

DELIVERABLE

D3.8 – KPI Assessment Framework

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Authors:	Víctor Corral [ATOS], Germán Herrero [ATOS], Guillermo Velázquez [UPM] Alfonso Román [UPM] Andrés Monzón
	[UPM]
Contributors	-
Internal reviewers:	Mauro Gil (INDRA), Stephane Lorin (THALES).
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	WP3/T3.7 "KPI Assessment Framework" continuing					
	the work performance in T2.2 where UPM and Atos					
	deliver the first common assessment framework for					
	assessing the performance in the 6 categories					
	selected to measure the results obtained in each of					
	the 13 TT pilots, in this occasion, we have completed					
	the work by delivering the methodology for the					
	assessment of the performance of the Strategic					
	Assessment of TT by using Project Level KPIs.					

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Definitions, Acronyms and Abbreviations

Acronym	Title
AM	Asset Management
CO2	Carbon Dioxide
DL	Deliverable Leader
DoA	Description of Action
Dx	Deliverable (where x defines the deliverable identification number e.g. D1.1.1)
EC	Energy Consumption
EEA	European Environmental Agency
EF	Economic
EQ	Environmental Quality
EU	European Union
GHG	Green House Gas
КРІ	Key Performance Indicator
LCV	Light Commercial Vehicle
NOx	Nitrogen Oxides
OE	Operational Efficiency
РС	Project Coordinator
РО	Project Officer
РТ	Priority Topic
PU	Public
R	Report
SF	Safety
TL	Task Leader
TT	Transforming Transport
Тх	Task (where x defines the task identification number e.g. T1.1)



Executive Summary

The overall goal of the Transforming Transport project (TT) is to demonstrate in a realistic, measurable, and replicable way the transformative effects that Big Data will have on the mobility and logistics sector. The project is designed to validate Big Data as capable of reshaping transport processes and services significantly increasing operational efficiency, improving customer experience, and fostering new business models. All of this will be achieved by demonstrating, evaluating and validating, in real operational scenarios (Pilots) belonging to different transportation domains, the capability of Big Data innovations to develop more efficient solutions.

This deliverable reports on the work performed in WP3, Task T3.1, specifically focussing on the aspect of KPI assessment. The goal of the task is to develop the framework that will perform the technical, operational, economical, and societal evaluation of the aggregated results obtained in each of the 13 pilots in TT. The deliverable covers the process of design, development and actual deployment of the TransformingTransport Key Performance Indicator (KPI) Assessment framework, which will be used to assess the Pilots involved in the project and their results.

This deliverable provides a definition of a holistic set of KPIs arranged in a common assessment framework for TT. The KPI assessment framework helps determining and estimating as accurately as possible the benefits that different innovations in each pilot domain might bring, and the impact occasioned in different assessment categories to multiple stakeholders of the Pilots. It is not intended to halt any of the innovations at the R&I stage, in case we don't get the performance we estimated, but to frame in what circumstances and scenarios they can be useful in order to widen the portfolio of solutions available for decision-makers. It should be noted that not only the numerical results of the KPIs are important, but also the frame and the interpretation of the results according to the circumstances. Also, experience gained by measuring the KPIs may lead to further improvements of the KPIs' definitions and application methodology from pilot domain as well as from project perspective.

This deliverable is complement by an exploitation methodology presented in the TT Impact plan (deliverables D3.7 and D3.10), which will allow us to identify which commercial opportunities arise from pilot and project execution to leverage the possibility the transferability of the results from the research programs to the transport market.



1 Introduction

The overall goal of TT is to demonstrate in a realistic, measurable, and replicable way the transformative effects that Big Data will have on the mobility and logistics sector. The project is designed to validate Big Data as capable of reshaping transport processes and services by significantly increasing operational efficiency, improving customer experience, and fostering new business models. All of this by demonstrating, evaluating and validating, in real operational scenarios (Pilots) belonging to seven different transportation domains, the capability of Big Data innovations to develop more efficient solutions. To achieve this objective, the project is based on a consolidated methodological approach characterised by three main activities:

- Defining both global and pilot domain performance targets.
- Testing the innovations in real operation conditions.
- Evaluation and validation of the potential impact of Big Data innovations.

Section 1: summarizes the main objectives of T3.1 Joint Exploitation, Market Impact & KPI achievement, concretely in the scope of D3.8 KPI Assessment Framework. This section provides an integrated framework overview of both tasks, T2.2 and T3.1. The alignment, objectives and outcomes are presented in this section.

Section 2: It has been presented the fourth level of Assessment which is the Strategic Assessment. The concrete objectives of this level and also, the methodology stages of this level have been defined.

Section 3: presents the assessment categories that will be evaluated under the Strategic Assessment Level. It has been indicated which formula will be used to evaluate the aggregated performance obtained in each of the categories. As well as, it has been selected, defined and explained which KPIs will be used to assess the performance of TT at a project level. The way to measure the degree of target achievement is also defined.

Section 4: provides a preliminary overview of the main TT impacts, categorised depending of the outcomes that TT is seeking to produce. The impacts have been fed by the preliminary identification carried out by Pilot domains in their priority topics.



1.1 Joint Exploitation, Market impact & KPI achievement

The main objective of <u>T3.1– Joint Exploitation, Market Impact & KPI achievement</u> described in the DoA is *"Set up the TransformingTransport KPI assessment framework, which will satisfy a set of basic needs of the private sector intending to investigate the adoption of TransformingTransport solutions"*. On top of that, there are additional objectives that T3.1 is aiming to reach:

- <u>Objective 1:</u> Implementation of the Strategic Assessment Level (KPI Project Level) based on the Four Level of Assessment within TT KPI Framework.
 - The final result arisen from the co-creation between Atos an UPM (leading partners in KPIs) has been reflected in the delivery of the final integrated KPI Assessment Framework between T2.2 and T3.1. Due to the importance to build up a common framework for assessing the performance of TT at a pilot and project level, it has been decided to start working on such task since M3, and finalise the implementation and methodology of the Strategic Assessment level (Project Level) in this deliverable, as explained afterwards in sections 2.1 and 2.2. Another important outcome has been delivered such as setting up the *Methodology* or *Structure of Work* for the Assessment framework development (Figure 3).
- <u>Objective 2:</u> Selection of the project KPIs that will depict which is the penetration and performance of the TransformingTransport Big Data ecosystem. In addition to indicating the value delivered by TransformingTransport with the different pilots, these KPIs will be provided as input to T3.1 "Joint Exploitation, Market Impact & KPI Achievement", in order to determine higher-level KPIs (as stated in the work programme) and thus determine potential market impact. Furthermore, for M18, we will collect the results achieved concerning which is the degree of KPI achievement accordingly to the performance targets set up for each of the KPIs selected.
- <u>Objective 3:</u> Performance of the methodology needed for the identification of the main market impacts achieved by TT project as well as, which stakeholders could benefit for the positive outcomes in transport and logistics areas achieved through the implementation of big data solutions in pilot location. Some of the areas under assessment are business improvement, socio-economic aspects, environmental and energy impacts, etc.



Taking as a basic the "Figure 2: Logic between Tasks and WPs related to T2.2" included in D2.2, we have updated it in order to include which are the connections with, and rationale behind, T2.2 and T3.1. Specifically, this figure shows the flow of KPI-related information. Concretely, between both deliverables related with the project's KPIs, D2.2 – Analysis of Pilot Requirements for Big Data Use and D3.8 – KPI Assessment Framework. Furthermore, we have advanced in the identification of liaisons with other WPs and Tasks of the project to understand better the interconnections with the overall project management structure.



Figure 1: Updated logic between Tasks and WPs related to T2.2. and T3.1

As described in the above figure, T2.2, and T3.1, through its dedicated deliverables, will set up the methodology and the framework needed to report the consolidated figures and results obtained by the pilot in terms of KPI achievement. Furthermore, it will set up the necessary process steps to implement the Strategic Assessment level evaluation using "Project level KPIs".

D3.8, which will serve as a guideline for the evaluation and validation activities delivered later in D3.11 and D3.12. Also, the work carried out in D*.2 – Performance Assessment Plan (for each pilot domain) [M9] will be considered to build up the performance targets at project level. In addition, D*.2 will explain concretely how pilot-specific KPIs will be measured and assessed. Task 2.2 will also feed the development of the day to day monitoring of pilots (to be implemented in T2.1).



Concretely, in order to provide better insights to the whole KPI Assessment Framework created for the TT project, the objectives and expected outcomes for each document and task are clearly defined under D2.2 and D3.8 boxes in Figure 2. These are as follows:

Tasks:	T2.2; D2.2 – Analysis of Pilot Requirements for Big Data Use	T3.1; D3.8 – KPI Assessment Framework
Objectives:	 To define domain-specific and transversal KPIs and their corresponding baselines, ensuring that they remain comparable to perform a cross pilot assessment. To perform a thorough intra-domain and cross-pilot analysis on the use of Big Data technologies. To offer an analysis of applicability of TT Big Data solutions in post-project replications. 	 Implementation of the Strategic Assessment Level (KPI Project Level) based on the Four-Level Assessment methodology within TT KPI Framework. Selection of the project's KPIs that will depict which is the penetration and performance of the TransformingTransport Big Data ecosystem. Performance of the methodology needed for the identification of the main market impacts achieved by the TT project.
Outcomes:	 Domain specific and transversal KPIs. Perform intra-domain and cross-pilot assessment. Analysis of post replication strategies. 	 Assessment framework level; Strategic Level. Selection of project-level KPIs. Market impact.
KPI achievement reporting in:	 D3.11 – Period 2 Impact & KP D3.12 – Period 3 Impact & KP 	I achievement report and Plan (M18) I achievement report and Plan (M30)

Figure 2: Comparison between the assessment objectives of KPIs tasks

Thus, based on the performance outcomes resulting from D*.2 delivered in M9, it will be feasible to identify which performance targets will be utilised in the Strategic Assessment Level in order to evaluate it according to the expected impact of TT already allocated in DoA, also complemented with the different impact tables (such as Table 12, Table 13, etc.). The process for setting up the performance targets at the Strategic Assessment Level will be carried out between M10-M11, and its achievements and progresses will be reported in M18 and M30.



1.2 Process for reporting KPI achievement from TT pilots

As indicated in Figure 3 (also in Figure 2), the KPI achievement reporting expected in D3.11 and D3.12 will be undertaken under the T2.2. and T3.1 task. For this purpose, we have been aligned with T2.1 to introduce the required inputs needed in D*.2 to establish the quantification of the performances achieved by the pilot domains. The alignment obtained is based on the inclusion of the following sections in the prior KPI tables (included in Annex I of D2.2):

- **Data sources:** this deliverable intends to advance in the KPI definition provided in D2.2. in order to include in close collaboration with Data ID card to understand which is the main data source inside the pilot's architecture that will feed the required inputs needed to compute the proposed equation(s) to obtain the assessment results.
- **Measurement procedure:** in this section, the information required from partners is aimed at understanding which process has been set up within the pilot domains in order to measure the results obtained during project execution.

This additional information will support the achievement of the complete KPI Framework Assessment, concretely to pilot domains to have a wide overview of the data needed for the dedicated KPIs in each of the WP scenarios, as well as, to have a common measurement procedure to analyse the performance within the selected evaluation timeframe. In relation with this point, one important aspect that is worth being mentioned is the need to establish an agreed due date for submission of the performance assessment of the KPIs defined for each of the pilots before M18 in order to arrange the time required by T2.2. and T3.1 to prepare D3.11 and D3.12 reports in close collaboration with each of the Pilot domain leaders. For this purpose, it has been established that pilot leaders must report the full figures and results measuring the performance of their activities by March 2018 (M15).

Therefore, by M15, Pilot leaders should report by using preliminary template to collect the results of the planned evaluation activities which have been created to ensure a uniform and high level of consistency of results across the evaluation of TT pilot domains. The template for the Measure Evaluation Results is presented in Table 1. The objectives of this template are:

- Facilitate KPI performance results collection in just one single template structure.
- Ensure that Pilot leaders will report all the evaluation-relevant information needed to prepare the KPI achievement reports in M18 and M30.
- Provide clear findings to assess which is the potential exploitation/replication of the big data solution in other transport scenarios by identifying the innovation's novelties and the improvements accomplished in the priority topics established by Pilots domains.

The first draft/attempt of the template to collect the results for assessment process is reflected in the following table:



Table 1: Evaluation Results Template

Section A: Introduction

- A1: Objectives
- A2: Description

Section B: KPI Evaluation Results

- B1: Measurement methodology
- B2: Measuring results
- B3: Achievement of quantifiable performance
- targets and priority topics
- B4: Intra-domain and cross-pilot assessment

findings

- **B5: Summary of evaluation results**
- B7: Future activities relating to the KPI

Assessment for M30 (D3.12).

Section C: Process Evaluation Findings

- C1: Deviations from the original plan
- C2: Barriers and drivers
- C3: Recommendations and lessons learned

Table 1: Evaluation Results Template¹

At this time, a project lifetime advances; this table will be improved continuously in order to reach the highest quality reports based on the findings and inputs from pilot domain execution.

Information collected by Pilot domain leaders (leader and replica) in the process of the assessment activities will be imported to the results template. Pilot leaders are responsible for completing this Evaluation Result Template. The completed templates are then sent to the KPI Assessment team (T2.2. and T3.1) who will perform a basic quality and completeness review process. This will be used as input when the KPI Assessment team summarises the results in the project evaluation report to complete the dedicated deliverables for reporting KPI Achievement D3.11 and D3.12.

¹ Adapted from Box 1: Measure Evaluation Results Template; D4.10 – Evaluation Framework in CIVITAS



2 KPI Assessment Framework

The main objective of the evaluation framework is to structure the overall assessment of the project and the pilots, taking into consideration the specific impacts per assessment category and the overall effects on the level of efficiency of the pilot domain and the transport sector.

From the early stages of the project development, UPM-Transyt and Atos have realised the importance of co-creating the KPI assessment Framework in order to reach the highest level of alignment between the two tasks (T2.2 and T3.1) which are mainly involved in TT KPI definition. The similarities and convergence points identified between both contributing parties requires comprising a common framework to assess the performance of the TT project in four levels. Three of these are mainly related with Pilot KPI levels and, the remaining stage is associated to the Project KPI level.

The main objective of the evaluation framework is to structure the overall assessment of the project and the pilots, taking into consideration the specific impacts per assessment category and the overall effects on the level of efficiency of the pilot domain and the transport sector.

In this sense, the rationale behind the KPI Assessment Framework at project level is to provide holistic and aggregated figures on the performance obtained with the development and deployment of big data solutions within each of the pilot domains. An initial outline of the alignment that TT is aiming to reach between the KPIs tasks (T2.2 and T3.1) is presented below:





The result derived from the combination of both tasks in just one single integrated Assessment Framework, from the pilot perspective as well as from the project level side, is represented in Figure 4:



Figure 3: Pilot and project level KPIs alignment

Starting from the left side, the figure taken from D2.2 (Figure 4: Transforming Transport Evaluation Process) represent the process to be undertaken for the assessment at pilot level. Afterwards, in the right-hand side of the illustration, the five main categories used for assessing the performance of TT at project level are presented. It is relevant to highlight that the project level categories have been selected based on the inputs at pilot-level, due to the fact that (some) of the KPIs selected for the project-level are fed by the results and performances achieved in the pilot domains. Finally, the main outcomes that once aggregated will build-up the TT KPI Assessment Framework required for D3.8 have been presented and explained. This figure will allow understanding which is the resulting alignment between the two different KPIs dimensions.

Moreover, the TT Assessment framework will establish the guidelines that will subsequently be used during the assessments performed in Months 9, 18 and 30, and the lesson learned analysis planned for month 26, in order to identify synergies among Pilots, implement a market potential analysis of the innovations, and define the transferability guidelines for the implementation of Big Data solutions in other European sites.

The results arisen from this co-creation between multiple project partners has been reflected in the release of the Evaluation Framework structure-levels for TT depicted in Figure 4: Four levels



T 2.2

T 2.2

assessment

assessment

3 - Horizontal

of assessment within TT. The need to understand how TT will perform the assessment process from the bottom to the top level is identified.



2.1 Evaluation Framework structure-levels for TT

The evaluation will be performed at four levels (Figure 4: Four levels of assessment within TT):

Environmental quality (EQ)

Energy Consumption (EC)

Safety (SF) Economic (EF)

Below, it will be specified which are the implications of each of the Four levels of assessment within TT Framework already included in D2.2:

Pilot-Category and Pilot-Objective assessment (covered in D2.2): based on local analysis and focused on the expected impacts at each individual pilot in the different categories. When the use of Big Data technology has effects on only a segment of the pilot's activity, an upscale exercise to the whole pilot's activity will be attempted. For this assessment level, a combination of the General Assessment Categories through both transversal and specific sectorial PTs and KPIs, and of a qualitative assessment of the pilot objectives will be used.





Figure 4: Four levels of assessment within TT



- **Domain-Category assessment (covered in D2.2):** above the Pilot Assessment level, an assessment based on a cross analysis for each pilot domain, crossing the impact attained at both the initial and the replica pilots for each of the assessment categories. for this assessment both transversal and specific sectorial PTs and KPIs will be used.
- Horizontal Category assessment (covered in D2.2): by General Assessment Category, to identify and evaluate the impact of Big Data use on the Category throughout the different Pilot domains. For instance, the Energy Consumption Category evaluates the influence of Big Data use in transportation fuel consumption, or in any other energy related variables. For this assessment only transversal PTs and KPIs will be utilised. The economic category is the categorization that will not include a transversal assessment across pilot domains.

For the purpose of this deliverable, progress in the definition of the strategy, methodology, and roadmap needed to set up the Strategic Assessment are necessary. Contributing parties' efforts during the first 6 months of the project have focused in developing the remaining Three levels of the assessment which are related with the definition of Assessment for Pilot domains. Taking this into consideration, the new stage intends to perform the Strategic Assessment which is considered as the Strategic (Project) Assessment level. Based on this perspective, TT's last and fourth level of assessment is described as follows:

 Strategic assessment (covered in D3.8): This appraisal combines the contribution of all Pilots to reach the global strategic targets determined from the expected impact of TT. This level of evaluation will quantify the foreseen effects if TT technologies were jointly tested and applied by also identifying and taking into consideration factors which provide synergic achievements and better results. For this assessment only global PTs and KPIs will be used (section 3).

2.2 Objectives of the Strategic Assessment

The objectives of the Strategic Assessment are now described:

1) To support the effective deployment of the Strategic Assessment Framework to depict which performance of the overarching goals of the R&I activities designed in the transport domains of the TT, and embedded within the TT Assessment Framework (section 3). The TT KPIs aims at qualifying the outcomes of R&I activities in transport and logistics sector to boost the adoption of Big Data solutions in both, in accordance with the expected impacts allocated in DoA. The results of the performance analysis of those KPIs will help policy makers, regulators and network operators in utilising the results of R&I activities to organise and manage the large-scale deployment of innovative solutions. Scalability and replicability of the results are two of the main factors that TT is



intending. So, for this purpose, the aggregated benefits provided by the demonstrations made in pilot domains must be highlighted, and this will be granted by evaluating the results achieved in the performance targets at both project and pilot level.

2) In parallel, the document will set up the processes and mechanisms that depict the market penetration of TT solutions (section 4) in the big data environment of transport projects. The first step is to identify the expected impacts of each pilot domain based on the objectives and requirements established in Pilot Design (delivered in M3) complemented with the Pilot KPI definition exercise already performed in D2.2, as well as, carrying out a preliminary analysis of which stakeholders are placed in each pilot domain. However, at this stage, due to the lack of operational results coming from pilots, the objective is to suggest the initial conditions to collect, quantify and present the aggregated TT market penetration. In parallel, TT is connecting the market penetration conditions of TT (expected impacts, stakeholders and benefits) with the exploitation strategy defined among the consortium partners. One of the key challenges of TT is enhancing the market uptake of Big Data solutions in transport, so it is required to perform the market penetration process and its mechanisms to discover which are the most promising technical and business knowledge/solutions developed by TT pilots, demonstrating to the transportation sector stakeholders that the implemented solutions are scalable and replicable within the concrete transport domain.

2.3 Specific methodology of the Strategic Assessment level and Market impact analysis

The methodology should be described as a process including several steps of information gathering, evaluation, validation within targeted stakeholders, as well as the usage of the outcomes obtained to transform intro joint exploitation scenarios, and promote the communication of the benefits behind TT to raise the awareness of the deployment of Big Data solutions within Transport and Urban Mobility environment, specially to the wide range of transport modes and value chains represented in TT pilots.

For this purpose, TT is aimed towards setting up the following methodology to be carried out in order to guarantee that the expected impacts described in DoW are being achieved through the development of the project. The stages which are mainly divided this methodology are depicted below:





<u>STAGE 1</u>: Design of the Impact Assessment Roadmap for KPIs as a project level:

Firstly, the design of an Impact Assessment Methodology for KPIs as a project level is required to present in early stages of project development which indicators will conform the main framework, followed by a concrete work plan which partners should comply in order to feed the Project KPIs aggregated data.

TT should guarantee the quality of the data collected as well as preserve its accuracy by providing to the Pilot domains the detail of concrete activities that should implemented in order to gather the data and transform it into accurate units for measuring the performance in terms of Project level categories. Most of the information needed from partners related with aggregated KPIs data will be collected through the coordination and alignment between WP2, concretely D2.2-Analysis of Pilots requirements in Big data use and WP3, concretely by D3.8-KPI Assessment Framework.

The objectives of this phase are now summarised:

	Cod	Objectives				Timeframe	
STAGE 1: Design of the		Identific	ation	and categor	izatio	n of the	
Impact Assessment Roadmap	Obj1	impacts	impacts effecting TT in each of the pilot				M6
for KPIs as a project level		domains					
	Obj2	Gather	and	aggregate	the	impacts	M6



		affecting TT pilot level to contribute to the configuration of impacts at project level	
(Obj3	Discover the benefits derived from the effects caused by project impacts	M18
(Obj4	Identify the list of stakeholders based on the specific value chain of the pilot domains	M6

Table 2: Objectives of Stage 1 of the methodology for the Specific Assessment

STAGE 2: Performance of the KPI collection activities

After the identification of which impacts, benefits and stakeholders are placed in each of the value chain network of pilot domains, advances in the performance of assessment reporting activities are now.

At this stage, the objective is to perform the assessment reporting by gathering the data resulting from Pilot domains to aggregate into the KPI tables in order to compile this information into the aggregated KPIs used at project level. Guidelines will also be provided to partners to identify those areas and aspects which should be monitored to afterwards translate into the KPI aggregated list.

The objectives of this phase are summarised below:

STAGE 2: Performance of the KPI collection activities	Cod	Objectives	Timeframe
	Obj4	Open a call to action to collect the information	
		from the pilot domain leaders by using Table 1:	M14
		Measurement Evaluation Results Template	
	Obj5	Aggregate the data collected from pilot domains	N/15
		into the KPI project level	IVIIS

 Table 3: Objectives of Stage 2 of the methodology for the Specific Assessment

STAGE 3: Evaluate the performance targets reached

As a continuation of the performance activities, once the innovations have been implemented and the tests are completed, the contribution of Big Data in each pilot case is assessed by comparing the results for the KPI variations with the expected/planned outcomes expressed by its related Performance Target. So, the evaluation will be performed by analysing relative indicators and by aggregating the results into a global rating.



The refinement of impact strategy, the information gathering on the achievements of TT, its assessment in terms of impact, and the relevant strategy decided according to the results will be reported (mainly on M18 and M30) through the dedicated deliverables.

The objectives of this phase are summarised below:

	Cod	Objectives	Timeframe	
	Ohi6	Evaluate the results obtained in order to draft		
	0000	the conclusions resulting from pilot execution		
STACE 2. Evaluate the		Document the results achieved as well as draft a	N41C	
stade 5. Evaluate the	Obj7	first set of conclusions to be included in D3.11		
reached		Period 2 Impact & KPI Achievement Report and		
		Plan		
	Ohio	Present the results of TT KPIs project level	N / 1 7	
	ODJo	evaluation to the project partners		
	Obj9	Submission of the deliverable into EC portal	M18	

Table 4: Objectives of Stage 3 of the methodology for the Specific Assessment

STAGE 4: Exploitation and Communication of the assessment results obtained

The final stage of the methodology is focused on communicating and exploiting the results achieved after the assessment process. The whole methodology should be focused not only on the achievements of the task but also on disseminate and communicate the global results obtained among our target audience; Public Bodies, End-users, Transport Operators, mainly to the audience identified in D3.1-Initial Impact Plan following the guidelines allocated in this document to follow-up the joint strategy settle down.

The dissemination and communication of the results provide us the necessary tools to spread and raise the awareness of the benefits of deploying big data measures and techniques into concrete transport sectors (Ports, Airports, Railway, etc.) where TT pilot domains are focusing. The multiple benefits arisen from business performance, economic growth, environmental and energy, as well as society categories, will be used to spread the innovations within our target audience and will allow them to understand which positive impacts have effected into the assessment categories identified.

Furthermore, this information will allow us to sketch a set of lessons learned from the pilot's execution that will enhance the transfer knowledge and cross-fertilization strategies related to the adoption of big data measures and techniques into the different transport domains.

The objectives of this phase are summarised as follows:



	Cod	Objectives	Timeframe
	Obj10	Identification of the main outcomes	N/19
		achieved at TT project level	IVIIO
STAGE 4: Exploitation and	Obj11	Select and communicate the outcomes	
communication of the		and benefits obtained to our targeted	N410
assessment results obtained		audience for this first KPI reporting	10119
		milestone in M18	
	Obj12	Draw a lessons learned sketch from first	M10 20
		KPI reporting milestone in M18	1113-20

Table 5: Objectives of Stage 4 of the methodology for the Specific Assessment



3 Strategic Assessment Level definition

3.1 Analysing the Strategic TT Assessment Categories

The Strategic TT Assessment Categories is composed of five main global targets. In each of the categories indicated, there is a set of concrete objectives which define the objectives followed by the consortium to evaluate the wide range of effects encountered when developing Big data measures and technologies in the transport and urban mobility value chain environment.



Figure 7: Strategic TT assessment categories

Below, a description of each of the Strategic assessment global targets will be provided:

• **GT1:** Supporting Economic Growth: this category can be defined as the evaluation of the effects on the level of economic activity in a given area. In the case of TT project, the main areas under study are being covered by the KPIs defined in the pilot domains which are related with the innovation's operation efficiency, cost reduction, etc. It's important to monitor the performance and results obtained in economic aspects, since cost is a key driver in transport operation activities. It will also serve as a guideline for



the exploitation strategy to increase the business potential of the TT outcomes and its replicability in transport and logistic big data solutions.

- **GT2:** Boosting the business performance of operations in pilots: The objective is to evaluate if the innovation and the technology designed and deployed in the TT project are aligned with the technical expectation of stakeholders and with the predictable impact described in Table 13: Improvements with respect to technological constraints allocated in DoW.
- **GT3: Improved environmental and energy consumption:** This category assesses one of the main objectives of the TT project which consists in preserving the environmental aspects as well as improving the energy efficiency during the operation of different transport networks/modes and, therefore, the energy requirements of those systems.
- **GT4:** Enhance the transport big data research and policy environment: These have been set up with the goal of bringing together transport stakeholders to foster innovation and integration in research, including the development of long-term visions for transport infrastructure at a European level. This category will contribute to address and retrieve the information allocated in DoW related to technological constraints from pilot domains.

Each of the aforementioned assessment categories underlies a concrete set of selected topics which provides a better understanding of which expected impacts must be measured in order to consequently establish the more appropriated KPIs. There are strong links between the topics of all the categories due to their nature and area covered. However, each TT categories topics are relevant for the discussion and are analysed separately in the following figure:





Figure 8: List of topics per Strategic Assessment Category

3.2 Implementation of the Strategic Assessment Level

The last level of the assessment approach is the Strategic Assessment which combines the contribution of all Pilots to reach the **Global Targets** set by the expected impact. This step will allow quantifying the predictable impacts when all pilot domains are applied together by also considering which influential factors contribute to achieve more synergies and better results. For this purpose, we have identified, based on the TT objectives and expected impact from a project and pilot perspective, which are the main Core Performance Targets that will best measure the level of achievement of the global targets established in TT.

The selection of the Core Performance Targets is based on the identification made by Pilot Leaders in their Pilot Priority Topics, as well as the expected impacts indicated in the DoA. As an initial approach, the selected Core PTs are:



Global strategic targets	Core PTs
Supporting Economic Growth	Overall transport and logistics productivity Reduction of the average travel times / Time savings Investments leveraged Market share of TT
Boosting the business performance operation in pilots	 Improvement of transport/mobility operations Reduction of operating cost Perform the current product/service portfolio New services/business models External-Joint collaboration within Third parties Number of external collaborations
Improved environmental and energy consumption	Pollutant emissions Energy savings
Enhance the transport big data research and policy environment	Knowledge transfer from research to business

Thus, a set of Objective Functions (OF) will be developed which will try to maximise all the strategic targets. An OF is a function of a sub-set of CORE PTs, to be used for strategy appraisal or for optimization purposes.

Our OF is defined as follows:

$$OF = f(CPTs)$$

Where *CPTs* are the **Core Performance Targets** selected to measure the global strategic targets. The measurement of the *CPTs* will be based on the variation of corresponding KPIs between scenarios.

Thus, the objective functions related to each strategic target are:

- Supporting economic growth: *EG* = *f* (*PT xx, PT xx, PT xx*)
- Boosting the business performance operation in pilots: BPO = f (PT xx, PT xx, PT xx)
- Improved environmental and energy consumption: *EE*= *f* (*PT xx, PT xx, PT xx*)



- Enhance the transport big data research and policy environment: *RP*= *f* (*PT xx, PT xx, PT xx, PT xx, PT xx*)

The Global impact of all the technologies implemented together in the project is:

```
TT Global Impact = \sum (\alpha \cdot EG + \beta \cdot BPO + \delta \cdot EE + \gamma \cdot RP)
```

Where α , β , γ and δ are weights assigned by a representative group of stakeholders for the different strategic targets. A consultant process will be carried out to obtain the corresponding weights.

3.3 Overview of KPIs per Strategic Assessment global targets

The last level of the assessment approach is the Strategic Assessment which combines the contribution of all Pilots to reach the *global targets* set by the expected impact. It will allow quantifying the predictable impacts when all TIs are applied together by also considering which influential factors contribute to achieve more synergies and better results.

The proper assessment of the interventions made during the project against the project objective is based on criteria, which are considered representative for the decision to be taken. Criteria usually refer to certain parameters that should be taken into account during the evaluation, such as production, input use and conditions of the project beneficiaries. The criteria are then translated into indicators, which represent yardsticks to measure the impacts. Adequate indicators are able to (1) assess the project's performances, (2) measure progress, including the identification of potential problems or successes and (3) ensure knowledge transfer and cross-fertilization strategies to selected targeted stakeholders.

Transforming Transport has elaborated a set of indicators including environmental, research and policy and other socioeconomic impacts. The TT assessment procedure gives to policy, research, business and society environment surrounding TT transport modes, the possibility to evaluate the wide range of benefits provided by Big Data measures and technologies, and their consequences on transportation network performance. It is applicable to both ex-ante assessments and ex-post evaluations. The objective is to perform an assessment baseline to demonstrate the benefits and impacts of applying Big Data analysis to transportation activities. The comparison achieved will allow us to evaluate the results accomplished in each of the TT categories to draft a lessons-learned statement from project and pilot competition.

The final aim of the selected KPIs is to ensure that, by defining an appropriate quantity of such indicators, the objectives of the project are duly covered (from operational efficiency, to energy management, economic sustainability and improvement, and raising the awareness of business



community specially SMEs). With these suppositions under consideration, the KPIs for this research work have been selected in accordance with the preceding composition of Project-level KPIs initially expressed in Section 2.1 of DoA and the Pilot KPIs (see D2.2) whose aggregated results will support the accomplishment of the performance objectives.



TT Project KPI Assessment Category	Related subtopics	Code	KPIs	Liaison with DoA	Units
	Overall transport and logistics productivity	EG-PR-1	Aggregated productivity increase in the TT pilot domains	"Demonstrated increase of productivity in target sector by at least 15%" [DoA, Sec 2.1.1]	%
Supporting Economic Growth	Investments leveraged	EG-IL-1	Total amount of additional target sector investments of TT industrial partners	"Leveraging additional target sector investments of more than 6 times the EC investment" [DoA, Sec 2.1.1]	€
	Market share	EG-MS-1	Total percentage of market share obtained by TT Industry Members	"Estimated increase of market share and size of TransformingTransport industry members" [DoA, Sec 2.1.2, Tab. 16]	%
Boosting the business performance of operations in pilots	Improvement of Transport/Mobility operations	BPO-IO-1	Total accumulated operations costs of existing processes and services reduced by TT pilot deployment	Fed by Operation Efficiency and Economic Assessment Categories of pilot domain "Table 12: Improvements in cost structure of existing processes and services" [DoA, Sec 2.1.2, Tab. 14]	€/%



	BPO-PS-1 Perform the current		Total number of new products/services/processes with big data features launched into the market	"Cost and performance of novel processes and services" [DoA, Sec 2.1.2, Tab. 14]	Unit
	product/service portfolio	BPO-PS-2	Total number of existing improved products/services/processes with big data features launched into the market	"Cost and performance of novel processes and services" [DoA, Sec 2.1.2, Tab. 14]	Unit
	External Joint- collaborations within Third parties	BPO-JC-1	Total number of Involved organizations which are participating actively in Big Data demonstrations	"At least 120 organizations participating actively in Big Data demonstrations" [DoA, Sec 2.1.1]	Unit
Improved environmental and	Pollutant emissions	EE-PE-1	Total direct CO2 emission reduction obtained	Obtained from Environmental Quality Assessment Category	(t/year)
energy consumption	Energy savings EE-ES-		Total direct energy savings obtained	Obtained from Energy Consumption Assessment Category	kWh/100 km
Enhance the transport big data research and policy environment	Knowledge transfer from research to business	RP-RTB-1	Total number of big data components integrated into pilot domain platforms	"Doubling the use of Big Data technology in the mobility and logistics sector from the currently 19% to at least 38%" [DoA, Sec 2.1.1]	%

The detailed description of each of the KPIs expressed in the above table, it's included the Annex 1-KPI Strategic Assessment KPI level.



3.4 KPI performance according to scenarios

As described in D2.2, "The assessment of the results provided by any investment in a transportation system is based on its validation and comparison in different scenarios. Within this methodology, the benefits are evaluated by means of the variation between the "No-TT", control or ex-ante, scenario (situation without the implementation of the Big Data Technology) and the "TT" scenario (according to the data collected when the corresponding innovations are being implemented)." In accordance with this definition of the measurement process to evaluate KPI performance, we are also reutilising this concept to measure the performance of TT in the defined KPIs.

<u>One key aspect still pending to be defined consists in setting up the performance targets at the</u> <u>Strategic Assessment Level.</u> Based on the objectives of D3.8, the calculation and definition of the project's performance targets is fed by the inputs coming from pilot domains. These specific KPI performance targets will be included in the dedicated deliverables referenced as D*.2. After the evaluation of the results and findings gathered in the referred deliverable, the Strategic Assessment Level will allow defining the performance targets at project level. This process will be undertaken between M10-12 in order to guarantee the accurateness and coherence of the performance targets from both pilot and project perspectives.

The process consists in calculating the variation in KPI values before and after Big Data techniques are integrated in pilot management decisions, as expressed in Equation (1):

$$KPI_{Var} = \left(\frac{KPI_2 - KPI_1}{KPI_1}\right) x100 \quad (1)$$

With KPI1 reporting the performance in the No-TT scenario (before or control) and KPI2 the performance during the TT scenario.

For each of the selected KPIs, its related definition, units of measurement and required sources for the data provision have been preliminarily established to avoid misunderstandings during the data procurement phase.



4 Market impact

The Market impact of TT intends to identify which are the main aggregated impacts and benefits from the multiple transport domains. These will be later categorised depending on the outcomes of interests (presented in Table 6) at a project level. The stakeholder mapping will allow us to grasp the opportunity for connecting the impacts and benefits from each pilot to the value chain of the stakeholders' domain. As an innovation action, the post-replication strategies are essential to reach the highest level of transferability from R&D environment to business scenarios. The results achieved in this phase will be used to configure which set of project KPIs will be utilised to assess and demonstrate the pilot performance in the transport and logistic domains.

From the supply side, for instance, the need to understand which are the impacts and benefits of applying Big Data solutions and techniques is a prerequisite to boost its adoption by endusers. It will enhance the decision making of the management bodies when decisions are required concerning the implementation of big data innovations among similar organizations. From the Demand Side perspective, the pilot deployment will be used as a test-bench to demonstrate the effectiveness and sustainability adoption of big data solutions in the transportation industry. For instance, the internal business portfolio of the partners involved in each pilot could be performed by adding this kind of Big Data features into their product or service offers, thus resulting in a market share gain for the company.

Thus, in this deliverable, we have complemented the development of the KPI Assessment Framework by including a preliminary definition of the intend market impacts that TT is aiming to reach. For this purpose, we have taken the information related to the Priority Topics stablished in D2.2, concretely in section 3.2 Overview of Priority Topics. We consider that each Priority Topic (PT) identified should be quantified through the establishment of a Performance Target by the Pilot leader in order for the assessment to introduce a comparison between the expected result (target) and the actual impact of the solution in the operation or business model.

So, in order to build up the initial definition of the Market impacts of TT as a whole, we have been analyzing and defining which PTs are horizontal to all the pilot domains in order to have a holistic composition of the impacts at a project level. Furthermore, we have also taken into account the current expected impacts indicated in the DoA for start making the necessary comparisons for demonstrating the potential of the adoption of Big data in transport.

The KPI Assessment Framework is more than a tool to evaluate the performance within the Assessment Objectives, and the expected impacts, the rationale behind is to develop the necessary resources for the pilot locations to understand how the big data has been upgrade the performance within the priority topics as well as, a framework that depicted which impacts will be occasioned by the pilot development.



In the methodology presented of the Strategic Assessment, the Market impact at this project phase is composed of the following objectives indicated in the STAGE 1: Design of the Impact Assessment Roadmap for KPIs as a project level.

4.1 Stakeholders mapping among Pilot domains value chain

According to the transport article published by the New Zealand Government², the supply of transport services occurs through a combination of providing and using infrastructure across a range of modes. Provision of infrastructure incurs capital costs and covers, for example, roads, railway lines, airports and ports, while usage is made possible through vehicles (for example, cars, trucks, trains, airplanes and boats) and management systems (for example, traffic lights, signals, air traffic control, navigational aids). It is evident that the transport system is broader than just physical transport networks and vehicles. It includes institutional settings and the soft systems that underpin the coordination of transport services. Figure 6 provides a diagrammatic representation of the transport system.



² Contribution of transport to economic development – International review with New Zealand perspectives



Figure 9: Transport system diagram³

As represented in Figure 6, within the transport and logistic value there are a set of multiple players exchanging, sharing and selling a wide range of services, products and all are surrounded by external actors which are part of the macroeconomic externalities of the transport modes. The interconnections and dependencies between transportation modes makes possible that implementing an innovative solution based on Big Data could positively affect the complete logistic processes in the value chain among all transport modes, or could have multi-side effects for the different stakeholders.

The wide range of transport modes, end-users, corridors and networks intervening in TT Pilot domains reveals the need to map which concrete stakeholders are present in order to perform an ad-hoc identification of the main impacts and benefits foreseen after pilot execution. The individual stakeholder value chain mapping allows us to connect both sides of the business cases presented in each D*1, the requisites established by demand and supply.

The main stakeholder groups who could benefit from the innovations related with Big Data techniques/algorithms deployed in the pilot scenario are presented in their respective figures. In order to perform the stakeholders' analysis per case study, the following steps are proposed:

- 1) Identify transport domain stakeholder groups: the main stakeholders groups for each of the pilot domains will be analysed. The different features related with the diverse transportation modes require providing ad-hoc identification in order to connect these in later project stages (in M18), when the expected impacts among groups are identified. This activity will allow us to present and communicate to the targeted stakeholders which are the main results, impacts and benefits that Big Data deployment would deliver, and how could these innovations influence their daily operations.
- 2) Identify concrete stakeholders: the groups obtained in the previous stage will be used to identify concrete enterprises, institutions that could be beneficiaries of the deployment of the Big data technologies used within TT pilot domains. The efforts of identifying concrete stakeholders will be undertaken within the region/country of the pilot domain. In this sense, the aim is to follow the statement of "Act Local, Think Globally" in order to replicate and cross-fertilise strategies within local actors among the

³ Adapted from Lakshmanan and Anderson (2002), Figure 9, p.21



region/country, but thinking globally in order to set up the conditions to export the innovation to third countries.

4.1.1 Smart Highways

The main stakeholders involved in the Smart Highways Value Chain are:



Figure 10: Stakeholder mapping in Smart Highways

4.1.2 Connected Vehicle

The main stakeholders involved in the Connected Vehicles are:





4.1.3 Proactive Rail Infrastructure

The main stakeholders involved in the Proactive Rail Infrastructure are:





4.1.4 Ports as Intelligent Logistics Hubs

The main stakeholders involved in the Ports as Intelligent Logistics Hub are:



4.1.5 Smart Airport Turnaround

The main stakeholders involved in the Smart Airport Turnaround are:





4.1.6 Integrated Urban Mobility

The main stakeholders involved in the Integrated Urban Mobility are:





4.1.7 Dynamics Supply Networks

The main stakeholders involved in the Integrated Urban Mobility are:



4.2 Identification of TT outcomes of interest

The formulation and identification of the impacts at project level are built up according to the objectives, expected effects and targets allocated in D*1 and D2.2 documents already submitted. These documents describes the Domain categories and the (Specific and Horizontal) priority topics which allow us to establish quantitative objectives that may be used to evaluate the results achieved by each Pilot in particular.

To understand the factors influencing the impacts at project level, it is necessary to comprehend the linkages and interactions among all impacts in the involved pilot domain categories. For this purpose, the current project level impacts will be identified, thus supporting the formulation of the project's high-level impacts. The result will complement and enrich the



current KPI process development, and will be used by TT project participants to evaluate which performance of TT as a whole in the transportation and mobility market may be delivered.

Below, the impacts arisen from each of the WP pilot domain depending on the outcomes reached by them will be categorised. The outcomes of interest⁴ of the transport system are a formulation of the general goals of transport domains in more concrete terms. They describe the issues that are relevant when observing the impacts of transport systems on society. To define the outcomes of interest we need to identify the necessary components, which all together influence the sustainability performance of the transport domain value chain and which must be monitored in order to assess its status.

The final list of outcomes of interests is shown in *Table 6: Group of selected outcomes of interest of TT project*. Source: Adaptation from SUMMA:

Category	Economic outcomes of interest	Technical outcomes of interest	Environmental outcomes of interest	Social outcomes of interest
Sub-category	Transport operation cost + Productivity / Efficiency	Big data techniques and algorithms adoption + Data volume management and processing	Emissions to air + Energy savings + Nosie	Safety and security

 Table 6: Group of selected outcomes of interest of TT project. Source: Adaptation from SUMMA

Below, we will present which is the explanation of each of the outcomes of interest that TT project is seeking to reach:

Outcome	Economic	Definition
category		

⁴ Source: SUstainable Mobility, policy Measures and Assessment SUMMA. GMA2/2000/32061-S07.14497



Sub-category	Transport operation cost	From industry transport users' perspective (i.e. manufacturers, retailers, wholesalers and logistics service providers), the expectation is to increase profit while meeting both people and social expectations. To address these expectations, they look forward to increase return on assets and working capital targeting full asset utilization, increase service levels while reducing costs, energy consumption and environmental impacts in their supply chains ⁵ . Big Data can help mitigate these problems. Transforming Transport will integrate, adapt and evolve existing Big Data architectures,	
		ervices and technologies, and will validate these through highly relevent onceptual prototypes. High impact scenarios have been chosen, emonstrate the large-scale applicability of the proposed solution. As xample, described in the DoW, a 10% efficiency improvement will lead U cost savings of 100 B€ (source: ALICE ETP). Thus, in TT, we have identified 3 main sub-categories which TT xpecting to deliver impacts based on the results achieved by p lomain during the S2 and S3 validation stages. Those ones are;	
	Productivity / Efficiency	• Transport operation costs: Operating costs are those expenses derived from the acquisition of the resources needed by an organization to accomplish its activities. For instance, cost of goods sold, office rental and labour costs are examples of operating costs. By the integration of big data solutions, TT is looking to improve the operation costs in each of the pilot domain in order to increase the competitive advantage, improves profitability while an optimization of the cost structure is achieved.	
		• Productivity/efficiency: the definition which applies to TT case; it is the ratio of total output to the inputs used in the production process. Inputs can include labour, capital, land, etc. If productivity increases, a business can produce the same output using fewer inputs. The business may then choose to produce more output, lower prices, invest in the business, or return income to shareholders ⁶ . For instance, clear examples of this	

⁶ Bureau of Transportation Statistics:

⁵ A truly integrated transport system for sustainable and efficient logistics: <u>http://www.ectri.org/Documents/2017-03-13_SETRIS_Truly%20integrated%20Final%20Edition%20(WEB).pdf</u>

https://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/transportation_economics_trends_and_mea surement_concepts/chapter_5/index.html



productivity will be demonstrated through the Asset Management Category, in WP6 case, the asset optimization use will impact in the workers operations allocation, improving the time used for the maintenance activities, as well as, impacting in the travel time reduction, fuel consumption, and CO2 emissions.
nowever, elements of efficiency that are in line with the definition presented above are included in studies (e.g., World Bank, 2012) and statistical resources of logistics performance at national level. Such elements may include:
 Vehicle utilization (utilization of available capacity of vehicles in terms of load factors, empty runs etc.); Cargo handling efficiency (efficiency of use of cargo handling equipment at storage facilities and terminals / transshipment points); Infrastructure utilization (efficiency of use of space and infrastructure of storage facilities and terminals / transshipment points); Frequency of on-time shipments arrival and dispatch (World Bank, 2012). Capacity utilization (warehouses and other cargo handling facilities, vehicles); Logistics process efficiency (proportion of time in which the cargo inventory is active/moving in logistics activities, average order cycle time); Stocking efficiency (inventory turns); Workforce efficiency (throughput and productivity of workforce).
As may be noticed, there a wide range of indirect impacts (such as Environmental areas) occasioned by the Economic Outcomes. At the time that the project advance in later stages, the deployment of the big data solutions will come up in parallel with a set of indirect benefits arisen from the economic areas of TT pilot domains.

 Table 7: Definition of TT Economic outcome

Outcome category	Technical	Definition
Sub- category	Big data techniques and algorithms adoption	In accordance with the DoA, TT is looking to unlock the untapped potential of big data technology: "Doubling the use of Big Data technology in the mobility and logistics sector from the currently 19% to at least 38%";



	TransformingTransport will provide the stakeholders with a set of baseline solutions that evolves the big data technologies in Transport and puts them into a privileged position using high-quality technology. The interest of applying Big Data technologies in the daily operations of the transport market is increasing each year, as well that now it is not largely applied according to the Industry partners of the project, it is expected that the project will achieve the ambition of doubling the use of big data technology in the mobility/logistics industry.
	In particular, it will be used data sources across all different transport modes and perform vertical and horizontal data integration, thereby contributing to break silos between "sectors" and to cross-fertilise the usage of Big Data technology and applications. Together with the significant improvements in cost structures of existing processes and the opportunity for new services and business models.
Data volume management and processing	 Big data techniques and algorithms adoption: each of the pilot have configured in their pilot design deliverable (M3) which is the technical architecture to deploy for the S2-S3 stages, which includes a large-scale experimentation and demonstration, for this purpose, the pilots will have running dedicated large-scale data processing infrastructure for experimental purposes. The adoption of this kind of big data large scale platforms will boost the adoption and replicability of them into the concrete transport domains. Data management and processing: in this category, the objective is to enhance the current processes for managing large transport data sets collected during the technology deployment. The large-scale demonstrations of the TransformingTransport pilots will work at the scale of data volume, velocity and variety expected by the end of the project (i.e., by the year 2020)
	Finally, the main advances in the state of the art beyond the technical outcomes of interest is that, TransformingTransport will stress test European Big Data technologies and establish best practices of employing Big Data at the technical level through the effective deployment of near-market ICT market technologies within large- scale transport pilots. The project will establish transferrable and reproducible best practices for Big Data that can be re-used in other data-intensive.

 Table 8: Definition of TT Technical outcome

Outcome	Environmental	Definition
-		Page 43



category						
Sub-category	Emission to air	T is also looking for producing a set of environmental and energy mpacts to the transport domain. Those impacts are directly connected with the performance of pilot domains in the categories and KPIs dentified for it.				
	Energy savings	According to the Transversal Priority Topics definition in D2.2, the outcomes that will be monitored in this category are the following one; Emission to air:				
		 <u>Reduction of pollutant emissions:</u> In order to assess transport pollutant emissions, Transforming Transport some pilots will estimate the contents of nitrogen oxides (NOx) and particulate matter (PM) generated during their activity. 				
	Noise	 <u>Reduction of GHG Emissions</u>: Emissions caused by transportation systems are a main contributor of global warming, which threatens to modify many natural processes in unpredictable ways. Greenhouse Gas (GHG) emissions, in particular carbon dioxide (CO2) emissions. 				
		 Energy savings: Which consists in improving the energy efficiency during the operation of the vehicles and therefore, the energy requirements of the fleet 				
		 <u>Noise pollution</u>: is harmful for the environment and for humans particularly, as it may originate psychological disturbance (stress, sleep disorders), physical troubles (difficulty to communicate, loss of audial capacity, cardiovascular disorders), social impacts (aggressive behaviour, scholar lags) and economic losses (increase in health costs, lower productivity, accidents, or even damage property value). Transport is responsible in a high percent of this kind of pollution, so the pilot domains will ideally try to reduce the noise of the transport modes used. 				

 Table 9: Definition of TT Environmental outcome

Outcome category	Social	Definition
Sub- category	Safety and security	Accidentally rates are relevant indicators to evaluate safety levels on transportation systems, since security is a priority matter when developing or modifying transport infrastructures. Fatalities and injuries caused by traffic accidents are one of the most important social costs associated with



	transport systems, so in order to retrieve this situation, the analytics of
	current accidents will bring insights on the main variables that can anticipate
	and prevent these situations. The definition of situations where a specific
	message should be addressed to road users it will allow to prevent certain
	unsafety events. TT will measure which is the performance in the current
	pilot locations by providing to end-users ad-hoc information of the highways
	status or unsafety events.

 Table 10: Definition of TT Social outcome

Therefore, based on this information, a detailed analysis of which is the relation between the outcomes of interest of TT project within the impacts resulting from pilot execution, and versus those detailed in the DoA, may now be accomplished. Below, the relation it's described presented as follow:



<u>TT level:</u> Outcomes of Interest Categories	Sub-category	<u>TT pilot level:</u> Transversal Priority Topic in Pilot domain	TT expected market impacts	Pilot Assessment category	Pilot domain
		Reduction of operational costs	 Competitiveness of logistics and transport enterprises/institutions/end-users and service providers Increase of the operating revenues Increase of profitability Logistics cost for shipment activities CAPEX variance OPEX Variance 	Operational Efficiency (OE)	Transversal (ALL)
Economic	Transport operation costs	Reduction of travel time	 Better service reliability Travel time and fuel consumption savings Decrease of the pollutant emissions to air Efficiency of vehicle use (idle time, empty runs, route planning efficiency) Reduction of congestion level Decrese of the end-to-end transportation time Reduction of overall turnaround times (airports) Increase delivery fleet efficiency and punctuality in last-mileage operations (dynamic supply networks) 	Operational Efficiency (OE)	Transversal (ALL)
	Productivity/ Efficiency	Maintenance optimisation	 The asset optimization-use will reduce the total maintenance costs Effective forecasting on demand Improve maintenance work scheduling 	Asset Management (AM)	Transversal (SH, CV, RI, PLH)



			 and planning Travel time and fuel consumption savings of the maintenance vehicle fleet Improve occupation rates in freight delivery parking areas 		
		Asset use optimisation	 Reduction of the operator expenses allocated to maintenance activities Integration of predictive maintenance activities Performance of the HMI (Human Machine Interface) systems to improve the maintenance operations of the assets. 	Asset Management (AM)	Transversal (SH, CV, RI, PLH)
Technical	Big data techniques and algorithm adoption Data management and processing	Transferability	 Openness and accuracy of data flows between logistics stakeholders Integration/interoperability of datasets among different transport modes Integration between different types of transport (passenger/freight) Increase of the total number of data sources Bigger amount of data collected in the transport domains Enhancing and contributing to the Open data ecosystem in the European transport 	Operational Efficiency (OE)	Transversal (ALL)
		Reduction of pollutant emissions	 domain Better air quality Reduction of pollutant emissions to air 	Environmental Quality (EQ)	Transversal (SH, CV, RI,
Environmental and Energy	Emissions to air	Reduction of GHG Emission	Decrease of CO2 emissionsDecrease of NOx emissions	Energy Consumption (EC)	Transversal (SH, CV, RI, IU, SN)
	Energy savings	Energy savings	Decrease of the energy consumption in	Energy	Transversal



			•	vehicle fleets Improve driver's compliance with green driving	(EC)	PLH IU, SN)
	Noise	Reduction of noise level	•	Noise reduction	Environmental Quality (EQ)	Transversal (SH, CV, RI, IU, SN)
Social	Safety and	Reduction of the % of accidentally rate	•	Effective bi-directional communication with end-users in order to avoid unsafety traffic events Enhancing worker safety	Safety (SF)	Transversal (SH, CV)
	security	Emergency response time	•	Reduction of the time required to activate and perform emergency assistance activities		Transversal (SH, CV

Table 11: Expected impacts at TT project level



The objective is to present in a conjunction of tables which are the current impacts identified within the pilot domains that will contribute to reach the expected impact stablished by TT;

The overall TT objectives established in the DoW, and consist of:

TT Expected impact	Related Outcome of Interest category	Sub-category	Assessment Categ	Project KPI gory	Pro leve co	ject I-KPI des
"Demonstrating an increase of	Economic	Transport operation costs	Supporting Economic Growth		EG-PR-1 EG-MS-1	
Transport sector of at least 15%"		Productivity/efficiency	Boosting the business performance of the operations in pilots		BPO-IO-1	
"Doubling the use of Big Data technology in the mobility and	Technical	Big data techniques and algorithm adoption	Boosting the business performance	Enhance the transport	BPO-	RD-
logistics sector from the currently 19% to at least 38%"		Data management and processing	of the operations in pilots	big data research and policy ecosystem	PS-1 R	RTB-1
"Leveraging additional target sector investments of more than 6 times the EC investment"			Supporting Grov	Economic vth	EG-	IL-1
"Involving at least 120 organizations participating actively in Big Data demonstrations"			Boosting the performations	e business ance of in pilots	BPO	-JC-1



5 Conclusions and next steps

The completion of this deliverable implies a deep understanding of whole KPI Framework based on the development and implementation of the Strategic Assessment Level, coming from the Four Level of TT Assessment Framework. The outcomes achieved provide the necessary tools and processes to assess which performance has been reached during project execution from a pilot and a project dimension. It will enhance the development of cross-fertilisation and replicability actions for other interested parties along the EU territory. Additionally, this document provides the EC with an evaluation method that could be re-used for a better understanding of the value of Big Data integration within the transport and logistic sectors.

The holistic KPI framework is also promoting the adoption and exploitation of Big Data solutions by showing which performance and positive results has been achieved during the piloting actions. It will serve for future research and innovation projects as guidelines for measuring the advance of Big Data in different areas of the categories groups under study.

Furthermore, we have identified the following next steps required to be performed in order to advance in the assessment activities as well as, for putting the basics for the measurement evaluation of the performance targets reports to be delivered in M18. The key next steps are:

- For Strategic Assessment Level implementation, a consultancy process will be implemented to assign weights to the various TT impacts. The magnitude of such values will depend on the inputs and feedback obtained from the internal prospective internal and in case it's required we will extend the consultation process arrangement with selected external stakeholders.
- The performance target values at project level based on the results obtained in the dedicated pilot deliverables referenced as "D*.2 Specific Performance Assessment Plan", due in M9. The indicative timeframe when the performance targets at project level should delivered is between M10-M12.
- Development of the KPI reporting document based on "Table 1: Measurement Evaluation Results template" for collecting the status of performance targets setting by the pilot domains, as well as, the aggregation of the pilot domains results in order to measure which has been the performance in the Strategic Assessment level.
- Finally, in the Market Impact section, an upgrade and updated including an impact identification revision within the scope of TT pilot actions will be delivered. On top of that, a preliminary list of potential benefit observations at a project level will be depicted to raise the awareness of TT within the transportation and mobility environment.



6. References

Tariq van Rooijen & Nina Nesterova; Don Guikink (2013) CIVITAS WIKI-- Coordination, evaluation and dissemination of CIVITAS PLUS II.

Silvia De Francisci, Christophe Dromacque, Thomas Mikkelsen Friedrich Georg Schwarzlaender (2016), D3.1 – Definition of project KPIs, Flexiciency project.

Final report (2011), Assessing the macroeconomic impact of SESAR.

European Institute of Innovation and Technology (EIT) (2015). EIT Monitoring Strategy

Maiju Vuolle, Antii Lönnqvist, Giovanni Schiuma (2014), Developing of Key Performance Indicators and impact assessment for SHOKs



ANNEX 1- Strategic Assessment KPI level

First of all, it's worth to mention which is the KPI terminology abbreviation legend used for each of the KPI table, we have summarised in the following table:

Supporting Economic Growth	EG
/Overall transport and logistics	
productivity	PR
/Investments leveraged	IL
/Market share	MS
Boosting the business performance of operations in pilots	вро
/Improvement of Transport/Mobility operations	10
/Perform the current product/service portfolio	PS
/External Joint-collaborations within	
Third parties	JC
Improved environmental and energy consumption	EE
Pollutant emissions	PE
Energy savings	ES
Enhance the transport big data research and policy enviroment	RP
Knowledge transfer from research to business	RTB



1. Supporting economic growth

EG-MS-1: Aggregated productivity increase in the TT pilot domains					
Project KPI Assesment Global Target	EG	Economic Growth			
Торіс	PR	Overall transport and logistics productivity			
Project KPI code	EG-PR-1				
Definition	In order to assess the productivity within the TT pilot domains, the factor which has been selected (among multiple productivity transport KPIs), it's is the time savings % of reduction due to the fact that it's a cross-domain KPI that will be measured inside all the pilot domains as well as based on the consideration that time savings is a key factor drive to enhance the productivity within their operational ecosystem. So, the aggregated results will allow us to determinate the total % aggregated increase of productivity in the project.				
Proposed formula		Productivity: Σ(P1, P2, P3, P4)			
Unit	Time savings: minutes/vehicle-km, minutes to users, minutes/tonnes Increase productivity: %				
Measurement method (Data sources, Frequency and reporting)	Data sources: the data/figures need to compute the proposed formula will come from the concrete inputs requested to pilots leaders in tje Transversal KPIs, concretely in Operational Efficiency (OE) assessment category. Eg; a KPI which monitorize the performance within time savings could be SH-OE-2. Frequency of measuring: the first reporting assessment of the aggregated results coming from pilot domains will be available for M18. The second KPI assessment performance will be available at the end of the project in M30.				
Liaison with TT objectives	☐ Ob ☑ Ob ☐ Ob ☐ Ob of ☐ Ob en Ob dat	jective O1 "Piloting": Execute effective large-scale piloting and targeted demonstrations jective O2 "Value": Operational efficiency of processes, improved customer experience and new business models. jective O3: "Reusability": Replicated Big Data solutions in cross-doamins jective O4: "Scalability": Ensure that the Big Data solutions developed in TransformingTransport will work at the scale the anticipated mobility and logistics processes jective O6: "Transfer": Doubling the use of Big Data solutions in the mobility and logistics sector jective O7: "Maket impact": Strengthen both the position of EU Big Data providers as well as sectorial companies to gage in bids and business opportunities. Fostering an increase of Market Share. jective O9: "Mobilisation": Mobilise verifiable commitment to additional sector investments in data assets and big ia technologies			



EG-PR-1: Total porcentage of market share obtained by TT Industry Members						
Project KPI Assesment Global Target	EG	G Economic Growth				
Торіс	PR	Overal transport and logistics productivity				
Project KPI code	EG-PR-1					
Definition	Market s indicates	Aarket share refers to a company's portion of sales within the entire market in which it operates. This metric ndicates a company's size within its market.				
Proposed formula	Market S Time Per	Market Share = (Particular Company's Sales Revenue in Time Period X) / (Relevant Market's Total Sales Revenue in Time Period X)				
Unit	Company and sales revenue: € Market share: %					
Measurement method (Data sources, Frequency and reporting,)	Data sources: the data/figures need to compute the proposed formula will come from the concrete inputs requester to pilots leaders in "Table 1: Measure Evaluation Results Template". Each of the WP leaders should report which Market Share % of increase has obtained. Frequency of measuring: the first reporting assessment of the aggregated results coming from pilot domains will be available for M18. The second KPI assessment performance will be availiable at the end of the project in M30.					
Liaison with TT objectives		 Objective O1 "Piloting": Execute effective large-scale piloting and targeted demonstrations Objective O2 "Value": Operational efficiency of processes, improved customer experience and new business models. Objective O3: "Reusability": Replicated Big Data solutions in cross-doamins Objective O4: "Scalability": Ensure that the Big Data solutions developed in TransformingTransport will work at the scale of the anticipated mobility and logistics processes Objective O6: "Transfer": Doubling the use of Big Data solutions in the mobility and logistics sector Objective O7: "Maket impact": Strengthen both the position of EU Big Data providers as well as sectorial companies to engage in bids and business opportunities. Fostering an increase of Market Share. Objective O9: "Mobilisation": Mobilise verifiable commitment to additional sector investments in data assets and big data 				



EG-IL-1: Total amount of additional target sector investments of TT industrial partners					
Project KPI Assesment Global Target	EG Economic Growth				
Торіс	IL	Investments leveraged			
Project KPI code	EG-IL-1				
	The investments leveraged by TT is one of the key aspects to be monitored in order to demonstrat				
Definition	willgnes	s of project partners to add investmetns to their already investment strategy provided by			
	Industria	l partners			
Proposed formula		Investement leveraged: Σ(I1, I2, I3, I4)			
Unit	Currency	:€			
	Data sou	rces: the data/figures need to assess the performance on this KPI has to be fed by the whole list			
	of Industrial Partners which appears in DoW "Table 17: Indicative exploitation plans, industrial strategy				
Measurement method	and plan	ned investments of TransformingTransport industry members" .			
(Data sources, Frequency and reporting,)	reporting,) Frequency of measuring: the first reporting assessment of the aggregated result				
	domains will be available for M18. The second KPI assessment performance will be available at the end				
	of the project in M30.				
	,	Objective O1 "Dilation" Events offective large ceals pilating and targeted demonstrations			
	.				
		Objective O2 "Value": Operational efficiency of processes, improved customer experience and new business models			
	(Objective O3: "Reusability": Replicated Big Data solutions in cross-doamins			
	1	Objective O4: "Scalability": Ensure that the Big Data solutions developed in TransformingTransport will work at the scale of the anticipated mobility and logistics processes			
Liaison with TT objective	Objective O6: "Transfer": Doubling the use of Big Data solutions in the mobility and logistics sector				
	1	Objective O7: "Maket impact": Strengthen both the position of EU Big Data providers as well as sectorial companies to en gage in bids and business opportunities. Fostering an increase of Market Share.			
	1	Objective O9: "Mobilisation": Mobilise verifiable commitment to additional sector investments in data assets and big data tech nologies			



2. Boosting the business performance of operations in pilots

BPO-IO-1: Total accumulated operations costs of existing proceses and services reduced by TT pilot deployment					
Project KPI Assesment Global Target	BPO	Business perfromance operations			
Торіс	10	Improvement of Transport/Mobility operations			
Project KPI code	BPO-IO-1				
	The aggreated % of operation costs reduced by TT will be expressed in conjunction within this KPI. The aim is to				
Definition	understand how	w much big data could impact within the operational costs structure of the pilot domains from the			
Proposed formula		Operational costs reduction: Σ(OP1, OP2, OP3, OP4, etc.)			
	€/(tonne x year				
Unit	€/vehicle-km ;	£/km			
	€/(passenger x	year)			
Measurement method (Data sources, Frequency and reporting,)	Data sources: the data/figures need to assess the performance on this KPI has to be fed by the concrete indicators that will measure the % of reduction inside the pilot domain. In this case, Operational Efficiency (OE), is the category defined for TT to assess the performance among pilots (eg; SH-OE-1). Frequency of measuring: the first reporting assessment of the aggregated results coming from pilot domains will be available for M18. The second KPI assessment performance will be available at the end of the project in M30.				
Liaison with TT objectives	 □ Objective O1 "Piloting": Execute effective large-scale piloting and targeted demonstrations □ Objective O2 "Value": Operational efficiency of processes, improved customer experience and new business models. □ Objective O3: "Reusability": Replicated Big Data solutions in cross-doamins □ Objective O4: "Scalability": Ensure that the Big Data solutions developed in TransformingTransport will work at the scale of anticipated mobility and logistics processes □ Objective O6: "Transfer": Doubling the use of Big Data solutions in the mobility and logistics sector □ Objective O7: "Maket impact": Strengthen both the position of EU Big Data providers as well as sectorial companies to engibility and business opportunities. Fostering an in crease of Market Share. □ Objective O9: "Mobilisation": Mobilise verifiable commitment to additional sector investments in data assets and big data technologies 				



BPO-PS-1: Total nu	mber of <u>new</u> p	roducts/services/processes with big data features launched into the market	
Project KPI Assesment Global Target	BPO	Business perfromance operations	
Торіс	PS	Perform the current product/service portfolio	
Project KPI code	BPO-PS-1		
Definition	The pilot design D*.1 has reveal which technical architecture as well as the concrete Business Cases will be under the deploy and assessment within TT pilot domains. The technical and business findings achieved up to M6 has revealed that in most of the pilot domains will come up with the development of new product/services/process in later project stages ath the time that the results are consolidating within the pilot domain. The design and implementation of the technical architecture is currently a big advance in the business art of different pilot leaders. So, we need to asses which is the potential of the big data to produce the kind of services and products expected.		
Proposed formula	Business performance: Σ(New Business Models X,New Products X, New Services X, New Processes X, etc.)		
Unit	Total number (asolute units)		
Measurement method (Data sources, Frequency and reporting,)	Data sources: the data/figures need to assess the performance on this KPI has to be fed by two different channels. One of them, it will directly taken from the exisitng (as well as future) exploitation assests definition, and the other one will be directly fed by the inputs from pilot leaders in case we haven't identify it within TT exploitable assets. This two-side analysis will serve to higlight and check the main results obtained in the business performance products/services that include big data features are in line with the exploitation assets identification. Frequency of measuring: the first reporting assessment of the aggregated results coming from pilot domains will be available for M18. The second KPI assessment performance will be availiable at the end of the project in M30.		
Liaison with TT objectives	☐ Obj ✔ Obj ✔ Obj ■ Obj ant ☐ Obj bid ☐ Obj tech	ective O1 "Piloting": Execute effective large-scale piloting and targeted demonstrations ective O2 "Value": Operational efficiency of processes, improved customer experience and new business models. ective O3: "Reusability": Replicated Big Data solutions in cross-doamins ective O4: "Scalability": Ensure that the Big Data solutions developed in TransformingTransport will work at the scale of the icipated mobility and logistics processes ective O6: "Transfer": Doubling the use of Big Data solutions in the mobility and logistics sector ective O7: "Maket impact": Strengthen both the position of EU Big Data providers as well as sectorial companies to engage in s and business opportunities. Fostering an increase of Market Share. ective O9: "Mobilisation": Mobilise verifiable commitment to additional sector investments in data assets and big data inologies	



BPO-PS-2: Total number o	f <u>existing</u> impr	oved products/services/processes with big data features launched into the market	
Project KPI Assesment Global Target	BPO	Business perfromance operations	
Торіс	PS	Perform the current product/service portfolio	
Project KPI code	BPO-PS-1		
Definition	The pilot design D*.1 has reveal which technical architecture as well as the concrete Business Cases will be under the deploy and assessment within TT pilot domains. The technical and business findings achieved up to M6 has revealed that in most of the pilot domains will come up with the performance of the existing product/services/process in later project stages ath the time that the results are consolidating within the pilot domain. The design and implementation of already technical big data architectures and components will enhance the development of the product/Service owner by adding big data features.		
Proposed formula	Business performance: Σ(Business Models X,Products X, Services X, Processes X, etc.)		
Unit	Total number (a	asolute units)	
Measurement method (Data sources, Frequency and reporting,)	Data sources: the data/figures need to assess the performance on this KPI has to be fed by two different channels. One of them, it will directly taken from the current and exisitng exploitation assests definition, and the other one will be directly fed by the inputs from pilot leaders in case we haven't identify it within TT exploitable assets. This two-side analysis will serve to higlight and check the main results obtained in the business performance products/services that include big data features are in line with the exploitation assets identification. Frequency of measuring: the first reporting assessment of the aggregated results coming from pilot domains will be available for M18. The second KPI assessment performance will be availiable at the end of the project in M30.		
Liaison with TT objectives	 Objective O1 "Piloting": Execute effective large-scale piloting and targeted demonstrations Objective O2 "Value": Operational efficiency of processes, improved customer experience and new business models. Objective O3: "Reusability": Replicated Big Data solutions in cross-doamins Objective O4: "Scalability": Ensure that the Big Data solutions developed in TransformingTransport will work at the scale of the anticipated mobility and logistics processes Objective O6: "Transfer": Doubling the use of Big Data solutions in the mobility and logistics sector Objective O7: "Maket impact": Strengthen both the position of EU Big Data providers as well as sectorial companies to engage in bids and business opportunities. Fostering an increase of Market Share. Objective O9: "Mobilisation": Mobilise verifiable commitment to additional sector investments in data assets and big data technologies 		



BPO-JC-1: Total number of Involved organizations which are participating actively in Big Data demonstrations			
Project KPI Assesment Global Target	BPO	Business perfromance operations	
Торіс	PS	Perform the current product/service portfolio	
Project KPI code	BPO-PS-1		
Definition	In order to asses which it's the performance of TT of the multiplier effect on project successful results by implementing a two-sided innovation and incubation strategy called 'from local-to-project-to-global', we have set up a KPI that reflects the total accumulated number of third party organizations that will joint TT to contribute to expand and exploit the results obtained.		
Proposed formula	External joint collaborations: Σ(Third parties)		
Unit	Total number (absolute units)		
Measurement method (Data sources, Frequency and reporting,)	Data sources: the data/figures need to assess the performance on this KPI has to be fed by the inputs coming from T3.6 – Post-project replication, Incubation & Innovation management Frequency of measuring: the first reporting assessment of the aggregated results coming from pilot domains will be available for M18. The second KPI assessment performance will be available at the end of the project in M30.		
Liaison with TT objectives	☐ Obj ☐ Obj ✔ Obj ant ☐ Obj bid ☐ Obj tech	ective O1 "Piloting": Execute effective large-scale piloting and targeted demonstrations ective O2 "Value": Operational efficiency of processes, improved customer experience and new business models. ective O3: "Reusability": Replicated Big Data solutions in cross-doamins ective O4: "Scalability": Ensure that the Big Data solutions developed in TransformingTransport will work at the scale of the cipated mobility and logistics processes ective O6: "Transfer": Doubling the use of Big Data solutions in the mobility and logistics sector ective O7: "Maket impact": Strengthen both the position of EU Big Data providers as well as sectorial companies to engage in s and business opportunities. Fostering an in α ease of Market Share.	



3. Improved environmental and energy consumption

EE-PE-1: Total direct CO2 emission reduction obtained				
Project KPI Assesment Global Target	EE	Energy efficiency		
Торіс	PE	Pollutant emissions		
Project KPI code	EE-PE-1			
Definition	The GHG emissions caused by the transportation systems are the main contributor to global warning, in particular TT will assess which carbon dioxide (CO2) emissions reduction will be evaluated as an indicator of energy consumption, as the emission of this substance is proportional to the vehicle's energy consumption.			
Proposed formula	% CO2 emissions reduction: Σ(PE1, PE2, PE3, etc.)			
Unit	CO2: g CO2/km			
Measurement method (Data sources, Frequency and reporting,)	Data sources: the data/figures need to assess the performance on this KPI has to be fed by the inputs coming from pilot domains, concretely to the Transversal KPIs included in the Energy Consumption (EC) Assessment Category. From example, CV-EC1 Frequency of measuring: the first reporting assessment of the aggregated results coming from pilot domains will be available for M18. The second KPI assessment performance will be available at the end of the project in M30.			
Liaison with TT objectives	 Objective O1 "Piloting": Execute effective large-scale piloting and targeted demonstrations Objective O2 "Value": Operational efficiency of processes, improved customer experience and new business models. Objective O3: "Reusability": Replicated Big Data solutions in cross-doamins Objective O4: "Scalability": Ensure that the Big Data solutions developed in TransformingTransport will work at the scale of the anticipated mobility and logistics processes Objective O6: "Transfer": Doubling the use of Big Data solutions in the mobility and logistics sector Objective O7: "Maket impact": Strengthen both the position of EU Big Data providers as well as sectorial companies to engage in bids and business opportunities. Fostering an increase of Market Share. Objective O9: "Mobilisation": Mobilise verifiable commitment to additional sector investments in data assets and big data 			



EE-ES-1: Total direct energy savings obtained				
Project KPI Assesment Global Target	EE	Energy efficiency		
Торіс	PE	Energy Savings		
Project KPI code	EE-ES-1			
Definition	This KPI assess the energy efficiency improvement during the operation of the vehicles and therefore, the energy requirements of the fleet. One important aspect is the way to demonstrate that Big data solutions have several direct and indirect impacts, for instance, a key challengue for EC is to decrease the energy demand for Public Transport operators as well as from the end-user perspective. The indirect impact is directly related with economic savings produced by the reduction of the energy consumption. So, the objective of TT is to compute which final % reduction has been achieved within TT pilot domains.			
Proposed formula	% Energy Savings: Σ(ES1, ES2, ES3, etc.)			
Unit	Fuel consumption: kWh/100 km			
Measurement method (Data sources, Frequency and reporting,)	Data sources: the data/figures need to assess the performance on this KPI has to be fed by the inputs coming from pilot domains, concretely to the Transversal KPIs included in the Energy Consumption (EC) Assessment Category. For example, we can extract an pilot KPI related with this topic which is IU-EC-2 "Vehicle energy consumption per 100 km." Frequency of measuring: the first reporting assessment of the aggregated results coming from pilot domains will be available for M18. The second KPI assessment performance will be available at the end of the project in M30.			
Liaison with TT objectives	 Objective O1 "Piloting": Execute effective large-scale piloting and targeted demonstrations Objective O2 "Value": Operational efficiency of processes, improved customer experience and new business models. Objective O3: "Reusability": Replicated Biq Data solutions in cross-doamins Objective O4: "Scalability": Ensure that the Big Data solutions developed in TransformingTransport will work at the scale of the anticipated mobility and logistics processes Objective O6: "Transfer": Doubling the use of Big Data solutions in the mobility and logistics sector Objective O7: "Maket impact": Strengthen both the position of EU Big Data providers as well as sectorial companies to engage in bids and business opportunities. Fostering an increase of Market Share. Objective O9: "Mobilisation": Mobilise verifiable commitment to additional sector investments in data assets and big data 			



4. Enhance the transport big data research and policy ecosystem

RP-RTE-1: Total number of big data components integrated into pilot domain platforms				
Project KPI Assesment Global Target	RP	Enhance the transport big data research and policy ecosystem		
Торіс	RTB	Knowledge transfer from research to business		
Project KPI code	RP-RTB-1			
Definition	TT is looking to boost the adoption of big data products and services within the pilot domains, so for this purpose, we have identified a KPI that will measure which is the performance degree for integration big data features within their current technical architectures. We will measure the total number of big data components integrated that will enhance the current position of the pilot in the big data transport ecoystem.			
Proposed formula	Big data components: Σ(BC1, BC2, BC3, etc.)			
Unit	Total components (absolute numbers)			
Measurement method (Data sources, Frequency and reporting,)	 Data sources: the data/figures need to compute the proposed formula will come from the concrete inputs requested to pilots leaders in "Table 1: Measure Evaluation Results Template". Each of the WP leaders should report which Market Share % of increase has obtained. Frequency of measuring: the first reporting assessment of the aggregated results coming from pilot domains will be available for M18. The second KPI assessment performance will be available at the end of the project in M30. 			
Liaison with TT objectives	 Objective O1 "Piloting": Execute effective large-scale piloting and targeted demonstrations Objective O2 "Value": Operational efficiency of processes, improved customer experience and new business models. Objective O3: "Reusability": Replicated Big Data solutions in cross-doamins Objective O4: "Scalability": Ensure that the Big Data solutions developed in TransformingTransport will work at the scale of the anticipated mobility and logistics processes Objective O6: "Transfer": Doubling the use of Big Data solutions in the mobility and logistics sector Objective O7: "Maket impact": Strengthen both the position of EU Big Data providers as well as sectorial companies to engage in bids and business opportunities. Fostering an increase of Market Share. Objective O9: "Mobilisation": Mobilise verifiable commitment to additional sector investments in data assets and big data technologies 			