 highlights the perceived added value resulting from establishing consistent indicators for measuring performance of ITS across Europe. 'Assessing benefits from ITS deployment from different stakeholder perspectives' and 'supporting policy making' are the two areas that respondents considered would benefit most from consistent metrics; although the differences between all responses was slight.

Figure 3.17: Key Benefits of Consistent Metrics



Sample: 108

Summary of Questionnaire Findings

The questionnaire survey was undertaken to add additional understanding to the current state of the art within the EU in relation to KPI usage in the field of ITS, as well as adding additional details on the kinds of KPI information being used and the data sources available to inform future KPIs.

110 responses were achieved representing a broad range of different individuals and organizations within the field of ITS. Analysis of responses indicates a skew in responses and KPI usage towards the EU15 and Western European countries. This matched the findings identified from the state of the art review in terms of the availability of published data sources.

Results have highlighted that a significant portion of the data used in monitoring performance is system generated, indicating the possibility of cost effective

KPI generation, however there were a variety of opinions on the quality of data and the ability to use the data to monitor performance and deployment.

Key barriers to the establishment of consistent metrics across Europe include the lack of guidance and available data, with EU harmonization and collaboration considered important means of overcoming barriers.

Responses to the questionnaire indicated that a significant portion of KPI and monitoring information respondents use is not made publically available. Consequently, the questionnaire has provided valuable additional details regarding KPI information and emerging technologies, such as cooperative systems, that are not in the public domain and that have helped to inform the emerging long list of KPIs, discussed below.

3.4 Task 3: Identification of an Emerging KPI Long list

The state of the art review and stakeholder questionnaire collectively established a list of 228 KPIs. These included a number of functional duplicates and other 'indicators' which were considered to fall short of being true KPIs for the purpose of this study, for example because they were too technology-specific or just represented a count of a specific type of ITS . An analysis process consisting of an initial scoring exercise, followed by removal of duplicates and consideration by a panel of AECOM experts was undertaken.

This process initially included a scoring assessment of each KPI against the headings of Clarity, Meaningfulness, Complexity and Transferability. Following this the full list was also reviewed to remove any duplicates and merge functionally similar indicators into a single KPI. These processes resulted in a shorter list of 74 KPIs for consideration.

The panel of AECOM experts then considered this list, looking particularly at refining definitions to ensure clear interpretation, full coverage across the taxonomy and future proofing against changing technologies.

Key considerations in establishing this list included ensuring a good balance of coverage across deployment and benefits, reflecting the importance of both types of KPI as identified in the state of the art review and stakeholder questionnaire.

In the development of this list we also mapped out the identified KPIs against the taxonomy and ITS priority areas as shown in table 3.9. This provided a means of ensuring good coverage was achieved across different types of ITS and policy areas.

Where gaps in coverage were identified in the KPIs stemming from the state of the art review and stakeholder questionnaire, additional KPIs were established by the AECOM experts based upon their knowledge of the field of ITS and wider monitoring within the transport sector.

Consideration was also given to how the KPIs were presented to ensure that they are not technology specific and instead are flexible enough to reflect the rapidly changing state of the art within the field of ITS. With this in mind additional KPIs were also identified for areas considered of potential importance in the future, for example the number of near misses (i.e. potential accident) reported by ITS in addition to the number of accidents that occur.

The emerging long list consisted of a total of 38 KPIs and achieved a balance of 58% to 42% between deployment and benefit KPIs. The slightly larger size of the deployment list reflected the need to cover a wide range of different types of ITS, with benefit KPIs more easily applied across a range of ITS implementations within a shorter list of KPIs.

Table 3.9: Breakdown of KPIs by type

	Category	Number of KPIs
Deployment	Optimal use of road traffic and travel data	7
	Continuity of traffic and freight management ITS services	7
	ITS road safety and security applications	6
	Linking the vehicle with the transport infrastructure	2
	Deployment total	**22**
Benefit	Network efficiency and congestion	5
	Improve Environmental Impacts	4
	Improve Road Safety	4
	Enhance Modal Integration	3
	Benefit total	**16**
Overall total		**38**

Emerging Long List

The KPIs comprised in the Long List were categorised as follow. First, they were divided into deployment and benefit KPIs, the former monitoring the extent to which ITS have been installed and/or made available to the public, while the later monitoring their impact on the main aspects of transport (such as journey times, accidents etc.).

Secondly, within these two main categories, a further level of grouping was considered necessary. Deployment KPIs have been grouped according to level 0 of the taxonomy which is aligned with the priorities of the ITS Directive and the EU ITS Action Plan, namely:

- Optimal use of road traffic and travel data
- Continuity of traffic and freight management ITS Services
- ITS road safety and security applications
- Linking the vehicle with the transport infrastructure

Benefits KPIs have been grouped into the following policy categories, as specified in the tender:

- Enhance network efficiency and reduce congestion
- Improve Environmental Impacts
- Improve Road Safety
- Enhance Modal Integration

The Emerging Long List of proposed KPIs as presented at the stakeholder Workshop is presented below:

Deployment KPIs

1. Optimal use of road traffic and travel data
   - % national transport network covered by websites offering comprehensive traveller information (e.g. Journey planning, traffic information)
   - % public transport ticket transactions that utilise electronic payment technologies
   - % public transport stops with dynamic traveller information available to public
   - % TEN-T network covered by traffic advisory radio and/or mobile network reception and offering appropriate information services
   - Number of visits to websites and portals offering traveller information (e.g. journey planning, traffic information)
   - % bus routes equipped with Automatic Vehicle Location
   - % demand responsive vehicles that operate under Computer Aided Dispatch
2. Continuity of traffic and freight management ITS Services
   - % road toll revenue collected by electronic toll collection systems
   - % compliance with the Directive on the interoperability of electronic toll road systems (EETS)
   - % urban intersections controlled using adaptive traffic control
   - % urban public transport network interchanges that are equipped with PT priority signals

- % TEN-T network covered by a minimum level of information infrastructures (e.g. traffic, weather and environmental conditions monitoring, CCTV or traffic information and control centres)
- % TEN-T network with a minimum level of traffic management and control (e.g. Dynamic lane management, ramp metering, VMS)
- Number of intelligent truck parking facilities per km of TEN-T network

3. ITS road safety and security applications
   - % vehicles sold featuring intelligent vehicle services (vision enhancement, safety readiness, automated operation, cooperative systems)
   - % hazardous/abnormal load movements for which ITS has been utilised to facilitate the sharing of information between relevant organisations
   - % emergency vehicle dispatches facilitated by computer aided dispatch
   - % hazardous load movements for which information is logged or monitored using ITS
   - % TEN-T network covered by incident detection and management algorithms
   - % urban intersections providing safety enhancements for pedestrians and disabled or other vulnerable road users
4. Linking the vehicle with the transport infrastructure
   - % TEN-T network supporting cooperative systems (I2V, V2I)
   - % vehicle models currently offered for sale featuring intelligent vehicle services (vision enhancement, safety readiness, automated operation, cooperative systems)

-

Benefits KPIs

1. Network efficiency and congestion
   - Change in peak hour journey time in conjunction with flow between key points along a route (all vehicles)
   - Change in peak hour flow between key points along a route (all vehicles)
   - Public Transport journey time reliability – deviation from scheduled timetable
   - Journey time variability as measured using standard deviation of journey times between key points along a route (all vehicles)
   - Change in Public Transport average daily person flow between key points along a route
2. Improve Environmental Impacts
   - Change in CO2 emissions per vehicle km
   - Change in number of hours where NOx levels are above threshold
   - Change in PM10 emissions per vehicle km
   - Change in number of hours where transport noise is above dB threshold
3. Improve Road Safety
   - Change in number of all reported accidents per vehicle km
   - Change in severity of accidents (i.e. numbers killed or serious injured) per number of accidents reported
   - Number of near misses (potential accidents) recorded by ITS[10]
   - Change in crime reports relating to truck parking
4. Enhance Modal Integration
   - Rail and inland waterway mode share along key corridors (tonne km)
   - Public Transport mode share along key corridors (people)
   - Active travel mode share (people)

[10] Considered as a possible future KPI if ITS systems in the future allow this to be recorded.

3.5 Task 4: Stakeholder Workshop and Homework Pack

The methodology used for the stakeholder workshop and homework pack is outlined in Section 2 of this report. The workshop took place on the 5th of November 2014 and was attended by 21 delegates representing different Member States, ITS service providers and individual experts within the field of ITS, plus European Commission members of staff.

As part of the initial open discussion delegates considered the importance of KPIs and their varied experiences with assessing ITS deployment and benefits. They highlighted that benefits were the key objective which ITS was trying to achieve, but recognised that there are inherent difficulties in isolating the direct impacts of ITS from wider/other policy measures. These discussion also highlighted the wide differences in levels of sophistication in the monitoring of ITS across EU Member States, which are a key consideration for the recommendations from this report.

As part of the breakout session discussions and homework pack, delegates were asked to consider the strengths and weaknesses of the KPIs presented. Additionally they were asked to consider whether there were any 'gaps' within the long list presented, and were encouraged to identify additional KPIs which could fill these gaps. Delegates were also given the opportunity to refine the presented KPIs to ensure that they were both clear and precise and reflected the realities of the data available to Member States to produce them. Finally delegates were asked to consider the key barriers to the implementation of KPIs generally.

The views of delegates undertaking these workshop breakout discussions were recorded via pre-printed flipcharts. These flipcharts were placed around the room so that all delegates could see the views of each group. The views of those completing the homework pack were recorded in a spreadsheet following the same methodology. All of the flip chart annotations and spreadsheet comments can be found in Appendix D and G. However, the key emerging patterns in relation to barriers to KPI adoption are outlined below. Whereas the strengths and weaknesses suggested for each KPI are outlined in Appendix G.

Deployment KPI barriers/issues

- Low levels of deployment do not necessarily indicate an issue: deployment is meant to address a policy objective, not an aim in itself.
- Data ownership leading to difficulties in accessing information.
- Organisational/administrative boundaries differ by country
- Identifying KPIs at the correct level of aggregation/disaggregation to be meaningful and comprehensive
- Correct and coherent definition of terms

Benefit KPI barriers/issues

- Difficulty in separating out ITS benefits from wider network impacts – how to attribute the benefits to ITS?
- Availability of benefit data and associated processing/analysis costs
- Staff resource and skills & associated costs
- Organisational/administrative boundaries differ by country
- Data privacy
- Varying definition of terms (e.g. Killed or Serious Injury accidents)

Votes

Following the individual breakout sessions at which delegates considered specific elements of the emerging KPIs long list a voting exercise was undertaken. Delegates were given time to consider the full emerging long list of KPIs which were placed around the room, as well as the comments provided by breakout groups and any additional KPIs identified.

Each workshop delegate was then given 10 voting stickers to 'spend' on any of the emerging long list KPIs, or additional KPIs identified during the course of the day. These stickers could be placed all on one KPI or across a range of KPIs at their discretion. This provided useful insight into the views of delegates as to the type of KPIs most suitable for recommendation, taking account of the strength, weakness and barriers discussions held earlier in the day.

For those completing the homework pack the same exercise was completed via a spreadsheet which included the additional KPIs suggested at the workshop as well as any additions from the individual participants.

In total 267 votes were cast, with 138 (52%) votes given to deployment KPIs and 129 (48%) given to benefit KPIs. This is a slightly different balance from that indicated in the state of the art review and stakeholder questionnaire, where a preference for benefit KPIs was identified, possibly reflecting a greater understanding amongst workshop attendees of the challenges inherent to benefit KPIs, such as the greater data requirements and costs and the issue of benefit attribution.

The top six deployment and benefit KPIs voted for at the stakeholder workshop are shown below in tables 3.10 and 3.11 using the colour scheme shown in Table 3.12. A full list of the results can be found in Appendix E.

Table 3.10: Top 6 Voted Deployment KPIs

KPI	Total Votes
% TEN-T network covered by a minimum level of information infrastructures (e.g. traffic, weather and environmental conditions monitoring, CCTV or traffic information and control centres)	23
% TEN-T network supporting cooperative systems (I2V, V2I)	18
% national transport network covered by websites offering comprehensive traveller information (e.g. Journey planning, traffic information)	15
% TEN-T network with a minimum level of traffic management and control(e.g. Dynamic lane management, ramp metering, VMS)	13
% vehicles sold featuring intelligent vehicle services (vision enhancement, safety readiness, automated operation, cooperative systems)	10
Quality assessment of information provided.	10

Table 3.11: Top 6 Voted Benefit KPIs

KPI	Total Votes
Change in -Travel times - Flow - Sustainable Mode share	15
Public Transport journey time reliability – deviation from scheduled timetable	14
Change in number of all reported accidents per vehicle km	12
Change in severity of accidents (i.e. numbers killed or serious injured) per number of accidents reported	12
Reduction in violations (speeding, red light violations…)	11
Quality (reaction time, proper info. Distribution, proper channel, right time, right place) of info	10

Table 3.12: Colour Structure

Proposed by AECOM – as resulting from the state of the art and online stakeholder survey analysis
Added by participants in the workshop – wording presented here as written by participants.

Identification of additional KPIs

The workshop and homework pack exercises also led to the identification of a number of additional KPIs in complement to those derived by AECOM and presented in the emerging long list. An additional 35 deployment KPIs and 25 benefit KPIs were identified by stakeholders as part of this process, based upon existing KPIs currently in use, as well as theoretical KPIs proposed to fill perceived gaps in the emerging long list. This brought the total number of KPIs within the long list to 98.

3.6 Task 5: The Analysis Process

The previously discussed state of the art review, stakeholder questionnaire, workshop, analysis and review stages brought together various sources of information on KPIs; their current levels of use and the views of experts within the field on future implementation within the EU. An analysis process was therefore undertaken to assimilate this information into the development of a set of recommendations to be

taken forward. The process utilised is outlined in Section 2 of this report.

The analysis process led to the identification of 15 KPIs recommended to be taken forward, consisting of 8 deployment and 7 benefit KPIs. Appendix H provides the details used in informing the process to go from the long list (the output of the stakeholder workshop and homework pack) to the short list, as well as the rationale used in the decision to approve or reject each KPI. It also provides the details of how the KPIs were altered to reflect the feedback received. An overview of the key decisions taken to get from the long to the short lists are presented below separately for deployment and benefit KPIs.

Please note that to allow the derivation of each KPI to be understood the shortlisted KPIs have each been given an ID code in the format **N1**. The initial letter indicates the ITS Priority Area or Benefit category to which the KPI relates:

O = **O**ptimal use of road traffic and travel data

C = **C**ontinuity of traffic and freight management ITS services

R = ITS **R**oad safety and security applications

L = **L**inking the vehicle with the transport infrastructure

N = **N**etwork efficiency and congestion

E = Improving **E**nvironmental impacts

S = Improve road **S**afety

I = Enhance modal **I**ntegration

The number is a sequential ID number providing a unique identifier for the KPI.

3.7 Derivation of the Deployment KPI shortlist

The long list for deployment consisted of 22 KPIs presented to stakeholders at the workshop, as well as an additional 35 KPIs suggested by attendees at the workshop and those completing the homework pack. An initial analysis of the voting trends amongst stakeholders and the specific stakeholder comments received identified that 18 of these KPIs had a lack of support, which contributed to the rationale to reject these such as KPI R1: *Percentage of emergency vehicle dispatches facilitated by computer aided dispatch* and KPI R2: *Percentage of hazardous load movements for which information is logged or monitored using ITS*.

Further analysis of the comments and study findings identified that some of the long listed deployment KPIs would be particularly difficult to achieve in terms of the collection of data or measurement of the indicator. This factor was a particular consideration in the decision to reject a further five KPIs including KPI R11: *Percentage of emergency vehicle dispatch systems linked to traffic management interventions*. In this instance the linkage between emergency vehicle dispatch systems and traffic management interventions was not considered to be adequately recorded in most instances to allow this KPI to be calculated.

A further factor influencing the decision to reject certain KPIs was the lack of a clear definition of terms within some of the KPIs. Nine KPIs were rejected partially or solely because it was not considered possible to clearly define the scope of these KPIs. Amongst the KPIs rejected based on this rationale were KPI C12: *The percentage of urban/interurban dynamic traffic management links* and KPI O8: *Coverage of incidents*. These KPIs suggested as part of the homework pack feedback were considered too broadly defined to allow consistent measurement to be achieved. These issues have instead been considered as part of other shortlisted KPIs.

Whilst some KPIs were rejected because terms were not clearly defined, in other instances KPIs were considered too tightly defined and specific to allow them to be widely used across the EU28. Seven KPIs were considered either too specific or only relevant to a limited number of Member States and were therefore rejected on these grounds. Amongst these were KPI L4: *Percentage of vehicles equipped with dynamic navigation,* and KPI C2: *Percentage of road toll revenue collected by electronic toll collection systems*. These KPIs were considered to either be too specific to a certain technology solution (in the case of KPI L4) or not relevant to a number of EU Member States (in the case of KPI C2).

Other factors which led to the decision to reject certain KPIs included:

- KPIs not considered directly linked to ITS, such as KPI R4: *% urban intersections providing safety enhancements for pedestrians and disabled or other vulnerable road users*,
- KPIs that were considered to replicate other KPIs or to be more appropriately merged with other KPIs,
- KPIs that would be too difficult to implement, such as KPI O2: *The percentage of public transport ticket transactions that utilise electronic payment technologies*, and
- KPIs that are too qualitative, making comparability between Member States difficult, such as KPI L7: *Quality assessment of information provided*.[11]

All of the above factors have contributed to decisions to reject certain KPIs. The full list of reasons for accepting or rejecting long list KPIs is outlined in Appendix H.

The Deployment Shortlist

Tables (3.13 to 3.16) outline the recommended shortlist of deployment KPIs. For the shortlisted KPIs the feedback provided by stakeholders has been used in the refinement of terminology compared to that presented at the long list stage to further improve the identified KPIs and take on board stakeholder feedback.

Where previously certain KPIs were presented in the long list in relation only to the TEN-T network, feedback received led to the consideration of wider networks including urban areas. However, the current lack of an agreed road hierarchy across Europe prevents full disaggregation by road types. Consideration of a wider range of network types within the identified KPIs may be possible in the future if an agreed EU classification is identified. *[*

The operational environment is likely to have an impact on the choice of technology and level of service requirements as outlined in the Easyway Operational Environment Deployment Guidelines[12].

The shortlisted deployment KPIs are discussed below in relation to the ITS priority areas to which they primarily relate.

Table 3.13: Optimal Use of road traffic and travel data

ID	Long List KPI	Shortlist KPI
O1	% national transport network covered by websites offering comprehensive traveler information (e.g. Journey planning, traffic information)	Length and % of transport / road network covered by websites/over-the-air services offering traffic and travel information. Report separately: 1) Travel information 2) Traffic information 3) Integrated traffic and travel information 3) Freight specific information Report separately by road type or area where possible.
O3	% public transport stops with dynamic traveler information available to public	Number and % of urban public transport stops for which dynamic traveller information is made available to the public. Report separately by public transport mode where possible.

[11] Quality of service is an important consideration and could be used by Member States as an optional KPI, however explicit definitions of quality levels would be required.

[12] http://dg.easyway-its.eu/DGs2012

ID	Long List KPI	Shortlist KPI
O6	% TEN-T network covered by a minimum level of information infrastructures (e.g. traffic, weather and environmental conditions monitoring, CCTV or traffic information and control centers)	Length and % of road network covered by the following. Report separately: 1) Information gathering infrastructures 2) Traffic information services 3) Traffic management plan(s) incl. cross border TMP 4) Traffic management and control measures / equipment 5) Infrastructure or equipment on the network to enable Cooperative-ITS 6) Intelligent safety services for disabled and vulnerable road users Report separately by road type or area where possible.

Three KPIs have been identified in relation to assessing optimal use of road traffic and travel data. These KPIs consider the coverage of traffic and travel information, dynamic traveler information at public transport stops and the coverage of a number of ITS technologies used in gathering information, managing traffic and communication with vehicles.

KPI O1 received a good degree of stakeholder support, but has been amended to reflect the range of ways in which travel and traffic information can be provided to users. It has also been amended to reflect the specific requirements of the freight industry and the fact that some services may provide both travel and traffic information. The ability to access information on travel and traffic information may be varied, for example depending upon whether the service is publically or privately owned. For simplicity the KPI also does not attempt to consider the quality of such information, although member states are free to give additional consideration to this.

KPI O3 has evolved to consider separately the deployment of dynamic traveller information across the full range of different types of public transport (e.g. bus, rail, tram/metro). Consideration has been given to the inclusion of on-line as well as at stop information. It was determined that online information is covered as part of KPI O1, hence KPI O3 only needs to consider information provided at the stop.

KPI O6 considers a range of different ITS technologies/measures/services which relate to the road network. This KPI has evolved to consider all types of road network. The concept of a minimum level of service has been removed as this was considered not to reflect the evolution of transport networks over time and the anticipation the Member States should aim for more than a minimum standard. Instead a number of different types of technologies/measures are considered separately within this KPI. The KPI has also been expanded to consider traffic management plans. Whilst ITS deployment is not dependent on traffic management plans, they are considered an important precursor to the delivery of effective ITS traffic management measures. To reflect the range of different types of users of a road network this KPI also considers the ITS technologies which may have been implemented to increase safety for vulnerable road users. The precise definition of the requested classifications under O6 and the other KPIs are discussed in the pro-formas provided as part of Section 4 of this report.

Table 3.14: Continuity of traffic and freight management ITS Services

ID	Long List KPI	Shortlist KPI
C4	% urban intersections controlled using adaptive traffic control	Number and % of signal controlled road intersections using adaptive traffic control or prioritisation. Report separately by road type or area where possible.

In terms of Continuity of traffic and freight management ITS Services KPI C4 is proposed alongside other KPIs discussed in relation to other ITS priority areas. This KPI considers the junctions where adaptive traffic control exists or where these are used in prioritizing certain traffic movements or vehicle types. Whilst this KPI was originally presented in relation to urban areas (e.g. hot spots) only feedback from stakeholders indicated the applicability of this KPI to wider networks (e.g. strategic corridors). The intention would therefore

be that this KPI is applied to the network types for which it is relevant on a country by country basis.

Table 3.15: ITS road safety and security applications

ID	Longlist KPI	Shortlist KPI
R3	% TEN-T network covered by incident detection and management algorithms	Length and % of road network covered by incident detection and incident management. Report separately by road type or area where possible.
R6	% urban network covered by speed cameras / CCTV and supported by centralised enforcement	Length and % of road network covered by automated speed detection. Report separately by road type or area where possible.
S11	% of network covered by real-time services providing information in accordance to Delegated Regulation on Road Safety Information Services	Provision of intelligent services on the TENT-T core and comprehensive networks that are compliant with the Delegated Regulations of the ITS Directive: 1) Length and % of TEN-T network covered by real-time traffic information services that are compliant with the requirements of Delegated Regulation xx/2015 2) Length and % of TEN-T network covered by road safety related traffic information services available free of charge to users that are compliant with the requirements of Delegated Regulation 886/2013 3) Length and % of TEN-T network covered by information services for safe and secure parking places for trucks and commercial vehicles that are compliant with the requirements of Delegated Regulation 885/2013.

The above KPIs are recommended in relation to ITS road safety and security deployment. These cover the detection and management of traffic incidents and the detection of speeding incidents as well as compliance with the Delegated Regulations adopted under the ITS Directive. It is intended that these KPIs would be reported for different classifications of road network. Whilst the enforcement of speeding incidents (previously included in KPI R6) was identified as an important factor in the objective of speed detection it was felt that the decision to penalize speeders would be a political one and therefore outside of the remit of ITS.

KPI S11 relating to the deployment of technologies/equipment/processes in compliance with the requirements of the ITS Directive and its Delegated Regulations has been altered to consider the full range of criteria to which the Regulations relates (e.g. data formats, access nodes). Following stakeholders feedback it has also been reworded to consider levels of compliance with the Regulations, as opposed to levels of deployment only[13]. The KPI presented in table 3.16 is recommended in relation to the ITS priority area of Linking the vehicle with the transport infrastructure. KPI (L3) considers the ITS features included within new vehicles. Consideration was given to inclusion of retrofitted vehicles and nomadic devises as part of this KPI, however it was not considered practical to gain access to data on these technologies to ascertain levels of deployment.

[13] In addition to the extent of network coverage of ITS services in compliance with the Delegated Regulations of the ITS Directive it would also be interesting to consider the percentage of users reached by these services (although this would be difficult to estimate and could be affected by external factors, such as the evolution of traffic flow.

Table 3.16: Linking the vehicle with the transport infrastructure

ID	Long List KPI	Shortlist KPI
L3	% vehicles sold featuring intelligent vehicle services (vision enhancement, safety readiness, automated operation, cooperative systems)	Number and % of new vehicles including the following intelligent vehicle features: 1) Safety readiness 2) Automated operation 3) Cooperative systems 4) Public (112) systems 5) Private eCall systems Report separately by vehicle types where possible

It was identified that there would be alternative ways of collecting information on intelligent vehicle features; either directly from vehicle manufacturers, from vehicle suppliers at the point of sale or as part of vehicle registration by national governments. Because of the range of possible ways to obtain this data it was felt most appropriate to leave this KPI open at this stage to allow Member States to recommend the most appropriate calculation method for this KPI.

3.8 Derivation of Benefit KPI Shortlist

As outlined above, the emerging long list consisted of 16 benefit related KPIs, which were presented to stakeholders at the workshop. Through this consultation, and following the homework pack activity, an additional 25 potential KPIs were identified. A review and rationalisation exercise was therefore undertaken, similar to that reported above for deployment KPIs.

A common rationale for omitting KPIs from the final shortlist was a considered lack of direct relevance to ITS policy and investment. An example of this was *N3 Public transport journey time reliability – deviation from scheduled timetable*. Although such an indicator was considered relatively easy to calculate, the majority of potential benefit would be likely to result from physical engineering and/or other policy measures (e.g. bus lanes) rather than ITS solutions. Similarly, *N5 Change in public transport average daily person flow between key points along a route* was also omitted for the same reason.

Many of the potential benefit KPIs were also considered very challenging to measure, often requiring a significant cost in both data collection and analysis. Examples of this included *S3 Number of near misses recorded by ITS, S4 Change in crime reports relating to truck parking,* and indicators *S7 to S10* covering issues such as secure parking related security and accidents in defined workzones.

One of the central challenges of monitoring ITS benefits will be the ability to link, or attribute, observed changes in KPIs to specific ITS investment. The difficulty in isolating ITS derived benefits from the wide array of contextual influences has resulted in KPIs being omitted from the short list. This included *E2 Changes in number of hours where NO_x levels were above thresholds* and *E4 Changes in number of hours where transport noise is above dB threshold.*

The final main criterion for omitting KPIs was the difficulty in defining the KPIs clearly. A core requirement of the short list of KPIs was to engender consistency and comparability between Member States and types of ITS services deployed. Central to this was ensuring that data was collected consistently and robustly. Some KPI were considered too complex and open to interpretation, including *N6 Quality of information (reaction time, correct information, proper channel)* and *N7 Reducing search time in an unfamiliar area.*

The Benefit Shortlist

Table 3.17 presents the recommended shortlist of seven benefit related KPIs. As for deployment indicators, the feedback from stakeholders and discussions with DG MOVE were used in refining the terminology and scope of individual indicators.

The wording of the benefit KPIs have been refined to ensure that KPIs are independent of the specific dissemination channels to users. The benefit KPIs are not meant to assess the performance of a specific technology but of a service. This also has the benefit of keeping the KPIs open with respect to future / emerging technologies.

The shortlisted benefit KPIs have been structured to consider the impacts achieved along routes where ITS have been deployed, rather than considering the impacts of individual pieces of infrastructure on a single junction or network section. This allows the wider impacts of the ITS deployed to be assessed, for example considering the impacts of rerouting or modal shift which might result from the ITS which would be lost when only looking at individual locations.

Table 3.17: ITS Benefit KPIs

ID	Longlist KPI	Shortlist KPI
N1	Change in peak hour journey time in conjunction with flow between key points along a route (all vehicles)	% change in peak period journey time along routes where ITS has been implemented. Report by vehicle type where possible.
N2	Change in peak hour flow between key points along a route (all vehicles)	% change in peak period traffic flow along routes where ITS has been implemented. Report by vehicle type where possible.
N4	Journey time variability as measured using standard deviation of journey times between key points along a route (all vehicles)	% change in journey time variability on routes where ITS has been implemented - as measured by coefficient of variation. Report by vehicle type where possible.
N9	Modal shift (Change between personal cars and public transport)	% change in mode share on corridors where ITS has been implemented. Report percentage mode share separately for each mode where possible.
S1	Change in number of all reported accidents per vehicle km Change in severity of accidents (i.e. numbers killed or serious injured) per number of accidents reported)	% change in number of reported accidents along routes where ITS has been implemented. Report by accident severity (i.e. fatal, serious injury, light injury) where possible.
E1	Change in CO^2 emissions per vehicle km	% change in annual CO^2 emissions (Tons) on routes where ITS has been implemented.
L9	Number of automatically initiated eCalls	Time taken between initiation of public (112) eCall to the presentation of the content of MSD in an intelligible way at the operator's desk in the Public Safety Answering Point.

In general, the benefit KPIs have not changed significantly since the versions presented in the long list. The KPIs have been refined to clarify that they should only be applied to sections of routes where ITS has been implemented (e.g. in the form of before – after implementations comparison). The rationale for this was to try to improve the level of benefit attribution to ITS that can be achieved by focusing on route sections/corridors where ITS has been implemented. This can be achieved through linking the benefit calculations to the locations identified in the deployment KPIs.

The majority of KPIs have also changed to now reflect the percentage change of a certain attribute, rather than the absolute change. This should allow the KPIs to take account of the differing lengths of road sections upon which ITS has been implemented. Where previously in a number of instances only the total number of vehicles was indicated feedback from stakeholders has led to a breakdown of impacts by vehicle type being requested, where possible. This will allow the impact of, for example freight specific ITS or public transport specific ITS to be more accurately understood. The proposed vehicle classifications to be used are outlined in Section 4 of this report.

In the case of journey time variability (KPI N4) the proposed methodology for the assessment of journey time variability has changed from Standard Deviation to the Coefficient of Variation. This reflects best practice in the calculation of journey time variability.

[*you might add few lines about a KPI for congestion e.g. vehicle loss hours (used by some MS and operators but lack of common approach)]*

Additionally, KPI E1 (CO_2 emissions) has been simplified to reflect the total CO_2 emissions, rather than expressing this per vehicle kilometre. This simpler measure should be more effective at assessing the various ways in which ITS could influence CO_2 levels (i.e. reducing traffic, reducing delays, reducing speeding or suggesting shorter routes) as well as facilitating different methodologies to calculate emissions (e.g. based on traffic flow/speed, vehicle efficiency and fuel sales).

It was identified that in addition to consideration of the deployment of eCall (public and private) amongst the vehicle fleet (considered in KPI L3) it was also important to take account of the performance of this service. KPI L9 has therefore emerged from the need to monitor the performance of Public eCall and was originally considered as part of a deployment KPI. Feedback received has identified that the effectiveness of eCall was more relevant than the level of use (i.e. the key benefit of eCall is the speed with which eCall can facilitate the dispatch of an emergency response vehicle). KPI L9 reformulated as Public eCall timeliness has therefore been framed to capture this impact. Due to the change in the nature of this KPI since its initial inception it is now considered a benefit KPI as opposed to a measure of deployment.

KPI S1 has been simplified from that presented in the long list to consider the total number of accidents, rather than the number of accidents per vehicle kilometre. This change has been made to separate this KPI from the wider impacts on traffic flow which might result from ITS deployment, but are considered in separate benefit KPIs. The data required to produce this KPI should be available to the majority of member states, although there may be inconsistencies in the way accident severity is recorded between Member States, as discussed in Section 4 of this report.

KPI N9 has been included in the final short list due to the strong levels of support for this KPI, as well as its importance in policy terms. However, it is believed that this KPI will be particularly challenging to monitor due to the complexity of the data required in monitoring all transport modes along a corridor. This KPI should therefore be considered a low priority at present due to data constraints. In the future it may be possible to ascertain mode share directly from ITS systems or transport users themselves. This may therefore make this KPI more achievable in the future.

KPIs N1, N2 and N4 are the key indicators proposed to measure the performance of highway based ITS systems which seek to overcome traffic congestion. They will assess how successful these technologies are at improving journey times (N1), journey time variability (N4) and the level of flow through a section of road (N2). Alternative suggestions for indicators of congestion relief included vehicle hours lost or vehicle kilometres travelled. These options were discounted as they are considered more complex to calculate and

hence less applicable to a range of ITS implementations. The calculation of these suggested metrics would require basic information on flow and journey times as part of the calculation process, so those Member States wishing to use these alternative metrics should also be able to report the simpler KPIs recommended as part of this study.

3.9 Summary of Findings

This section has outlined the findings from the various tasks undertaken as part of this study (the state of the art review, stakeholder questionnaire and workshop). These tasks have collectively provided the evidence base which has informed the development of a set of recommended KPIs. Initially the state of the art review and stakeholder questionnaire collectively identified 228 indicators currently in use within the EU, although a number of these were considered to fall short of true KPIs. This list was assessed and refined to produce an emerging long list of 38 KPIs providing coverage across the ITS taxonomy and linked to the ITS Priority Areas of the ITS Directive and policy goals. This list was consulted on as part of the stakeholder workshop and homework pack, providing valuable feedback from EU experts on the identified list and their preferences. Feedback from the various consultation activities and the wider study findings has allowed this list to be refined further down to a list of 15 recommended KPIs. The process that has led to decisions to accept, reject or amend KPIs have also been documented to justify the list identified.

A key finding from all of the above project stages was the need to achieve an appropriate balance between benefit and deployment KPIs. Achieving benefits for transport users was recognised as the fundamental objective of the deployment of ITS technologies, and benefits were initially considered by stakeholders to be the most important aspect of interest to them. However, it was also identified throughout the study that a number of barriers exist which limited their application. For example, it is not always possible to isolate the impacts of ITS from other factors occurring within the wider network when assessing the benefits of ITS. Therefore deployment indicators were also considered important due to their relative simplicity and more direct links to specific ITS implementations. This conclusion was demonstrated in the stakeholder consultation voting exercises which, following consideration of the identified benefit and deployment KPIs stakeholders voted slightly in favour of deployment, rather than benefit KPIs. It was despite the preference for assessing benefits identified as part of the state of the art review and stakeholder questionnaire. Deployment KPIs were also identified to have limitations, particularly the fact that a low level of deployment may not indicate a problem as ITS should only be deployed in instances where it is required and beneficial. Therefore, given the positives and negatives inherent to both types of KPIs it was considered important to maintain both types of KPI, but also to provide linkages between both types of KPI to provide a fuller picture of the impacts of ITS.

Throughout the study consideration has been given to the coverage of KPIs across the ITS Priority Areas of the ITS Action Plan and ITS Directive, the identified ITS taxonomy and benefit areas. It showed an existing focus toward traffic management and control and information infrastructures in terms of the KPIs currently in use. Acknowledging this existing focus, the process of establishing a short list has sought nonetheless to achieve a good level of coverage across all types of ITS, whilst also giving consideration to the future development of ITS and areas which may grow in importance in the future, such as cooperative ITS and automated vehicle operation.

The availability of data has been a key consideration in the identification of an appropriate short list. This study has identified that system generated data is a key data source currently used in the assessment of ITS benefits and deployment. Where available this data source offers the opportunity to assess ITS performance potentially at no additional cost and in real-time, although it is recognised that system data is unlikely to be available to consider all aspects of ITS performance or for all types of ITS deployment. Other forms of transport monitoring, such as traffic and journey time counts will therefore be required to assess ITS benefits in some instances. The findings from this study indicate that these data sources are extensively used at present, although data ownership and cost issues may exist.

Ongoing technological developments, such as intelligent vehicle systems should facilitate new sources of data, such as floating vehicle data and crowd sourced data. This will further facilitate the calculation of the identified KPIs, which are flexible enough to facilitate new data collection methodologies as they become available.

The above findings from this study have been key factors influencing the identified recommended KPIs the details of which are discussed further in the next section of this report.

4. Recommended KPIs

4 Recommended KPIs

4.1 Introduction

Sections 2 and 3 of this report have outlined the methodology used in establishing a KPI shortlist and the key findings from this process including the decisions that have led to the short list identified. This section outlines the recommended KPI shortlist, as well as providing additional details to aid practitioners in the collection, analysis and presentation of this KPI information.

4.2 The KPI Shortlist

Tables 4.1 and 4.2 outline the KPI shortlist recommended by this study, split into deployment and benefit related KPIs.

The shortlist includes eight deployment KPIs and seven benefit KPIs. This list aims to achieve a suitable balance between deployment and benefit KPIs, recognising the inherent strengths and weaknesses in each approach as discussed in Section 3 of this report. The shortlist also seeks to achieve a suitable coverage across the identified ITS Taxonomy to ensure it is representative of the wide range of ITS types being implemented across the Member States.

A key goal of the identified list was to ensure that linkages exist between deployment and benefit KPIs. The linkages between both lists are therefore identified in the benefit table 4.2. Unique identifying codes are provided to express these linkages. These codes also allow the derivation of KPIs to be traced through the decision making processes as part of the appendices to this report. It is intended that the use of both types of KPI (deployment and benefit) in parallel should allow the benefit of deployment to be ascertained, partially overcoming the challenges of measure/service attribution associated with the assessment of benefits.

To assist practitioners in the implementation of these KPIs a series of pro-forma have been produced to provide additional details regarding the definition of terms, calculation of metrics and recommended presentation of results. The pro-forma also include a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis to ensure the identified KPIs maximise the available strengths and opportunities whilst minimising weaknesses and threats. Additional information is also provided on the rationale and coverage of each KPI and the data requirements in producing each KPI.

Adoption of KPIs

The findings from this study have identified that currently levels of ITS deployment, the use of KPIs and the level of sophistication of KPIs are at very different stages across the EU. It is therefore considered unrealistic to provide a prescriptive list of KPIs which will meet the requirements of all Member States. The identified KPI shortlist can therefore be seen as a list of suitable tools to monitor ITS deployment and benefits where it is practical and useful to do so and in the short term Member States can be asked to focus their efforts on those indicators they consider of most use to them.

The recommended KPIs typically request information to be broken down by various classifications, such as road / areas and vehicle types. It is recognised that practical and technological limitations may make this unfeasible in some instances. Practitioners should therefore provide as much detail as is possible within the existing constraints.

Table 4.1: Recommended Shortlist of Deployment KPIs

ID	Deployment KPIs
R3	Length and % of road network covered by incident detection and incident management. Report separately by road type or area where possible, see breakdown by classification section above.
R6	Length and % of road network covered by automated speed detection. Report separately by road type or area where possible, see breakdown by classification section above.
O1	Length and % of transport / road network covered by websites/over-the-air services offering traffic and travel information. Report separately: 1) Travel information 2) Traffic information 3) Integrated traffic and travel information 4) Freight specific information Report separately by road type or area where possible, see breakdown by classification section above.
O3	Number and % of urban public transport stops for which dynamic traveller information is made available to the public. Report separately by public transport mode where possible.
O6	Length and % of road network covered by the following. Report separately: 1) Information gathering infrastructures 2) Traffic information services 3) Traffic management plan(s) incl. cross border TMP 4) Traffic management and control measures / equipment 5) Infrastructure or equipment on the network to enable Cooperative-ITS 6) Intelligent safety services for disabled and vulnerable road users Report separately by road type or area where possible, see breakdown by classification section above.
C4	Number and % of signal controlled road intersections using adaptive traffic control or prioritisation. Report separately by road type or area where possible, see breakdown by classification section above.
S11	Provision of intelligent services on the TENT-T core and comprehensive networks that are compliant with the Delegated Regulations of the ITS Directive: 1) Length and % of TEN-T network covered by real-time traffic information services that are compliant with the requirements of Delegated Regulation xx/2015 2) Length and % of TEN-T network covered by road safety related traffic information services available free of charge to users that are compliant with the requirements of Delegated Regulation 886/2013 3) Length and % of TEN-T network covered by information services for safe and secure parking places for trucks and commercial vehicles that are compliant with the requirements of Delegated Regulation 885/2013.
L3	Number and % of new vehicles including the following intelligent vehicle features: 1) Safety readiness 2) Automated operation 3) Cooperative systems 4) Public (112) systems 5) Private eCall systems Report separately by vehicle types where possible, see breakdown by vehicle classification section above.

Table 4.2: Recommended Shortlist of Benefit KPIs

ID	Benefit KPIs	Linkages to deployment KPIs
N1	% change in peak period journey time along routes where ITS has been implemented. Report by vehicle type where possible, see breakdown by vehicle classification section above.	R3, O6, C3, C4, L3, S11
N2	% change in peak period traffic flow along routes where ITS has been implemented. Report by vehicle type where possible, see breakdown by vehicle classification section above.	R3, O6, C3, C4, L3, S11
N4	% change in journey time variability on routes where ITS has been implemented -as measured by coefficient of variation. Report by vehicle type where possible, see breakdown by vehicle classification section above.	R3, O6, C3, C4, L3, S11
N9	% change in mode share on corridors where ITS has been implemented. Report percentage mode share separately for each mode where possible.	O1, O3, O21
S1	% change in number of reported accidents along routes where ITS has been implemented. Report by accident severity where possible.	R3, R6, L3, L9, S11
E1	% change in annual CO^2 emissions (Tons) on routes where ITS has been implemented.	
L9	Time taken between initiation of public (112) eCall to the presentation of the content of MSD in an intelligible way at the operator's desk in the Public Safety Answering Point.	L3

4.3 Calculation of deployment KPIs

The provided deployment KPI pro-forma provided at the end of this section offer additional information to provide practitioners with the details on data sources, calculation methodologies, monitoring frequencies and presentation approaches to allow them to begin monitoring and generating the identified KPIs.

Deployment by network length

The majority of the deployment KPIs shown in table 4.1 considers the level of deployment (e.g. number of ITS deployed) against a characteristic of the transport network, typically the length of the road network. To calculate this practitioners will therefore have to associate their ITS assets with the section (and length) of road network to which they functionally relate. Where available this can be achieved relatively easily using a GIS representation of the road network and ITS asset locations, although the same can equally be calculated manually. The deployment KPI would then be presented as the percentage of road type *X* for which ITS type *Y* exists. It will be the responsibility of practitioners to make a judgement as to how much of the network can be considered to be influenced by each ITS implementation. It is likely to be dependent upon the nature of the ITS under consideration and the operational environments. It is recommended that consistent network sections are used in the calculation of both the deployment and benefits of a specific ITS. The locations and network sections used in determining each KPI should be presented alongside the headline figures.

Breakdown by classification

Where possible and relevant the deployment KPIs are requested to be broken down into different road or vehicle types following consistent classifications. This will better reflect the differing make up of road or vehicle types that may exist between countries. Member States can decide which network types are appropriate to report for different types of ITS deployment. For example, adaptive traffic control at intersections may only be applied within urban areas in some Member States. In this instance the KPI (C4) can be reported for urban areas only.

Where possible network based deployment KPIs should be broken down based upon the below classification:

- TEN-T Core;
- TEN-T Comprehensive;
- Other National routes; and
- Urban Areas.

The definition of the TEN-T Core and TEN-T comprehensive networks is clearly defined by the European Commission[14]. However, the majority of routes which form the national network of a country (typically motorways and dual carriageways) are not included in the TEN-T network. To reflect this it is also important to consider this wider network of national routes. There is currently no agreed definition of national routes beyond the TEN-T at a European level and differing approaches exist at a Member State level.

Individual Member States should therefore make use of any appropriate local definition of the national network. The definitions used should be referenced alongside the KPI information to provide transparency as to what is or is not included within the definition for each Member State.

In addition to the consideration of TEN-T and national routes some forms of ITS are typically implemented within the context of urban areas. In urban areas the calculation of network length was considered to be too challenging for practitioners to ascertain due to the density of urban road networks. Consideration has been given for this to be based upon density of ITS at urban hot spots or along urban corridors; however in the absence of consistent definition of urban hot spots / corridors Member States might therefore make use of any appropriate local definition. It is recommended that the definitions used should be referenced alongside the KPI information. The OECD-EC Urban definition[15] offers a consistent definition of urban areas across Europe.

[14] http://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/main.jsp

[15] http://ec.europa.eu/regional_policy/sources/docgener/focus/2012_01_city.pdf

A recommended breakdown of vehicle types is discussed in the below section.

4.4 The Calculation of Benefit KPIs

Table 4.2 presents the benefit KPI shortlist. This list covers the key areas of network performance that ITS implementations can influence: journey times and journey time variability, traffic flow, mode share, traffic accident numbers and severity and transport emissions. Additional details regarding these KPIs are presented in the subsequent benefit KPI pro-forma which provide assistance to practitioners in the calculation of each KPI.

Identification of ITS Implementation
For each KPI it is first necessary to identify the types of ITS which can influence each benefit area. To facilitate this, the linkages between deployment and benefit KPIs have been identified as part of table 4.2. This should allow a list of locations where appropriate ITS measures have been implemented to be identified, these form the '*routes where ITS has been implemented*' quoted within each KPI. The list of road sections under consideration within each benefit KPI should be listed alongside the KPI result to aid interpretation of the results ahead of aggregation to a Member State level.

Establishment of benefits
To capture the benefits of ITS it is optimal to adopt a before/after approach to monitoring network performance. Therefore the recommended benefit KPIs have been presented in the form of a percentage change in each benefit attribute since ITS implementations. This approach will require practitioners to have data on the performance of the network prior to the implementation of ITS. This may be possible for future implementations of ITS, but presents a problem where ITS has already been implemented and prior data does not exist. In these circumstances it may be possible to 'infer' the prior conditions, for example using a period when the ITS is turned off to infer conditions prior to its implementation or information from a "comparable" use case. Where this is not possible practitioners should focus on new ITS implementations where before monitoring is available or can be undertaken.

Breakdown by vehicle classification
In some instances the recommended benefit and deployment KPIs request a breakdown of each KPI based upon vehicle type. This provides useful additional detail regarding trends or ITS implementations which may only relate to certain types of vehicles, for example cars or trucks. For simplicity the aim should be to utilise system generated data in the calculation of benefits wherever possible. Therefore it may not be possible to provide a breakdown of performance by vehicle classification in all instances where available data sources do not facilitate this. Where possible practitioners should use the following high level classification of motor vehicles, which is an EU standard[16] used for emissions, although practitioners are encouraged to provide more detailed breakdowns of vehicle classification where viable :

- Category L vehicles – Mopeds and motorbikes
- Category M1 vehicles – Cars
- Category M2, M3 – Buses
- Category N vehicles - Lorries and vans

In addition to these categories where relevant the following public transport modes should be considered:

- Buses
- Trains
- Metro/Tram

Non-motorised modes may also be of relevance in urban environments, for example in relation to mode share (N9) and accident level/severity (S1):

- Pedestrians
- Cyclists

16 http://ec.europa.eu/transport/road_safety/topics/vehicles/vehicle_categories/index_en.htm

Definition of terms

Through the consultation and state of the art research activities undertaken as part of the study process it has become apparent that there are differing definitions of key transport parameters in use within the EU. For example, accident severity is determined at the scene of the accident by first responders in some countries and at a later point based upon hospital records in others. Additionally, different ITS systems and monitoring technologies will classify attributes differently. For example, determining vehicle classification based upon weight or the number of axles. Therefore it is problematic to ensure consistency across the EU and across different types of ITS using existing technologies and monitoring methodologies. However, the identified benefit KPIs have been designed to consider benefit attributes in terms of a percentage change, rather than absolute numbers. This, to some extent, should negate some of the comparability issues associated with inconsistent definitions, although attempts should be made to ensure consistency wherever possible in line with the definitions outlined in the provided pro-forma and other available EU guidance.

4.5 Summary

This section of the report has outlined the recommended list of KPIs which have emerged from the findings of this study, as well as the proposed methods for the data collection, calculation and presentation of these indicators. It is recommended that the next stage in the process of implementation of KPIs for ITS should be for the sharing of the findings of this study. This could then be followed by a period of consultation with Member State experts on the most appropriate next steps in the process of implementation of the recommended KPIs.

4.6 Recommended Deployment KPI Pro-formas

KPI Details: Deployment	
Reference Number	R3
Short Name	Incident detection and incident management
Long Name	Length and % of road network covered by incident detection and incident management. Report separately by road type or area where possible, see breakdown by classification section.
Definition	• **Incident detection**: Any road based ITS infrastructure which is used to detect traffic incidents (e.g. accidents and congestion) on a section of road network. • **Incident management**: Any automated means of acting upon a detected incident – for example by reducing speed limits. • **% of road network:** Will require calculation of kilometres of road network of different classifications with and without the identified technologies.
Calculation	KPI = (kilometres of road network type X with compliant ITS / kilometres of road network type X) x 100
Presentation	To be presented in number (length in km) and percentage format reporting separately by road type where possible. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Clearly defined • Easily compared across Member States
Weaknesses	• Does not consider the impacts of ITS incident detection and management for users. • Assumes all incident detection and management systems are of equal significance.
Opportunities	• Functional focus rather than technological focus, so KPI likely to be sustainable over time.
Threats	• Maybe devalued/overtaken by vehicle sourced data as opposed to network sources, reporting more rapidly highlighting incident locations, not in the short to medium term. • Maybe dependent on information gathering technology measured in O6 and consequently deployment may always lag O6 status
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	Contributes to the following objectives: • ITS road safety and security applications • Continuity of traffic and freight management ITS Services • Optimal use of road traffic and travel data
Constraints in aggregation to EU level	Definitions of urban networks may vary by Member State. Precise technologies utilised may also vary.
Taxonomy Coverage (Level 2)	• Hazardous Materials and Incident Notification • Road Safety Related Traffic Information • Disaster Response Management • On-Trip traffic & travel Information
Road Type	All road types and urban areas
Data Requirements	
Source	List of implemented ITS incident detection and management systems linked to road network section, length and road type.
Ownership	Data likely to be owned by roads authority or toll road operator.
Frequency	Data to be reviewed on an annual basis.

KPI Details: Deployment	
Reference Number	R6
Short Name	Automated speed detection
Long Name	Length and % of road network covered by automated speed detection. Report separately by road type or area where possible, see breakdown by classification section.
Definition	• **Automated speed detection**: Any road based ITS infrastructure which is used to detect the speed of passing vehicles. • **% of road network:** Will require calculation of kilometres of road network of different classifications with and without identified technologies.
Calculation	KPI = (kilometres of road network type X with compliant ITS / kilometres of road network type X) x 100
Presentation	To be presented in number (length in km) and percentage format separated by road type where possible. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Clearly defined • Easily compared across Member States.
Weaknesses	• Does not consider the impacts of ITS speed detection for users. • Assumes all speed detection systems are of equal value.
Opportunities	• Maybe opportunities for the technologies deployed to support benefits KPIs N1 and N2. • KPI could also be considered for incentivising drivers' behaviour change (through warning or enforcement). • Functional focus rather than technological focus, so KPI likely to be sustainable over time.
Threats	• Speed detection may be undertaken based upon systems built into vehicles in the future, negating the need for network based speed detection.
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	Contributes to the following objectives: • Continuity of traffic and freight management ITS Services • ITS road safety and security applications
Constraints in aggregation to EU level	Definitions of urban networks may vary by Member State. Precise technologies utilised may also vary.
Taxonomy Coverage (Level 2)	• Information Infrastructures
Road Type	All road types and urban areas
Data Requirements	
Source	List of implemented ITS speed detection systems linked to road network section, length and road type.
Ownership	Data likely to be owned by roads authority or toll road operator.
Frequency	Data to be reviewed on an annual basis.

KPI Details: Deployment	
Reference Number	O1
Short Name	Traffic and Travel Information
Long Name	Length and % of transport / road network covered by websites/over-the-air services offering traffic and travel information. Report separately: 1) Travel information 2) Traffic information 3) Integrated traffic and travel information 4) Freight specific information Report separately by road type or area where possible, see breakdown by classification section.
Definition	• **Websites/over the air services**: Any internet or over the air service offering publically available and free to use relevant journey planning or traffic information to travellers prior to or during a trip. This could include websites, apps and radio services. • **% of transport / road network:** Will require calculation of the kilometres of transport / road network for which the above services are available. Where possible this should be divided by network type. • **Traffic information:** Real-time information related to current traffic conditions on the road network. This could include accident locations, roadworks or congestion hotspots. • **Travel information:** Information related to trips a user is planning to or currently undertaking (e.g. journey planning/on trip journey planning). This can include multimodal information, schedules, prices, incidents. • **Integrated traffic and travel information:** Any service offering both journey planning and 'live' traffic information, for example indicating travel times taking account of current traffic levels. • **Freight specific information**: Service offering bespoke traffic or travel information tailored to the needs of the freight industry, e.g. Smartfreight[17] or the London Freight Journey Planner[18].
Calculation	KPI = (kilometres of road network type X for which compliant traffic and travel information is available / kilometres of road network type X) x 100
Presentation	To be presented in number (length in km) and percentage format separated by road type where possible. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Comprehensive coverage of different types of traveller information • Can be disaggregated across ITS and information sources
Weaknesses	• Does not consider the quality of information. • May result in 100% coverage in many instances • Definition of traveller information may vary.
Opportunities	• Potential for App/Phone data to record and report on usage.
Threats	• A broad and fast moving arena, with a mix of government and private organisations involved, therefore a mix of data sources, not all of which are interoperable/comparable.
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	Contributes to the following objectives: • Optimal use of road traffic and travel data

[17] http://www.smartfreight.info/

[18] http://www.piemapping.com/products/freight-journey-planner/

Constraints in aggregation to EU level	Precise technologies utilised may also vary. 100% coverage likely in some Member States.
Taxonomy Coverage (Level 2)	• Pre-trip traffic and travel information • On-trip traffic and travel information
Road Type	All road types and urban areas
Data Requirements	
Source	List of compliant traffic and travel information services indicating the coverage of these services linked to road network type and length.
Ownership	A coordinated record of all traffic and travel services is unlikely to be collated at present and data will be owned by a variety of parties, but the specified services should be publically available making their identification and extent of coverage easier to define through online searches for instance.
Frequency	Data to be reviewed on an annual basis.

KPI Details: Deployment	
Reference Number	O3
Short Name	Dynamic public transport traveller information
Long Name	Number and % of urban public transport stops for which dynamic traveler information is made available to the public. Report separately by public transport mode where possible.
Definition	• **Public transport stops**: Any public transport stops including bus stops, rail and bus/coach stations and other multimodal interchanges • **Public transport**: Where possible public transport modes should be reported separately i.e. bus, coach, rail (light, heavy), tram/ metro. • **Dynamic Traveler information:** Information providing up to date estimates of public transport services i.e. arrival, delays or cancellations. • **Multimodal interchanges**: Any public transport node that facilitates interchange between modes i.e. bus and rail stations.
Calculation	KPI = (Number of public transport stops of type X for which dynamic traveler information is available / Total number of public transport stops) x 100
Presentation	To be presented in number and percentage format broken down by public transport mode where possible. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Comprehensive coverage of different types of public transport traveller information • Easily compared across Member States
Weaknesses	• Does not consider the quality or use of traveller information.
Opportunities	• Potential to expand KPI to consider public transport traveller information delivered online or by apps, although to some extent this is covered within KPI O1.
Threats	• Future direction of information services unknown • Likely to be overtaken by increasing use of mobile phone information services
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	Contributes to the following objectives: • Optimal use of road traffic and travel data
Constraints in aggregation to EU level	None
Taxonomy Coverage (Level 2)	• Pre-trip traffic and travel information • On-trip traffic and travel information
Road Type	Urban areas. The OECD-EC Urban definition[19] cities should be used in determining the locations for which this is calculated and the boundary of the area of interest.
Data Requirements	
Source	List of public transport stops associated with the availability of dynamic traveler information services.
Ownership	Data held by public transport authorities and service operators
Frequency	Data to be reviewed on an annual basis.

[19] http://ec.europa.eu/regional_policy/sources/docgener/focus/2012_01_city.pdf

KPI Details: Deployment	
Reference Number	O6
Short Name	Coverage of Traffic Information, Management and Cooperative-ITS
Long Name	Length and % of road network covered by the following. Report separately: 1) Information gathering infrastructures 2) Traffic information services 3) Traffic management plan(s) incl. cross border TMP 4) Traffic management and control measures / equipment 5) Infrastructure or equipment on the network to enable Cooperative-ITS 6) Intelligent safety services for disabled and vulnerable road users Report separately by road type or area where possible, see breakdown by classification section.
Definition	• **Information gathering infrastructures:** Any road based ITS offering traffic monitoring, weather or environmental conditions monitoring, emissions monitoring or planning and forecasting of traffic conditions. • **Traffic information services**: Any road based ITS offering dynamic information and incident warning capabilities. • **Traffic management plan:** A pre-defined allocation of a set of measures to a specific situation in order to control and guide traffic flows as well as to inform road-users in real-time and provide a consistent and timely service to the road user. Initial situations can be unforeseeable (incidents, accidents) or predictable (recurrent or non-recurrent events). The measures are always applied on a temporary basis.[20] • **Traffic management and control:** Any road based ITS controlling traffic movement, hard shoulder running, ramp metering, HGV overtaking ban, variable speed limits. It also includes parking management. • **Cooperative ITS:** Any road based ITS infrastructure to facilitate infrastructure to vehicle or vehicle to infrastructure communication as well as autonomous systems. • **Intelligent Safety Provision:** Any road based ITS facilitating improved road safety for disabled and vulnerable road users, such as smart pedestrian crossings.
Calculation	KPI = (Kilometres of road network for which ITS type X is available / Kilometres of road network) x 100
Presentation	To be presented in number (length in km) and percentage format. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Comprehensive coverage of different types of ITS
Weaknesses	• Includes various ITS types, therefore would not isolate the deployment of specific ITS interventions • Large data collation required
Opportunities	• As cooperative ITS services roll out, increasing ability for services to be self-reporting and to reduce challenges of data sourcing and KPI reporting
Threats	• Difficulty in consistent definitions across EU. • Cross border requirements for traffic management plans may make reporting more challenging

[20] Traffic Management Services – Traffic management plays for corridors and networks – Deployment Guideline. EASYWAY, 2012

Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	Contributes to the following objectives: • Continuity of traffic and freight management ITS Services • Optimal Use of road traffic and travel data • ITS road safety and security applications • Linking the vehicle with the transport infrastructure
Constraints in aggregation to EU level	Variations in definitions may affect ability to aggregate to EU level.
Taxonomy Coverage (Level 2)	• Traffic Management and Control • On-Trip traffic & travel Information • Information Infrastructures
Road Type	All road types and urban areas
Data Requirements	
Source	List of ITS deployed by category associated with the road network, length and road type
Ownership	Data held by road authorities and service providers.
Frequency	Data to be reviewed on an annual basis.

KPI Details: Deployment	
Reference Number	C4
Short Name	Adaptive Traffic Control or prioritisation
Long Name	Number and % of signal controlled road intersections using adaptive traffic control or prioritisation. Report separately by road type or area where possible, see breakdown by classification section.
Definition	• **Signal Controlled road intersection**: Any signalised junction between two or more roads including signalised roundabouts. • **Adaptive Traffic Control:** Any ITS technology controlling junction flow that is able to adapt to traffic levels or prioritise certain movements and certain vehicle fleets / type of users. This could include technologies such as SCOOT[21] or MOVA[22].
Calculation	KPI = (Number of road intersections on network type X with adaptive traffic control or prioritisation / Number of road intersections on network type X) x 100
Presentation	To be presented in number and percentage format and reported by road type/ area where possible. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Assesses the prevalence of adaptive traffic control and prioritisation at a junction level • Applicable to a number of different technologies
Weaknesses	• Only relates to junctions, rather than road links • Reliant on technologies applied at a junction level
Opportunities	• May support integration between networks
Threats	• Inclusion of standalone technologies in the KPI definition (such as MOVA) may imply a greater level of central network control than actually exists affecting interpretation of KPI results by policy makers.
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	Contributes to the following objectives: • Continuity of traffic and freight management ITS Services
Constraints in aggregation to EU level	None
Taxonomy Coverage (Level 2)	• Traffic Management and Control
Road Type	All road types and urban areas
Data Requirements	
Source	List of all signal controlled intersections on a specific network type indicating the type of technology used to control traffic movements.
Ownership	Data held by roads authority / traffic control centres
Frequency	Data to be reviewed on an annual basis.

[21] http://www.scoot-utc.com/

[22] https://trlsoftware.co.uk/products/traffic_control/mova

KPI Details: Deployment	
Reference Number	L3
Short Name	Intelligent vehicles
Long Name	Number and % of new vehicles including the following intelligent vehicle features. Report separately for: 1) safety readiness 2) automated operation 3) cooperative systems 4) Public (112) systems 5) Private eCall systems Report separately by vehicle types where possible, see breakdown by vehicle classification section.
Definition	• **New vehicles**: The number of vehicles that have entered into use in a Member State during the year. This could be the number of vehicles sold by manufacturers or the number registered by the government, depending upon the most appropriate source of this data. • **Intelligent Vehicle features**: Any technology which facilitates safety readiness, automated operation, cooperative systems or eCall • **Safety Readiness:** Any in vehicle technology which facilitates safety benefits. Examples include Alcohol Interlocks, Adaptive Headlights, Local Danger Warnings, Collision avoidance and automated breaking, Lane keeping and blindspot monitoring. • **Automated operation:** Any in vehicle technology that facilitates automated operation. This could include automated parking and platooning capabilities, but must be beyond the capabilities outlined in Safety Readiness. SAE international standard J3016 provides further details of what constitutes automated operation. • **Cooperative systems:** Any technology utilising infrastructure to vehicle, vehicle to infrastructure or vehicle to vehicle cooperation in determining vehicle behaviour. • **eCall**: referred to in EU Directive 2010/40/EU as 'interoperable EU-wide eCall') means an in-vehicle emergency call to 112, made either automatically by means of the activation of in- vehicle sensors or manually, which carries a standardised minimum set of data and establishes an audio channel between the vehicle and the eCall PSAP via public mobile wireless communications networks.[23]
Calculation	KPI = (Number of new vehicles with intelligent vehicle feature X / Number of new vehicles) x 100
Presentation	To be presented in number and percentage format for a calendar year. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Provides a good understanding of the proliferation of intelligent vehicle features amongst new cars.
Weaknesses	• Does not take account of the historic fleet or retrofitted technologies and nomadic devices.
Opportunities	• List can be expanded to include additional technologies as technologies evolve. • Manufacturers can provide data directly at a EU level and are likely to have access to the most detailed data.

[23] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0305&from=EN

Threats	• Technologies may not always be comprehensively recorded as part of vehicle registrations or sales records • Keeping the list of technologies up to date may be challenging in a fast moving market • Technologies may be able to be 'enabled' or 'expanded' by future software updates to existing registered cars that would then not be included in the registration or original sales records • Manufacturers may not accurately report what technologies are deployed to protect commercial positions
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	Contributes to the following objectives: • ITS road safety and security • Linking the vehicle with the transport infrastructure
Constraints in aggregation to EU level	The level of detail recorded in vehicle registrations may vary by EU Member State.
Taxonomy Coverage (Level 2)	• Safety Readiness • Automated Vehicle Operation • Co-operative Systems
Road Type	N/A
Data Requirements	
Source	List of vehicle registrations or vehicles sold listing compliant ITS technologies included within the vehicles.
Ownership	Data held by national governments, vehicle manufacturers, distributors and trade organisations.
Frequency	Data to be reviewed on an annual basis.

KPI Details: Deployment	
Reference Number	S11
Short Name	Intelligent Services in accordance to Delegated Regulations under the ITS Directive
Long Name	Provision of intelligent services on the TENT-T core and comprehensive networks that are compliant with the Delegated Regulations of the ITS Directive: 1) Length and % of TEN-T network covered by real-time traffic information services that are compliant with the requirements of Delegated Regulation xx/2015 2) Length and % of TEN-T network covered by road safety related traffic information services available free of charge to users that are compliant with the requirements of Delegated Regulation 886/2013 3) Length and % of TEN-T network covered by information services for safe and secure parking places for trucks and commercial vehicles that are compliant with the requirements of Delegated Regulation 885/2013.
Definition	Please see the '*Directive 2010/40/EU on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport*'[24] and its Delegated Regulations for precise definitions of the above technologies and the standards required to be in compliance with the Directive and its Delegated Regulations
Calculation	KPI = (Number of intelligent services of type X in accordance with the ITS Directive and its Delegated Regulations / Number of intelligent services of type X) x 100
Presentation	To be presented in number and percentage format. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Assessed levels of deployment of intelligent services, data and procedures. • Allows levels of compliance with the ITS Directive and its Delegated Regulations to be assessed
Weaknesses	• Only relates to the TEN-T network
Opportunities	• Changes could be made in the future to reflect additional regulations.
Threats	• Once Member States are fully compliant with the requirements of the Delegated Regulations this KPI may become obsolete.
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	Contributes to the following objectives: • ITS road safety and security applications • Optimal Use of road traffic and travel data
Constraints in aggregation to EU level	None
Taxonomy Coverage (Level 2)	• Transport Related Emergency Notification and Personal Security • Road Safety Related Traffic Information • Disaster Response Management
Road Type	TEN-T core and comprehensive network[25]
Data Requirements	

[24] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010L0040

[25] Definition of TEN-T network, regulations and maps available at the below: http://ec.europa.eu/transport/themes/its/road/action_plan/index_en.htmhttp://ec.europa.eu/transport/themes/infrastructure/ten-t-guidelines/legal-basis_en.htm

Source	List of ITS deployed including information regarding compliance with Delegated Regulations, associated with the TEN-T network and network length.
Ownership	Data held by roads authorities, road / parking operators and service providers
Frequency	Data to be reviewed on an annual basis.

4.1 Recommended Benefit KPI Pro-formas

KPI Details: Benefits	
Reference Number	N1
Short Name	Change in journey time
Long Name	% change in peak period journey time along routes where ITS has been implemented. Report separately by vehicle type where possible, see breakdown by vehicle classification section.
Definition	• **Peak period**: The period or hour with the highest flow during a weekday. The period used can vary by route, but must be fixed between before and after surveys. • **Vehicle Types**: All (but a disaggregation by vehicle type can also be provided if appropriate, see breakdown by vehicle classification section) • **Routes where ITS has been implemented:** Member States should specify which routes will be included within this KPI. This could be based upon those outlined in the associated Deployment KPIs, but sufficient data is unlikely to be available in all instances. The selection of key points between which the journey time change will be measured should be defined in relation to the nature of the ITS implemented on the route. Typically this would be the journey time between key junctions.
Calculation	KPI = ((Journey time before ITS implementation – Journey time after ITS implementation) / Journey time before ITS implementation) *100
Presentation	Percentage change before and after to be presented alongside list of ITS deployment locations used in the calculation. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Can be assessed using standard transport monitoring methodologies. • Should allow any journey time benefits resulting from ITS to be quantified.
Weaknesses	• May require additional data collection and associated costs. • Requires data collection before and after implementation of ITS –this may be an issue where ITS is newly implemented or when past data have not been collected / are not available.
Opportunities	• Alignment with ITS deployment should improve attribution of benefits. • System generated data may be available to calculate this KPI post system implementation, though comparing information from different sources may be challenging
Threats	• Other factors in additional to ITS may influence journey time – e.g. traffic growth, and inability to disaggregate impact of ITS may call ITS deployment into question.
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	• Measure of network efficiency and congestion.
Constraints in aggregation to EU level	In some instances this will require additional data collection, but there should be no constraints in the aggregation of results at Member State and EU levels.
Road Type	All road types where ITS have been implemented
Data Requirements	
Source	Journey time survey data – e.g. ANPR or Bluetooth. As technologies develop floating vehicle and crowd sourced data may be available to allow calculation of this KPI without the requirement for specific data collection. Size of sample required to be determined based upon variation in results.
Ownership	Data likely to be owned by roads authority / toll road operator and PT operators.
Frequency	Data to be collected immediately before and after implementation of the ITS improvement with continued monitoring carried out on an annual basis during a neutral month.

KPI Details: Benefits	
Reference Number	N2
Short Name	Change in flow
Long Name	% change in peak hour traffic flow along routes where ITS has been implemented. Report separately by vehicle type where possible, see breakdown by vehicle classification section.
Definition	• **Traffic Flow:** The number of vehicles passing a set point in the transport network within a given period of time. • **Peak period**: The period or hour with the highest flow during a weekday. The period used can vary by route, but must be fixed between before and after surveys. • **Vehicle Types**: All (but a disaggregation by vehicle type can also be provided if appropriate) • **Routes where ITS has been implemented:** Member States should specify which routes will be included within this KPI. This could be based upon those outlined in the associated Deployment KPIs, but sufficient data is unlikely to be available in all instances. The selection of key points between which the change in traffic flow will be measured should be defined in relation to the nature of the ITS implemented on the route. Typically this would be the flow between key junctions.
Calculation	KPI = ((Flow before ITS implementation – Flow after ITS implementation) / Flow before ITS implementation) *100
Presentation	Percentage change before and after to be presented. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Can be assessed using standard transport monitoring methodologies. • Should allow any road capacity benefits resulting from ITS to be quantified.
Weaknesses	• May require additional data collection and associated costs. • Requires data collection before and after implementation of ITS –this may be an issue where ITS has already been implemented.
Opportunities	• Alignment with ITS deployment should improve attribution of benefits. • System generated data may be available to calculate this KPI post system implementation, though comparing information from different sources may be challenging.
Threats	• Other factors in additional to ITS may influence traffic flow – e.g. traffic growth, and inability to disaggregate impact of ITS may call ITS deployment into question..
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	• Measure of network efficiency and congestion.
Constraints in aggregation to EU level	In some instances this will require additional data collection, but there should be no constraints in the aggregation of results to member state and EU level.
Road Type	All road types where ITS have been implemented
Data Requirements	
Source	Traffic flow data collected via automated traffic counters, manual traffic counts or directly recorded by the ITS itself. Where possible this data should be broken down by vehicle type. In the future crowd sourced data may be available to establish this KPI.
Ownership	Data likely to be owned by roads authority or toll road operator.
Frequency	Data to be collected immediately before and after implementation of the ITS improvement with continued monitoring carried out on an annual basis during a neutral month.

KPI Details: Benefits	
Reference Number	N4
Short Name	Change in road traffic journey time variability
Long Name	% change in journey time variability on routes where ITS has been implemented -as measured coefficient of variation. Report separately by vehicle type where possible/relevant, see breakdown by vehicle classification section.
Definition	• **Journey times**: The time it takes to go between set points along a route • **Journey time variability**: A measure of the level of variability of journey times at a section of road through time. • **Coefficient of variation**: The ratio of the standard deviation between observed journey times against the mean journey time. • **Vehicle Types**: All (but a disaggregation by vehicle type can also be provided if appropriate) • **Routes where ITS has been implemented:** Member States should specify which routes will be included within this KPI. This could be based upon those outlined in the associated Deployment KPIs, but sufficient data is unlikely to be available in all instances. The selection of key points between which the journey time variability will be measured should be defined in relation to the nature of the ITS implemented on the route. Typically this would be the journey time variability between key junctions.
Calculation	Coefficient of variation = Standard Deviation of journey time observations/mean journey time observation KPI = ((Coefficient of variation before ITS implementation –Coefficient of variation after ITS implementation) / Coefficient of variation before ITS implementation) *100
Presentation	Percentage change before and after to be presented. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Can be assessed using standard transport monitoring methodologies. • Should allow journey time reliability impacts resulting from ITS to be quantified.
Weaknesses	• May require additional data collection and associated costs. • Requires data collection before and after implementation of ITS –this may be an issue where ITS has already been implemented.
Opportunities	• Alignment with ITS deployment should improve attribution of benefits. • System generated data may be available to calculate this KPI post system implementation, though comparing information from different sources may be challenging.
Threats	• Other factors in additional to ITS may influence journey time reliability – e.g. changes in traffic volumes, and inability to disaggregate impact of ITS may call ITS deployment into question.
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	• Measure of network efficiency and congestion.
Constraints in aggregation to EU level	In some instances this will require additional data collection, but there should be no constraints in the aggregation of results to member state and EU level.
Road Type	All road types where ITS have been implemented
Data Requirements	
Source	Journey time survey data – e.g. ANPR, Bluetooth, floating vehicle. A number of journey time runs will be required to establish levels of variability. Crowd sourced data may be available in the future to accurately record journey time variability impacts.
Ownership	Data likely to be owned by roads authority / toll road operator and public transport operators.
Frequency	Data to be collected immediately before and after implementation of the ITS improvement with continued monitoring carried out on an annual basis during a neutral

	month.
KPI Details: Benefits	
Reference Number	N9
Short Name	Change in mode share
Long Name	% change in mode share on corridors where ITS has been implemented. Report percentage mode share separately for each mode, see breakdown by vehicle classification section.
Definition	• **Modes:** The method of transport used, i.e. walking, cycling, cars and light vehicles, trucks and commercial vehicles, bus, tram and train. All relevant modes should all be reported. Whether to include certain modes of transport is likely to be dependent upon the corridor geography, for example walking and cycling are not likely to be significant modes on an inter-urban corridor. • **Mode share**: The percentage of journeys on a corridor undertaken by a specific mode of transport. • **Corridors where ITS has been implemented:** A key route between two places. This could be a road but can also be widened to include public transport routes, such as rail lines. Member States should specify the multi-modal corridors that will be included within this KPI and the points between which mode share will be measured. This could be based upon locations outlined in the associated Deployment KPIs, but it is not anticipated that sufficient data will be available to calculate this KPI in all instances.
Calculation	KPI = ((Mode share of mode X before ITS implementation – Mode share of mode X after ITS implementation) / Mode share of mode X before ITS implementation) *100
Presentation	Percentage change before and after to be presented. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Should allow mode share impacts resulting from ITS to be quantified.
Weaknesses	• May require significant additional data collection and associated costs. • There may be methodological issues in designing a survey to include all transport modes. • Requires data collection before and after implementation of ITS –this may be an issue where ITS has already been implemented.
Opportunities	Alignment with ITS deployment should improve attribution of benefits.
Threats	• Other factors in additional to ITS may influence journey time reliability – e.g. changes in traffic volumes, and inability to disaggregate impact of ITS may call ITS deployment into question. • Definition of appropriate multi-modal corridors may be difficult
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	Measure of: • Network efficiency and congestion • Improve environmental impacts • Enhance modal integration
Constraints in aggregation to EU level	This is likely to require additional data collection, but there should be no constraints in the aggregation of results at Member State and EU levels.
Road Type	All corridors where ITS have been implemented
Data Requirements	
Source	Bespoke surveys of flows by mode. This would include a classified traffic and vehicle occupancy count for road transport modes as well as on vehicle or boarding and alighting surveys for public transport modes.
Ownership	Data likely to be required from a number of sources including roads authorities and public transport operators.
Frequency	Data to be collected immediately before and after implementation of the ITS improvement with continued monitoring carried out on an annual basis during a neutral month.

KPI Details: Benefits	
Reference Number	S1
Short Name	Change in accident numbers and severity
Long Name	% change in number of reported accidents along routes where ITS has been implemented. Report separately by accident severity where possible.
Definition	**Reported accidents**: The number of accidents of all severities on a route as reported by the emergency services. **Routes where ITS has been implemented:** Member States should specify which routes will be included within this KPI and the points between which accident numbers will be measured. This could be based upon those outlined in the associated Deployment KPIs. **Accident severity**: Accidents should also be reported based upon their severity (fatalities, serious injuries, light injuries) where possible following the latest definitions used as part of the Community database on Accidents on the Roads in Europe (CARE)[26]. The CADAS glossary also provides guidance in the calculation of these statistics.[27]
Calculation	KPI = ((Number of accidents before ITS implementation – Number of Accidents after ITS implementation) / Number of accidents before ITS implementation) *100
Presentation	Percentage change before and after to be presented alongside absolute number of accidents. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Accident numbers and severity likely to be recorded as standard. • Should allow accident reductions and severity reductions resulting from ITS to be quantified.
Weaknesses	• Requires data collection before and after implementation of ITS –this may be an issue where ITS has already been implemented.
Opportunities	• Alignment with ITS deployment should improve attribution of benefits. • Total number of accidents and number of fatalities should be comparable across all Member States.
Threats	• Other factors in additional to ITS may influence accident levels and severity – e.g. changes to road and vehicle design, and inability to disaggregate impact of ITS may call ITS deployment into question. • Variations in classification of accident severities across Member States may affect comparability.
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	• Improve Road Safety
Constraints in aggregation to EU level	Variations in approach to reporting of accidents across Member States may make direct comparisons between Member States more difficult.
Road Type	All road types where ITS have been implemented
Data Requirements	
Source	Accident records including accident location and severity.
Ownership	Accident data collected by emergency services.
Frequency	Data to be collected immediately before and after implementation of the ITS improvement with continued monitoring carried out on an annual basis during a neutral month.

[26] http://ec.europa.eu/idabc/en/document/2281/5926.html

[25] http://ec.europa.eu/transport/road_safety/pdf/statistics/cadas_glossary.pdf

KPI Details: Benefits	
Reference Number	E1
Short Name	CO_2 emissions
Long Name	% change in annual CO_2 emissions (Tons) on routes where ITS has been implemented.
Definition	**CO^2 emissions**: The amount of carbon dioxide emitted collectively by the vehicles utilising a route. This should be aggregated up to produce an annual figure. For transport CO_2 emissions are typically estimated based upon fuel consumption at the pump and therefore cannot easily be directly measured at a network level. At a network level emissions are therefore typically inferred based upon traffic flows, speeds and assumptions regarding average vehicle efficiency per kilometre for the different vehicle types using a route. Where available national guidance should be used in the calculation of CO^2 emissions to take account of variations in national vehicle fleet makeup. Where suitable national guidance does not exist UK guidance provides an appropriate starting point[28]. **Routes where ITS has been implemented:** Member States should specify which routes will be included within this KPI and the points between which carbon emissions will be calculated. This could be based upon those outlined in the associated Deployment KPIs.
Calculation	KPI = ((CO_2 emissions before ITS implementation – CO_2 emissions after implementation) / CO_2 emissions before ITS implementation)*100
Presentation	Average percentage change before and after to be presented. Time-series data to be presented as a line graph.
SWOT Analysis	
Strengths	• Can be measured using flow and journey time data collected as part of KPIs N1 and N2. • Should allow carbon emission impacts resulting from ITS to be quantified.
Weaknesses	• Requires data collection before and after implementation of ITS –this may be an issue where ITS has already been implemented. • At a network level CO_2 emissions can only be inferred from other measures of network performance and assumptions of vehicle fuel efficiency. This information may not be available for all routes and assumptions of average vehicle efficiency would not be the same for all Member States.
Opportunities	• Alignment with ITS deployment should improve attribution of benefits.
Threats	• Other factors in additional to ITS may influence carbon emissions – e.g. changes in fuel efficiency of vehicles. • Variations in fleet makeup in different areas may make establishment of suitable average vehicle efficiency values difficult.
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	• Improve environmental impacts
Constraints in aggregation to EU level	Variations in fleet makeup in different countries may make establishment of suitable average vehicle efficiency values difficult
Road Type	All road types where ITS have been implemented
Data Requirements	
Source	Recording of CO^2 emissions in not likely to be possible at a network level. This KPI will therefore need to be inferred based upon traffic data on flow, length and journey time, which may have been collected as part of KPIs N1 and N2. Assumptions on average

[28] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/313823/webtag-tag-unit-a3-environmental-impact-appraisal.pdf

	vehicle type fuel efficiencies will also be required and may be available from national guidance. These can also be calculated from vehicle registration data.
Ownership	Traffic data held by roads authorities, vehicle efficiency information held by vehicle manufacturers and as part of vehicle registration.
Frequency	Data to be collected immediately before and after implementation of the ITS improvement with continued monitoring carried out on an annual basis during a neutral month.

KPI Details: Benefit	
Reference Number	L9
Short Name	Public eCall timeliness
Long Name	Time taken between initiation of public (112) eCall to the presentation of the content of MSD in an intelligible way at the operator's desk in the Public Safety Answering Point.
Definition	• **eCall**: referred to in EU Directive 2010/40/EU as 'interoperable EU-wide eCall') means an in-vehicle emergency call to 112, made either automatically by means of the activation of in- vehicle sensors or manually, which carries a standardised minimum set of data and establishes an audio channel between the vehicle and the eCall PSAP via public mobile wireless communications networks.[29] • **Public Safety Answering Point** (PSAP): A physical location where emergency calls are first received under the responsibility of a public authority or a private organisation recognised by the Member State. • **Minimum set of data (MSD)**: The information defined by the standard 'Road transport and traffic telematics – eSafety – eCall minimum set of data (MSD)' (EN 15722) which is sent to the eCall PSAP.
Calculation	KPI = Average time (seconds) from emergency response call made with public (112) eCall to presentation of the content of MSD in an intelligible way at the operator's desk in the PSAP.
Presentation	To be presented in time format. Time-series data to be presented as a line graph. Proliferation of eCall amongst vehicles from KPI K3 should also be presented alongside this to provide context.
SWOT Analysis	
Strengths	• Ascertains the benefits of use of eCall in terms of response time.
Weaknesses	• Does not compare the timeliness of eCall against the alternative of a manual telephone call.
Opportunities	• KPI could be expanded to include other non-standardised automated call/sms technologies.
Threats	• KPI may become less informative as eCall becomes standardised.
Rationale and Coverage	
Rationale (contribution to White Paper and ITS Action Plan)	Contributes to the following objectives: • ITS road safety and security applications
Constraints in aggregation to EU level	There should be no constraints in aggregation to EU level.
Taxonomy Coverage (Level 2)	• Safety Readiness
Road Type	N/A
Data Requirements	
Source	Will require data on the average time taken between initiation of public (112) ecall and arrival of an automated message at the PSAP.
Ownership	PSAP

[29] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0305&from=EN

Frequency	Data to be reviewed on an annual basis.

Appendices

Appendix A: Questionnaire Survey

Key Performance Indicators for Intelligent Transport Systems

Introduction

DG MOVE of the European Commission has commissioned consultants AECOM to carry out a study looking at current levels of use across Europe of Key Performance Indicators (KPIs) within the field of Intelligent Transport Systems (ITS), with the aim of developing a consistent set of KPIs that can be used by different stakeholders across Europe to monitor, assess and report on ITS performance.

As an individual expert or organisation active within the field of ITS, we are seeking your input to this study through this survey which will ask you about data collection, the metrics or indicators used to monitor ITS deployment and assess ITS performance, and your views on common KPIs that could be used in the future.

As part of the study we are interested in all aspects of ITS performance, this includes but is not limited to the following areas:
- Levels of deployment of ITS services and systems, e.g. the extent of systems deployed and network covered by ITS.
- Impacts on end users, e.g. service quality.
- Area wide impacts, e.g. reduction in congestion, reduction in accidents.
- Operator impacts, e.g. cost efficiency, return on investment.

Once completed please return to: stephen.payne@aecom.com

Please provide the following details:

Name: _____

Organisation Name: _____

Email: _____

Telephone Number: _____

About you/ your organisation

Q1 Which of the following best describes the type of organisation you represent?

Tick one only

- ❑ 1 EU Institution
- ❑ 2 National Roads Authority
- ❑ 3 Regional Roads Authority
- ❑ 4 Local Roads Authority
- ❑ 5 Local Transport / Public Transport Authority
- ❑ 6 Public Transport Operator
- ❑ 7 Road Operator
- ❑ 8 Freight Operator
- ❑ 9 Non-Governmental Organisation
- ❑ 10 ITS Service Provider
- ❑ 11 ITS Association
- ❑ 12 Vehicle / Component Manufacturer
- ❑ 13 Academic / Research Organisation
- ❑ 14 Independent Expert
- ❑ 15 Other (Please specify)

Other (please specify)

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Q2a In which of the following countries do you operate?

Tick all that apply

- ❑ 1 Austria
- ❑ 2 Belgium
- ❑ 3 Bulgaria
- ❑ 4 Croatia
- ❑ 5 Cyprus
- ❑ 6 Czech Republic
- ❑ 16 Latvia
- ❑ 17 Lithuania
- ❑ 18 Luxembourg
- ❑ 19 Malta
- ❑ 20 Netherlands
- ❑ 21 Poland

- ❑ 7 Denmark
- ❑ 8 Estonia
- ❑ 9 Finland
- ❑ 10 France
- ❑ 11 Germany
- ❑ 12 Greece
- ❑ 13 Hungary
- ❑ 14 Ireland
- ❑ 15 Italy
- ❑ 22 Portugal
- ❑ 23 Romania
- ❑ 24 Slovakia
- ❑ 25 Slovenia
- ❑ 26 Spain
- ❑ 27 Sweden
- ❑ 28 United Kingdom
- ❑ 29 All of the above
- ❑ 30 Other (please specify)

Other (please specify)

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Q2b How would you classify the network on which your ITS activity is focused?

Tick one only

- ❑ 1 Urban streets and arteries
- ❑ 2 Interurban highways / motorways
- ❑ 3 Secondary roads
- ❑ 4 Public transport network
- ❑ 5 Multimodal network
- ❑ 6 Other (please specify)
- ❑ 7 Not applicable

Other (please specify)

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Q3a Which of the following best describes the types of Intelligent Transport Services that you or your organisation is involved in / interested in?

Tick all that apply

Traffic Management and Operations Services

- ❑ Traffic Management and Control
- ❑ Incident Management
- ❑ Demand Management
- ❑ Transport Infrastructure Maintenance Management
- ❑ Policing / Enforcement

Road Transport Personal Safety and Security

- ❑ Emergency notification (accidents / eCall)
- ❑ Emergency notification (weather / disaster)
- ❑ Management of sensitive road sections
- ❑ Safety Enhancements for Vulnerable Road Users

Intelligent Vehicle Services

- ❑ Advance Driver Assistant Systems (e.g. collision warning, adaptive cruise control, emergency braking systems, electronic stability)

- ❑ Automated Vehicle Operation
- ❑ Cooperative Systems (V2V / V2I)

Freight and Logistics

- ❑ Management of Dangerous / Abnormal Freight
- ❑ Intelligent Truck Parking
- ❑ Positioning and tracing services

Transport-related Electronic Payment services

- ❑ Electronic road tolling
- ❑ Public transport electronic payment
- ❑ Integration of Transport Related Electronic Payment Services
- ❑ Fare management

Public Transport ITS Services

- ❑ Public Transport Management
- ❑ Demand Responsive and Shared Transport

Information Services

- ❑ Travel information pre-trip (e.g. journey planner, website, call centre)
- ❑ Travel information on-trip (e.g. VMS, apps, radio, on board navigation)
- ❑ Passenger terminals information
- ❑ Real time traffic information Services
- ❑ Road safety related traffic information / incident warning
- ❑ Multimodal / co-modal information

Other

- ❑ Other (Please specify)

Other (please specify)

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Q3b **In your own words, please describe the type/s of Intelligent Transport Services you are involved in.**

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Data Collection

Q4 **What information (e.g. data, metrics or indicators) do you collect / use to monitor the extent of deployment of products / services around Intelligent Transport Systems**

Please provide as much detail as possible including examples, units, formulas etc, or if you prefer please provide links to any relevant documentation.

Q5 **What information (e.g. data, metrics or indicators) do you collect / use to monitor the performance / success of products / services around Intelligent Transport Systems?**

Please provide as much detail as possible including examples, units, formulas etc, or if you prefer please provide links to any relevant documentation. If you combine different data sets or metrics together to form indicators please indicate the different elements used and how these are combined.

Q6 **Of the information you describe, which information is most useful to you and why?**

Please list appropriate information and provide rationale

Q7 For what purpose do you use the information previously mentioned?

Tick all that apply or write in if the answer you wish to give is not listed

- ❑ 1 To monitor / assess deployment
- ❑ 2 To monitor / asses performance
- ❑ 3 To identify gaps in provision
- ❑ 4 To benchmark against other
- ❑ 5 Other (please specify)
- ❑ 6 None of the above

Other (please specify)

Q8a What datasets and sources of information are collected / used for measuring performance / benefits of ITS by you / your organisation

Please list all relevant data sources e.g. traffic counts, vehicle journey times, website visits etc and indicate which types of ITS services or systems they have been used for

Q8b How frequently is the data described in Q8a collected?

Please tick the most appropriate of the below

- ❑ 1 Continuous data
- ❑ 2 Every minute or less
- ❑ 3 Hourly
- ❑ 4 Daily
- ❑ 5 Weekly
- ❑ 6 Monthly
- ❑ 7 Annually
- ❑ 8 Other (please write in)

Other (please write in)

Q8c Roughly, how long is this data kept for?

Please tick the most appropriate of the below

- ❑ 1 A day or less
- ❑ 2 A week
- ❑ 3 A month
- ❑ 4 A year
- ❑ 5 Longer than a year

Q9 Who collects the data you use?

Tick all that apply

- ❑ 1 Public sector (e.g. data collected by local authority)
- ❑ 2 Private contractor (e.g. data collected by a road concessionaire / operator)
- ❑ 3 Privately collected (e.g. floating car data, vehicle generated data)
- ❑ 4 Internally collected (e.g. internal bespoke data collection exercises)
- ❑ 5 ITS systems (e.g. data collected and reported automatically)
- ❑ 6 Other (please specify)

Other (please specify)

_____

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Q10a Do you publish the findings of the performance monitoring methods you describe?

Tick one only

- ❑ 1 Yes - internally
- ❑ 2 Yes - publically
- ❑ 3 Both - internal and externally
- ❑ 4 No

Q10b If Yes, please provide a web link

_____

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Q10c If No, are there are any data privacy issues preventing publication?

Tick one only

- ❑ 1 No
- ❑ 2 Yes (please specify)

Yes (please specify)

Q11 **For which of the following areas do you publish performance monitoring?**

Tick all that apply

- ❑ 1 Technology deployment (e.g. number of speed cameras installed)
- ❑ 2 System functionality (e.g. time out of service)
- ❑ 3 Service deployment (e.g. active travel plan websites)
- ❑ 4 Service provision (including quality / level of service)
- ❑ 5 User benefits (e.g. reduction in journey times)
- ❑ 6 Network benefits (e.g. reduction in traffic congestion)
- ❑ 7 Policy achievement (e.g. achievement of policy goals / targets)
- ❑ 8 Return on investment (including indicators of financial sustainability / contribution)
- ❑ 9 Wider economic impacts (e.g. jobs created, Gross Value Added)
- ❑ 10 Other (please specify)

Other (please specify)

Q12a **Do you compare / benchmark ITS performance, benefits and deployment / usage with other EU Member States?**

Tick one only

- ❑ 1 Yes
- ❑ 2 No

Q12b **Please specify the main reasons preventing comparison / benchmarking.**

Q12c **Do you compare / benchmark ITS performance, benefits and deployment / usage with other ITS service providers?**

Tick one only

- ❑ 1 Yes
- ❑ 2 No

Q12d **Please specify the main reasons preventing comparison / benchmarking.**

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Q13 **Focusing on the data you require / use to measure the performance / benefits of ITS by you / your organisation. How would you rate the following?**

Please tick one for each statement

	Very good	Good	Neutral	Poor	Very poor	Don't know / Not applicable
Quality of the data currently available	❑	❑	❑	❑	❑	❑
Completeness of the data currently available	❑	❑	❑	❑	❑	❑
Geographic coverage of the data currently available	❑	❑	❑	❑	❑	❑
Frequency of collection for data currently available	❑	❑	❑	❑	❑	❑
Consistency of data currently available for measuring performance of ITS over time	❑	❑	❑	❑	❑	❑
Consistency of data currently available for measuring performance of ITS across EU Member States	❑	❑	❑	❑	❑	❑
Consistency of data currently available for measuring performance of ITS across networks	❑	❑	❑	❑	❑	❑
Ease of obtaining the data	❑	❑	❑	❑	❑	❑
Ease of processing the data into KPIs for ITS	❑	❑	❑	❑	❑	❑
Affordability of obtaining the data	❑	❑	❑	❑	❑	❑
Affordability of processing the data into KPI for ITS	❑	❑	❑	❑	❑	❑
Ability to assess the performance / success of ITS from different stakeholders perspectives	❑	❑	❑	❑	❑	❑
Ability to benchmark performance ITS between EU Member States	❑	❑	❑	❑	❑	❑

Evolution of ITS performance monitoring

Q14 How important do you consider monitoring performance of each of the following areas to be?

Please tick one for each statement

	Very important	Somewhat important	Neutral	Not important	Not at all important	Don't know / Not applicable
Technology deployment (e.g. number of speed cameras installed)	❑	❑	❑	❑	❑	❑
System functionality (e.g. time out of service)	❑	❑	❑	❑	❑	❑
Service deployment (e.g. active travel plan websites)	❑	❑	❑	❑	❑	❑
Service provision (including quality / level of service)	❑	❑	❑	❑	❑	❑
User benefits (e.g. reduction in journey times)	❑	❑	❑	❑	❑	❑
Network benefits (e.g. reduction in traffic congestion)	❑	❑	❑	❑	❑	❑
Wider economic impacts (e.g. jobs created, Gross Value Added)	❑	❑	❑	❑	❑	❑
Policy achievement (e.g. achievement of policy goals / targets)	❑	❑	❑	❑	❑	❑
Return on investment (including indicators of financial sustainability / contribution)	❑	❑	❑	❑	❑	❑

Q15 Is there anything related to Intelligent Transport Systems that you do not currently monitor / measure / assess that you think should be monitored / measured / assessed?

Tick one only

❑ 1 No

❑ 2 Yes (please specify including reasons)

Yes (please specify including reasons)

Q16a **What, if anything, prevents you from measuring ITS performance, benefits and deployment / usage more often or to a higher quality?**

Tick all relevant

- ❑ 1 Lack of available data
- ❑ 2 Fragmentation and incompatibility of data
- ❑ 3 Lack of finance / funding
- ❑ 4 Lack of staff resources
- ❑ 5 Lack of knowledge / skills
- ❑ 6 Unsure of benefits
- ❑ 7 Lack of guidance / best practice
- ❑ 8 Complexity
- ❑ 9 Lack of co-operation with other stakeholders
- ❑ 10 Other (please specify)
- ❑ 11 Nothing

Other (please specify)

Q16b **Which <u>ONE</u> prevents you the most from measuring ITS performance, benefits and deployment / usage more often to a higher quality?**

Tick the main one

- ❑ 1 Lack of available data
- ❑ 2 Fragmentation and incompatibility of data
- ❑ 3 Lack of finance / funding
- ❑ 4 Lack of staff resources
- ❑ 5 Lack of knowledge / skills
- ❑ 6 Unsure of benefits
- ❑ 7 Lack of guidance / best practice
- ❑ 8 Complexity
- ❑ 9 Lack of co-operation with other stakeholders
- ❑ 10 Other (please specify)

Other (please specify)

Q17a **What are the main barriers to establishing consistent metrics / indicators for measuring performance of Intelligent Transport Systems across Europe?**

Tick all relevant

- ❑ 1 Lack of available data
- ❑ 2 Data is not recorded in comparable formats (please provide details below)
- ❑ 3 Lack of finance / funding
- ❑ 4 Lack of staff resources
- ❑ 5 Lack of knowledge / skills
- ❑ 6 Difference in system specifications across Europe (please provide details below)
- ❑ 7 Lack of guidance / Best practice
- ❑ 8 Lack of co-operation with interested parties
- ❑ 9 Other (please specify)
- ❑ 10 None

Other (please specify)

_____

_____

_____

Data is not recorded in comparable formats - Please provide details

_____

_____

_____

Difference in system specifications across Europe - Please provide details

_____

_____

_____

Q17b **Of the barriers listed, which <u>ONE</u> is the main barrier to establishing consistent metrics / indicators for measuring performance of Intelligent Transport Systems across Europe**

Tick the main one

- ❑ 1 Lack of available data
- ❑ 2 Data is not recorded in compatible formats
- ❑ 3 Lack of finance / funding
- ❑ 4 Lack of staff resources
- ❑ 5 Lack of knowledge / skills
- ❑ 6 Difference in system specifications across Europe
- ❑ 7 Difference in ITS deployment across Europe
- ❑ 8 Lack of guidance / best practice
- ❑ 9 Lack of co-operation with interested parties
- ❑ 10 Other

Other (please specify)

_____

_____

_____

Q18 What can be done to overcome such barriers?

Please be as specific as possible

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_____
_____
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_____
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_____
_____

Q19a What would be the added value / benefits resulting from establishing consistent metrics / indicators for measuring performance of ITS across Europe?

Tick all relevant

- ❑ 1 Increasing the amounts of available data
- ❑ 2 Promotion of harmonised formats of collected data and metrics
- ❑ 3 Making data collection / ITS deployment more cost efficient
- ❑ 4 Fostering shared investment in data / ITS
- ❑ 5 Assessing benefits from ITS deployment from different stakeholder perspectives
- ❑ 6 Enabling benchmarking across Europe
- ❑ 7 Supporting policy making
- ❑ 8 Supporting project prioritisation / guiding investment decisions
- ❑ 9 Other (please specify)

Other (please specify)

_____
_____
_____

Q19b Which <u>ONE</u> would be of greatest value / benefits resulting from establishing consistent metrics / indicators for measuring performance of ITS across Europe?

Tick the main one

- ❑ 1 Increasing the amounts of available data
- ❑ 2 Promotion of harmonised formats of collected data and metrics
- ❑ 3 Making data collection more cost efficient
- ❑ 4 Making ITS deployment more cost efficient (project prioritisation)
- ❑ 5 Shared investment in data / ITS deployment
- ❑ 6 Assessing benefits from ITS deployment from different stakeholder perspectives
- ❑ 7 Enabling benchmarking across Europe
- ❑ 8 Other (please specify)

Other (please specify)

_____
_____
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Thank you for completing this questionnaire. The information you have provided will assist us in developing an understanding of the level of use of performance indicators across the EU within the field of Intelligent Transport Systems, and the development of appropriate harmonised key performance indicators.

Q20 **Received contributions, together with the identity of the contributor, might be published on the Internet. Do you consent to the publication of your response by the European Commission**

Tick one only

- ❑ 1 Yes
- ❑ 2 Yes, but anonymously
- ❑ 3 No

Q21 **Would you be willing to be contacted again regarding this work?**

Tick one only

- ❑ 1 Yes
- ❑ 2 No

Appendix B: Questionnaire Responses

The below summarises responses to all closed questions within the questionnaire. The free text responses to open questions are not presented below for simplicity and for the avoidance of data privacy issues.

Q1: Which of the following best describes the type of organisation you represent?	Frequency
EU Institution	2
National Roads Authority	17
Regional Roads Authority	2
Local Roads Authority	5
Local Transport / Public Transport Authority	2
Public Transport Operator	1
Road Operator	5
Non-Governmental Organisation	10
ITS Service Provider	10
ITS Association	4
Vehicle / Component Manufacturer	4
Academic / Research Organisation	20
Independent Expert	11
Other	19
Total Respondents	112

Q2a: In which of the following countries do you operate?	Frequency
Austria	14
Belgium	14
Bulgaria	4
Croatia	9
Cyprus	4
Czech Republic	13
Denmark	8
Estonia	3
Finland	11
France	18
Germany	27
Greece	11
Hungary	9
Ireland	10
Italy	14
Latvia	3
Lithuania	6
Luxembourg	3
Malta	4
Netherlands	19
Poland	10
Portugal	9
Romania	7
Slovakia	6
Slovenia	4
Spain	17
Sweden	12
United Kingdom	21
All of the above	13
Other	12
Total Respondents	109

Q2b: How would you classify the network on which your ITS activity is focused?	Frequency
Urban streets and arteries	14
Interurban highways / motorways	32
Secondary roads	1
Public transport network	4
Multimodal network	27
Other	27
Not applicable	5
Total Respondents	110

Q3a: Which of the following best describes the types of Intelligent Transport Services that you or your organisation is involved in / interested in?	Frequency
Traffic Management and Control	88
Incident Management	57
Demand Management	43
Transport Infrastructure Maintenance Management	43
Policing / Enforcement	38
Emergency notification (accidents / eCall)	53
Emergency notification (weather / disaster)	48
Management of sensitive road sections	42
Safety Enhancements for Vulnerable Road Users	48
Advance Driver Assistant Systems (e.g. collision warning, adaptive cruise control, emergency braking systems, electronic stability)	38
Automated Vehicle Operation	34
Cooperative Systems (V2V / V2I)	65
Management of Dangerous / Abnormal Freight	41
Intelligent Truck Parking	40
Positioning and tracing services	39
Electronic road tolling	47
Public transport electronic payment	27
Integration of Transport Related Electronic Payment Services	30
Fare management	17
Public Transport Management	36
Demand Responsive and Shared Transport	30
Travel information pre-trip (e.g. journey planner, website, call centre)	73
Travel information on-trip (e.g. VMS, apps, radio, on board navigation)	81
Passenger terminals information	30
Real time traffic information Services	84
Road safety related traffic information / incident warning	77
Multimodal / co-modal information	62
Other	10
Total Respondents	109

Q7: For what purpose do you use the information previously mentioned?	Frequency
To monitor / assess deployment	57
To monitor / asses performance	85
To identify gaps in provision	41
To benchmark against other	43
Other	17
None of the above	9
Total Respondents	106

Q8b: How frequently is the data described in Q8a collected?	Frequency
Continuous data	28
Every minute or less	7
Hourly	1
Daily	3
Weekly	3
Monthly	5
Annually	10
Other	45
Total Respondents	102

Q8c: Roughly, how long is this data kept for?	Frequency
A day or less	3
A week	4
A month	3
A year	15
Longer than a year	68
Total Respondents	93

Q9: Who collects the data you use?	Frequency
Public sector (e.g. data collected by local authority)	59
Private contractor (e.g. data collected by a road concessionaire / operator)	38
Privately collected (e.g. floating car data, vehicle generated data)	37
Internally collected (e.g. internal bespoke data collection exercises)	40
ITS systems (e.g. data collected and reported automatically)	63
Other	16
Total Respondents	104

Q10a: Do you publish the findings of the performance monitoring methods you describe?	Frequency
Yes - internally	35
Yes - publically	14
Both - internal and externally	26
No	30
Total Respondents	105

Q10c: If No, are there are any data privacy issues preventing publication? Tick one only	Frequency
No	17
Yes	11
Total Respondents	28

Q11: For which of the following areas do you publish performance monitoring?	Frequency
Technology deployment (e.g. number of speed cameras installed)	30
System functionality (e.g. time out of service)	24
Service deployment (e.g. active travel plan websites)	21
Service provision (including quality / level of service)	35
User benefits (e.g. reduction in journey times)	55
Network benefits (e.g. reduction in traffic congestion)	45
Policy achievement (e.g. achievement of policy goals / targets)	44
Return on investment (including indicators of financial sustainability / contribution)	21
Wider economic impacts (e.g. jobs created, Gross Value Added)	15
Other	14
Total Respondents	94

Q12a: Do you compare / benchmark ITS performance, benefits and deployment / usage with other EU Member States?	Frequency
Yes	49
No	57
Total	106

Q12c: Do you compare / benchmark ITS performance, benefits and deployment / usage with other ITS service providers?	Frequency
Yes	38
No	67
Total	105

Q13: Focusing on the data you require / use to measure the performance / benefits of ITS by you / your organisation. How would you rate the following?	Very good	Good	Neutral	Poor	Very poor	Don't know / Not applicable	Total
Quality of the data currently available	15	40	24	14	1	7	101
Completeness of the data currently available	8	32	25	24	3	7	99
Geographic coverage of the data currently available	12	35	18	21	6	9	101
Frequency of collection for data currently available	12	41	19	13	2	13	100
Consistency of data currently available for measuring performance of ITS over time	11	23	26	21	3	16	100
Consistency of data currently available for measuring performance of ITS across EU Member States	4	5	24	21	17	28	99
Consistency of data currently available for measuring performance of ITS across networks	6	11	19	29	5	29	99
Ease of obtaining the data	7	20	25	24	13	10	99
Ease of processing the data into KPIs for ITS	5	18	30	25	4	15	97
Affordability of obtaining the data	11	17	34	14	7	16	99
Affordability of processing the data into KPI for ITS	11	19	27	13	4	24	98
Ability to assess the performance / success of ITS from different stakeholders perspectives	6	19	28	16	7	23	99
Ability to benchmark performance ITS between EU Member States	4	8	20	22	17	27	98

Q14: How important do you consider monitoring performance of each of the following areas to be?	Important	Neutral	Not Important	Don't know / Not applicable	Total
Technology deployment (e.g. number of speed cameras installed)	64	29	11	8	112
System functionality (e.g. time out of service)	84	12	1	6	103
Service deployment (e.g. active travel plan websites)	79	15	2	9	105
Service provision (including quality / level of service)	90	10	0	5	105
User benefits (e.g. reduction in journey times)	97	4	0	5	106
Network benefits (e.g. reduction in traffic congestion)	92	7	0	6	105
Wider economic impacts (e.g. jobs created, Gross Value Added)	69	26	3	10	108
Policy achievement (e.g. achievement of policy goals / targets)	81	13	3	10	107
Return on investment (including indicators of financial sustainability / contribution)	75	21	3	9	108

Q15: Is there anything related to Intelligent Transport Systems that you do not currently monitor / measure / assess that you think should be monitored / measured / assessed?	Frequency
No	63
Yes	38
Total	101

Q16a: What, if anything, prevents you from measuring ITS performance, benefits and deployment / usage more often or to a higher quality?	Frequency
Lack of available data	42
Fragmentation and incompatibility of data	43
Lack of finance / funding	48
Lack of staff resources	34
Lack of knowledge / skills	17
Unsure of benefits	21
Lack of guidance / best practice	23
Complexity	37
Lack of co-operation with other stakeholders	41
Other	11
Nothing	9
Total Respondents	105

Q16b: Which ONE prevents you the most from measuring ITS performance, benefits and deployment / usage more often to a higher quality?	Frequency
Lack of available data	15
Fragmentation and incompatibility of data	10
Lack of finance / funding	25
Lack of staff resources	12
Lack of knowledge / skills	1
Unsure of benefits	6
Lack of guidance / best practice	7
Complexity	7
Lack of co-operation with other stakeholders	6
Other	5
Total Respondents	94

Q17a: What are the main barriers to establishing consistent metrics / indicators for measuring performance of Intelligent Transport Systems across Europe?	Frequency
Lack of available data	46
Data is not recorded in comparable formats (please provide details below)	25
Lack of finance / funding	33
Lack of staff resources	27
Lack of knowledge / skills	23
Difference in system specifications across Europe (please provide details below)	21
Difference in ITS deployment across Europe	38
Lack of guidance / best practice	47
Lack of co-operation with interested parties	19
Other	7
None	1
Total Respondents	104

Q17b: Of the barriers listed, which ONE is the main barrier to establishing consistent metrics / indicators for measuring performance of Intelligent Transport Systems across Europe	Frequency
Lack of available data	21
Data is not recorded in compatible formats	6
Lack of finance / funding	16
Lack of staff resources	6
Lack of knowledge / skills	6
Difference in system specifications across Europe	10
Difference in ITS deployment across Europe	11
Lack of guidance / best practice	12
Lack of co-operation with interested parties	5
Other	5
Total Respondents	98

Q19a: What would be the added value / benefits resulting from establishing consistent metrics / indicators for measuring performance of ITS across Europe?	Frequency
Increasing the amounts of available data	48
Promotion of harmonised formats of collected data and metrics	55
Making data collection / ITS deployment more cost efficient	58
Fostering shared investment in data / ITS	47
Assessing benefits from ITS deployment from different stakeholder perspectives	60
Enabling benchmarking across Europe	53
Supporting policy making	60
Supporting project prioritisation / guiding investment decisions	55
Other	6
Total Respondents	108

Q19b: Which ONE would be of greatest value / benefits resulting from establishing consistent metrics / indicators for measuring performance of ITS across Europe?	Frequency
Increasing the amounts of available data	16
Promotion of harmonised formats of collected data and metrics	24
Making data collection more cost efficient	9
Making ITS deployment more cost efficient (project prioritisation)	12
Shared investment in data / ITS deployment	10
Assessing benefits from ITS deployment from different stakeholder perspectives	23
Enabling benchmarking across Europe	5
Other	4
Total Respondents	103

Q20: Received contributions, together with the identity of the contributor, might be published on the Internet. Do you consent to the publication of your response by the European Commission	Frequency
Yes	37
Yes, but anonymously	60
No	10
Total Respondents	107

Q21: Would you be willing to be contacted again regarding this work?	Frequency
Yes	91
No	18
Total Respondents	109

Appendix C: Stakeholder Workshop Presentation

Scope of Presentation

- Welcome
- Housekeeping
- Facilitation Team
- Agenda
- Overview of Study
- Purpose of the workshop

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AECOM Facilitation Team

John Finnegan

Jo Christensen

Daniel Hobbs

Stephen Payne

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Agenda

Time	Activity
9.00	Registration
9.30	Opening Presentation
9.45	Discussion on role of KPIs
10.15	Breakout Session 1 - Deployment
11.15	Coffee Break
11.45	Breakout Session 2 - Benefits
12.45	Lunch
14.00	Plenary Session
15.00	Close

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Objectives of the Study

- To undertake a state of the art review of KPIs relating to Intelligent Transport Systems, with particular focus on the type, method of calculation, terminology used and approaches and how these vary between Member States; and
- To define/recommend a set of common KPIs for road transport, with supporting guidance on their application, presentation and reporting.

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Key Elements of Study

- **Scoping Phase**: confirming the study approach, taxonomy of ITS and the intention to focus on **deployment** and **benefit** KPIs
- **State of the Art Review**: establishing current levels of KPI use amongst EU28 and ITS priority areas based upon review of published data sources.
- **Stakeholder Questionnaire Survey**: Add depth to SOTA findings and establish barriers to KPI adoption.
- **Stakeholder Workshop**: Test and refine identified 'long list' of possible KPIs.
- Produce **Final Report** outlining recommended KPIs – ca.15

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State of the Art Review

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State of the Art Review – Objectives

- Identify the use of KPIs on deployment and effects of ITS
  - Across the EU28
  - Across the priority areas of the ITS Action Plan
- Identify existing data sources used in generating KPIs
- Identify any ownership and privacy issues associated with data sources
- Identify the potential cost of data collection/collation
- Assess the adequacy/scope/rigor of KPIs

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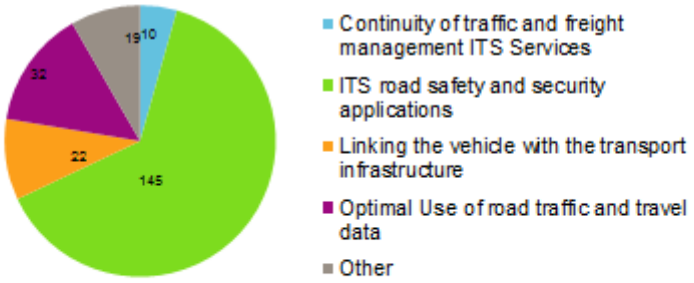
State of the Art Analysis – KPIs Identified

- 228 'KPIs' identified
  - 89 were deployment related
  - 139 were benefit related
- By ITS Directive priority area



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State of the Art Analysis – KPIs or Indicators?

- A ***Key Performance Indicator*** (***KPI***) is a measurable value that demonstrates how effectively an organisation is achieving ***key*** objectives
- Some 'indicators' recorded were not considered true KPIs for the following reasons:
  - Some were project or **technology specific** in the way they were worded or calculated making comparability with other areas difficult
  - Some deployment metrics were presented as a **count of the number of ITS**, rather than expressing this against the extent of the network
  - Several metrics were **standard indicators** of transport network performance (such as journey time, flow or accident levels) – attribution to ITS was not presented

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State of the Art Analysis – Data Issues

- Very limited information available on data
- Difficult to draw conclusions on:
  - Ownership
  - Privacy
  - Costs

Data Source	Total
Traffic Counts	14
User Surveys	9
Systems data	7
Accident Data	3
Investment Costs	2
Police Records	2
Journey Time Data	2
Incident Logs	1
Tachographs	1
ANPR Cameras	1
Sales data	1
Hospital Records	1

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Stakeholder Consultation – Purpose

- Purpose
  - Brief stakeholders about research activity
  - Ensure comprehensive SOTA is achieved
  - Provide forum for stakeholders to engage in emerging KPIs
  - Understand MS and practitioner constraints to KPI adoption
- Test initial high level review findings
  - Coverage across taxonomy
  - Quality of data
  - Member State maturity and evaluation scope

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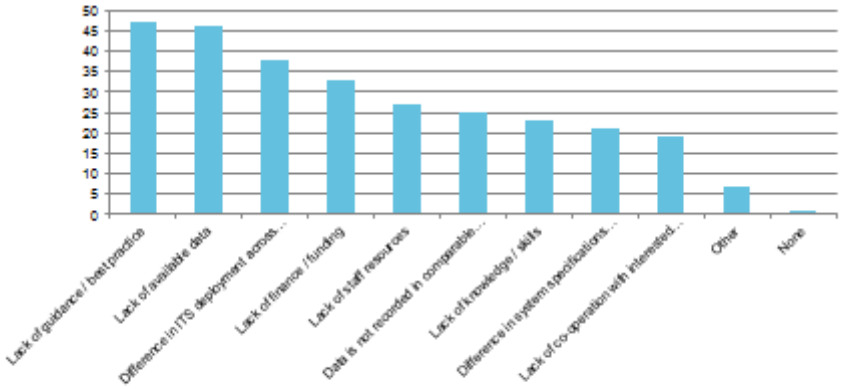
Stakeholder Consultation – Barriers to KPIs

- Main barriers to the establishment of consistent metrics for measuring performance of ITS across Europe



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Stakeholder Workshop

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Purpose of this workshop

- Provide an overview of the study activities and findings
- Present the emerging KPIs and obtain feedback
- Identify any additional KPIs
- Discuss the barriers and constraints to their application
- Support the definition and refinement of terminology

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Agenda for the day

Time	Activity	Tasks
9.00	Registration	
9.30	Opening Presentation	• Overview of the commission to-date • Purpose of the workshop
9.45	Discussion on role of KPIs	• What is the role of KPIs in assessment ITS performance? • What are the requirements from Member States/experts to support the assessment of ITS?
10.15	Breakout Session 1 - Deployment	• Introduction and purpose of the session • Review of emerging long list of KPIs (gap analysis) • Strengths and Weaknesses exercise • Barriers/challenges • Report back 3 key barriers
11.15	Coffee Break	
11.45	Breakout Session 2 - Benefits	• Introduction and purpose of the session • Review of emerging long list of KPIs (gap analysis) • Strengths and Weaknesses exercise • Barriers/challenges • Report back 3 key barriers
12.45	Lunch Break	
14.00	Plenary Session	• Prioritisation across deployment/benefit KPIs • Presentation/discussion of key challenges/barriers • What further support is required?
15.00	Close	• Next steps

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The role of KPIs

- What is a KPI – do you use them?
- Do you compare against other member states/networks?
- Types of KPIs

Stakeholder Workshop

- Breakout Structure

Group	Facilitator	Breakout 1 - Deployment	Breakout 2 - Benefit
1: Red	John Finnegan	ITS road safety and security	Improve environmental impacts; Enhance mode integration
2: Green	Jo Christensen	Linking the vehicle with the transport infrastructure; Continuity of traffic and freight management	Network efficiency and congestion
3: Blue	Daniel Hobbs	Optimal use of road traffic and travel data	Improve road safety

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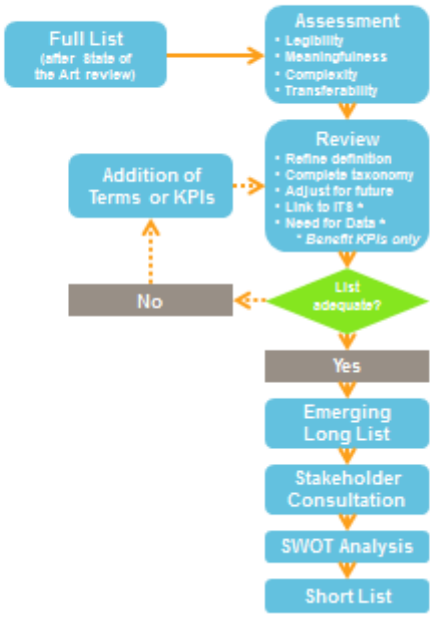
KPI Selection Process



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Breakout Session 1 - Deployment

- Introduction
- Review emerging long list of KPIs – any additional KPIs
- Strengths/weaknesses exercise
- Identify top 3 barriers

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Breakout Session 2 - Benefits

- Introduction
- Review emerging long list of KPIs – any additional KPIs
- Strengths/weaknesses exercise
- Identify top 3 barriers

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Voting Exercise after Lunch

- 10 stickers per person
- Vote for your preferred KPIs
- Your choice whether to 'spend' all on one KPI or distribute however you feel.
- Will inform the prioritisation of ca.15 KPIs to recommend

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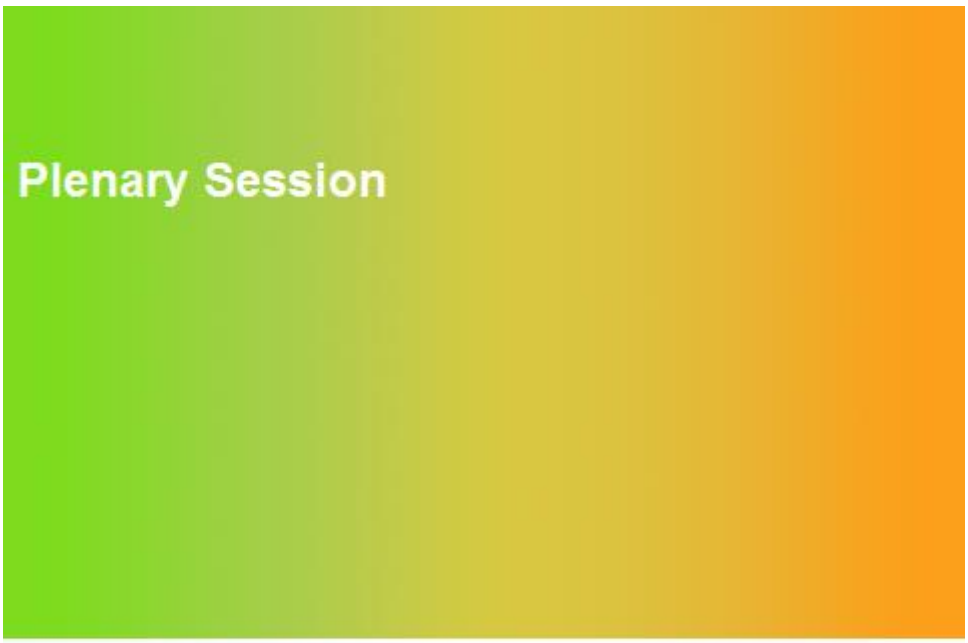

Voting Exercise (15 minutes)

- 10 stickers per person
- Vote for your preferred KPIs
- Your choice whether to 'spend' all on one KPI or distribute however you feel.
- Will inform the prioritisation of ca.15 KPIs to recommend

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Stakeholder Questionnaire– Barriers to KPIs

- Respondents were asked to rate the importance of monitoring different aspects of ITS:
  - Most important to monitor user, benefits network benefits and service provision.
  - Least important to monitor technology deployment and wider economic benefits.

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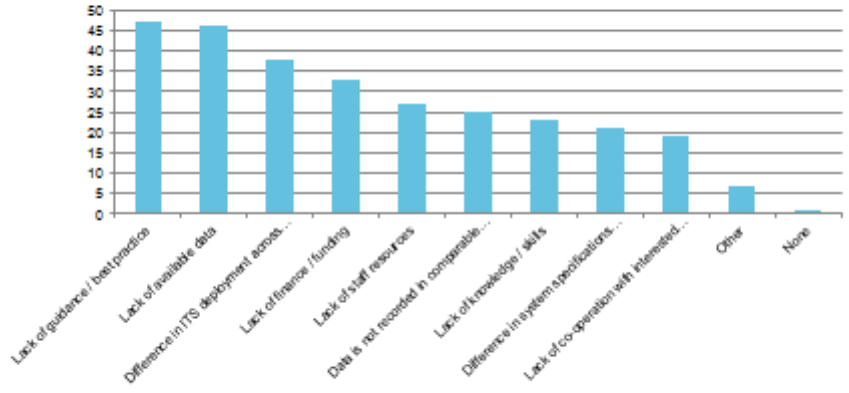
Stakeholder Questionnaire – Barriers to KPIs

- Main barriers to the establishment of consistent metrics for measuring performance of ITS across Europe



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Stakeholder Questionnaire – Barriers to KPIs

- Key ways to overcome barriers:
  - EU Harmonisation
  - Improved Collaboration
  - EU Financial Support
  - Common KPIs
- Key benefits of consistent metrics:
  - Assessing benefits from ITS deployment from different stakeholder perspectives
  - Supporting policy making
  - Making data collection/ITS deployment more cost efficient
  - Supporting project prioritisation/guiding investment decisions

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Findings from the Workshop

- Key barriers to KPI implementation
- Prioritised List
- Deployment/benefits

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Deployment KPI Barriers

- Low levels of deployment do not necessarily indicate an issue – deployment in itself isn't a policy objective.
- Data ownership – difficulties bringing information together
- Organisation administrative boundaries
- Identifying KPIs at the correct level of aggregation/disaggregation to be meaningful and comprehensive
- Correct definition of terms

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Benefit KPI Barriers

- Difficulty in separating out ITS benefits from wider network impacts – attribution
- Availability of data & associated costs
- Staff resource and skills & associated costs
- Organisation administrative boundaries
- Data privacy
- Correct definition of terms (e.g. KSI's)

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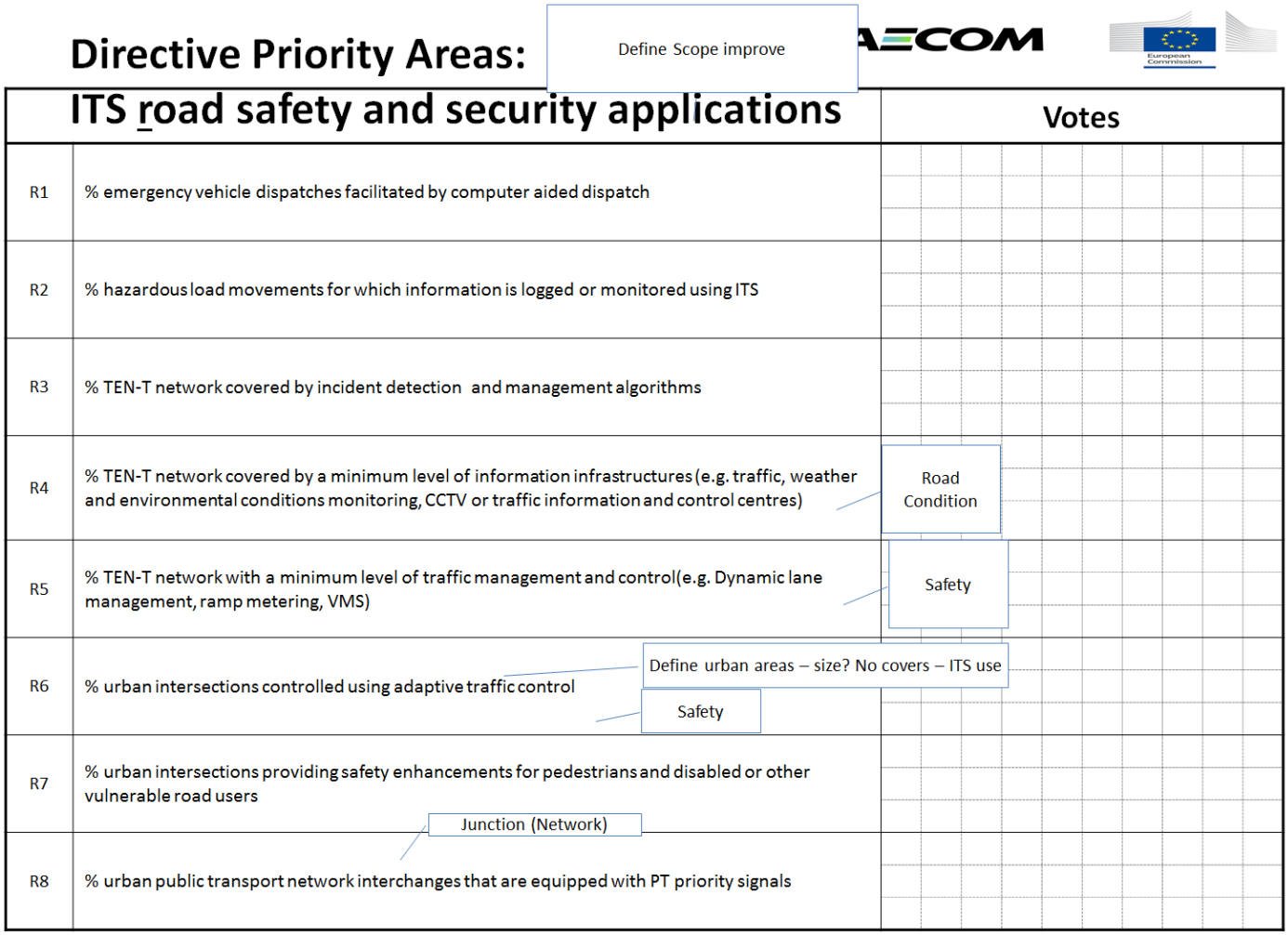
Appendix D: Stakeholder Workshop Flipchart Annotations

The below tables were presented to stakeholders at the workshop as part of facilitated breakout sessions. As part of these sessions comments were made on how to improve the individuals KPIs. These are presented on the below as annotations. These sheets were then used as part of the later voting exercises to establish stakeholder priorities.



Directive Priority Areas:

Optimal use of road traffic & travel data

		Votes
O1	% bus routes equipped with Automatic Vehicle Location	
O2	% demand responsive vehicles that operate under Computer Aided Dispatch	
O3	% national transport network covered by websites offering comprehensive traveller information (e.g. Journey planning, traffic information)	
O4	% public transport ticket transactions that utilise electronic payment technologies	
O5	% public transport stops with dynamic traveler information available to public	
O6	% TEN-T network covered by traffic advisory radio and/or mobile network reception and offering appropriate information services	
O7	No of visits to websites and portals offering traveler information (e.g. journey planning, traffic information)	

Barrier: Agreeing routes

Barrier: Cooperation of the different agencies with pieces of the data

% Service Vehicles equipped

Collecting data Disaggregating data

% of uncensored vehicles

EIP refers December 5 indicators in Traffic information

Should include disruption PUSH

Barrier: Agreeing the Network

Information channels – combine 3 & 6

% Service Vehicles network – Modal services and physical network

Includes mobile network

Barrier: If ITS is a private service cant get the data ...

Nor deployment

Directive Priority Areas:
Continuity of traffic and freight management ITS Services

% of Network covered by traffic management

Freight Transport
- Data availability sharing
- -Goods transport network efficiency e.g. Close to ports

	KPI	Votes
C1	% hazardous/abnormal load movements for which ITS has been utilised to facilitate the sharing of information between relevant organisations	
C2	% road toll revenue collected by electronic toll collection systems	
C3	Number of intelligent truck parking facilities per km of TEN-T network	
C4	% compliance with the interoperability directive of the European Electronic Toll Service (EETS)	

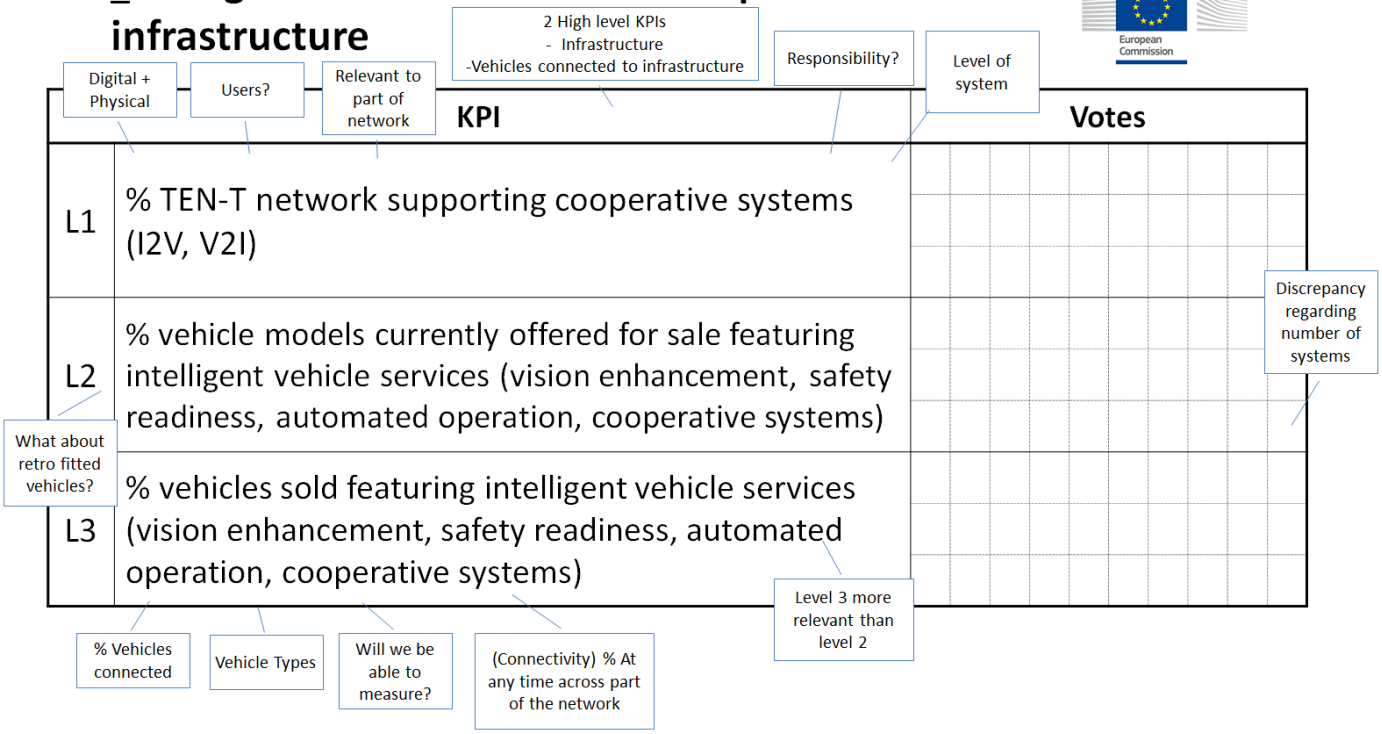
Relevance to all member states?

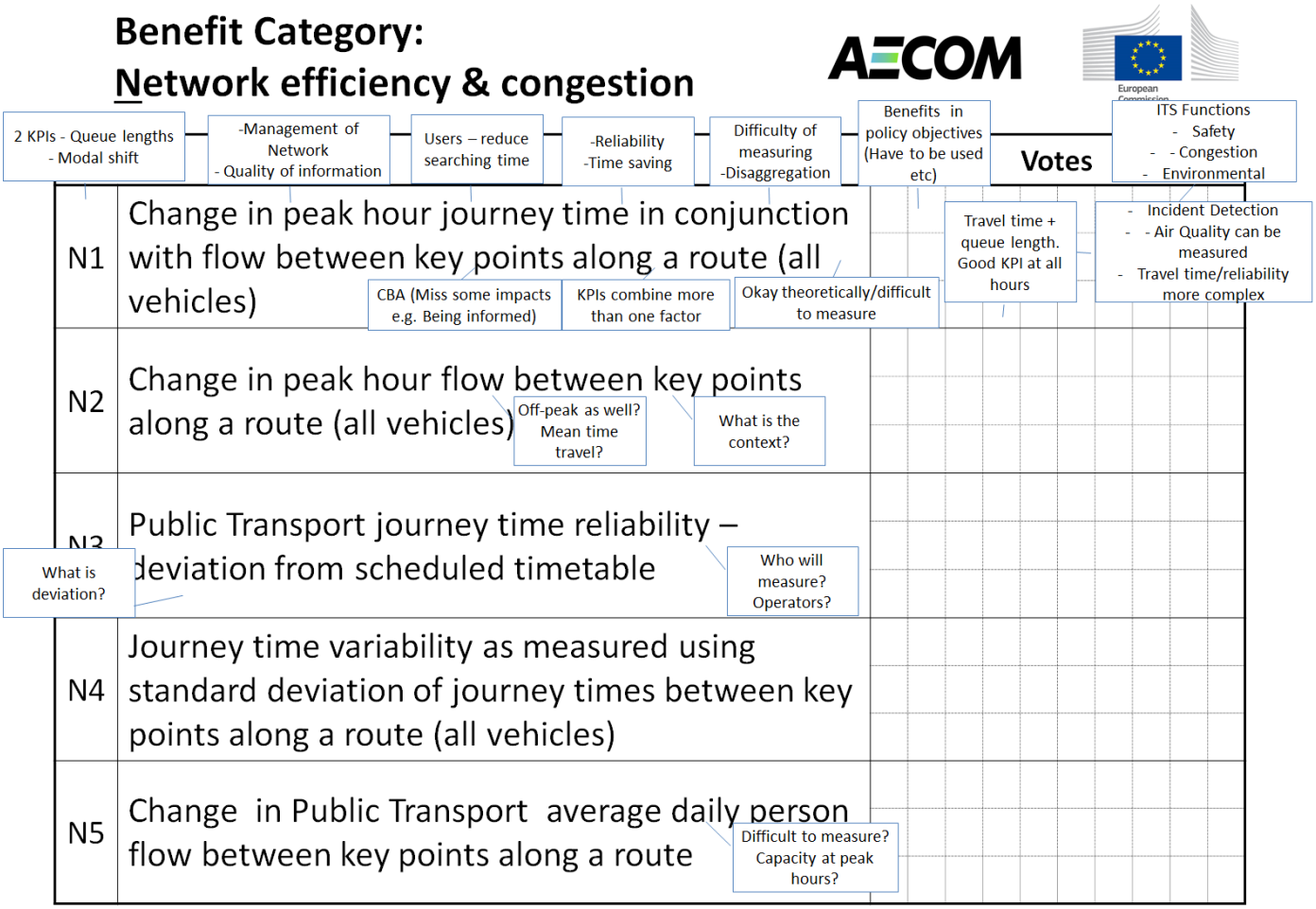
Relevance to all member states?

Directive Priority Areas:
Continuity of traffic and freight management
ITS Services

KPI		Votes
C5	% of Network covered by traffic management plans	

Directive Priority Areas: Linking the vehicle with the transport infrastructure




Benefit Category:
Network efficiency & congestion
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European Commission
2 KPIs - Queue lengths
- Modal shift
-Management of Network
- Quality of information
Users – reduce searching time
-Reliability
-Time saving
Difficulty of measuring
-Disaggregation
Benefits in policy objectives (Have to be used etc)
Votes
ITS Functions
- Safety
- - Congestion
- Environmental
N1
Change in peak hour journey time in conjunction with flow between key points along a route (all vehicles)
CBA (Miss some impacts e.g. Being informed)
KPIs combine more than one factor
Okay theoretically/difficult to measure
Travel time + queue length. Good KPI at all hours
- Incident Detection
- - Air Quality can be measured
- Travel time/reliability more complex
N2
Change in peak hour flow between key points along a route (all vehicles)
Off-peak as well? Mean time travel?
What is the context?
N3
Public Transport journey time reliability – deviation from scheduled timetable
What is deviation?
Who will measure? Operators?
N4
Journey time variability as measured using standard deviation of journey times between key points along a route (all vehicles)
N5
Change in Public Transport average daily person flow between key points along a route
Difficult to measure? Capacity at peak hours?

Benefit Category:
Improve Environmental Impacts

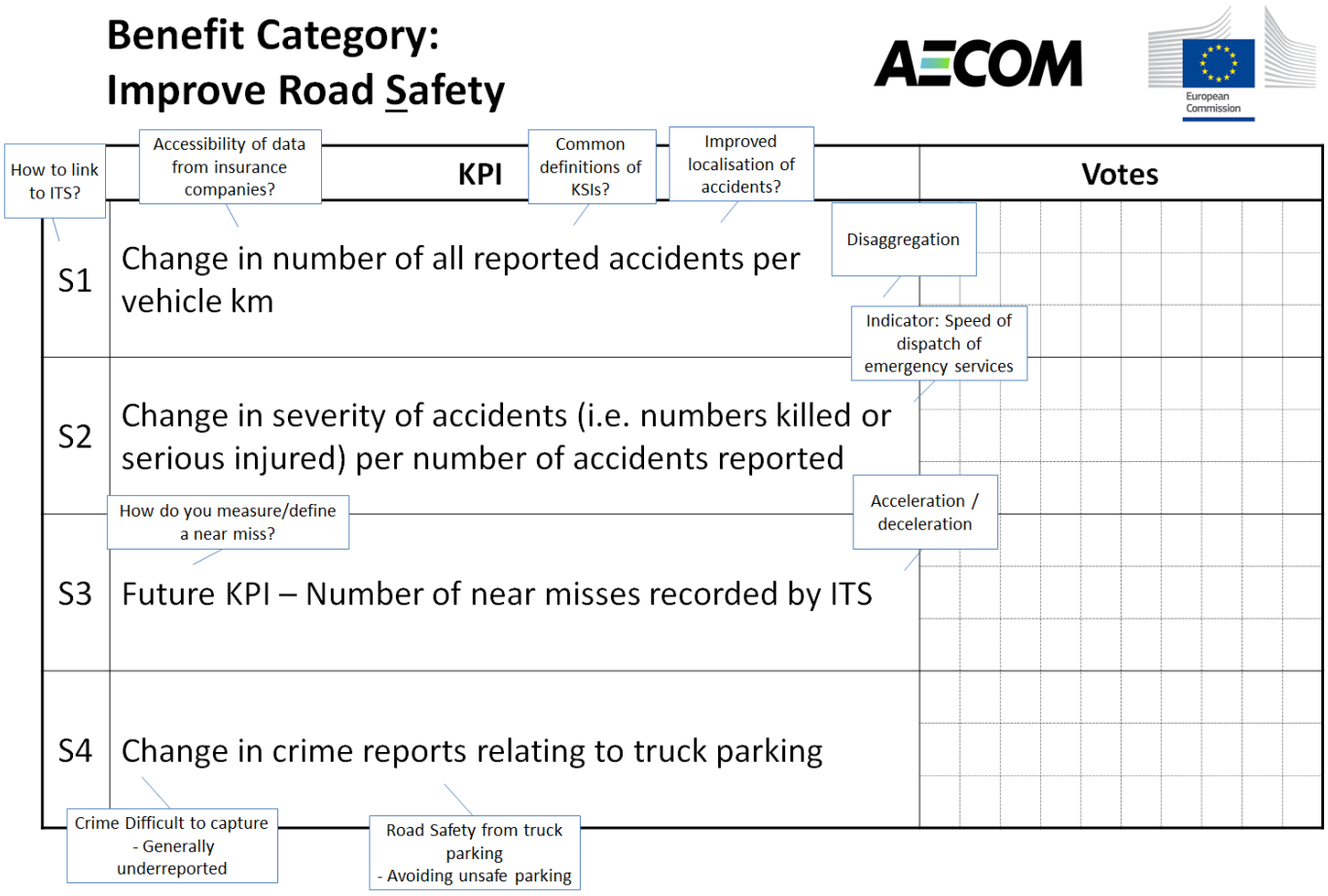
	KPI	Votes
E1	Change in CO2 emissions per vehicle km	
E2	Change in number of hours where NOx levels are above threshold	
E3	Change in PM10 emissions per vehicle km	
E4	Change in number of hours where transport noise is above dB threshold	

- Travel time
- Flow
- Mode share

- Very useful for PT mode share

Benefit Category:
Improve Environmental Impacts

	KPI	Votes
	Change in - Travel times - Flow - Sustainable Mode share (ITS - … - CO_2)	
	Use of telematics to manage freight vehicles (ITS is key to Public Transport Promotion)	


Benefit Category:
Improve Road Safety
How to link to ITS?
Accessibility of data from insurance companies?
KPI
Common definitions of KSIs?
Improved localisation of accidents?
Votes
Disaggregation
Indicator: Speed of dispatch of emergency services
S1
Change in number of all reported accidents per vehicle km
S2
Change in severity of accidents (i.e. numbers killed or serious injured) per number of accidents reported
Acceleration / deceleration
How do you measure/define a near miss?
S3
Future KPI – Number of near misses recorded by ITS
S4
Change in crime reports relating to truck parking
Crime Difficult to capture - Generally underreported
Road Safety from truck parking - Avoiding unsafe parking

Benefit Category: Improve Road Safety

KPI	Votes
Perception of road safety	
Reduction in violations (Speeding, red light violations…)	
Benefits from road safety messages during congestion / incidents etc	
Road safety improvements from safe and secure parking	

Questionnaire barrier?

Link to education process

Benefit Category:
Enhance Modal Integration

KPI		Votes
I1	Rail and inland waterway mode share along key corridors (tonne km)	
I2	Public Transport mode share along key corridors (people)	
I3	Active travel mode share (people)	

Define Relevance for PT

3 presentations
-EC: Meeting next week

Benefit Category:
Enhance Modal Integration

KPI		Votes
	Opinion / qualitative research on availability / use of multimodal	
	Sustainable / PT mode share n key urban areas	

Directive Priority Areas:
ITS road safety and security applications

	KPI	Votes
	% Ten + T - Covered by speed cameras. Centralised enforcement	
	% Urban – Covered by speed cameras. Centralised enforcement	
	Benefit: - Safety ITS - - Accident	
	Learning…. Barrier: ITS not on list	

Directive Priority Areas:
Optimal use of road traffic & travel data

	KPI	Votes
	Timelines incident – Info messages	
	Coverage of incidents	
	Coverage of networks	
	% of “Wrong” Messages + % of detection of incidents Quality assessment of information provided.	

Directive Priority Areas: Linking the vehicle with the transport infrastructure (ii)

Strengths	Weaknesses
L1 measures what we need (Infrastructure) L2/3 need a % of vehicles connected	L2 - Only models - Mix of options L3 - Retro fitted? - Nomadic? L1 – Depends on how measured? L1 – Depends on need for that part of the network L1 – Data variesacross areas (e.g. urban vs inter urban congestion) L2/L3 Privacy laws

Directive Priority Areas: ITS road safety and security applications (i)

Strengths	Weaknesses
	- In vehicle ITS - % Network N.A. - Need to disaggregate TEN-T - Diff implementation for same benefits - Why compare - Judge/ score - Learn what works

Directive Priority Areas: ITS road safety and security applications (ii)

Strengths	Weaknesses
	R8 - Not possible to gather from cities – and obligation to collect data - Can be good reasons for 0% implementation shouldn't have a red box - ITS pat of policy can you measure

Benefit Category:
Network efficiency & congestion (ii)

Barriers
- Measurement not in place so expensive to introduce (N1, N2, N4, N5) - Will data be made available, (ownership) (N3) - Disaggregation (ITS?) - Data privacy laws – barrier for measurement (some member states/ areas) - No common method of measurement - Level of complexity of definition – KPIs / measure

Benefit Category: Improve Road Safety (i)

Strengths	Weaknesses
	3) Do near misses matter? 3) "Near miss" is to wide Disaggregating ITS benefits - Need an indicator directly linked to ITS

Benefit Category: Enhance Modal Integration (i)

Strengths	Weaknesses
CO2, Nox PM, Noise - Available - Objective - Multimodality / Co-modality are a daily reality	- Attribution - Perception of multimodal freight - Barriers to M.M freight are cost not information / ITS

Appendix E: Stakeholder Workshop
Total Votes

Top 6 Voted KPIs

	KPI	Votes	Category
L1	% TEN-T network supporting cooperative systems (I2V, V2I)	14	Deployment
R4	% TEN-T network covered by a minimum level of information infrastructures (e.g. traffic, weather and environmental conditions monitoring, CCTV or traffic information and control centers)	13	Deployment
E5	Change in -Travel times -Flow -Sustainable Mode share (ITS - ... - CO2)	12	Benefit
S2	Change in severity of accidents (i.e. numbers killed or serious injured) per number of accidents reported	9	Benefit
R5	% TEN-T network with a minimum level of traffic management and control(e.g. Dynamic lane management, ramp metering, VMS)	9	Deployment
N3	Public Transport journey time reliability – deviation from scheduled timetable	8	Benefit

Proposed by AECOM
Added by participants in the workshop

Top 6 Voted Benefit KPIs

	KPI	Total Votes
E5	Change in -Travel times - Flow -Sustainable Mode share (ITS - ... - CO2)	12
S2	Change in severity of accidents (i.e. numbers killed or serious injured) per number of accidents reported	9
N3	Public Transport journey time reliability – deviation from scheduled timetable	8
S1	Change in number of all reported accidents per vehicle km	8
S6	Reduction in violations (Speeding, red light violations...)	8
I4	Opinion / qualitative research on availability / use of multimodal	8

Proposed by AECOM
Added by participants in the workshop

Top 6 Voted Deployment KPIs

	KPI	Total Votes
L1	% TEN-T network supporting cooperative systems (I2V, V2I)	14
R4	% TEN-T network covered by a minimum level of information infrastructures (e.g. traffic, weather and environmental conditions monitoring, CCTV or traffic information and control centers)	13
R5	% TEN-T network with a minimum level of traffic management and control(e.g. Dynamic lane management, ramp metering, VMS)	9
O3	% national transport network covered by websites offering comprehensive traveler information (e.g. Journey planning, traffic information)	8
L3	% vehicles sold featuring intelligent vehicle services (vision enhancement, safety readiness, automated operation, cooperative systems)	8
O12	Quality assessment of information provided.	6

Proposed by AECOM
Added by participants in the workshop

Deployment - ITS Road Safety and Security Application Results

	KPIs	Total Votes
R1	% emergency vehicle dispatches facilitated by computer aided dispatch	
R2	% hazardous load movements for which information is logged or monitored using ITS	
R3	% TEN-T network covered by incident detection and management algorithms	2
R4	% TEN-T network covered by a minimum level of information infrastructures (e.g. traffic, weather and environmental conditions monitoring, CCTV or traffic information and control centres)	13
R5	% TEN-T network with a minimum level of traffic management and control (e.g. Dynamic lane management, ramp metering, VMS)	9
R6	% urban intersections controlled using adaptive traffic control	1
R7	% urban intersections providing safety enhancements for pedestrians and disabled or other vulnerable road users	
R8	% urban public transport network interchanges that are equipped with PT priority signals	
R9	% Ten + T - Covered by speed cameras. Centralised enforcement	4
R10	% Urban – Covered by speed cameras. Centralised enforcement	
R11	Benefit: -Safety ITS - Accident	2
R12	Learning....	
R13	Barrier: ITS not on list	

Proposed by AECOM
Added by participants in the workshop

Deployment - Optimal Use of Road Traffic & Travel Data Results

	KPIs	Total Votes
O1	% bus routes equipped with Automatic Vehicle Location	
O2	% demand responsive vehicles that operate under Computer Aided Dispatch	
O3	% national transport network covered by websites offering comprehensive traveler information (e.g. Journey planning, traffic information)	8
O4	% public transport ticket transactions that utilise electronic payment technologies	
O5	% public transport stops with dynamic traveler information available to public	2
O6	% TEN-T network covered by traffic advisory radio and/or mobile network reception and offering appropriate information services	3
O7	No of visits to websites and portals offering traveler information (e.g. journey planning, traffic information)	1
O8	Timelines incident – Info messages	3
O9	Coverage of incidents	3
O10	Coverage of networks	
O11	% of "Wrong" Messages + % of detection of incidents	
O12	Quality assessment of information provided.	6

Proposed by AECOM
Added by participants in the workshop

Deployment - Continuity of Traffic and Freight Management ITS Services Results

	KPIs	Total Votes
C1	% hazardous/abnormal load movements for which ITS has been utilised to facilitate the sharing of information between relevant organisations	
C2	% road toll revenue collected by electronic toll collection systems	4
C3	Number of intelligent truck parking facilities per km of TEN-T network	2
C4	% compliance with the interoperability directive of the European Electronic Toll Service (EETS)	
C5	% of Network covered by traffic management plans	3

Proposed by AECOM
Added by participants in the workshop

Deployment - Linking the Vehicle with the Transport Infrastructure Results

	KPIs	Total Votes
L1	% TEN-T network supporting cooperative systems (I2V, V2I)	14
L2	% vehicle models currently offered for sale featuring intelligent vehicle services (vision enhancement, safety readiness, automated operation, cooperative systems)	
L3	% vehicles sold featuring intelligent vehicle services (vision enhancement, safety readiness, automated operation, cooperative systems)	8

Proposed by AECOM
Added by participants in the workshop

Benefit - Network Efficiency & Congestion Results

	Network efficiency & congestion KPIs	Total Votes
N1	Change in peak hour journey time in conjunction with flow between key points along a route (all vehicles)	7
N2	Change in peak hour flow between key points along a route (all vehicles)	
N3	Public Transport journey time reliability – deviation from scheduled timetable	8
N4	Journey time variability as measured using standard deviation of journey times between key points along a route (all vehicles)	
N5	Change in Public Transport average daily person flow between key points along a route	4
N6	Quality (reaction time, pro per info. Distribution, proper channel, right time, right place) of info	7
N7	Reducing searching time in an unfamiliar area	2
N8	Journey time / reliability Safety traffic efficiency energy efficiency / (environment)	3
N9	Modal shift (Change between personal cars and public transport	

Proposed by AECOM
Added by participants in the workshop

Benefit - Improve Environmental Impacts Results

	KPIs	Total Votes
E1	Change in CO2 emissions per vehicle km	2
E2	Change in number of hours where NOx levels are above threshold	2
E3	Change in PM10 emissions per vehicle km	1
E4	Change in number of hours where transport noise is above dB threshold	1
E5	Change in -Travel times -Flow -Sustainable Mode share (ITS - … - CO2)	12
E6	Use of telematics to manage freight vehicles (ITS is key to Public Transport Promotion)	

Proposed by AECOM
Added by participants in the workshop

Benefit - Improve Road Safety Results

	KPIs	Total Votes
S1	Change in number of all reported accidents per vehicle km	8
S2	Change in severity of accidents (i.e. numbers killed or serious injured) per number of accidents reported	9
S3	Future KPI – Number of near misses recorded by ITS	
S4	Change in crime reports relating to truck parking	
S5	Perception of road safety	
S6	Reduction in violations (Speeding, red light violations…)	8
S7	Benefits from road safety messages during congestion / incidents etc.	1
S8	Road safety improvements from safe and secure parking	

Proposed by AECOM
Added by participants in the workshop

Benefit - Enhance Modal Integration Results

	KPIs	Total Votes
I1	Rail and inland waterway mode share along key corridors (tonne km)	
I2	Public Transport mode share along key corridors (people)	4
I3	Active travel mode share (people)	
I4	Opinion / qualitative research on availability / use of multimodal	8
I5	Sustainable / PT mode share n key urban areas	

Proposed by AECOM
Added by participants in the workshop

Appendix F: Additional Slides Added to Homework Pack

Workshop Findings - Deployment KPI Barriers

- Low levels of deployment do not necessarily indicate an issue – deployment in itself isn't a policy objective.
- Data ownership – difficulties bringing information together
- Organisation administrative boundaries
- Identifying KPIs at the correct level of aggregation/disaggregation to be meaningful and comprehensive
- Correct definition of terms

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Workshop Findings - Benefit KPI Barriers

- Difficulty in separating out ITS benefits from wider network impacts – attribution
- Availability of data & associated costs
- Staff resource and skills & associated costs
- Organisation administrative boundaries
- Data privacy
- Correct definition of terms (e.g. KSI's)

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Voting Exercise

- Even split between Deployment and Benefit KPIs – a difference from that identified in the Questionnaire – possibly reflecting relative ease of recording deployment.

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Top 6 Voted Deployment KPIs

KPI	Total Votes
% TEN-T network supporting cooperative systems (I2V, V2I)	14
% TEN-T network covered by a minimum level of information infrastructures (e.g. traffic, weather and environmental conditions monitoring, CCTV or traffic information and control centers)	13
% TEN-T network with a minimum level of traffic management and control(e.g. Dynamic lane management, ramp metering, VMS)	9
% national transport network covered by websites offering comprehensive traveler information (e.g. Journey planning, traffic information)	8
% vehicles sold featuring intelligent vehicle services (vision enhancement, safety readiness, automated operation, cooperative systems)	8
Quality assessment of information provided.	6

Proposed by AECOM
Added by participants in the workshop

Top 6 Voted Benefit KPIs

KPI	Total Votes
Change in -Travel times - Flow -Sustainable Mode share (ITS - ... - CO2)	12
Change in severity of accidents (i.e. numbers killed or serious injured) per number of accidents reported	9
Public Transport journey time reliability – deviation from scheduled timetable	8
Change in number of all reported accidents per vehicle km	8
Reduction in violations (Speeding, red light violations...)	8
Opinion / qualitative research on availability / use of multimodal	8

Proposed by AECOM
Added by participants in the workshop

Appendix G: Homework Pack Collated Responses

Deployment KPIs

Deployment Category	KPI		Strengths	Weaknesses
ITS **R**oad safety and security applications	R1	% emergency vehicle dispatches facilitated by computer aided dispatch	we see, how we are prepared for future services Measurable	this will be 100% hard to get data many stakeholders, especially in rural areas difficult to collect, has no effect on real support and therefore no direct safety effect Is meaningless unless the correlation between numbers of calls, numbers of dispatches and actual incidents is known. Not directly related to ITS, but more to general emergent response
	R2	% hazardous load movements for which information is logged or monitored using ITS	Control of every hazardous load movements with the load description Useful would be highly important to know - even operators are not prepared to monitor all hazardous movements (e.g. in tunnels) this would be highly effective Measurable Useful for tracking of the most risky vehicles in traffic centers	information available only at companies? difficult to be collected (private issue). In most cases, companies are hardly communicate on hazardous loadings Are hazardous movements a significant road safety risk / feature ? In fact, there should be rather status (yes/no), than percentage of fleet coverage
	R3	% TEN-T network covered by incident detection and management algorithms	Comprehensible, Easy to compute / provide clear and easy collectable figure Measurable; contributes to 'O' and '' lists below as well Important criteria of roadside ITS penetration	difficult to define, better: automatic incident detection doesn't account for effectiveness of algorithms hard to collect: a detector has a point location but shall provide link information (network covered - subjective assessment). Why does the KPI only reflect on TERN? I would like to have a general KPI and afterwards provide figures for different operating environments (TERN, urban, secondary network, rural network) Hard to describe, because some measures are rather local, than linear across the route
	R4	% urban intersections providing safety enhancements for pedestrians and disabled or other vulnerable road users	Useful easy to collect Clear and discrete (countable) criteria	must be defined very clearly too dependent on non-ITS facilities accompanying does not say anything on the effectiveness of the implemented solutions. This seems to ignore the load factor: needs to be done in a much more targeted way that links to

Deployment	KPI		Strengths	Weaknesses
				incident volumes. None
	R5	Number of intelligent truck parking facilities per km of TEN-T network	Information for drivers with possibility of reservation Comprehensible, Easy to compute/ provide clearly to define and easy to calculate easy to collect. Clear link to the ITS Directive Can't see any related to road safety Clear and discrete (countable) criteria; proposal is number of fac. per 100km	This could be rather % of intelligent truck parking facilities what is "intelligent"? how to deal with ITP aside TERN Coverage is to be related to capacity of transit corridors and real demand for them
	R6	% urban network covered by speed cameras / CCTV and supported by centralized enforcement	rather: cameras/km of network easy to collect. In combination with average speed and total accident numbers a good safety indicator showing also the benefit/effect of speed enforcement. Clear and discrete (countable) criteria; proposal is to include here also systems of red-light and banned overtaking enforcement and to wide it also to national roads	Coverage is difficult to define better to focus on hotspots (e.g. % of junctions with red light cameras)? never combine 2 KPIs - here it is a combination of monitoring and enforcement. Why only urban networks? We have speed enforcement also in rural/TERN-areas. Many Member States' policies are to deploy safety cameras only at high incident sites so it's not at all convincing that the measurements will reflect the real world The same as R3, the more objective criteria could be percentage of posts per a unit of length (100km), than overall percentage
	R7	% of TEN-T long-term work zone equipped with security applications and information (management) system	Information about work zone layouts, delays and probability of problems	Organization of process needs to be setup.
	R8	% urban intersections providing priority signals for emergency blue light forces		

Deployment	KPI		Strengths	Weaknesses
	R9	Number of gantries with dynamic traffic management functions/100 000 car Kilometers/day	includes traffic charge and not only section length	
	R10	Number of hours when dynamic traffic advice is displayed (or on time of gantries)		
	R11	% emergency vehicle dispatch systems linked to traffic management interventions		hard to measure
	R12	Number of accidents	the most logical KPI - what is the number of accidents in an operating environment	
	R13	Number of security constraints		
	R14	% of national fleet fitted with e-Call		
	R15	Status (yes/no/ how many) of TPS inclusion in national E-Call platform	Awareness about optional extensions of interoperable E-Call	
	R16	% of long (to be defined) tunnels/bridges, equipped with complex incident det./res. System	how often have trucks been broken up on ITP areas, etc. The change of this KPI over time shoes the benefit of measures Data about performance of network's hot spots	Will take some time to go beyond single figures
Optimal use of road traffic & travel data	O1	% national transport network covered by websites offering comprehensive traveler information (e.g. Journey planning, traffic information)	Useful, Easy to compute/ provide clearly defined very operator will indicate the whole network covered. But the info is not available language independent, you need to know where to get it from - a kind of access-to-information KPI would be helpful Measurable Important criteria (counting to be specified) of overall ITS development	hard to estimate for private and commercial services how would you measure the %age? a definition of comprehensive is difficult. Why do you reduce yourself to websites? What is about RDS-TMC or apps? Quite broad criteria that equally reflects different levels of corresponding services

Deployment	KPI		Strengths	Weaknesses
	O2	% public transport ticket transactions that utilize electronic payment technologies	does this include, if I buy my ticket using my Credit Card? This is a high technology dependent KPI including organisational frameworks Measurable Clear and discrete (countable) criteria; proposal is to rely mainly on areas, not % of overall transactions	not clearly defined; there may be electronic payment technologies at various stages, not necessarily directly benefiting the user need to get data from private operators very difficult to collect. What is the purpose of this KPI? Very unclear. More interesting would be % of cross border door-to-door journeys paid electronically in a single step (even I have no clue how to collect that) Is measuring the electronic cash against the gross income a better KPI than counting tickets ? None
	O3	% public transport stops with dynamic traveler information available to public	Comprehensible, Technological mature easy to verify easy to collect. If this means real-time updates to travelers while on the public vehicles then this is very strong Clear and discrete (countable) criteria	does this include only at-stop signs or also web/mobile info services? More important would be the quality of the dynamic traveler information (e.g. all devices - app, on-site-information, website - give the same information) None
	O4	% TEN-T network covered by traffic advisory radio and/or mobile network reception and offering appropriate information services	Comprehensible, Technological mature easy to collect Measurable Clear and discrete (countable) criteria	In road sections with tunnels, it demands additional installations by mobile operators to ensure broad coverage will often be 100% or difficult to verify should be replaced by the 2 proposed later on - differentiation between "free available" and "paid services" should be done. Please don`t focus only on TERN - as KPI it should be used for all kinds of operating environments None
	O5	No of visits to websites and portals offering traveler information (e.g. journey planning, traffic information)	no of visits does not say anything on usage Measurable Important criteria for services' usability; to be related to overall population during certain period, not as only overall number	data on private and commercial websites usually not available not very connected to outcomes (though useful research information) should be replaced by the KPI proposed later on Visit numbers only half the story: how can you measure the quality / usefulness None, if measurable parameter will be defined correctly

Deployment	KPI		Strengths	Weaknesses
	O6	% TEN-T network covered by a minimum level of information infrastructures (e.g. traffic, weather and environmental conditions monitoring, CCTV or traffic information and control centers)	Useful, Easy to compute and present to a GIS platform easy to collect Measurable Important criteria of ITS penetration, but not so easy to be strictly defined and counted as proposed	It is only minimum, should be possible to control all ITS facilities on TEN-T network. rather stations per km of motorway; coverage is not easy to define too loosely specified has no direct effect on safety, efficiency, sustainability or comfort service provision How to evaluate if there is partly implementation (e.g. if there no "ghost driver" detection/warning)
	O7	Timelines incident – Info messages	Useful I like this one - as this is a quality KPI	don't understand this difficult to collect This is only an idea, without clear interpretation
	O8	Coverage of incidents	I like this one - as this is a quality KPI	no metric difficult to collect Not clear extent
	O9	Coverage of networks	I like this one - as this is a quality KPI	no metric difficult to collect Not clear extent
	O10	% of “Wrong” Messages + % of detection of incidents	I like this one - as this is a quality KPI Measurable Can be quite descriptive for evaluation of procedures' efficiency	hard to prove hard to monitor (would need on-the-ground audit) difficult to collect To be decide more precisely
	O11	Quality assessment of information provided.	Useful and with proper standardization it could be of direct benefit of the public & ITS service customers in principle Quality labels should be assigned I like this one - as this is a quality KPI Ok, if it'll be status (yes/no/partly), otherwise it can't be measured	No methodology how to specify "quality of information" Lack of standardization same as previous? difficult to collect very hard to do and even harder to measure
	O12	% of TEN-T network covered by information about real-time delays (predictions)	Better on trip planning	Data ownership issue (private data from floating car data).
	O13	Number of applications based on open data/open services	Data available for third parties developers	Data ownership, governmental support needed. Certification of used algorithms of the the third parties needed (without any not allowed support)
	O14	% of passengers served by dynamic information at stops or on internet		

Deployment	KPI		Strengths	Weaknesses
	O15	Likelihood that information about a severe event (accident, congestion > 5Km) is distributed after < 5 Min.		
	O16	Likelihood that information about a severe event (accident, congestion > 5Km) is received by a driver after < 5 Min.		
	O17	No of routing requests	has more importance than app-downloads or visits	difficult to collect
	O18	Road network covered by open app and TMC services (free to be use by travelers)	are the operators prepared to provide end-user services directly into the vehicle?	
	O19	Road network covered by private app and TMC services (costs traveler)		
	O20	Datex II implemented for traffic data exchange (yes/no)	are the operators prepared to provide end-user services directly into the vehicle? Good criteria for traffic data interoperability	
Continuity of traffic and freight management ITS Services	C1	% hazardous/abnormal load movements for which ITS has been utilized to facilitate the sharing of information between relevant organisations	Useful like Measurable Ok	Important mainly to relevant authorities (i.e. road operators, port authorities, …) too loosely specified - also, surely a safety metric? as we do not know the total number of dangerous goods movements it is hard to collect that KPI Are hazardous movements a significant road safety risk / feature ? Should be merged with R2, as a common service
	C2	% road toll revenue collected by electronic toll collection systems	What is meant by % revenue? In principal this figure seems easy to be collected, but this are business data and no ITS related data Measurable but measuring cash is a better KPI Clear and discrete (countable) criteria	is not a goal in itself better to focus specifically on free flow systems (to achieve continuity outcome)? no added value for safety, efficiency or sustainability None

Deployment	KPI		Strengths	Weaknesses
	C3	% compliance with the interoperability directive of the European Electronic Toll Service (EETS)	Useful and provides incentives to enhance tolls interoperability Measurable and strong Clear and discrete (countable) criteria	is not a goal in itself not connected to outcome % of what? Difficult to measure. What precisely will be counted: operators or route miles or what ? None
	C4	% urban intersections controlled using adaptive traffic control	Useful good easy to collect Measurable and strong Important criteria	why only urban? Overall percentage sometimes can't be reflective enough, we propose to apply it only to % of arterial transit routes with such intersections
	C5	% urban public transport network interchanges that are equipped with PT priority signals	Useful easy to collect Measurable Clear and discrete (countable) criteria	better refer to trips that benefit than to infrastructure why interchanges? why only urban? None
	C6	% TEN-T network with a minimum level of traffic management and control (e.g. Dynamic lane management, ramp metering, VMS)	Useful, Easy to compute and present to a GIS platform easy to collect. Sometimes it is not network related , but % of total number (e.g. ramp metering) Measurable Clear and discrete (countable) criteria	should be defined in detail too loosely specified why only TERN? None
	C7	% bus routes equipped with Automatic Vehicle Location	Useful easy to collect Measurable but buses change routes so better to measure % equipped vehicles surely? Useful criteria	or bus trips ? routes, or buses? To be defined rather by status (yes/no/partly), than percentage
	C8	% demand responsive vehicles that operate under Computer Aided Dispatch	see R1	usually the case for all relevant PT companies better as absolute number (probably per capita of population)? what is meant with % of vehicles? Or are we speaking about services? Does it mean special emergent fleet excluding Police and Rescue teams?
	C9	% of Network covered by traffic management plans	Useful Measurable Overall OK	It has similarities with C6 / Maybe they can combine or rather traffic share if available too loosely specified A TMP has no direct impact. To have a strategy is one thing - to follow the strategy and to obtain the related measures is another thing. Therefore I see no need for this KPI To be specified by scope

Deployment	KPI		Strengths	Weaknesses
	C10	Cross border agreements on cooperation between road operators in place for data exchange		
	C11	Cross border agreements on cooperation between road operators in place for operating adjacent traffic management systems		
	C12	% of urban/interurban dynamic traffic management links	Extent of internal networks' integration	
Linking the vehicle with the transport infrastructure	L1	% TEN-T network supporting cooperative systems (I2V, V2I)	easy to collect, as soon as we have a definition for I2V (in most cases also G3 and G4 networks are used for transmission). Maybe, to be even clearer, the KPI should be renamed to "% Road network covered by cooperative I2V and V2I services" (and not systems) Good concept but .. .. .. Clear and discrete (countable) criteria	not yet usable should be opened to urban environments and secondary networks as well. This looks much to imprecise to be of value None
	L2	% vehicle models currently offered for sale featuring intelligent vehicle services (vision enhancement, safety readiness, automated operation, cooperative systems)	ok	not very relevant and difficult to define (what exactly is a distinct model) not connected to outcomes (many IVS are local and not V2I) Need to differentiate linked services from those that stand alone for example vision enhancement isn't a connected service. This number is quite common for whole EU-market and don't rely on national ITS efforts
	L3	% vehicles sold featuring intelligent vehicle services (vision enhancement, safety readiness, automated operation, cooperative systems)	Useful to highlight ITS readiness of vehicles to cooperate with the infrastructure ITS facilities needs to be defined in detail, but seems possible ok Can reflect road users' attitude and readiness to pay for advanced traffic technologies	as previous Need to differentiate linked services from those that stand alone for example vision enhancement isn't a connected service. Almost the same as L3
	L4	% vehicles equipped with dynamic navigation		

Deployment	KPI		Strengths	Weaknesses
	L5	Number of cooperative services provided by infrastructure operators	as we expect a broad range of services (including proportion of public transport) I see this KPI as high important (otherwise there might be no big difference to TMC)	
	L6	% of “Wrong” Messages	we need to ensure quality assurance	
	L7	Quality assessment of information provided.		
	L8	Number of cooperative services in use	we need to ensure quality assurance Common awareness	

Benefit KPIs

Benefit Category	KPI		Strengths	Weaknesses
Network efficiency & congestion	N1	Change in peak hour journey time in conjunction with flow between key points along a route (all vehicles)	Of reasonable value but the definition of 'peak' can change and would not necessarily be related to the network Good one for efficiency evaluation	needs to be measured over longer periods of time Harmonized methodology should be provided
	N2	Change in peak hour flow between key points along a route (all vehicles)	Of reasonable value but the definition of 'peak' can change and would not necessarily be related to the network Clear and measurable criteria	needs to be measured over longer periods of time None
	N3	Public Transport journey time reliability – deviation from scheduled timetable	Comprehensible, Easy to compute/ provide delivers good information Potentially useful as a sub-set of N4 Clear and measurable criteria	needs to be measured over longer periods of time should include as well information similar in different dissemination/information channels Network efficiency is not the only contributory parameter; needs to be designed with great care None
	N4	Journey time variability as measured using standard deviation of journey times between key points along a route (all vehicles)	Comprehensible, Easy to compute/ provide innovative , indicates need for ITS An instant indicator of the behavior of a network or links Ok, if data extraction will not pay too much	Almost the other expression of N2, methodology is needed

Benefit	KPI		Strengths	Weaknesses
	N5	Change in Public Transport average daily person flow between key points along a route	innovative , indicates need for ITS Looks good politically Ok	Doesn't relate strongly to the efficiency etc of the network; to many contributory variables Interpretation is to be clear
	N6	Quality (reaction time, pro per info. Distribution, proper channel, right time, right place) of info	Useful and with proper standardization it could be of direct benefit of the public & ITS service customers I like this one None Very essential criteria of ITS traffic info service provisions	Lack of common quality standards too loosely specified I can't see how this can be accurately and consistently Evaluation methodology for so complex parameters is needed
	N7	Reducing searching time in an unfamiliar area	None Can be valuable	Vague (searching time for transport media?) difficult to estimate too loosely specified I can't see how this can be accurately and consistently How to measure? It should not be based only on users' enquiry
	N8	Journey time / reliability Safety traffic efficiency energy efficiency / (environment)	Useful like N5 None Ok	Composite KPI. Lack of common definition / computation method too loosely specified Changes do not relate to the efficiency of the network; too many contributory variables Harmonized evaluation methodology is needed
	N9	Modal shift (Change between personal cars and public transport	Useful Useful high level policy indicator Clear and measurable criteria	needs to be measured over longer periods of time None
	N10	Average time loss through waiting at cross-sections (cars, PT, cycles)	indicates need for technological solutions	
	N11	Network speed variability	low variability over sections and within network types (motorway, urban) indicates smooth flow and safety	
	N12	In case of congestion re-routing to alternative modes/routes (even to the secondary road network) based on operator's recommendation		

Benefit	KPI		Strengths	Weaknesses
Improve Environmental Impacts	E1	Change in CO2 emissions per vehicle km	Useful but might need to be sub-divided by engine class or similar Clear and measurable criteria	Difficult to distinguish solely the contributions of ITS difficult to measure across whole network, or more locally? Why not totals rather than per veh.km? Methodology to be provided
	E2	Change in number of hours where NOx levels are above threshold	already used Good Clear and measurable criteria (to be related only on certain network's part)	Difficult to distinguish solely the contributions of ITS available only for certain sections across whole network, or more locally? None, if correct algorithm
	E3	Change in PM10 emissions per vehicle km	Good Similar to E2	Difficult to distinguish solely the contributions of ITS difficult to measure across whole network, or more locally? Why not totals rather than per veh.km? None
	E4	Change in number of hours where transport noise is above dB threshold	night an day may be distinguished Useful but might need to be linked to time of day: noise tolerance reduces at night Similar to E3 and E4	Difficult to distinguish solely the contributions of ITS must be measured for emissions (position of houses etc. to to be taken into account) across whole network, or more locally? None
	E5	Change in -Travel times -Flow - Sustainable Mode share (ITS - … - CO2)	Can't see any	not clear don't understand this What would you measure and relate to what inputs ? The other expression of N8 (to be merged)
	E6	Use of telematics to manage freight vehicles (ITS is key to Public Transport Promotion)	Useful None	not clear don't understand this How would you differentiate high-emission vehicles cleverly managed by ITS and low emission vehicles incompetently operated ? This is not directly addressed to environmental issues
	E7	Change in noise level on detection point		
	E8	Carbon footprint per transport media and route		
	E9	Number of peak noise events		

Benefit	KPI		Strengths	Weaknesses
	E10	Network's throughput increase due to ITS as substitution of land use for road widening	Acceleration, passing noisy bridges etc. adds to detrimental impacts as compared to continuous noise level Effect of network's capacity grow due to soft instead of hard measures	
Improve Road **S**afety	S1	Change in number of all reported accidents per vehicle km	Useful good and easy to measure Useful; in use now in the UK Clear and measurable criteria	Depends on consistent and accurate police work However, some effect can be indirect and not related to ITS
	S2	Change in severity of accidents (i.e. numbers killed or serious injured) per number of accidents reported	Useful good and easy to measure Useful; in use now in the UK Clear and measurable criteria	semi-attached - a rising number could simply reflect a rapid reduction in minor accidents Depends on consistent and accurate police work The same as for S1
	S3	Future KPI – Number of near misses recorded by ITS	Dream on!	hard to measure semi-attached - a rising number could be good (i.e. indicating better ITS What would you measure and how would you do it ? To be defined more precisely
	S4	Change in crime reports relating to truck parking	Useful Possibly valuable but does this vary depending on regional policing policies? Clear and measurable criteria	hard to measure None
	S5	Perception of road safety	None	what is metric? Not connected to outcome? Most members of the public haven't a clue about this. In the UK 50 times as many people are killed each year as a result of smoking-related illnesses but people fret about road deaths one at a time. Too broad, need to be specified
	S6	Reduction in violations (Speeding, red light violations…)	Useful depends on enforcement strategy but in principle good indicator Possibly useful Clear and measurable criteria	Does this vary depending on regional policing policies? Some effect is not related to ITS
	S7	Benefits from road safety messages during congestion / incidents etc		measured how? How would you measure this? How to measure?

Benefit	KPI		Strengths	Weaknesses
	S8	Road safety improvements from safe and secure parking	Useful Ok	It might be a composite KPI along with S4 what is metric - number value of thefts of vehicles/freight? How would you measure this? How to measure?
	S9	Change in severity of accidents in work zones		
	S10	Number of misplaced vehicles on parking areas	easy to estimate	
	S11	% of network covered by real-time services providing information in accordance to Delegated Regulation on Road Safety Information Services		
	S12	% of network where data in accordance to Delegated Regulation on Road Safety Information Services are collected and provided		
Enhance Modal Integration	I1	Rail and inland waterway mode share along key corridors (ton km)	Useful may be even better: balance between modes Looks interesting Clear and measurable criteria	How independent of the load type is mode choice?
	I2	Public Transport mode share along key corridors (people)	Useful if available, very good indicator Looks interesting Clear and measurable criteria	people km? How do you isolate the commercial pricing? People choose Ryanair and Easyjet which give dreadful service because it is cheap: what policy available to Governments would move travelers from air to rail? Trend is more descriptive, than number by itself
	I3	Active travel mode share (people)	Looks interesting Clear and measurable criteria	not clear hard to measure reliably (though I guess survey info is widespread) The same as for I2
	I4	Opinion / qualitative research on availability / use of multimodal	if available, good indicator Only if it'll show common activity by status (yes/no)	don't understand this How would you measure this ?
	I5	Sustainable / PT mode share n key urban areas	if available, good indicator	too loosely specified How would you measure this ? Need clarification
	I6	The occupancy of the P+R parking place	Could be monitored the % of using the modal shift.	

Benefit	KPI		Strengths	Weaknesses
	I7	Share of walking for children on their way to school	if high, indicates generally good living conditions	

Appendix H: Longlist to Shortlist Process

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
R1	% emergency vehicle dispatches facilitated by computer aided dispatch		this will be 100% hard to get data we see, how we are prepared for future services many stakeholders, especially in rural areas difficult to collect, has no effect on real support and therefore no direct safety effect Measurable Is meaningless unless the correlation between numbers of calls, numbers of dispatches and actual incidents is known. Not directly related to ITS, but more to general emergent response		AECOM	Reject	No support for this KPI	
R2	% hazardous load movements for which information is logged or monitored using ITS		Control of every hazardous load movements with the load description Useful information available only at companies? would be highly important to know - even operators are not prepared to monitor all hazardous movements (e.g. in tunnels) this would be highly effective difficult to be collected (private issue). In most cases, companies are hardly communicate on hazardous loadings Measurable Are hazardous movements a significant road safety risk / feature ? Useful for tracking of the most risky vehicles in traffic centers In fact, there should be rather status (yes/no), than percentage of fleet coverage		AECOM	Reject	Difficulty in collection, lack of rationale for this plus lack of support	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
R3	% TEN-T network covered by incident detection and management algorithms		Comprehensible, Easy to compute / provide difficult to define, better: automatic incident detection. Doesn't account for effectiveness of algorithms clear and easy collectable figure hard to collect: a detector has a point location but shall provide link information (network covered - subjective assessment). Why does the KPI only reflect on TERN? I would like to have a general KPI and afterwards provide figures for different operating environments (TERN, urban, secondary network, rural network) Measurable; contributes to 'O' and '' lists below as well Important criteria of roadside ITS penetration Hard to describe, because some measures are rather local, than linear across the route	4	AECOM	Accept	Some support - may be better to divide by network type, rather than TEN-T only	Length and % of road network covered by incident detection and incident management. Report separately by road type where possible.
R4	% urban intersections providing safety enhancements for pedestrians and disabled or other vulnerable road users	Road condition	Useful. Must be defined very clearly too dependent on non-ITS facilities accompanying easy to collect does not say anything on the effectiveness of the implemented solutions. This seems to ignore the load factor: needs to be done in a much more targetted way that links to incident volumes. Clear and discrete (countable) criteria None	1	AECOM	Reject	Cannot ascertain ITS benefits, lack of support	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
R5	Number of intelligent truck parking facilities per km of TEN-T network	Relevance to all member states?	Information for drivers with possibility of reservation This could be rather % of intelligent truck parking facilities Comprehensible, Easy to compute/ provide clearly to define and easy to calculate what is "intelligent"?. Easy to collect. Clear link to the ITS Directive how to deal with ITP aside TERN Can't see any related to road safety Clear and discrete (countable) criteria; proposal is number of fac. per 100km Coverage is to be related to capacity of transit corridors and real demand for them	4	AECOM	Reject	Not relevant to all member states, plus lack of support	
R6	% urban network covered by speed cameras / CCTV and supported by centralised enforcement	Define urban areas - size? No covers - ITS use, safety	Rather: cameras/km of network Coverage is difficult to define better to focus on hotspots (eg % of junctions with red light cameras)? Easy to collect. In combination with average speed and total accident numbers a good safety indicator showing also the benefit/effect of speed enforcement. never combine 2 KPIs - here it is a combination of monitoring and enforcement. Why only urban networks? We have speed enforcement also in rural/TERN-areas. Many Member States' policies are to deploy safety cameras only at high incident sites so it's not at all convincing that the measurements will reflect the real world Clear and discrete (countable) criteria; proposal is to include here also systems of	1	Workshop	Accept	Could be expanded to include rural areas or focused in on key problem locations	Length and % of road network covered by automated speed detection. Report separately by road type where possible.

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
			redlight and banned overtakings enforcement and to wide it also to national roads The same as R3, the more objective criteria could be percentage of posts per a unit of length (100km), than overall percentage					
R7	% of TEN-T long-term workzone equipped with security applications and information (management) system		Information about work zone layouts, delays and probability of problems Organisation of process needs to be setup.	1	Home pack	Reject	Unclear, plus lack of support	
R8	% urban intersections providing priority signals for emergency blue light forces	junction (network), not possible to gather from cities - and obligation to collect data. Can be good reasons for 0% implementation shouldnt have a red box - ITS part of policy you can measure		1	Home pack	Reject	Lack of support and issues in collection	
R9	Number of gantries with dynamic traffic management functions/100000 car Kilometers/day		includes traffic charge and not only section length		Home pack	Reject	Lack of support	
R10	Number of hours when dynamic traffic advice is displayed (or on time of gantries)				Home pack	Reject	Too specific, lack of support	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
R11	% emergency vehicle despatch systems linked to traffic management interventions		hard to measure		Home pack	Reject	Difficulty in measurement	
R12	Number of accidents		the most logical KPI - what is the number of accidents in an operating environment		Home pack	Reject	Covered under benefit KPIs	
R13	Number of security constrains				Home pack	Reject	Poorly defined	
R14	% of national fleet fitted with e-Call			1	Home pack	Reject	Incorporated into L3	
R15	Status (yes/no/ how many) of TPS inclusion in national E-Call platform		Awareness about optional extensions of interoperable E-Call		Home pack	Reject	Unclear, plus lack of support	
R16	% of long (to be defined) tunnels/bridges, equipped with complex incident det./res. System		How often have trucks been broken up on ITP areas, etc. The change of this KPI over time shoes the benefit of measures Will take some time to go beyond single figures Data about performance of network's hot spots		Home pack	Reject	Only relates to tunnels, too specific.	
O1	% national transport network covered by websites offering comprehensive traveller information (e.g. Journey planning, traffic information)	could be combined with O6 - information channels, % service vehicles network - model services and physical network, should include disruption PUSH, Barrier - agreeing the network	Useful, Easy to compute/ provide clearly defined hard to estimate for private and commercial services how would you measure the %age? Every operator will indicate the whole network covered. But the info is not available language independent, you need to know where to get it from - a kind of access-to-information KPI would be helpful a definition of comprehensive is difficult. Why do you reduce yourself to websites? What is about RDS-TMC or apps? Measurable Important criteria	15	AECOM	Accept	Decent levels of support - may need rewording	Length and % of transport / road network covered by websites/over-the-air services offering traffic and travel information. Report separately: 1) Travel information 2) Traffic information 3) Integrated traffic and travel information 3) Freight specific information

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
			(counting isto be precised) of overall ITS development Quite broad criteria, that equally reflects different levels of corresp. services					
O2	% public transport ticket transactions that utilise electronic payment technologies		not clearly defined; there may be electronic payment techologies at various stages, not necessarily directly befiting the user need to get data from private operators does this include, if I buy my ticket using my Credit Card? This is a high technology dependent KPI including organisational frameworks very difficult to collect. What is the purpose of this KPI? Very unclear. More interesting would be % of cross border door-to-door journeys paid electronically in a single step (even I have no clue how to collect that) Measurable Is measuring the electronic cash against the gross income a better KPI than counting tickets ? Clear and discrete (countable) criteria; proposal is to rely mainly on areas, not % of overall transactions None		AECOM	Reject	Too difficult to implement	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
O3	% public transport stops with dynamic traveler information available to public	includes mobile network	Comprehensible, Technological mature easy to verify does this include only at-stop signs or also web/mobile info services? easy to collect. More important would be the quality of the dynamic traveller information (eg all devices - app, on-site-information, website - give the same information) If this means real-time updates to travellers while on the public vehicles then this is very strong Clear and discrete (countable) criteria None	5	AECOM	Accept	To explore further - may need to link with mobile data and possibly combine with KPI related to other forms of travel information	Number and % of urban public transport stops for which dynamic traveler information is made available to the public. Report separately by public transport mode where possible.
O4	% TEN-T network covered by traffic advisory radio and/or mobile network reception and offering appropriate information services		Comprehensible, Technological mature In road sections with tunnels, it demands additional installations by mobile operators to ensure broad coverage will often be 100% or difficult to verify easy to collect should be replaced by the 2 proposed lateron - differentiation between "free available" and "paied services" should be done. Please don`t focus only on TERN - as KPI it should be used for all kinds of operating environments Measurable Clear and discrete (countable) criteria None	4	AECOM	Reject	Low levels of support, plus values may all be at or near 100%	
O5	No of visits to websites and portals offering traveler information (e.g. journey planning, traffic information)	Barrier - if ITS is a private service, cant get the data, nor deployment	data on private and commercial websites usually not available not very connected to outcomes (though useful research information) no of visits does not say anything on usage should be replaced by the KPI proposed later on Measurable Visit numbers only half the story: how can you measure the quality /	2	AECOM	Reject	Data access issues and issues related to population size	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
			usefulness Important criteria for services' usability; to be related to overall population during certain period, not as only overall number None, if measurable parameter will be defined correctly					
O6	% TEN-T network covered by a minimum level of information infrastructures (e.g. traffic, weather and environmental conditions monitoring, CCTV or traffic information and control centres)		It is only minimum, should be possible to control all ITS facilities on TEN-T network. Useful, Easy to compute and present to a GIS platform rather stations per km of motorway; coverage is not easy to define too loosely specified easy to collect has no direct effect on safety, efficiency, sustainability or comfort service provision Measurable Important criteria of ITS penetration, but not so easy to be strictly defined and counted as proposed How to evaluate if there is partly implementation (f.i., if there no "ghost driver" detection/warning)	23	AECOM	Accept	High levels of support and positive feedback. KPI needs more precisely defining and consideration of levels.	Length and % of road network covered by the following (Report separately): 1) Information gathering infrastructures 2) Traffic information services 3) A traffic management plan (s) incl. cross border TMP 4) Traffic management and control 5) Infrastructure or equipment on the network to enable Cooperative-ITS 6) Intelligent safety provision for disabled and vulnerable road users
O7	Timelines incident – Info messages		Useful don't understand this I like this one - as this is a quality KPI difficult to collect This is only an idea, without clear interpretation	3	Workshop	Reject	Meaning unclear	
O8	Coverage of incidents		no metric I like this one - as this is a quality KPI difficult to collect Not clear extent	4	Workshop	Reject	Lack of support and definition unclear	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
O9	Coverage of networks		no metric I like this one - as this is a quality KPI difficult to collect Not clear extent	1	Workshop	Reject	Lack of support and definition unclear	
O10	% of “Wrong” Messages + % of detection of incidents		hard to prove hard to monitor (would need on-the-ground audit) I like this one - as this is a quality KPI difficult to collect Measurable Can be quite descriptive for evaluation of procedures' efficiency To be decide more precisely	1	Workshop	Reject	Difficult to collect and lack of support	
O11	Quality assessment of information provided.		No methodology how to specify "quality of information" Useful and with proper standarization it could be of direct benefit of the public & ITS servicfe customers Lack of standarization in principle Quality labels should be assigned same as previous? I like this one - as this is a quality KPI difficult to collect very hard to do and even harder to measure Ok, if it'll be status (yes/no/partly), otherwise it can't be measured	10	Workshop	Reject	Decent levels of support, but cannot usefully be turned into a KPI	
O12	% of TEN-T network covered by information about real-time delays (predictions)		Better on trip planning Data ownership issue (private data from floating car data).	1	Home pack	Reject	Duplicates other KPIs	
O13	Number of applications based on open data/open services		Data available for third parties developers Data ownership, governmental support needed. Certification of used algorithms of the the third parties needed (without any not allowed support)		Home pack	Reject	Open data in itself is not of particular relevance, only the applications for which it is used	
O14	% of passengers served by dynmamic information at stops or on internet				Home pack	Reject	Covered in O3	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
O15	Likelihood that information about a severe event (accident, congestion > 5Km) is distributed after < 5 Min.				Home pack	Reject	Would need an alternative means of establishing when event began to establish speed of information delivery	
O16	Likelihood that information about a severe event (accident, congestion > 5Km) is received by a driver after < 5 Min.				Home pack	Reject	Difficulty in measurement	
O17	No of routing requests		has more importance than app-downloads or visits difficult to collect	1	Home pack	Reject	alternative/addition to O5, but this has been rejected//	
O18	Road network covered by open app and TMC services (free to be use by travellers)		are the operators prepared to provide end-user services directly into the vehicle?		Home pack	Reject	alternative to 04 which had little support	
O19	Road network covered by private app and TMC services (costs traveller)				Home pack	Reject	alternative to 04 which had little support	
O20	Datex II implemented for traffic data exchange (yes/no)		are the operators prepared to provide end-user services directly into the vehicle? Good criteria for traffic data interoperability		Home pack	Reject	Too specific, lack of support	
C1	% hazardous/abnormal load movements for which ITS has been utilised to facilitate the sharing of information between relevant organisations	% network covered by traffic management. Freight transport - data availability sharing - goods transport	Useful Important mainly to relevant authorities (i.e. road operators, port authorities) too loosely specified - also, surely a safety metric? like as we do not know the total number of dangerous goods movements it is hard to collect that KPI Measurable Are hazardous movements a significant raod	1	AECOM	Reject	Only significant to relevant authorities	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
		network efficiency eg. close to ports	safety risk / feature ? Ok Should be merged with R2, as a common service					
C2	% road toll revenue collected by electronic toll collection systems	relevance to all member states?	is not a goal in itself better to focus specifically on freeflow systems (to achieve continuity outcome)? What is meant by % revenue? In principal this figure seems easy to be collected, but this are business data and no ITS related data no added value for safety, efficiency or sustainability Measurable but measuring cash is a better KPI Clear and discrete (countable) criteria None	4	AECOM	Reject	Not relevant to all member states, revenue not a measure of ITS performance	
C3	% compliance with the interoperability directive of the European Electronic Toll Service (EETS)		Useful and provides incentives to enhance tolls interoperability is not a goal in itself not connected to outcome % of what? Difficult to measure. Measurable and strong What precisely will be counted: operators or route miles or what ? Clear and discrete (countable) criteria None	2	AECOM	Reject	Not relevant to all member states. Lack of support	
C4	% urban intersections controlled using adaptive traffic control		Useful good easy to collect why only urban? Measurable and strong Important criteria Overall percentage sometimes can't be reflective enough, we propose to apply it only to % of arterial transit routes with such intersections	3	AECOM	Accept	Consider widening to strategic network	Number and % of signal controlled road intersections using adaptive traffic control or prioritisation. Report separately by road type or area where possible.
C5	% urban public transport network interchanges that are equipped with PT priority signals		Useful better refer to trips that benefit than to infrastructure why interchanges? easy to collect why only urban? Measurable Clear and discrete (countable) criteria None		AECOM	Reject	Little evidence of support	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
C6	% TEN-T network with a minimum level of traffic management and control(e.g. Dynamic lane management, ramp metering, VMS)		Useful, Easy to compute and present to a GIS platform should be defined in detail too loosely specified easyto collect. Sometimes it is not network related , but % of total number (e.g. ramp metering) why only TERN? Measurable Clear and discrete (countable) criteria None	13	AECOM	Reject	Now included in O6	
C7	% bus routes equipped with Automatic Vehicle Location	Barrier - agreeing routes, cooperation of the different agencies with pieces of the data, % service vehicles equipped, collecting data, disaggregating data	Useful or bus trips ? routes, or buses? easy to collect Measurable but buses change routes so better to measure % equipped vehicles surely ? Useful criteria To be defined rather by status (yes/no/partly), than percentage		AECOM	Reject	Conflicting views on most appropriate means of measuring, lack of support	
C8	% demand responsive vehicles that operate under Computer Aided Dispatch	% of uncensored vehicles	Usually the case for alle relevant PT companies better as absolute number (probably per capita of population)? what is meant with % of vehicles? Or are we speaking about services? see R1 Does it mean special emergent fleet excluding Police and Rescue teams?		AECOM	Reject	Lack of support	
C9	% of Network covered by traffic management plans		Useful It has similarities with C6 / Maybe they can combine or rather traffic share if available too loosely specified A TMP has no direct impact. To have a strategy is one thing - to follow the strategy and to obtain the related measures is an other thing. Therefore I see no need for	3	Workshop	Reject	Now included in o6	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
			this KPI Measurable Overall OK To be precise by scope					
C10	Cross border agreements on cooperation between road operators in place for data exchange				Home pack	Reject	Lack of support	
C11	Cross border agreements on cooperation between road operators in place for operating adjacent traffic management systems				Home pack	Reject	Lack of support, unclear	
C12	% of urban/interurban dynamic traffic management links		Extent of internal networks' integration		Home pack	Reject	Similar to existing, not well defined	
L1	% TEN-T network supporting cooperative systems (I2V, V2I)	Digital and physical - users? - relevant to part of network - 2 High level KPIs - infrastructure, vehicles connected to infrastructure - responsibility? - Level of system	Not yet usable easy to collect, as soon as we have a definition for I2V (in most cases also G3 and G4 networks are used for transmission). Maybe, to be even clearer, the KPI should be renamed to "% Road network covered by cooperative I2V and V2I services" (and not systems) should be opened to urban environments and secondary networks as well. Good concept but this looks much to imprecise to be of value Clear and discrete (countable) criteria None	18	AECOM	Reject	Consider separating into 2 kpis. Consider wider networks. This is now covered by KPI O6	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
L2	% vehicle models currently offered for sale featuring intelligent vehicle services (vision enhancement, safety readiness, automated operation, cooperative systems)	What about retrofitted vehicles? Discrepancy regarding number of systems	Not very relevant and difficult to define (what exactly is a distinct model?) not connected to outcomes (many IVS are local and not V2I) ok Need to differentiate linked services from those that stand alone for example vision enhancement isn't a connected service. This number is quite common for whole EU-market and don't rely on national ITS efforts		AECOM	Reject	Lack of support and varied views on appropriate definitions	
L3	% vehicles sold featuring intelligent vehicle services (vision enhancement, safety readiness, automated operation, cooperative systems)	L3 more relevant than L2. % vehicles connected, vehicle types - will we be able to measure? Connectivity % at any time across part of the network.	Useful to highlight ITS readiness of vehicles to cooperate with the infrastructure ITS facilities needs to be defined in detail, but seems possible as previous ok Need to differentiate linked services from those that stand alone for example vision enhancement isn't a connected service. Can reflect road user's attitude and readiness to pay for advanced traffic technologies Almost the same as L3	10	AECOM	Accept	Good degree of support. To include eCall. Further definition required, including consideration of sub-measures	Number and % of new vehicles including the following intelligent vehicle features: 1) safety readiness 2) automated operation 3) cooperative systems 4) eCall To be reported by vehicle type (cars and commercial vehicles) where possible.
L4	% vehicles equipped with dynamic navigation				Home pack	Reject	Too specific, lack of support	
L5	Number of cooperative services provided by infrastructure operators		as we expect a broad range of services (including proportion of public transport) I see this KPI as high important (otherwise there might be no big difference to TMC)	1	Home pack	Reject	Unclear, plus lack of support	
L6	% of "Wrong" Messages		we need to ensure quality assurance		Home pack	Reject	Difficult to measure	
L7	Quality assessment of information provided.				Home pack	Reject	Qualitative, making comparability difficult	
L8	Number of		we need to ensure quality		Home	Reject	Lack of support	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
	cooperative services in use		assurance Common awareness		pack			
L9	Number of automatically initiated eCalls					Accept	Move to benefit KPIs. Consider response times as key benefit of eCall	Time taken between initiation of public (112) eCall and arrival of automatic message to Public Safety Answering Point.
N1	Change in peak hour journey time in conjunction with flow between key points along a route (all vehicles)	2 kpis - queue length + modal shift. Management of network - quality of information. Users - reduce searching time, reliability - time savings, difficulty of measuring - disaggregation, benefits in policy objectives (have to be used etc), ITS functions - safety, congestion, environmental. CBA (missing some impacts, e.g. being informed) KPIs combine more than one factor, OK theoretically, difficult to	needs to be measured over longer periods of time Of reasonable value but the definition of 'peak' can change and would not necessarily be related to the network Good one for efficiency evaluation Harmonized methodology should be provided	8	AECOM	Accept	Reasonable level of support. Further consideration required on definition - eg peak hour	% change in peak hour journey time along routes where ITS has been implemented. Report by vehicle type where possible.

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
		measure, travel time and queue length. good KPIs at all hours, Incident detection, air quality can be measured, travel time/reliability more complex						
N2	Change in peak hour flow between key points along a route (all vehicles)	off peak as well? Mean time travel? What is the context?	needs to be measured over longer periods of time Of reasonable value but the definition of 'peak' can change and would not necessarily be related to the network Clear and measurable criteria None	1	AECOM	Accept	Low levels of support, but useful alongside N2 and a fundamental aim of most ITS	% change in peak hour traffic flow along routes where ITS has been implemented. Report by vehicle type where possible.
N3	Public Transport journey time reliability – deviation from scheduled timetable	What is deviation? Who will measure operators? Will data be available?	Comprehensible, Easy to compute/ provide delivers good information needs to be measured over longer periods of time should include as well information similar in different dissemination/information channels Potentially useful as a sub-set of N4 Network efficiency is not the only contributory parameter; needs to be designed with great care Clear and measurable criteria None	14	AECOM	Reject	Good level of support, but considered to be difficult to influence by ITS.	
N4	Journey time variability as measured using standard deviation of journey times between key points along a route (all vehicles)		Comprehensible, Easy to compute/ provide innovative , indicates need for ITS An instant indicator of the behavior of a network or links Ok, if data extraction will not pay too much Almost the other expression of N2, methodology is needed	4	AECOM	Accept	Few votes, but comments indicate support and well aligned with popular n3 above - could consider combining	% change in journey time variability on routes where ITS has been implemented -as measured by coefficient of variation. Report by vehicle type where possible.

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
N5	Change in Public Transport average daily person flow between key points along a route	Difficult to measure? Capacity at peak hours?	innovative , indicates need for ITS Looks good politically Doesn't relate strongly to the efficiency etc of the network; to many contributory variables Ok Interpretation is to be clear	5	AECOM	Reject	Not strongly influenced by ITS - other factors more significant	
N6	Quality (reaction time, pro per info. Distribution, proper channel, right time, right place) of info		Useful and with proper standardization it could be of direct benefit of the public & ITS service customers Lack of common quality standards too loosely specified I like this one None I can't see how this can be accurately and consistently Very essential criteria of ITS traffic info service provisions Evaluation methodology for so complex parameters is needed	10	Workshop	Reject	Moderate support, but poorly define. Consider further, but may not be possible to measure consistently - Now considered too difficult to define	
N7	Reducing searching time in an unfamiliar area		Vague (searching time for transport media ?) difficult to estimate too loosely specified None I can't see how this can be accurately and consistently Can be valuable How to measure? It should not be based only on users' enquiry	2	Workshop	Reject	Too vague	
N8	Journey time / reliability Safety traffic efficiency energy efficiency / (environment)		Useful Composite KPI. Lack of common definition / computation method like N5 too loosely specified None Changes do not relate to the efficiency of the network; too many contributory variables Ok harmonized evaluation methodology is needed	3	Workshop	Reject	Too many factors combined into 1 KPI - results would not be meaningful	
N9	Modal shift (Change between personal cars and public transport		Useful needs to be measured over longer periods of time Useful high level policy indicator Clear and measurable criteria None	2	Workshop	Accept	Few votes, but worth considering further as a key policy objective. Data requirements may be prohibitive	% change in mode share on corridors where ITS has been implemented. Report percentage mode

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
								share separately for each mode.
N10	Average time loss through waiting at cross-sections (cars, PT, cycles)		indicates need for technological solutions	1	Home pack	Reject	Average delay at intersections - consider in relation to JT KPI (N1) - considered in N1	
N11	Network speed variability		low variability over sections and within network types (motorway, urban) indicates smooth flow and safety		Home pack	Reject	JT variability already a KPI	
N12	In case of congestion re-routing to alternative modes/routes (even to the secondary road network) based on operator's recommendation				Home pack	Reject	KPI poorly defined	
E1	Change in CO2 emissions per vehicle km	Travel time, flow, mode share	Difficult to distinguish solely the contributions of ITS difficult to measure across whole network, or more locally? Why not totals rather than per veh.km? Useful but might need to be sub-divided by engine class or similar Clear and measurable criteria Methodology to be provided	5	AECOM	Accept	Aligned with key EU policy goals, although emissions can only be inferred from other network characteristics (flow, speed and vehicle efficiency)	% change in annual CO^2 emissions (Tons) on routes where ITS has been implemented.
E2	Change in number of hours where NOx levels are above threshold		Difficult to distinguish solely the contributions of ITS already used available only for certain sections across whole network, or more locally? Good Clear and measurable criteria (to be related only on certain network's part) None, if correct algorythm	3	AECOM	Reject	Only available on specific locations and difficult to isolate ITS benefits	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
E3	Change in PM10 emissions per vehicle km		Difficult to distinguish solely the contributions of ITS difficult to measure across whole network, or more locally? Why not totals rather than per veh.km? Good Similar to E2 None	1	AECOM	Reject	Only available on specific locations and difficult to isolate ITS benefits	
E4	Change in number of hours where transport noise is above dB threshold	very useful for PT mode share	Difficult to distinguish solely the contributions of ITS night an day may be distinguished must be measured for emissions (position of houses etc. to be taken into account) across whole network, or more locally? Useful but might need to be linked to time of day: noise tolerance reduces at night Similar to E3 and E4 None	1	AECOM	Reject	Difficulty in measurement	
E5	Change in -Travel times -Flow - Sustainable Mode share (ITS - … - CO2)		not clear don't understand this Can't see any What would you measure and relate to what inputs ? The other expression of N8 (to be merged)	15	Workshop	Reject	Poorly defined - elements contained in previous KPIs	
E6	Use of telematics to manage freight vehicles (ITS is key to Public Transport Promotion)		Useful not clear don't understand this None How would you differentiate high-emission vehicles cleverly managed by ITS and low emission vehicles incompetntly operated ? This is not directly adressed to environmental issues	1	Workshop	Reject	Too specific	
E7	Change in noise level on detection point				Home pack	Reject	Covered in previous noise KPI, also rejected	
E8	Carbon footprint per transport media and route				Home pack	Reject	unclear	
E9	Number of peak noise events			0	Home pack	Reject	Covered in previous noise KPI, also rejected	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
E10	Network's throughput increase due to ITS as substitution of land use for road widening		Acceleration, passing noisy bridges etc. adds to detrimental impacts as compared to continuous noise level Effect of network's capacity grow due to soft instead of hard measures		Home pack	Reject	unclear	
S1	Change in number of all reported accidents per vehicle km	How to link to ITS? Accessibility of data for insurance companies? Common definitions of KSIs? Improved localization of accidents? disaggregation,	Useful good and easy to measure Useful; in use now in the UK Depends on consistent and accurate police work Clear and measurable criteria However, some effect can be indirect and not related to ITS	12	AECOM	Accept	High levels of support, further work required in identifying a consistent definition	% change in number of reported accidents along routes where ITS has been implemented. Report by accident severity where possible.
S2	Change in severity of accidents (i.e. numbers killed or serious injured) per number of accidents reported	indicator: speed of dispatch of emergency services	Useful good and easy to measure semi-attached - a rising number could simply reflect a rapid reduction in minor accidents Useful; in use now in the UK Depends on consistent and accurate police work Clear and measurable criteria The same as for S1	12	AECOM	Reject	High levels of support, currently in use. Merge with KPI S1	
S3	Future KPI – Number of near misses recorded by ITS	How do you measure/define a near miss? Acceleration/deceleration	hard to measure semi-attached - a rising number could be good (i.e. indicating better ITS Dream on ! What would you measure and how would you do it? To be defined more precisely		AECOM	Reject	Difficult to define and measure near misses	
S4	Change in crime reports relating to truck parking	crime difficult to capture - generally underreported, road safety	Useful hard to measure Possibly valuable but does this vary depending on regional policing policies ? Clear and measurable criteria None		AECOM	Reject	Hard to measure, lack of support	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
		from truck parking, avoiding unsafe parking						
S5	Perception of road safety	questionnaire barrier? Link to education process	what is metric? Not connected to outcome? None Most members of the public haven't a clue about this. In the UK 50 times as many people are killed each year as a result of smoking-related illnesses but people fret about road deaths one at a time. Too broad, need to be precise		Workshop	Reject	Not specific and measurable	
S6	Reduction in violations (Speeding, red light violations…)		Useful depends on enforcement strategy but in principle good indicator Possibly useful Does this vary depending on regional policing policies ? Clear and measurable criteria Some effect is not related to ITS	11	Workshop	Reject	Good degree of support, but potentially not related to ITS. ITS is the way of measuring this, not influencing it - Decision to reject based upon these grounds.	
S7	Benefits from road safety messages during congestion / incidents etc		measured how? How would you measure this? How to measure?	2	Workshop	Reject	Difficult to measure	
S8	Road safety improvements from safe and secure parking		Useful It might be a composite KPI along with S4 what is metric – number/value of thefts of vehicles/freight? How would you measure this ? Ok How to measure?		Workshop	Reject	Hard to measure, lack of support	
S9	Change in severity of accidents in workzones				Home pack	Reject	Too specific	
S10	Number of misplaced vehicles on parking areas		easy to estimate		Home pack	Reject	Too specific, not relevant	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
S11	% of network covered by real-time services providing information in accordance to Delegated Regulation on Road Safety Information Services			1	Home pack	Accept	To be moved into deployment, but seems to relate to recent EU regulation	Provision of intelligent services on the TENT-T core and comprehensive network that are in accordance to the Delegated Regulations of the ITS Directive.
S12	% of network where data in accordance to Delegated Regulation on Road Safety Information Services are collected and provided				Home pack	Reject	To be merged with S11, but related to recent EU regulation.	
I1	Rail and inland waterway mode share along key corridors (tonne km)	measures what we need (infrastructure)	Useful may be even better: balance between modes Looks interesting How independent of the load type is mode choice ? Clear and measurable criteria	1	AECOM	Reject	Lack of support, difficulty in collecting data and difficulty of influencing	
I2	Public Transport mode share along key corridors (people)	define relevance for PT - only models	Useful if available, very good indicator people km? Looks interesting How do you isoltae the commercial pricing ? People choose Ryanair and easyjet which give dreadful service because it is cheap: what policy available to Governments would move travellers from air to rail ? Clear and measurable criteria Trend is more descriptive, than number by itself	5	AECOM	Reject	Difficulty/cost of collecting data - lack of influence of ITS	
I3	Active travel mode share (people)		not clear hard to measure reliably (though I guess survey info is widespread) Looks interesting Clear and measurable criteria The same as for I2		AECOM	Reject	Difficulty/cost of collecting data - lack of influence of ITS	

	KPI	Workshop comments	Homework pack comments	Votes	Proposed by	Accept/ Reject	AECOM consideration of the evidence,	Amended Version
I4	Opinion / qualitative research on availability / use of multimodal		if available, good indicator don't understand this How would you measure this ? Only if it'll show common activity by status (yes/no)	9	Workshop	Reject	Not a KPI	
I5	Sustainable / PT mode share n key urban areas		if available, good indicator too loosely specified How would you measure this ? Need clarification		Workshop	Reject	Same as above mode share KPIs	
I6	The occupancy of the P+R parking place				Home pack	Reject	Too specific	
I7	Share of walking for children on their way to school		if high, indicates generally good living conditions		Home pack	Reject	Not influenced by ITS	