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Executive Summary

Motivation

The transportation sector has an important impact on Europe's economy. In a sector, where margins are very low and societal impact is very high, small efficiency gains have a large impact on individual companies, the sector, and society as a whole. For example, reducing the number of kilometres driven by empty trucks by only 1% and using more environmentally friendly resources for only 2% of the transportation orders in Europe, would reduce Diesel consumption by 2,3 billion litres and CO_2 emission by 6,5 million tonnes.

Vision and Goal

While an efficiency improvement in the transportation sector can certainly be expected by building better roads and better engines, there are limits to the extent and the speed with which such improvements can be made. Consequently, to stay up to speed with growing transportation demands, improvements must come from other sources as well. Therefore, the GET Service project looks for an efficiency gain by improving communication between transportation partners and by exploiting that communication to improve transportation plans in terms of transportation time, robustness of the plan, CO_2 emission, and cost. Against this background, the goal of the GET Service project has been to develop a platform for sharing information in the logistics sector, as well as developing planning services that exploit that information, in order to improve the efficiency of transport plans.

Results

To achieve this goal, a core platform has been developed that supports information sharing, based on service orientation and complex event processing. To the core platform, all objects and services that provide information, such as traffic information, GPS locations of transportation resources, water levels, and queues at the harbour gate, are event sources. Subsequently, information aggregators are developed that use low level events to aggregate information like the estimated arrival time of a truck at the harbour and the expected loading time of the container from the resource onto a ship. Planning services were built on top of these information services, to improve transportation plans by exploiting real-time information about resource positions and infrastructure status and by improving the robustness of transportation plans in handling unexpected events. Also, monitoring services were built, which planners and drivers of transportation companies can use to monitor the status of their own resources and other resources.

Impact

We have shown that the information sharing facilities and services that were developed in the context of the project can indeed help to: reduce the number of kilometres driven by empty trucks, choose more environmentally friendly resources, and create more robust transportation plans. In doing so, we have shown the potential of an information sharing platform for reducing transportation cost, transportation time and CO_2 emission.

Results of the project - in particular, planning algorithms and information sharing facilities - have been implemented at project partners and at a spin-off company has been started to exploit results.

1 Introduction

This final report presents a summary of the most important results of the GET Service project. This section provides the background to this deliverable, by presenting the goal of the project as a whole, and the goal of the deliverable itself. Finally, it presents the structure of the remainder of the deliverable.

1.1 Project Goal

The GET Service platform provides transportation planners with the means to plan transportation routes more efficiently and to respond quickly to unexpected events during transportation. To this end, it connects to existing transportation management systems and improves on their performance by enabling sharing of selected information between transportation partners, logistics service providers and authorities. In particular, the GET Service platform consists of components that: (i) enable aggregation of information from the raw data that is shared between partners and transportation information providers; (ii) facilitate planning and re-planning of transportation based on that real-time information; and (iii) facilitate real-time monitoring and control of transportation, as it is being carried out by own resources and partner resources.

By providing this functionality, the GET Service platform aims to reduce the number of empty miles that are driven, improve the modal split, and reduce transportation times and slack, as well as response times to unexpected events during transportation. Thus it reduces CO2 emissions and improves efficiency.

1.2 Deliverable goal

This deliverable presents the most important results of the GET Service project. It presents a summary of the context and objectives of the project, which is based on the original description of work and updated based on the results that were achieved in the project. It also presents an overview of the main results and foreground that was developed per work package, an overview of the potential impact, the main dissemination activities and the exploitation results. Finally, it contains an overview of the dissemination of the developed foreground.

1.3 Deliverable structure

Against this background, the remainder of this deliverable is structured as follows. Chapter 2 presents a summary of the project context and objectives. Chapter 3 presents the main technical results of the project and Chapter 4 the potential impact of these results on European companies and organizations and society in the large. Chapter 5 contains contact and publicity information. Chapter 6 provides an overview of the dissemination results of the project. Chapter 7 contains the questionnaire on societal implications and Chapter 8 the financial report.

2 Summary

2.1 Context

The European transportation ecosystem faces a major challenge in a globalizing world, where the demand for transport capacity is ever increasing. It has to ensure that the transportation demand can continue be met, while mitigating the strain that this puts on:

- the transportation infrastructure;
- the environment, due to the emission of toxic byproducts and CO2; and
- the productivity of European transportation companies and the population in general, due to traffic congestion.

Particularly problematic is the (increasing) environmental impact of the transport sector. In Europe, "transport is the most problematic emitting sector, with upward emission trends" (European Environment Agency, 2009). Between 1990 and 2007, CO_2 emissions from transport rose by 29% in Europe. Road transport accounts for a sizable portion of CO_2 transport related emissions, nearly 73% in 2000 (Fuglestvedt et al., 2008).

The increasing transportation demand is nearing the limitations of what the transportation infrastructure can handle and improvements to the infrastructure (such as building wider roads) do not create a definitive solution for this problem, which is apparent from yearly increasing traffic congestion levels. In addition, improving the infrastructure is not the final answer to decreasing CO_2 emission, as it does not decrease the number of kilometers driven.

Therefore, the aim of this project is to address the challenges that are faced by the European transportation ecosystem, by taking a different, information-based, approach. Thus, the project aims to support a European transportation ecosystem that is demonstrably more environmentally friendly and efficient and provides new business opportunities for transportation information providers and organizations that can use this information to provide innovative services.

To achieve this aim, the project leverages existing transportation management and route planning systems. Currently, these systems focus on one partner in the transportation value chain, for example, a trucking company or a driver. Typically, these systems consist of centralized transportation planning software and context-aware route planning devices that are associated with transportation resources. The centralized transportation planning software provides planners with insight into pick-ups and deliveries and enables them to assign resources to that. The context-aware route planning devices provide drivers of transportation resources with the ability to plan their routes. Optionally, these devices interact with the planning software, such that they can update the transportation planning software on their current status and, in some cases, the transportation planning software can send route information directly to the devices. The most advanced devices cooperate to provide aggregate information, such as congestion information and average travel times, while experiments are being performed with devices that interact with the transportation infrastructure and with each other to detect and notify, for example, accidents and roadwork.

2.2 Objectives

The GET Service project advances current transportation and route planning systems to the next major level, by: empowering transport management and route planning systems with information from multiple sources; and enabling the incorporation of transportation-related tasks into transportation planning. In doing so, GET Service facilitates:

- real-time planning;
- multi-modal planning;
- efficient resource selection;
- continuous and integrated monitoring; and
- efficient re-planning.

Real-time planning is the use of real-time information from multiple sources in transportation and route planning, leading to improved planning algorithms. By aggregating information from multiple sources, planning algorithms can be made more accurate. Currently, planning algorithms are based on historical data or estimates of travel times and CO_2 emission on a particular route. However, actual travel times and CO_2 emission differ depending on the current positions of the transportation resources, the situation on the road, weather conditions and other factors. By taking such real-time information into account, the accuracy of planning algorithms can be improved further. At the same time, this presents a technical challenge, because computation times for transportation plans short be short when they must be created in real time, while at the same time more information must be taken into account. The GET Service project also shows how to exploit real-time information to do predictive planning. Using predictive planning it becomes, for example, possible to predict whether an airplane will land at another airport than scheduled, what the estimated waiting time is for a lock that is undergoing repair, and whether traffic congestion on a certain stretch of road is resolved by the time a driver arrives at the congestion.

Multi-modal planning refers to the use of multiple modes of transportation in combination to achieve an optimal and sustainable utilization of resources. To achieve an optimal use of resources in this manner, it is important for different parties in the transportation value chain to have information about each other's status. The GET Service platform provides that information to all participants in the transportation value chain, while taking into account that this information may be sensitive or strategic and access may therefore be restricted or billed.

Efficient resource selection is also enabled by sharing information between transportation partners. In particular, it facilitates the selection of the truck that is closest to the pick-up point of a particular transportation order, even if that truck is not owned by the company that got the transportation order itself. Efficient resource selection greatly reduces empty miles. Empty miles are miles driven by empty trucks, but, while the term is used for trucks, it applies to other modes of transportation and even to shipping containers as well. Over 20% of truck-miles in Europe are driven with empty trucks (Pasi, 2007), thus causing unnecessary environmental pollution and placing an unnecessary strain on the transportation infrastructure.

Continuous and integrated monitoring allows transportation planners to keep an eye – at all times – on the transportation orders that that planner manages, including their current position, estimated time of arrival and information on whether the transportation plan is at risk (especially of not meeting the required arrival time). When this becomes integrated, the transportation planner also has insight into information from transportation partners, such as the estimated time of arrival and delays in connecting modes of transportation. Currently, such information is often unavailable or spread over many different sources, from which the transportation planner must continuously collect them. Providing this information in a manner that is easily accessible and user friendly, will help transportation planners to create more efficient plans and quickly respond to unexpected events as they happen.

Efficient re-planning helps to reduce the transportation time of orders that need re-planning. At the same time, it motivates transportation planners to choose more environmentally friendly routes that have a higher risk of requiring re-planning later, because they know that when re-planning is needed, this can be done relatively painlessly.

In order to support these objectives, a number of components were developed that together realized the GET Service Platform. These components are:

- components for transportation planning and a transportation control;
- core components, including an information aggregation component;
- components that encapsulates transportation planning algorithms; and
- components that encapsulates transportation process logic.

The transportation planning and transportation control components provide end-user services that directly support the end-user with transportation planning and control. The end-user services included functionality for real-time, predictive, and multi-modal planning as well as functionality for monitoring transportation orders in detail both via desktops and laptops of planners and mobile devices of drivers. These end-user services were used to evaluate the potential effect in three usage scenarios. The first usage scenario concerned planning of a single transportation order for export, and efficiently dealing with the unexpected event that the transportation order would not make the onward connection at the harbour, due to traffic congestion. The second usage scenario concerned monitoring and predictive planning of multiple transportation orders that were executed partly as airfreight and required re-planning due to re-routing of an airplane to another airport. The third usage scenario concerned robust and real-time planning of multiple transportation orders via inland waterways.

The end-user components are supported by core components that provide re-usable generic services. These include services for logging, service registration, and authentication and authorisation.

An important core-component is the information aggregation component. This component takes data that is provided by multiple data sources and aggregates that into information that can be used by the planning and control algorithms. To this end, the stream of sensory events is automatically correlated with transportation processes and aggregated into business events that can be related directly to the state of a transportation order. There are complex relationships between events on different levels of abstraction possible. One sensory event may be related to several business events, e.g., information about traffic delay on part of a route, and one high level event may be composed of several sensory events. In addition, some sensory events might be missing, due to loss of communication because of limited coverage of the mobile communication network or other exceptional reasons. Methods to deal with incomplete and exceptional events were analysed and adapted to the transportation domain

The end-user services build on components that encapsulate transportation planning algorithms. Within the GET Service project, algorithms were developed to plan a transportation route, using real-time data that is aggregated from multiple sources. The transportation route must be optimized to given criteria such as minimal CO_2 emission and minimal cost. Also, it must observe relevant constraints, which can either be hard constraints that cannot be violated (for example, the transportation route is bound by the fact that one leg of the route must connect to the next and may be bound by contractual constraints of the transportation company) or soft constraints that may be violated in case no feasible route can be found that meets the constraints (for example, the user may set a maximum bound to the travel time or exclude a certain mode of transportation). Particular attention was paid to the development of predictive algorithms, which combine real-time and historical information to predict properties of a transportation plan. Predictive algorithms can, for example, predict the length and future presence traffic congestion, where current algorithms merely detect the current length and presence of traffic congestion.

The end-user services also build on components for transportation process composition and orchestration. These components take the transportation or route plan, generated by the transportation planning algorithms as input and constructs a service composition that enables monitoring and control of the planned route. It has specific features for supporting transportation-specific control structures, such as bundling and unbundling of goods (services) upon transfer of goods from one transportation resource to another and end-to-end control and monitoring of individual loads or packages. Service composition development and orchestration enables the automated performance of transportation-related tasks, such as the generation of a Bill of Lading, reservation of transportation resources, such as loading and unloading terminals, containers and trucks and necessary administrative processing, such as customs clearance and registration with (the security of) the port authority. Service composition development and orchestration also enables the reconfiguration of a service composition when the transportation plan changes during transport. This includes automated cancellations of parts of the composition that have not yet been performed, roll-back of parts that have been performed and restructuring the composition in a manner that is consistent with both the new transportation plan and the current status of the execution of the transportation plan.

The various components interact via a service-based standardized message exchange. This standardized message exchange consists of a service bus and the definition of messaging standards between the different components. Messaging standards that have been developed in previous European Projects have been taken into account, in order to enable interfacing with other service platforms. In particular, the GET Service platform is envisioned to interact with other components of the European Wide Service Platform (EWSP) based on these communication standards and provides some of the essential components of this platform, in particular: planning services, technological means to monitor and control transportation, transportation information provisioning services and service composition technology.

3 Main results

3.1 Overall results

Overall, the GET Service Platform provides an information sharing platform for transportation service providers and services built on top of that information sharing platform to facilitate transportation planning and transportation monitoring. Figure 1 shows the components that make up the GET Service platform from a high level of abstraction. Each of these components provides important and innovative functionality, as we will explain below. A more detailed description and decomposition of the components, including an interface description, is provided in Deliverable D2.2.2.

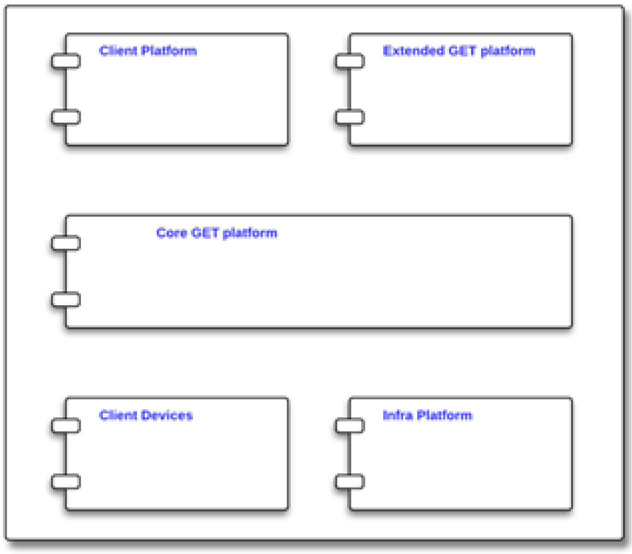

Figure 1. High-level GET Service Platform components

The **client platform** is the backbone of the transportation planning system of a transportation company. It can be used by transportation planners to plan transportation orders, based on information that is provided by the GET Service platform. In the context of the GET Service project, innovative functionality has been developed within this component to:

- plan multi-modal transportation routes based on transportation schedules, i.e. transportation routes that use multiple transportation modes, like barges, trains, sea ships and trucks.
- robust transportation planning, i.e. transportation planning that exploits historic data about occurrence of unexpected events such as traffic congestion or water levels, to plan transportation routes that have a low probability of requiring re-planning.
- real-time transportation planning, i.e. transportation planning that exploits real-time position and status information from transportation resources and infrastructure.

Client devices are the on-board and mobile devices. They can be used to send status and location information to the GET Service platform and they can be used to receive planning updates from the GET Service platform and for communication with the client platform. In the context of the GET Service project, innovative functionality has been developed within this component to:

- facilitate communication about transportation plan updates in a highly configurable and open manner, thus facilitating ‘single drivers’ (i.e. one-man companies that own and drive one truck) to be easily integrated into the transportation processes of larger companies.

Infrastructure platforms distribute status information on the transportation infrastructure, including information about traffic, tides, bridges and locks. The GET Service platform can subscribe to events that contain infrastructure status information, such that it can be used for planning purposes.

The **Core GET Service platform** correlates and aggregates the external events from multiple infra platforms and client devices. It also contains core functionality that is required by a service platform. In particular, it has:

- highly innovative functionality for subscribing to events that are of interest to a particular transportation order and processing these subscriptions in a computationally efficient manner;
- highly innovative functionality for aggregating information from low level data, e.g. aggregating information about estimated time of arrival from truck positions and traffic on the road, and aggregating a warning that an airplane will land at another airport than planned from continuous GPS position updates of that airplane;
- core functionality required by a service platform like the GET Service platform, including: a service repository, a log manager, an information store and functionality for authenticating and authorizing people.

The **extended GET service platform** is the part of the platform that can be used for the creation of detailed transportation processes, which describe the detailed tasks that need to be performed for transportation plans. It consists of highly innovative functionality for:

- authoring and combining transportation process ‘snippets’ for different transportation modes and types;
- supporting quick adaptation of a transportation process at execution time.

By providing this functionality, the GET Service platform can achieve the objectives that it set for itself.

- CO_2 emission and cost are decreased by reducing the number of empty kilometres driven, which was made possible by facilitating decision support for the selection of the trucks that were cheapest or closest to the pick-up location of the goods.
- CO_2 emission and cost are decreased by facilitating multi-modal planning, thus encouraging the use of less CO_2 intensive modalities.
- Changes to the transportation plan can be made quickly and partly automatically, thus encouraging transportation planners to choose transportation plans with lower costs and CO_2 emissions that are more likely to require changes during their execution, because these changes are easier to implement.
- Re-planning time is decreased and time for reaction to events is increased by facilitating a quick detection and correlation of unexpected events like a freight-shift event to a transportation order.
- Overall service and, thereby, other KPI’s are increased due to better facilities for communication and collaboration between partners.

- The number of re-planning activities that are needed during transportation execution is reduced by anticipating possible problems in transportation execution and reducing the chance that they occur.
- Transportation time is reduced by anticipating possible problems in transportation execution and reducing the chance that they occur.
- Re-planning time is decreased by incorporating real-time information about transportation resources and infrastructure into transportation plans.
- Transportation time is reduced by facilitating re-planning of resources as they are being used, taking their current position into account.

The functionality shown in Figure 1 is developed in separate work packages and then integrated.

This chapter first presents the primary results of the project. Then, the work packages and the functionality that they develop are described below.

3.2 Primary Results

The primary results of the project include the following.

A core platform has been developed that supports information sharing, based on service orientation and complex event processing. The services that are provided by the core platform, specifically services for logging, security services, registry services and information services were implemented as part of the service offerings of Portbase and are commercially available. Extended services in line with the GET Service vision can be built on top of the core services.

As part of the core platform, information aggregation services were developed, which can be used to aggregate events that are sent by various sources into meaningful information. In particular, the project shows that the event aggregation services are useful for aggregating information about potential delays and presenting them to transportation planners. A spin-off company, Synfioo, was started around these information aggregation services.

The information aggregation services were also released under an open source license as the ‘UNICORN’ event aggregation engine. It is accessible from: https://bpt.hpi.uni-potsdam.de/UNICORN.

As extended services, process-based monitoring services were developed as well as transportation planning services. In addition to that services were developed for information exchange through mobile clients. These extended services became part of the offerings of some of the project partners. Specifically, the planning services became part of PTV’s transportation management system and the functionality for information exchange through a mobile client became part of a product that will be exploited by Exus.

Some of the services that were developed in the context of the project, were implemented at Jan de Rijk, both as part of the validation of the services and also as part of their production environment. Specifically, planning services around charter selection and transportation planning were implemented at Jan de Rijk. Also, information aggregation services were implemented at Jan de Rijk.

An integrated prototype was developed during the project. This prototype demonstrates the potential for having a core platform for information exchange in the transportation sector as well as the possibilities of the extended services for planning and monitoring that can be built on top of that core platform. A publicly available version of the prototype was made available online (http://is.ieis.tue.nl/research/getservice) along with a description of a scenario that can be used to test it. The scenario is described in deliverable D8.3.2.

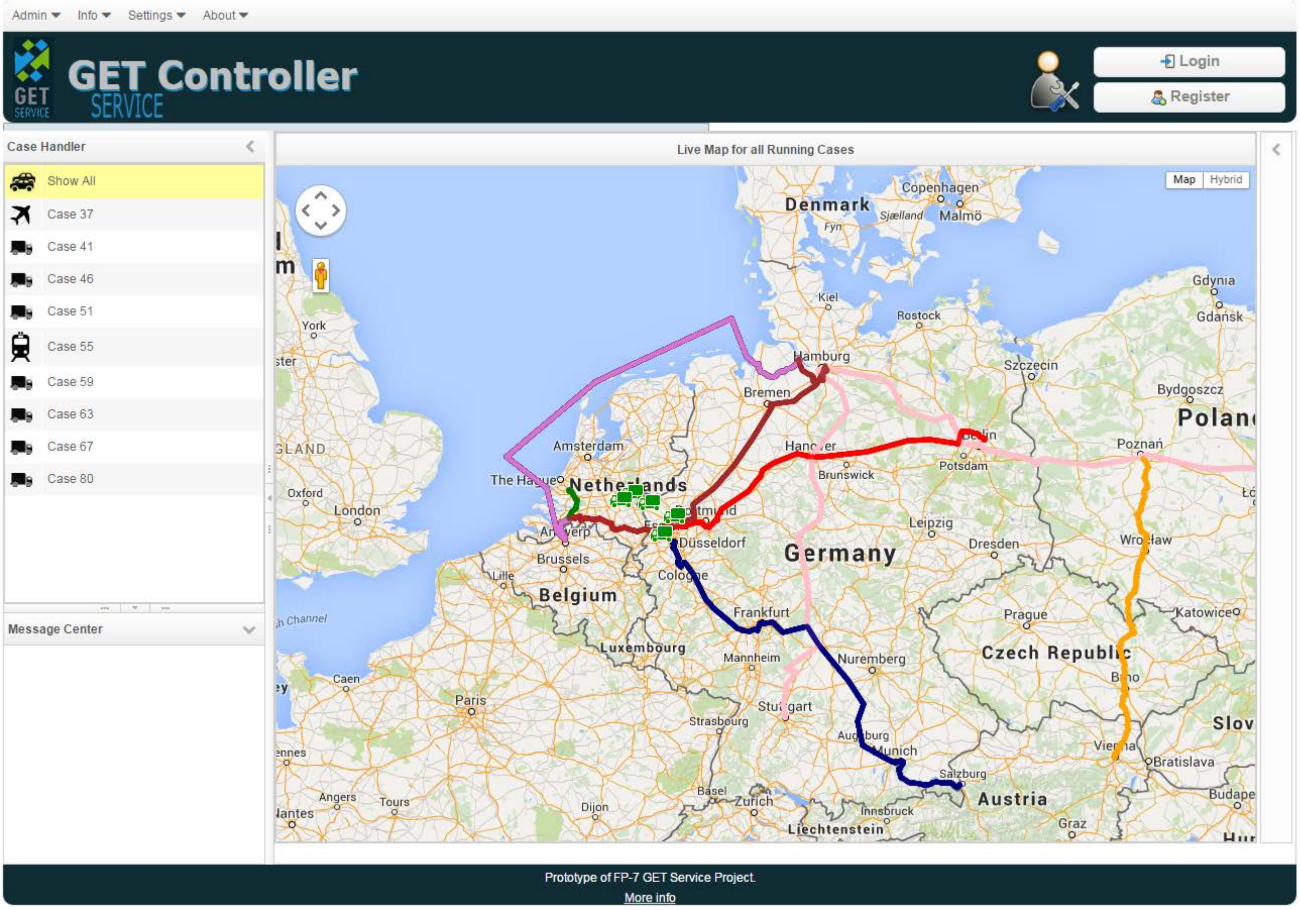

Figure 2. Screenshot of the Public Prototype.

A large number of scientific results were produced as a result of the GET Service project. These are presented in detail in chapter 6 of this deliverable. Three of these publications are considered A* publications. In addition to that, two workshops were organized as part of the project. A number of educational activities were inspired by the project, which are also presented in detail in chapter 6. A highlight was the organization of a weeklong business course for European students that was completely based on GET Service inspired material.

There were a large number of collaborations with other European projects, as presented in detail in chapter 6. The most successful collaboration was the collaboration with the SIMPLI-CITY project. Together with the SIMPLI-CITY project, a reference architecture was developed for information exchange in the transportation domain, where the GET Service project focused on parts of the architecture that concern transportation of goods and the SIMPLI-CITY project focused no parts of the architecture that concern transportation of people.

The results of the GET Service project, including the prototype of the platform and the exploitation results and plans, were presented during a dedicated event. This event was organized in

Rotterdam, due to the importance of the city to the logistics sector in Europe. The event was attended by approximately 80 people from 12 different countries.

In addition to the start-up company and the inclusion of GET Service results into service and product offerings of project partners, the project has led to follow-up research in the DATAS project, which is funded by the Dutch foundation for scientific research (NWO).

3.3 Work Package 1: End-user studies

Work Package 1 served as an introduction to the project, defining the problems that need to be addressed, the requirements that the GET Service platform has to fulfill and the criteria that serve as the basis for evaluation of the project results. Based on the results achieved during the first year of the project, two prototypes of the GET Service platform were built in the next two years and evaluated using a number of evaluation scenarios adapted from the analysis in user analysis from the first year.

In order to have common knowledge about the processes and events which occur during a transport process, the objective of Deliverable D1.1 was to define so-called usage scenarios showing the different actors involved and the tasks that have to be fulfilled when goods are transported between origin and destination. In cooperation with partners from different companies five scenarios were developed showing real-world transport processes using either single transport modes or combining them in intermodal transport chains. These scenarios cover road transport, rail transport, inland waterway transport and short sea shipping with their specific characteristics as well as transshipment activities in terminals and administrative processes supporting the physical movement of goods (e.g. order confirmation, issue of transport documents, customs clearance, payment etc.). The identified tasks were assigned to four different categories of actors: the Client, who has the need for transport and places an order, the Planner, who is responsible for transport planning and control, the Operator, who drives a vehicle or operates the terminal, and other stakeholders consisting mainly of customs offices and transport regulators. In this way a detailed picture of each transport process was created showing the interactions between the actors. This was then used for deriving the requirements for the GET Service platform. In order to evaluate the scenarios, a three-dimensional framework was used which does not only focus on transport costs but considers also service in form of transport time and CO_2 emissions which have to be reduced in order to make transport more environmentally friendly. This framework is shown in Figure 3.

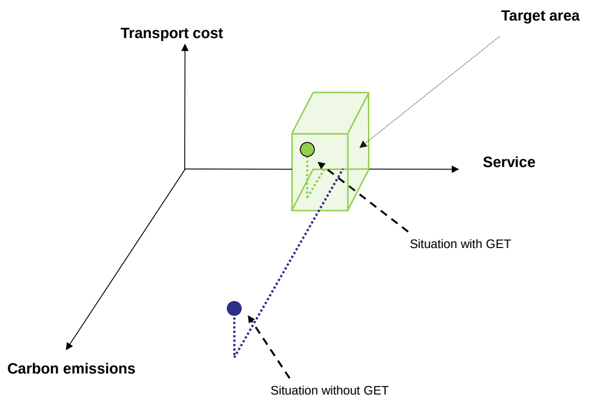

Figure 3: 3-D evaluation framework for usage scenarios

Whereas the usage scenarios showed how transport operations are conducted in ideal case, the focus of the second part of Deliverable D1.1 was put on possible disruptions caused by different unexpected events. These events were categorized ranging from human failures (e.g. carelessness, sickness) through endogenous (e.g. limited capacity, different rail gauges, priority of passenger transport over freight transport) and exogenous factors (e.g. weather, natural disasters, crime) up to other events (e.g. change or cancellation of order, communication problems). Some of these events were then applied to the usage scenarios showing in the so-called use cases which effect an unexpected event could have on the original transport plan and which tasks have to be performed when re-planning due to a disruption is needed. In each case multiple transport alternatives were compared according to the three-dimensional framework showing the differences in costs, time and emissions in comparison to the original (and now infeasible) transport plan.

Based on the analysis of usage scenarios and derived use cases, a list of requirements for the GET Service platform was developed which were specified in more detail in Deliverable D1.2. These include the requirements for planning, information provisioning, status monitoring and control as well as a generic data model. The definition of each required function of the system consists of its trigger, a short description of what the function does and the interaction with other system components and stakeholders. In case of planning the process was divided into offline planning and online planning. Whereas offline planning is conducted before the start of the transport and uses mainly general infrastructure and capacity data and historical data about e.g. travel times, online planning is triggered by an unexpected event happening during the transport and requires additional information about the event and the real-time status of the transport network and vehicles. The data needed for planning is provided through the information provisioning function which can access either internal GET Service database or external databases in order to deliver the information required by every user. This information might either have a persistent character (e.g. locations of terminals, transport network, regulations, transport schedules etc.) or real-time character describing the actual situation of the network which might change quickly (e.g. free capacities, estimated arrival time etc.). Moreover, information provisioning is also responsible for detecting unexpected (e.g. congestion, accident) and expected (e.g. vehicle arrived, goods loaded) events that are important for status monitoring and control. The status monitoring and control component provides the user with the information about the current status of the system and the tasks which need to be performed. In order to be able to provide this information, the transport legs with their respective tasks and events are modelled as process snippets and composed into a transport process. In case of re-planning due to an unexpected event these transport processes have to be reconfigured either by using existing snippets or by creating new snippets. The input data for all described functions was summarized in a generic data model consisting of administrative, process, real-time and planning data.

The correct measurement of CO_2 emissions is necessary for evaluation of different transport alternatives and reduction of the environmental impact of transport. Therefore Deliverable D1.3 defined the CO_2 calculation methodology used in the project. This methodology was based on an extensive literature review of emission models, emission measurement projects and emission calculators available in the literature. The objective was to find a calculation method for each transport mode which would on one hand take into account all important factors (e.g. weight, speed, engine type, load factor, gradient etc.) but on the other hand the method should not require too much detailed input data which might not always be available (e.g. air resistance and other physical characteristics of the vehicle). The derived models take into account the specific characteristics of each transport mode and the calculation can be conducted using either average values or specific data for a certain vehicle when available. In addition to emissions from transport, the emissions from transshipment were also considered. The emission values include all greenhouse gases expressed as CO_2 equivalents and the scope is well-to-wheel taking into account emissions from transport and from the production of fuel.

The evaluation of the GET Service platform was the core interest of Task T1.4. This resulted in an annual Deliverable at the end of each project year. The first Deliverable D1.4.1 defined a methodology that was to be applied in the subsequent two Deliverables using for instance the findings of Deliverable D1.1 and D1.2. In order to estimate the impact of GET Service the scenarios and prototypes developed for the project have been used along with real-world trip data from Jan de Rijk. The prototypes were developed with a specific use case in mind. Thus different heterogeneous data was compiled and was consequently also used for the evaluation. Key findings of Deliverable D1.4.2 as well as D1.4.3 are:

- A minimization of CO_2 is possible with more and between information. Depending on the individual case a reduction in CO_2 may be to a fictional demand assuming a status quo e.g. when reorganizing transport assets for air freight with a deviated flight.
- Accurate information in time and space is of a very high importance for any planning system.
- Modern planning tools using real-time data e.g. from traffic information can – in long distance transport where route and time alternatives are available – reduce trip times spent with low average speeds.
- Intermodal outbound and inbound routes can have different total trip times despite the same route and transport modes taken. This is e.g. the case with the Channel Tunnel towards the United Kingdom.

The CO_2 functions derived for Deliverable D1.3 perform well when being compared to real-world data. In contrast to the description of work it was scientifically not possible to calculate a modal shift resp. split or a reduction of total transport costs on a general basis because the samples were too small. These aggregated figures cannot be generated based on tailored scenarios. They would require a collection of real-world data over a relatively long time to ensure that different customer demands, transport orders, routes chosen, etc. are eliminated due to the large number of samples.

By offering a modern freight transport planning system integrating business processes, real-time data and intermodal information, an efficiency gain in a minimization of CO_2, increase of reliability and a reduction of transport costs seems possible.

3.4 Work Package 2: Standardization and integration

The goal of Work Package 2 has been to develop the architecture that governs the integration of the distributed GET Service platform components, to ensure the integration of GET Service platform with other components of the European Wide Service Platform, to develop a subset of the GET Service platform core components, and finally to integrate all the distributed GET Service platform components into an operational platform. The architecture has gradually evolved in several stages, because an incremental design with several stages of refinement yields a better architecture design and hence better system design in the end.

The GET Service platform will not exist as a singular entity, but as part of a larger whole in the vision of the European Wide Service Platform (EWSP). Therefore, it is important to prepare the interface of the GET Service platform with other service platforms, by adhering to existing messaging standards and service platforms. In Deliverable D2.1 existing and implemented messaging standards and reference architectures from the transportation and logistics domain have been surveyed. Existing standards have been compared to the requirements of the GET Service platform (Deliverable D1.2) in order to investigate the extent in which these standards can be reused.

The GET Service platform (Deliverable D2.2.1, section 6) is a loosely-coupled distributed system. This ensures that the GET Service platform can both meet the required characteristics and that it can connect to existing systems that are already operational and therefore represent considerable investments. Loose coupling is achieved by means of a design that promotes single-responsibility and separation of concerns.

From a business perspective, this distributed model and the underlying separation of concerns is vital, since this allows the GET architecture to support the broad spectrum of diverse market characteristics that influence the way the information exchange takes place

The design of the distributed GET architecture combined with the GET exploitation model is generic, and can be fitted to the entire European transportation domain. It allows all actors involved to select their trusted partners, their business services can be adapted to different geographical areas and transport domains, while reusing the same shared reference architecture and exploitation model foundation.

The primary justification for grouping the GET architecture components is based on the usage scenarios for the different actors as described in Deliverable D2.2.2. Another grouping aspect is the rate in which the major components can change. This rate is governed by market influences, and the architecture must be able to cope with these different rates of change. The GET Service architecture, including a standardization of the interfaces (data flows) between the different components, has been designed. The final prototype is based on this architecture, and serves as basis for the integration software deliverables from other GET work packages.

The main dependencies between the components and the resulting interfaces have been identified. The dependencies between the GET components must adhere to the interface specifications.

Different exchange patterns that will be used in the interaction between GET interfaces have been listed, as well as the standards and rules that are required for maintaining the interoperability between GET Platform components.

The interface definitions have been published in three stages. The first official version served as a design blueprint for the GET work packages. The second version summarised the reported interface design details, such as the input type signature (operation arguments) and output type signature (return types). The third version contains the reported interface specifications with more details, such as resource URL's and web service endpoints.

Core components of the GET platform (Deliverable D2.3) provide the integration functionality that is required by the distributed GET architecture. These components do not have any dependency on the extended GET architecture components. This allows the core platform to remain stable, while different business-specific components on top can be realized by independent IT suppliers. The competitive position of these suppliers is not harmed, leading to a higher adoption degree. It also emphasizes the crucial neutral position of the Core GET platform, which is operated by a trusted third party

Each component has been provided with a short description of its functionality, its use cases and relations with the other Core components. The combined set of Core components have been developed into a stable and integrated platform that is used in the final stage of the GET Service project.

Finally, a prototype of the GET Service platform was delivered in three iterations.

An early prototype was developed as a first release of the integration of the component of the GET Service Platform into an operational platform. This first release was developed as an addition to the original work plan. The prototype was delivered in two iterations, which support scenarios of increasing complexity. The first scenario involved a single transport order. The second scenario involved multiple transport orders, the addition of new transport orders and the occurrence of exceptional events that affect transportation. The early prototype served as a means to visualize the goals of the project in an early stage, thus enabling discussion between the project participants. It also served as an exercise to identify the interfaces that exist between the different platform components, as they are identified in the architecture (Deliverable D2.2.1 and D2.2.2), and to practice with the integration of the different components at these interfaces.

The year two prototype (Deliverable D2.4.1) of the GET Service was developed by integrating the different components that were developed in year one and two of the project into an operational platform. It served as a means to validate the goals of the project by integrating all GET Service components while using three realistic scenarios. It also served as a means of fine-tuning the already identified components and their interfaces (Deliverable D2.2.1 and D2.2.2) that exist between the different GET Service components, and to create a stable and integrated platform that can by readily used for the next stage of the project.

The year three prototype (Deliverable D2.4.2) extended the previous version of the prototype by enabling online planning and re-planning. Consequently, this deliverable should also be considered an extension of the deliverable that describes the year two of the prototype. Online planning is defined as planning based on real-time status information on transportation resources and infrastructure. Re-planning is defined as changing a transportation plan as it is being executed.

3.5 Work Package 3: End-User Services

Work Package 3 consisted of two parallel activities. The first one concerned the development of mobile end-user services and the second one was the creation of PC-based aggregated planning services. The work that took place in context of this Work Package can be split into three parts: (1) Initial work during Y1, (2) Development of the first applications' versions during Y2 and (3) Development of the final applications' versions during Y3. More details concerning the work performed in each of the parts are given in the subsections below:

Initial work Y1

As the WP started on M9 of the project some initial work took place during Y1. This was harmonized with the system's design and the architecture definition performed in the context of WP2. The outputs of this procedure led the development took place in WP6 tasks. The results of this period was the generation of the WP3 applications' design, the identification of the applications' users and their characteristics and the creation of mock-ups for the mobile application as well as the exposure of initial web-services concerning the planning application in order to be circulated to the users/consortium.

Development of the first applications' versions during Y2
The work took place during Y2 had as an ultimate goal the production of the first prototypes for the mobile and planning applications. In order to reach this goal WP3 partners firstly froze the first applications' design and then proceeded to the development, making sure that the requirements (user and system), as imposed by the design and the overall architecture (WP2), were reflected correctly. Additionally the partners participated in the development within the project as a whole to decide and organize the integration procedures for the production of GET Service's first integrated prototype. The applications were part of the year two prototype. The work performed during Y2 within WP3 was reflected by the public deliverables D3.1 and D3.2.

Development of the final applications' versions during Y3
Two tasks (task 3.3 and task 3.4) were active and completed during Y3. The main goal during this period was the addition of features enabling real-time control and adaptation of transportation. Thus applications developed during the previous year were further extended and improved in order to generate their final applications' versions. In addition one more application was created in the context of Task 3.4. More specifically a match-making application was created that aggregates all the information generated from the mobile clients. This application aims to be a supporting tool to the functionalities of the mobile one and complementary to the work performed in WP6 and WP7. The final versions and the match-making application presented in the Y3 periodic review and were parts of the demo scenarios. The work performed during Y3 is described in Deliverable D3.3 and D3.4.

3.6 Work Package 4: Service composition development

The problems addressed by Work Package 4 can be seen from an application-centric point of view and from a technology-centric point of view. The technology leveraged and advanced by Work Package 4 is *business process technology*, i.e., technology for modelling, monitoring and automating business processes. That technology is applied to the domain of transportation and logistics.

From the application point of view, the problem we address is how transport process monitoring and automation can be supported in a highly flexible way. That is, how can we support transport processes that have a high degree of variability because they change over time or the process is highly dependent on variables such as the type of goods being transported, the service provider, or the countries being traversed. Business process technology provides a framework and standard technology to support many different processes at the same time because the process being supported is not hard-coded but modelled as a separated artefact such that a process and its associated details can be easily changed. In this context, the process model serves as a prescription for the process execution as well as a canvas for reporting the detailed execution status.

However, at the onset of the project, business process technology was not ready to support transport processes and their variability. To model transport processes, important expressive means such as time annotations were missing in the process modelling languages, e.g. BPMN. More importantly, support for dynamic process variability is not yet well developed in business process modelling. In particular, we find a specific kind of variability in multi-modal transport processes that hasn't been addressed at all in business process modelling so far. The support of multi-modal transport processes is crucial for the GET Service platform because improving the multi-modal split is an important mean to reduce carbon emissions. A multi-modal transport process consists of discrete process parts, which we call *snippets* in the project, each of which corresponds to a leg or transhipment of the transport plan, which can depend on a variety of parameters, e.g. the transport mode, the transport provider etc. WP 4 addresses how operational models for multi-modal processes can be dynamically created.

This already provides a technology centric view by naming previous limitations of business process technology. Those limitations lead to the adoption of business process technology being limited to particular domains such as financial services and public administration. An additional limitation for a wider adoption of process technology is that the creation and maintenance of a comprehensive set of detailed process models is costly. By addressing automated dynamic creation of process models we also address the problem of how process models can be created at lower cost.

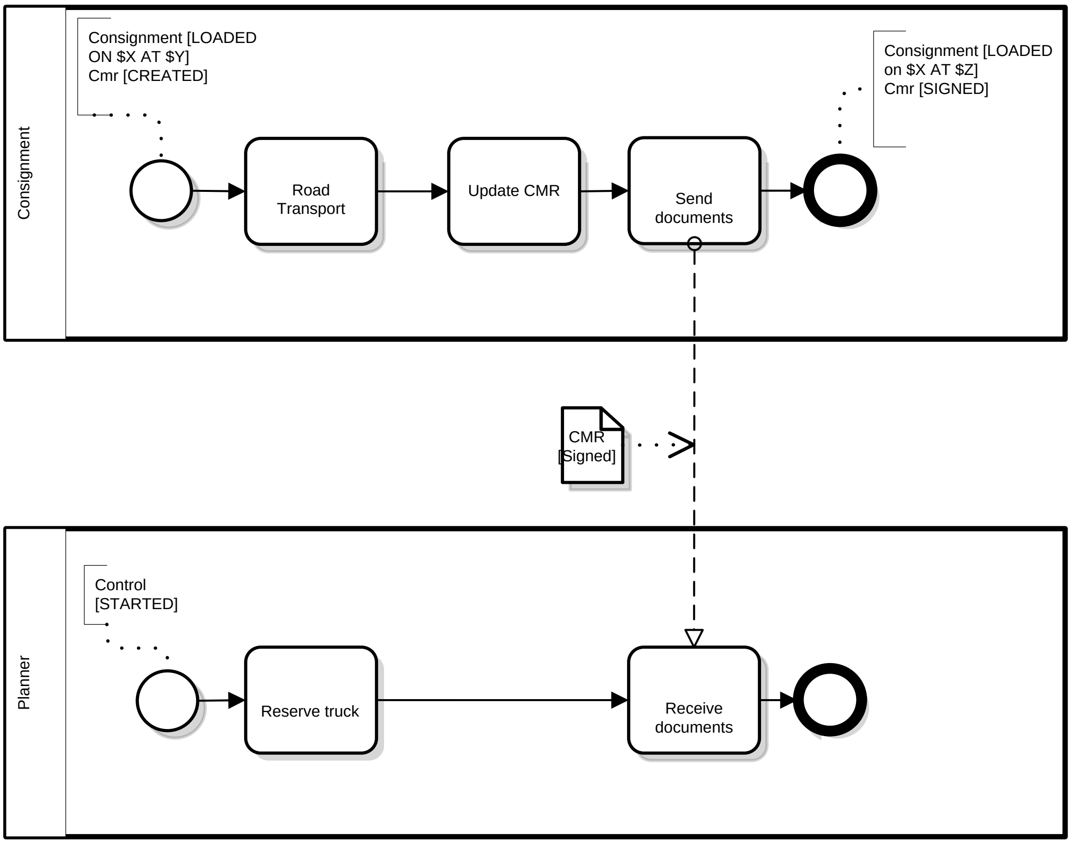

Figure 1: Example of a transport snippet with interfaces

The main result of the work package is a novel method and prototype for automated creation of transport process models from multi-modal transport plans. This method allows us to use generic process technology to support monitoring and control of transport processes. Our prototype has been integrated with the extended GET platform and a proof of concept for various scenarios was conducted that shows the feasibility of the overall approach.

The overall method and prototype consists of several contributions and components that we describe in the following.

First we developed *BPMN-T*, a language and meta-model to describe transport processes and their constituent snippets (cf. Deliverable 4.1). BPMN-T is an extension of the well-known and widely adopted OMG standard BPMN 2.0 for business process modeling. The extensions overcome the previous limitations of BPMN to describe transport processes and the variability found in multi-modal transport processes as well as provide some features to implement transport process monitoring. The main extensions of BPMN-T are (1) various time annotations that are important to plan the schedule for individual activities and to monitor the timeliness of their execution at runtime, (2) snippet interface descriptions that are needed to specify process snippets in isolation and to enable their meaningful composition (cf. Figure 1), (3) event subscriptions that are necessary to facilitate status monitoring.

Furthermore, we developed a *modelling methodology* (cf. Deliverable 4.1) that describes how transport processes and snippets should be modelled using BPMN-T in order to support the use cases considered in the project. This modelling methodology allows the modeller to easily create processes from snippets where each snippet corresponds to a transport leg or a transhipment of a multi-modal transport plan. Hence the modelling methodology implies a *method of decomposing* a process into snippets.

We then developed the *Process Development Workbench* (cf. Deliverable 4.2), a development environment for BPMN-T process models by extending an existing open source development environment for BPMN to deal with the extensions of BPMN-T, i.e., creating them, validating them and persisting them. More importantly, we created a technique to *manage re-usable transport process snippets* – a crucial component for the automated creation of transport processes. This includes the design of a process repository and a technique to register snippets to the repository in a way that allows a search algorithm to find snippets that exactly or approximately match a snippet description of a leg of a multi-modal transport plan (cf. Deliverable 4.2).

Finally we developed the *automated composition* of process snippets and the *automated creation* of an end-to-end process model from a transport plan description. This includes an algorithm for *snippet interface matching*, a technique for *binary snippet composition* including its graphical composition (cf. Deliverable 4.3).

Another important result of WP 4 in conjunction with the other work packages is a *proof of concept* that the process models generated in this way indeed can be used to support continuous transport monitoring and control. To this end, the Process Development Workbench was integrated with the Extended GET Service platform. The process models were enhanced with *event subscription annotations* and *process migration annotations*. Event subscription annotations allow the process control to display and respond to events that are provided by the event aggregation engine, e.g. events that inform about traffic congestions and predict schedule disruptions. Process migration annotations allow a planner to rapidly react to transport plan disruptions by re-planning, re-composing and migrating a disrupted process instance onto a new process. These features allow a planner to deal with unexpected events more efficiently, which encourages planners to use greener multi-modal routes more often and therefore help to reduce carbon emissions. The proof of concept is conducted using the three main demo scenarios of the GET Service project.

Publications

Mirela Botezatu, Hagen Völzer: Language and Meta-Model for Transport Processes and –Snippets (Deliverable 4.1)

Mirela Botezatu, Hagen Völzer: Prototype for Transport Process Snippet Authoring (Deliverable 4.2)

Mirela Botezatu, Hagen Völzer: Prototype for Automated Composition of Transport Process Snippets (Deliverable 4.3)

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3.7 Work Package 5: Transportation Planning Algorithms

Work package 5 concerned developing advanced planning algorithms. This was achieved in three different stages during the last three years.

Stage 1

In the first stage of the WP5, the aim was to see the whole picture of the state-of-the-art transport planning tools for the GET Service project. In total, 49 Transportation Management System (TMS) solutions and four online freight platforms were investigated. Some of the findings are listed below.

- Planning & Optimization are important components of a standard TMS solution.
- Network integration and sustainability are major developments that will continue to shape the market in the close future.
- Green awareness should be included in transport planning systems. It is therefore very important to measure the carbon dioxide equivalent (CO_2e) emissions accurately.
- Current TMS software is very focused on the planning and optimization of assets. In a lot of cases, this is completely centred on trucks, but some of the solutions have multimodal capabilities. Mode selection, service network design and capacity management should be processed within a transportation management system.

Stage 2

Task 5.2 deals with offline planning performed before the start of a transport. The approach used for offline planning is described in D5.2. In order to develop an intermodal planning algorithm, it is necessary to take into consideration a number of specific factors. The intermodal transport chain usually consists of a number of transport legs served by different transport modes. Between the transport legs there are terminals where transhipment needs to be modelled considering capacities, costs and emissions. Departure times can be considered as another important factor since they are relatively flexible for road transport but fixed for trains and vessels because they usually operate according to a fixed schedule. Moreover, the requirements of the Client regarding the type and amount of goods, origin and destination, pick-up and delivery dates as well as optimization objectives have to be reflected by the model. The possible objectives can be transport costs, time or CO_2e emissions which can be also combined depending on the weights assigned to each of the objectives. Last but not least, the uncertainty and possible disruptions happening in the real world have to be taken into account.

In order to include all necessary factors into the planning model, service network design (SND) was chosen as the optimization modelling approach. In this approach transports are modelled as services between two terminals characterized by a certain vehicle, capacity, route, departure time, travel time, costs and emissions. The feasible services for a certain transport order have to be chosen before the optimization which then shows the optimal result according to the chosen criteria. The model can be run either in a deterministic or a stochastic version. The deterministic version considers only certain data about the transport services and state of the infrastructure known at the planning moment. In addition to that, the stochastic version takes into account historical data and probabilities of occurrence for certain events such as congestions or accidents. Based on this data, travel time uncertainty can be included in the model in form of a travel time distribution which allows to create more robust plans and reduce the need for re-planning in case of a disruption. The stochastic version of the model is solved using the sample average approximation (SAA) method which takes samples from possible travel time combinations and chooses the best optimal route which is feasible in a certain number of scenarios (e.g. 95%).

Stage 3

Task 5.3 describes the approach used for online planning which is triggered by a disruption that causes infeasibility of the offline plan. The developed approach reflects the realities of intermodal transport chains as well as order-related requirements.

This approach, in comparison to the approach presented in D 5.2, though, has to deliver transport plans in real-time and also be able to use real-time traffic information for the path decisions. Thereby, at first, a feasibility check is developed which analyses the impact of real-time status changes on the offline planned and currently executed plans. If these real-time changes lead to infeasibility, the online plan has to be developed. The model used is very similar to the offline planning model, however, the planning is based on the real-time information about the current network status and position of vehicles and orders which increases the accuracy of the results. The process of re-planning, though, needs to be very fast (compared to offline planning) because the affected vehicles are on their way to the next terminal and might pass an important terminal or junction where the original route can be changed. This can be accomplished by some available real data in place of distribution functions as well as the replacement of the chance constraint by penalty costs for late delivery.

The stochastic version is again solved using the Sample Average Approximation (SAA) method in which a number of scenarios with different probability realizations are run and then the most robust route is selected. In this way the probability of arriving on time is increased and the need for a second re-planning is reduced. Thereby, the amount of samples needed, in comparison to the offline planning approach, is reduced in order to speed up the decision process.

In addition to the real-time planning algorithm, a methodology for vehicle allocation has been developed within D5.3. This algorithm helps with the identification and allocation of vehicles to orders. Thus, it can be seen as additional element to the developed offline and online planning algorithms. Specifically, a mathematical model with cost-based objective function is developed. It resembles a Vehicle Allocation Problem (VAP) and is able to assign multiple vehicles to multiple orders.

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3.8 Work Package 6: Information aggregation service

Work package 6 focused on real-time processing of events that occur in logistics processes such as transportations. Therefore, the research spans three major directions: Integration of event processing and business processes on design- and run-time level, the actual processing of events and the corresponding implementation, and the application of these results in the context of process monitoring in the logistics domain. For the potential impact of these findings see Chapter 4.

At project start, business process management (especially activity-based modeling as usual in the logistics domain) and complex event processing were typically not used in combination. This was mainly due to the lack of information how such combination and connection could work. Starting from this point, the integration of both aspects was thoroughly looked into and a set of challenges arising upon integration was created in [9]. In parallel, a first version of framework that focused on some of these challenges was created. It described different dimensions of events (event types) and which dimension is feasible for integration. At that time, the process model got specifically annotated with so-called process monitoring points that directly relate to corresponding event types or sets of event types [2]. Extending this first solution, [14] shows how to include information of and about processed objects like transport plans in this framework. Up to this point, the connection is mainly done manually, e.g. manual specification of event queries denoting information of interest for the user and manual specification of event sources and their integration to retrieve event information. Supporting the user by reducing the work load and avoiding inconsistencies, some automation is required. In this respect, [8] developed means to automatically identify event sources that are of use for a specific process model while [7] describes an algorithm to automatically generate event queries based on process model annotations (process monitoring points mentioned above) to monitor the business process. Finally, combining the knowledge collected on integrating business process management and complex event processing, [5] introduces a metamodel extension to BPMN, the industry standard for activity-based process modeling.

The second stream focused on engineering questions and aimed at building a system that allows to process event for business processes in general and logistics processes specifically. The first prototype is described in [4]. Introducing further knowledge and integrating into the overall architecture of the GET platform and the other components, the prototype got extended and refactored. The final results are described in [10] putting event processing in the larger GET context, [11] discussing the event processing component in a demonstrative fashion, and [12] highlighting the development process and the engineering aspects. As result the UNICORN platform was developed as basis for event processing in the business process management context. HPI is currently in the process of putting it under an open source license. Further information to UNICORN as well as additional extensions for logistics can be found at http://bpt.hpi.uni-potsdam.de/UNICORN. After developing the basic foundation of the integration and basing an implementation for event processing on top, both results (in the final state as well as in some previous state) were used for process monitoring and application on real-world data. A major effort has been put to create automated routines capable of examining real-world data sources and extract valuable integrated information out of them. Data sources spans over public websites monitoring the positions of ships, aircrafts and road traffic, and internal event logs and documents collected by project partners. The enriched information gathered has been made available to the whole consortium, also to conduct transport performance analyses, and to produce runtime simulation data for the GET Service platform prototype testing and showcase. Results of the performance analysis have been published in [17] in the context of open-sea transportation, where studies on the effect of weather conditions on vessels speed and delays are reported. The studies on the effect of adverse conditions on flights timeliness have been outlined in [18]. [13] shows a collection of six applications including location-based monitoring, delay propagation, and monitoring of multiple transportations at the same time. [3] shows the application to batch processing, where multiple containers are transported on a single train or ship such that the vehicle is monitored and the results are pushed forward to the single containers, where they may be used for different calculations providing reasoning on container level instead of vehicle level. In [6], it is shown how semantic features can be enabled for event processing. This is done on the example of correlating occurring events to the route of a specific truck; an event is only relevant if its area of influence is close to the route. Spanning further modes of transportation, [1] utilizes flight data for process monitoring. Actual aircraft movements were analyzed and based of deviations from the planned route, re-routings are identified to earlier inform logistics service providers on changes in the pick-up locations of airfreight. Compared to a notice after landing as it is common at the moment, logistics service providers can earlier re-arrange their plans accordingly. In the same paper [1] a general framework for a run-time predictive mechanism has been outlined, which is meant to automatically detect the conditions that would most likely lead to the disruption of a task in the context of a transportation process. It mainly bases upon the adoption of learning systems that act as automated classifiers on the available data provided by the means of transportation. After an initial training phase on the analysis of previous data, such classifiers are used at run-time, to check whether the monitored transport is evolving towards potentially dangerous conditions. [19] describes the application of such framework on real-time flight data.

In addition to project internal research, two public workshops have been organized to foster discussions between project members and both the research community and practice. These workshops focused on event modeling and their processing [15] as well as the consideration of physical objects and their events into business process management [16].

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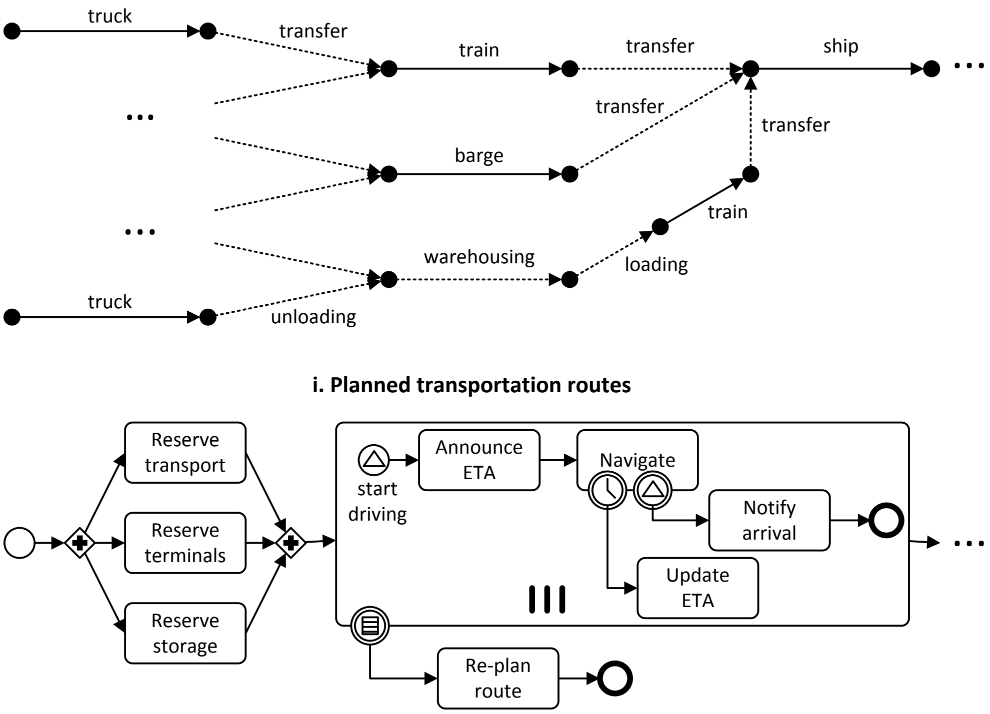
3.9 Work Package 7: Service orchestration and reconfiguration

The goal of Work Package 7 was to develop support for monitoring and executing a detailed transportation plan, also called a 'transportation process'. In particular it also supports the automated adaptation of transportation process when the corresponding transportation plan changes.

Figure 4 illustrates the relation between a transportation plan and a transportation process with an example. In the example, a planner of a transportation company must plan the bulk transportation of several electronics components on behalf of one of the company's clients, from different locations in Europe to the Far East. The planner enters the pick-up locations of the components into the system, as well as the times at which the components are estimated to be available for pick-up, the time at which the components should be in the factory in the Far East and several other criteria for planning, such as the desire to minimize CO_2 emission. The planner does this through the graphical user interface (GUI) that is provided by the transportation planning service. The transportation planning service computes an optimal route, which may look like the one shown in Figure 4.i. The planner is informed of this option through the GUI. Alternatively, the planner may be provided with multiple alternatives from which he can select one, or the planner can manually adapt the planned route via the graphical user interface. After the planner selects a route, a service composition is created that will control the route. This composition is created based on the planned route and individual control services that are associated with the different segments of the route. This composition may look like the one shown in Figure 4.ii.



i. Planned transportation routes

ii. Transportation control

Figure 4. Example planning and control output

The first goal of the work package was to select an orchestration service that facilitates monitoring of logistics tasks, for use in the GET Service platform. A systematic review was used to search for the available execution engines in practice, which was reported in Deliverable D7.1 [6]. The primary outcome of our search returned 36 systems that have execution engines. We reviewed those candidates in more detail and selected the Activiti BPM Platform as the engine for further development. While other engines such as the Camunda BPM Platform are also suitable, we preferred the Activiti BPM Platform, because their development team was interested in further collaboration. This collaboration has led to some knowledge exchange between the GET Service consortium and the Activiti development team. A far more detailed survey was done specifically for orchestration services and mechanisms that allow for dynamic changes to transportation processes [8].

The second goal of the work package was to adapt the selected orchestration engine for use in the logistics domain. This effort has led to a strong collaboration between the other work packages that developed components. The interaction between these work packages is technologically complex and constituted a contribution of the GET Service project, of which several aspects were described in a number of scientific papers [1,2,3].

One of the explicit aims of the GET Service platform is to cater for unforeseen circumstances that may change the transportation plan, such as unexpected traffic congestions, delays of onward transportation and changes in the plans of the customers. Consequently, when the transportation plan changes, the orchestration that controls the transportation plan also changes. The main challenge, which must be addressed, is to determine how this affects the running process instances: tasks that are being executed may have to be cancelled, tasks that have been executed may have to be rolled back, and the control structure must be reconfigured in such a way that it affects the tasks that have been executed and that are being executed as little as possible, while creating a new control structure that can replace the previous one successfully. A design for a technique that supports this was delivered in Deliverable 7.2 [4], where we presented an algorithm that facilitates the change in the detailed transportation plan, while the abstract-view of the plan remains the same before and after the change. The details and formal specifications of this technique have been elaborated in [5]. One especially part of the algorithm was addressed and published separately [9]. This part concerned the reconstruction of collaboration orchestrations from the event logs of multiple transportation partners. The implementation of the algorithms that were presented in these documents and implemented as part of the orchestration engine that was selected for the GET Service project, were presented in Deliverable D7.3 [7].

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3.10 Work Package 8: Business model

In Work Package 8 of the GET Service project, the objective was the dissemination of the project utilizing various means of communication and targeting varying external audiences. The tasks that were performed in the work package were website creation (Task T8.1), dissemination (Task T8.2) and exploitation (Task T8.3).

A web-site was created for the project (Deliverable D8.1) and made available to the general public[1].

The exploitation task led to some concrete exploitation results as outlined in the impact of the project in Chapter 4 and an plan for future exploitation of the GET Service platform as a whole, which was described in Deliverable D8.3. An important part of the exploitation plan is the development of a business model for the GET Service platform. The business model must ensure profitability of the platform itself, (route planning) services that are built on top of the platform and information provisioning services. In the Description of Work it was stated that the exploitation of GET Service first and foremost focuses on the exploitation of the platform itself and to a lesser

[1] http://is.ieis.tue.nl/research/getservice

extent to exploiting other results of the project, including the CO_2 measurement instrument, the reconfigurable orchestration engine and the transportation domain specific service development support.

Deliverable D8.3 presents an approach for creating business models that can be used by all actors involved in the supply chain. These business models help the market companies in establishing exploitation models that are better suited to the cooperative environment that GET aims to achieve, while preserving their own vital interests. The exploitation model covers aspects such as market and IT characteristics, the network-centric character of logistics, existing positions and roles, and the demand for trust and the wish for more flexibility in transport options.

The first result of this deliverable was the creation of an exploitation model for the GET Service project and its project partners, combined with examples on how to create network-centric strategies and business models, thereby visualising the value-in-use of the provided solution.

For this, the BASE/X framework, developed by the TU/Eindhoven, was used as foundation. Based upon this framework examples of strategies and business models have been developed for the GET Service project and several of its project partners. These models are clearly linked to the role models and architecture as delivered in Work Package 2 of the GET Service project. These examples provide valuable insights into how organizations, clients and providers of transport, IT systems, and community systems can cooperate and establish new business services that are aimed at a flexible, dynamic and green transportation sector. The business models provided in this deliverable can be further quantified at a later stage. The financial ‘numbers game’ is not included in this exploitation model.
The design of the distributed GET architecture combined with the GET exploitation model is generic, and can be fitted to the entire European transportation domain. It allows all actors involved selecting their trusted partners; their business services can be adapted to different geographical areas and transport domains, while reusing the same shared reference architecture and exploitation model foundation. As a second result of this deliverable, this approach was also recommended for the market adoption and exploitation model of European-wide Service Platform.

In the second version of this deliverable an overview of the exploitation plan of each industrial GET Service project partner is provided, for exploiting parts of the intellectual property, tools and algorithms that are being developed as part of the project.

4 Potential Impact

4.1 Strategic impact

One of the major challenges that Europe faces in the 21st century is the ever increasing demand for transport capacity. While continuously meeting transportation demand is a challenge in itself, at the same time, the strain that an increased transportation demand put on the transportation the environment and the productivity of European transportation companies and society in general has to be considered.

Since no significant decrease of transport demand is expected, and infrastructure improvements are not a sustainable solution for reducing the strains on the infrastructure, the environment and the society, other, innovative ideas are needed that focus on the effectiveness of the transport process itself. To establish effective, efficient and therefore green transport, all actors involved in the supply chains have to collaborate. An integral view on planning, alternative intermodal options and actual operations is needed, combined with real-time events, both internal and external. All these improvements require a higher degree of information-sharing capabilities.

The GET Service project has shown the potential of using information-sharing capabilities to efficiently use the existing transportation infrastructure more efficiently.

4.2 Contribution towards impacts in FP7 work programme

The expected impacts listed in the work programme for objective ICT-2011.6.7 are:

- Decarbonisation of transport. Significant improvements in energy efficiency and environmental friendliness of transport and mobility in Europe.
- Improving the competitiveness of the European transport industry as a whole, and enabling them to continue to address global markets successfully. World leadership of Europe's automotive industry in the area of Cooperative Systems.
- Opening new markets for mobility, safety, energy efficiency and comfort services in Europe. Ensuring market leadership by Europe's industry in green products and services.

The GET Service platform has demonstrated how CO_2 emission of transportation can be reduced by providing information sharing services for transportation and exploiting that information to plan more efficiently. By doing so, CO_2 emission can be reduced by:

- sharing information on the truck that is closest to the pick-up point, thus reducing the number of empty miles that are driven and the associated CO_2 emission;
- providing and improving multi-modal transportation planning, thus improving the modal split and using more CO_2 efficient transportation resources;
- creating multi-modal plans that are more robust to unexpected events, such as missing a connection, thus convincing transportation planners that multi-modal plans are a serious alternative to pure trucking routes; and
- by providing more accurate transportation plans and associated CO_2 calculations, thus allowing transportation planners to select these more efficient plans.

The GET Service platform has an impact on European competitiveness, by assisting with making transportation plans more efficient, also because CO_2 emission is directly associated to diesel consumption, which equals transportation cost. Since the profit margins in this sector are very small, improvements in efficiency have a strong impact on each individual company and on the competitiveness of the European transport industry as outlined below. In addition to the points mentioned above, the GET Service platform assists with making more efficient transportation plans by:

- facilitating quick communication between stakeholders in transportation, allowing them to respond quickly to unexpected events;
- facilitating quick re-planning of transportation as unexpected events occur; and
- providing transportation planners with a single view on all information that they need for a particular transportation order, thus enabling them to do their work more efficiently.

4.3 Impact on European Scientific Community

The GET Service project strengthened the research in three particular research areas. In addition to that, an important contribution to the European Scientific Community was the multidisciplinarity of the work, which has led to an increased mutual understanding of the ICT and logistics domains and follow-up research projects. The research has also led to data collections that can be used for research and education. These three elements will be discussed below in detail.

Many transport and route planning tools are available in the industry, but very often they are based on deterministic data and consideration of real-time and stochastic data is only limited. However, the world in which transports are conducted does not fit into a deterministic and static straitjacket. The planning algorithms in the GET service platform further scientific research by contributing to stochastic planning. More specifically, the planning functionalities in the GET service platform helps the following components: (i) facilitate offline planning of transport based on the historical information; (ii) facilitate re-planning of transport based on the real-time information. By providing these functionality, the GET service platform aims to reduce the number of empty miles that is driven, improve the modal split, and reduce transport times and slack, as well as response times to unexpected events during transport.

The consortium also has a strong reputation in the domain of business process management research. The research in this domain was strengthened, by contributions to existing research streams on process model adaptation and process model design, but also by opening up entirely new research streams. In particular, a research stream on event aggregation and monitoring in business process management systems. For this research stream, business process management, data mining, machine learning, and complex event processing, have been used together to yield new results in the intersection of the respective areas. Research achievements have indeed found international recognition, as evidenced by the numerous publications in international journals and conference proceedings in the field of business process management and information systems.

In the context of GET Service project, an unprecedented real-world data analysis has been conducted, aimed at discovering the improvement opportunities of a multi-modal Europe-wide transportation. Such analysis has been rooted into the detailed inspection of both historical and real-time information. Data have been gathered from open portals (such as the maritime information offered by AIS portals, on-line flight monitoring services, public governmental updates on the level of water in rivers, weather reports, etc.), as well as from private data logs provided by industrial partners (e.g., the trucks-based shipment data from the fleet of Jan de Rijk). The availability of such information has led to a detailed inspection of the situation as-is in the first place, but also provided a new set of ad-hoc software tools for the runtime monitoring and off-line analysis of such information.

The partners of the GET Service project stem from different research domains. In particular the operations research and logistics domain and the information systems domain. In the context of the GET Service project, they increased their collaborative efforts toward information systems for logistics. Of particular interest is the software architecture that was the result of this collaboration and of which several aspects have been published at various international scientific forums.

Finally, as part of the GET Service project, a large collection of data has been created, stemming from various sources. This data includes, data from AIS transponders about GPS locations of ships, data about GPS locations of airplanes, weather reports, traffic information, water levels of rivers, private status information about Jan de Rijk trucks, and private status information about sea ships at Rotterdam harbour. The public information can be used to evaluate and compare alternative algorithms to the ones developed in the GET Service project and can be provided to third parties. The private information can also be used for those purposes, but requires third parties to make a request to the data owner and to sign a non-disclosure agreement. This private data has already been used by third parties, both for teaching and for research purposes.

4.4 Impact on European Competitiveness

The GET Service platform aims to make European transportation more efficient, using optimized planning algorithms and information sharing. Since the profit margins in this sector are very small, improvements in efficiency have a strong impact on the competitiveness of the transport industry as a whole.

The efficiency of the European transport industry has an impact on Europe's attractiveness for import, export and production, because the costs of import, export and production are impacted by the costs of transportation. Indirectly, the efficiency of the European transport industry has an impact on the European economy as a whole, because traffic road transportation is an important cause of traffic congestion, such that reducing empty miles and improving the modal split, which are explicit goals of the GET Service project, should also reduce (a cause of) traffic congestion.

4.5 Steps to bring about impacts

In addition, HPI developed an event model/taxonomy and a reference architecture for an information aggregation engine that can be put forward for standardization.
In the economic area, the conceptual results of HPI's project contributions are planned to be used for commercial exploitation purposes. Employees of HPI that have been contributing to the GET Service project are preparing the formation of a company named Synfioo that offers information aggregation services to the logistics domain. These services are expected to be publicly offered to the European market in the second half of year 2016. They are offered to logistics service providers directly as well as to software providers for logistics purposes, i.e. transport management system providers. The services will help to operate more robust and energy efficient supply chains and will increase the attractiveness of multi-modal transportation by facilitating the monitoring of complex transportation chains.

Impact can be identified within the field of logistics software solutions. With the GET project activities future oriented solutions can be further developed and offered to the logistic market. Leading industry solutions for a more efficient and environmental friendly transport sector have been further developed and tested in real world surroundings.
These solutions support the planner/ dispatcher, the driver and end user in having more accurate information for re-planning, reaction on events and finding appropriate event handling measures at hand.
Based on practical requirements from the logistics sector services have been developed which can be of great value for time sensitive and high value international deliveries.
For the IT-sector it can be stated that the outcomes of the GET Service project form the basis for agile developments of dynamic services which can interact flexible with different software systems in a distributed architecture. Easy to handle web service interfaces ensure the fast interaction between the business partners respectively different database technologies.
More concrete the planning solutions enhance the planning ability for transport chains over different transport modes. Therefore the competitiveness of European software solution providers is being improved.
Another future oriented impact can be determined in terms of integration/ interaction between industry or production oriented systems and logistic planning systems. With the developments the basis is given for closer collaboration between transportation and logistics management systems and facility/ production demand related management systems, which will become more and more relevant in future (industry 4.0).

Existing Community System providers as Portbase play a vital role in establishing connectivity between all actors in different types of supply chain. These providers have a profound knowledge of supply chains, and also of the dependencies between these chains. Because of this aspect, these parties are able to create the much needed integral view on planning and operations. This capability is further increased by their actual coverage of already connected actors to their centralized system (one-stop-shops)

Moreover, Community System providers establish trust, which is essential for the sharing of information across different supply chains. Because of their neutral role, they will do not take planning decisions or corrective actions in the operations. Information that is exchanged through these Community Systems is safeguarded, the information is only shared after the explicit approval of the owner of the information. In most cases, the business model of these operators is cost-based (not- profit).

The components Portbase provided to the GET Service project are the information store, the service registry, the community passport and the log manager. These components are situated in the core platform, which functions as an integration layer, and are necessary for the coupling of all other components in the GET environment. The components provide high-quality (reference) data, authentication and thereby trust, and logging of actions performed by connected users and systems (audit trail). Through these core services, customers of Portbase (i.e. transportation companies, technology providers and other stakeholders in the logistics value chain) will be able to communicate with each other in the spirit of the GET Service platform.

The Port Community System of Portbase shields more than 40 different services, which provide actors in port logistics the capabilities to share data. The strategic plan for the upcoming years is that Portbase aims at connecting more chain-wide real-time data and events to its infrastructure. In order to do so, Portbase needs to take up a different role. The GET Service project, and more specific the business modelling, has supported Portbase in identifying more explicitly its role as an integrator, next to the role of service provider. Integration services are needed in order to establish connectivity with other system providers and have them being able to develop own services connected to the infrastructure of Portbase. Doing so, the needed integral view on port logistics on administrative level will be broadened by combining it with real-time operational data.

The impact Portbase will create by providing the core platform and these integration services is that the competiveness of the European transport industry and the IT system providers in this domain will increase. Flexibility, connectivity, new business models and more effective use of assets are the main aspects. The impact per customer segment is defined as follows:

- IT Service providers - is an organisation that provides IT services in the transport and logistics domain, thereby enabling, amongst others, information exchange. The concrete value in use is for the IT Service provider to be able to operate as trusted partner with a broad and flexible connectivity, offering a full control over data usage and ownership and quality of that data;
- Single transport executor - is a single driver with one truck handling one leg (shipment from A to B). The concrete value-in-use the core platform operator provides is that the transport executor has a trusted connectivity for sharing capacity and receiving orders from a LSP;
- Transport service provider - is an asset based transport company with multiple drivers and trucks handling multiple legs and shipments. The concrete value-in-use the core platform operator provides is that the TSP has a trusted connectivity for sharing capacity (multi-legged transport) and receiving orders from a LSP;
- Logistics service provider - is a non-asset based company which coordinates logistics activities. The LSP is responsible for coordinating the transportation and thus for knowing of delays (transportation and handling at DC’s and terminals). It cooperates with TSP’s based on the demand from LSC’s. The concrete value-in-use the core platform operator provides is that the LSP has a trusted connectivity for managing synchro-modal and real-time transport;
- Logistics service client - is an entity which has a certain freight demand and is in need of transport capacity. The concrete value-in-use the core platform operator provides is that the client has a trusted connectivity for discovering the best partners for transportation and can establish a real-time outsourced transport management, thereby being able to meet requirements for green transportation;

By enabling all actors to exchange data via a trusted connection, the needed integral view on logistics can be extended, implying that supply chains will be connected improving the needed flexibility, pro-active steering and monitoring.

The approach provided in this project for business modelling in the transport and logistics domain, based on the distributed business and architecture, is highly useable for the implementation of the European-wide Service platform.

By having a distributed network of core platforms (Community Systems), via the members of IPCSA and other neutral Community Systems, a circle of trust is present. Large business communities are already connected to and exchanging information via these systems, as the operators of it also provide services. Most relevant for the establishment of the stable part of the architecture, as above-mentioned in the description of the three layers, and business model however, is the provision of the core platform components.

Every business actor, both profit and non-profit, can connect, via its own client platform, to these core platforms. The Community Systems need to adopt the interfaces as delivered in the GET Service project. By doing so, they are able to interconnect, and allow the business actors to be authenticated throughout the entire European transport and logistics domain. This will lead to a very high degree of agility in choosing own trusted partners in the supply chain and hence to a flexible support for Pan-European synchro-modal logistics. When designing the business model for the EWSP, the Community System providers should be involved as partners.

Next to agility for choosing the partners in the supply chain, it also generates agility in choosing the IT and Technology providers of the platforms and devices. All business organizations are able to use own preferred systems. The business services can be adapted to different geographical areas and transport domains. Of importance is that the interfaces as designed in this project are implemented in order to use the same shared reference architecture. Next of importance is that the services of IT providers and their users are registered at least at one of the core platforms, to be able to authenticate and establish trusted connectivity.

4.6 Necessity of a European approach

Both the challenges of efficient transportation and CO_2 emission are inherently a European wide, or even a worldwide problem, because both transportation and CO_2 cross country borders. Therefore, these problems can only be tackled through a European or worldwide effort.

The GET Service platform indeed aims to provide an internationally accessible information sharing platform, that enables, for example, individual truck drivers from Poland to easily offer their services to a freight forwarder that happens to need transportation capacity at the port of Rotterdam.

The GET Service project has actively worked on realizing a pan European impact, by exploiting the contacts that the consortium has with organizations like the International Port Community Association (IPSCA) and the European Supply Chain Forum (ESCF).

4.7 Complementarities to other research

The GET Service project both builds on existing research and contributes to that research.

As a multidisciplinary research project that studied multiple research areas, the GET Service project did literature surveys in each of those areas. Of particular importance is Deliverable D5.1 that describes a survey of available transportation planning tools. As the GET Service Platform primarily delivers transportation planning and monitoring services, this deliverable can be seen as the state-of-the-art study on which the GET Service Platform builds. Other literature surveys were conducted in the areas of CO_2 calculators, complex event processing and orchestration engines.

Of particular interest are the collaborations that the GET Service project had with other research projects. The most notable collaborations were the following.

An important deliverable of the GET Service project was the architecture and interface description. This deliverable governed the integration of the individual components that were delivered during the GET Service project. When developing the architecture and interfaces, previous results from the E-Freight project were taken into account, in which a messaging standard was developed for message exchange in the logistics sector. A detailed description of how the E-Freight messaging standard was used, can be found in the deliverable that describes the architecture and interfaces.

The SIMPLI-CITY project also created an architecture in the domain of traffic management systems in cities. This domain is related to the logistics domain in which GET Service operates. However, there are also differences. While information systems in the logistics domain typically start from the IT systems of large logistics service providers, traffic management systems typically start from sensors and actuators in, for example, cars, roads and traffic lights. Nonetheless, the integration of logistics and traffic management systems can also help both types of systems to exploit the information that the other produces. Therefore, the GET Service project and the SIMPLI-CITY project, set out together to develop a reference architecture that combines both types of systems. This reference architecture is described in a separate public report.

The GET Service project took part in the ADVENTURE concertation workgroup. This workgroup had as a goal to facilitate quick adaptation of production and logistics processes to novel or changed ways of working. While most projects in the ADVENTURE concertation workgroup were concerned with production processes, GET Service contributed from the perspective of the logistics domain. During a number of meetings knowledge was exchanged that contributed to the designs of the task monitoring system that was developed during the GET Service project.

Bilateral discussions between project partners of several other projects, led to similar inspiration for various components of the GET Service project. These discussions included discussions with the MOBINET project on the service repository, the PEACOX project on the user interface of the mobile device, the REDUCTION project on CO2 emission calculation, and the SUPERHUB project on a service marketplace.

Contributions to research in both the area of operations research and logistics and the area of information systems are described in Section 4.3.

4.8 Assumptions and external factors determining impact

Selected results of the GET Service project are exploited by GET Service partners and a spin-off company of the GET Service project. Realizing the ideal of a ‘European Wide Service Platform’, through which all logistics parties in Europe interact to fully optimize their operations, depends on some assumptions and external factors.

First, realizing a ‘European Wide Service Platform’ that enables communication between logistics parties, requires a driving force that both facilitates that communication technologically and ‘sells’ that technology. Portbase can play the role of such a driving force, because it already plays that role for the Dutch harbours. More importantly, as a member of the International Port Community Systems Association (IPSCA), it can also influence other system providers and develop interfaces with their systems, to realize a European (or even International) service platform.

Legislation and standardization is an important factor here. Standardization has also been addressed in the E-Freight platform, while different forms of legislation can help convince logistics partners to connect to a ‘European Wide Service Platform’. Legislative efforts are already underway in the form of the European Single Window for Logistics.

A more detailed discussion of role of the GET Service project in this larger context, is discussed in project deliverables, both from a technological perspective and from a dissemination and exploitation perspective.

4.9 Wider societal implications of the work

By facilitating information sharing between logistics service providers and providing monitoring and planning services on top of those facilities, the GET Service project aims to make transportation more efficient.

Efficient transportation has direct impact on logistics service providers. As a result of information sharing, they can select transportation resources that are closer to the pick-up point, plan more cost-effective and environmentally friendly transportation resources, and have a better overview of the planned transportation orders. This helps them to reduce diesel consumption and, therewith, CO_2 emission and cost. It also helps them to reduce transportation time by planning more efficiently, improve customer satisfaction by creating transportation plans that are less likely to change and keeping customers informed about the status of their order at all times. Finally, it makes the jobs of transportation planners easier by providing them with a better overview of what is happening with their transportation orders, thus increasing job satisfaction and reducing stress.

Efficient transportation affects the European community as a whole as well. First, because transportation costs are a part of product costs. Therefore, more efficient transportation reduces product costs and makes Europe more attractive as an import and an export partner. Second, because shifting transportation to more environmentally friendly means and by reducing the number of empty miles driven, the number of truck kilometres as a whole decreases. This can have an impact on traffic congestion, which is – to some extent – caused by trucks. Third, because reduced CO_2 emission is in the interest of the European and international community as a whole.

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Promotional Animation
https://youtu.be/XNIPWquZvsY

Public deliverables
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6 Use and dissemination of foreground

6.1 Journal publications

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Anne Baumgraß, Mirela Botezatu, Claudio Di Ciccio, Remco Dijkman, Paul Grefen, Marcin Hewelt, Jan Mendling, Andreas Meyer, Shaya Pourmirza, Hagen Voelzer: “Towards a Methodology for the Engineering of Event-driven Process Applications”, International Workshop on Process Engineering (IWPE’15), (Accepted)

6.3 Book chapters, magazines, and other publications

Paul Grefen; IT Subway Maze; Supply Chain Magazine; Vol. 6, No. 2014; Supply Chain Media; 2014; pp. 31-31.

6.4 GET Service related publications

F. van Otterdijk; Met de app in de hand over de Brennerpas; Cursor; Vol. 55, No. 6; 2012; pp. 8.

D. Redeker; Grip op Horizon 2020; I/O Magazine; Vol. 10, No. 3; 2013; pp. 9-10.

6.5 Education

Bachelor project on designing and implementing an event capturing platform, organized and lectured by HPI, Sept 2012 – July 2013, 5 Bachelor students.

Seminar with master students on “Event Processing Technologies” organized by HPI and lectured by WU (J. Mendling), April 10th, 2013 till July 26th, 2013, 4 Master students.

Student exchange between University of Ljubljana and WU Vienna on "IT-based Logistic Processes" on 11-13 April (Vienna) and 19-21 April (Ljubljana). 40 Master students.

1CM55- Strategic and Operational DecisionMaking in Transportation and Logistics (MSc), Eindhoven University of Technology. Lecturers: Prof Tom Van Woensel, Dr Emrah Demir

P.W.P.J. Grefen, R.M. Dijkman, S. Pourmirza, M. van der Velde, E. Demir, T. Van Woensel. ESTIEM Business Intelligence Logistics Days, 12-16 May 2014.

R.M. Dijkman. Business Modeling. 31 March 2014.

Baumgrass. Event Processing. HPI master lecture. Summer semester 2014.

J. Mendling. Business Process Implementation. Master lecture at WU. Winter semester, 2013.

Paul Grefen. Hybrid Control Models + New Business (Models) + Complex Decision Making + Advanced Technology = Innovating Towards Zero ?; Masterclass for Industria International Research Project 2015, Eindhoven University of Technology, November 2014.

Paul Grefen. Innovating Towards Zero = Controlling + Deciding (?); Masterclass for Industria International Research Project 2015 sponsor companies; Eindhoven, May 2015.

19 January 2015 Martin Hrusovsky presented the current state of GET offline planning algorithm in his talk "Transport planning under the consideration of relevant supply chain risks" within the research seminar for PhD students at WU Vienna

Masterseminar: Event Processing Systems (Winter 2014/2015); HPI, Prof. Dr. Mathias Weske, Dr. Anne Baumgrass

Master lecture: Event Processing (Summer 2015); HPI, Prof. Dr. Mathias Weske, Dr. Anne Baumgrass

Master project: Event processing for Smart Logistics (Summer 2015); HPI, Prof. Dr. Mathias Weske, Dr. Anne Baumgrass, Andreas Meyer

Guest lecture by PTV at WU Vienna – 16.03.15; Innovative solutions for transportation, modelling and simulation; applications and future developments by PTV

J. Mendling. Business Process Implementation. Master lecture at WU Vienna. Winter semester, 2014-15.

8 June 2015 – Martin Hrusovsky presented the online planning approach as well as the improvements in the offline planning algorithm within the research seminar for PhD students at WU Vienna

Sepember-October 2015. Remco Dijkman used the GET Service project as a case for the course Business Information Systems Management.

6.6 Invited talks

2 December 2013, Claudio Di Ciccio (WU), at Eindhoven University of Technology, The Netherlands: "Automated Dectection of Flight Diversions"

5 February 2014, Anne Baumgrass (HPI), at Vienna University of Economics and Business: "Event-Driven Business Process Monitoring"

19 March 2014, Jan Mendling (WU), at eMov-Workshop at Modellierung 2014, Austria. "Challenges for Processing Events in Logistics Processes"

25 March 2014, Jan Mendling (WU), at Faculty of Economics, University of Ljubljana, Slovenia: "Challenges for Processing Events in Logistics Processes"

4 December 2014. Paul Grefen. Towards Real-Time Synchro-Modal Logistics. Logistiek Platform ’s-Hertogenbosch.

16 April, 2015, Anne Baumgrass. Geschäftsprozessmanagement für smarte Logistik – Wie Prozesse und Ereignisverarbeitung helfen CO2 zu sparen. Tag der Logistik, TU Berlin

6.7 Dissemination Activities

Date	Name & Title	Conference name or equivalent& Location	Type	Partner abbrev.
1 October 2012	Remco Dijkman, “The GET Service Project”	European Supply Chain Forum, Eindhoven	Presentation	TU/e, PB
8 November 2012	Remco Dijkman, “A Service Platform for Green European Transportation”	European Conference for ICT in Logistics, Gothenburg, Sweden	Presentation	TU/e
16 - 17 January 2013	Remco Dijkman, “The GET Service Project”	Technical University of Vienna, Austria	Presentation	TU/e
25 February – 1 March 2013	Werner Jammernegg, “Economic and environmental sustainability of freight transport in Europe: The EU-FP7 projects LOGMAN and GET Service”	Kobe University, Japan	Seminar	WU
27 March 2013	Jan Mendling, A BPM Perspective on Green Logistics: The GET Service Project²	University of Ljubljana, Slovenia	Presentation	WU
3 April 2013	Remco Dijkman: GET Service (Pitch)	Eindhoven University of Technology – Smart Mobility Cluster	Presentation	TU/e
17 April 2013	Remco Dijkman: GET Service	Eindhoven University of Technology - Alumni	Presentation	TU/e
26 August 2013	Cristina Cabanillas, Anne Baumgrass, Jan Mendling, Patricia Rogetzer, Bruno Bellovoda, “Towards the Enhancement of Business Process Monitoring for Complex Logistics Chains”	PALS 2013 Workshop at BPM Conference, Beijing, China	Presentation	HPI & WU
16	Jan Mendling, “Challenges	DERI (Digital	Presentation	WU

Date	Name & Title	Conference name or equivalent& Location	Type	Partner abbrev.
September 2013	for Business Process Management in Logistics”	Enterprise Research Institute), Galway, Ireland		
7-8 October 2013	Sustainable Supply Chains	Systemic Sustainability Management Complexity, Resilience and System Thinking Autumn meeting of the Section Sustainability Management of the German Academic Association for Business Research WU Vienna	Poster and presentation	WU
6-8 November 2013	Mr. Andreas Raptopoulos	ICT 2013, Vilnius, Lithuania	Conference	EXUS
2 December, 2013	Backmann, Baumgrass, Herzberg, Mayer, Weske: Model-driven Event Query Generation for Business Process Monitoring	ICSOC 2013, Berlin, Germany	Presentation of a workshop paper	HPI
2 December, 2013	Metzke, Rogge-Solti, Baumgrass, Mendling, Weske: Enabling Semantic Complex Event Processing in the Domain of Logistics	ICSOC 2013, Berlin, Germany	Presentation of a workshop paper	HPI
2 December, 2013	Herzberg, Khovalko, Baumgrass, Weske: Towards Automating the Detection of Event Sources	ICSOC 2013, Berlin, Germany	Presentation of a workshop paper	HPI
10 December 2013	Demir, E., Van Woensel T.: Mathematical Modeling of CO2e emissions in one-to-one pickup and delivery problems	IEEM 2013	Conference proceeding, presentation	TU/e -OPAC
16 January 2014	Everything connected	Minor Airport / Seaport, Amsterdam	Lecture	PB
19 March,	1st Workshop on Event	Modellierung 2014	Organisation	HPI

Date	Name & Title	Conference name or equivalent& Location	Type	Partner abbrev.
2014	Modeling and Processing in Business Process Management (http://emov-workshop.org)		of a workshop	
19-20 March 2014	Mr. Andreas Raptopoulos, Dr. Dimitris Vassiliadis	EDF2014, Athens, Greece	Meeting	EXUS
25 March 2014	Marten van der Velde	Lecture on port logistics and information sharing for information science students	Lecture	PB
30 April 2014	P.W.P.J. Grefen	FP7 ICT Call 7&8 Concertation Workshop		
13-14 May 2014	Albert-Charrel Ernst	Koln, Fit for Profit conference	Presentation	JDR
15 May 2014	Marten van der Velde (Portbase), Remco Dijkman (Tu/Eindhoven)	Lecture on port logistics and information sharing for international BI students	Lecture	PB
22 June 2014	Ghilas, V., Demir, E. and Van Woensel, T.: Adaptive large neighborhood search algorithm for the PDP-FSL	VEROLOG 2014	Presentation	TU/e -OPAC
13 July 2014	Demir, E, Van Woensel, T.: Vehicle Assignment Problem	IFORS2014, Barcelona, Spain	Conference presentation	TU/e-OPAC
14 July 2014	Arikan, Burgholzer, Demir, Jammernegg, Hrusovsky, van Woensel: A multi-objective modelling approach for intermodal transport planning with environmental aspects	IFORS2014, Barcelona, Spain	Conference presentation	WU+TU/e-OPAC
4 September 2014	Shaya Pourmirza	EDOC 2014, Ulm	Conference presentation	TU/e
7-11 September 2014	Hagen Voelzer, Mirela Botezatu	BPM 2014, Eindhoven, NL	Conference	IBM
8-11 September 2014	Cabanillas, Di Ciccio, Mendling, Baumgrass: Predictive Task Monitoring for Business Processes	BPM 2014, Eindhoven, NL	Conference	WU-IS
25-26	Baumgrass, Herzberg,	EMISA 2014,	Workshop	HPI

Date	Name & Title	Conference name or equivalent& Location	Type	Partner abbrev.
September 2014	Meyer, Weske: BPMN Extension for Business Process Monitoring	Luxembourg	presentation	
5 October 2014	Remco Dijkman, A Software Architecture for a Transportation Control Tower	EC-ITL, Dortmund	Conference	TU/e
13 October 2014	IPCSA meeting	IPCSA, Le Havre	Presentation	PB
10 November 2014	Anne Baumgrass	Konferenz „Zukunft internationaler Logistiknetze“, TU Berlin	Participation	HPI
17-18 November 2014	Anne Baumgrass: Event Processing for Risk Management	RISK Information Management, Risk Models and Applications; Berlin; http://rimma2014.net	Workshop	HPI
13 February 2015	Remco Dijkman	Concertation meeting	Presentation	TU/e
26 March 2015	Shaya Pourmirza, Dynamic reconfiguration of business processes at run-time	Smart Mobility Meeting, Eindhoven	Research meetup	TU/e
2 April 2015	M. van der Velde, Portbase: business model and integration services	Software suppliers meeting, Dordrecht	Presentation	PB
16 April 2015	Anne Baumgrass	Tag der Logistik, TU Berlin	Invited talk	HPI
16 April 2015	Remco Dijkman	‘Data Value’ project meeting	Presentation	TU/e
17 April 2015	IPCSA meeting	IPCSA workshop, Rotterdam	Workshop	PB
9 – 12 May 2015	Anne Baumgrass, Marian Pufahl	Transport Logistics congress	Participation	HPI
2 June 2015	Marten van der Velde: information sharing in logistics	Guest lecture minor airport / seaport	Presentation	PB
8 June 2015	Remco Dijkman Claudio Di Ciccio Anne Baumgrass	CAiSE Conference, Stockholm	Workshop	TU/e, WU, HPI
8-10 June 2015	Wolfgang Burgholzer, WU-PM Werner Jammernegg, WU-PM	Verolog Conference	A meeting between WU-PM and TU/e OPAC	WU

Date	Name & Title	Conference name or equivalent& Location	Type	Partner abbrev.
	Martin Hrusovsky, WU-PM Emrah Demir, TU/e OPAC			
7 July 2015	Marian Pufahl	Physical Internet Conference, Paris	Invited talk; participation	HPI
14 July 2015	Hrusovsky, M., Burgholzer, W., Arikan, E., Jammernegg, W., Demir, E., Van Woensel, T.: A Multicommodity and Multimodal Service Network Design Problem with Uncertain Travel Times	EURO 2015, Glasgow	Conference	WU-PM
31 August 2015	Anne Baumgraß: Towards a Methodology for the Engineering of Event-driven Process Applications	IWPE Workshop at Business Process Management Conference	Workshop	HPI
2 September 2015	Anne Baumgraß: GET Controller and UNICORN	Demo Session at International Conference on Business Process Management (BPM)	Demo session	HPI
18 September 2015	Hrusovsky, M., Demir, E., Burgholzer, W., Arikan, E., Jammernegg, W., Van Woensel, T.: Offline and online intermodal transport planning using Service Network Design with Uncertain Travel Times	Logistikmanagement, Braunschweig	Conference	WU-PM
24 September 2015	Marian Pufahl	ITT-Event in Greven	Participation	HPI
1 October 2015	All	GET Service Final Event	Workshop	All

6.8 Software

Type of Software	Available via	License	Owner
Event Aggregation Middleware	https://bpt.hpi.uni-potsdam.de/UNICORN/	Open Source Licence, Free for any use	HPI
Prototypical Transportation Management	http://is.ieis.tue.nl/research/getservice	Free for any use	TU/e

System			
Planning Services	PTV xServer	Commercial	PTV
Communication Services	Portbase Port Community System	Commercial	Portbase

7 Societal Implications

Replies to the following questions will assist the Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

A General Information

Grant Agreement Number:	2013-318275
Title of Project:	GET Service
Name and Title of Coordinator:	Dr.ir. Remco M. Dijkman

B Ethics

1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***0 Yes*** ***X No***
2. Please indicate whether your project involved any of the following issues (tick box) :	***NO***
RESEARCH ON HUMANS	
• Did the project involve children?	
• Did the project involve patients?	
• Did the project involve persons not able to give consent?	
• Did the project involve adult healthy volunteers?	
• Did the project involve Human genetic material?	
• Did the project involve Human biological samples?	
• Did the project involve Human data collection?	
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	
• Did the project involve Human Foetal Tissue / Cells?	
• Did the project involve Human Embryonic Stem Cells (hESCs)?	
• Did the project on human Embryonic Stem Cells involve cells in culture?	
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	
• Did the project involve tracking the location or observation of people?	
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	
• Were those animals transgenic small laboratory animals?	
• Were those animals transgenic farm animals?	
• Were those animals cloned farm animals?	

• Were those animals non-human primates?	
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	
DUAL USE	
• Research having direct military use	0 Yes X No
• Research having the potential for terrorist abuse	

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator		2
Work package leaders	1	5
Experienced researchers (i.e. PhD holders)	3	14
PhD Students	1	3
Other		7

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	**6**
Of which, indicate the number of men:	5

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?

○ Yes
X No

6. Which of the following actions did you carry out and how effective were they?

		Not at all effective				Very effective
❑	Design and implement an equal opportunity policy	○	○	○	○	○
❑	Set targets to achieve a gender balance in the workforce	○	○	○	○	○
❑	Organise conferences and workshops on gender	○	○	○	○	○
❑	Actions to improve work-life balance	○	○	○	○	○

○ Other:

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ Yes- please specify

X No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

X Yes- please specify: Use of project material, data, results and ideas in coursework.

○ No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

X Yes- please specify: Flyer, YouTube animation, Public prototype

○ No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

○ Main discipline[2]: 1.1 Mathematics and Computer Sciences

○ Associated discipline[2]: 2.3 Other Engineering Sciences

○ Associated discipline[2]: 5.4 Other Social Sciences

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*

○ Yes
X No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

○ No
○ Yes- in determining what research should be performed
○ Yes - in implementing the research
○ Yes, in communicating /disseminating / using the results of the project

[2] Insert number from list below (Frascati Manual).

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	○ ○	Yes No

12. Did you engage with government / public bodies or policy makers (including international organisations)

- ○ No
- ○ Yes- in framing the research agenda
- ○ Yes - in implementing the research agenda
- ○ Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

- ○ Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
- ○ Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
- X No

13b If Yes, in which fields?

Agriculture Audiovisual and Media Budget Competition Consumers Culture Customs Development Economic and Monetary Affairs Education, Training, Youth Employment and Social Affairs		Energy Enlargement Enterprise Environment External Relations External Trade Fisheries and Maritime Affairs Food Safety Foreign and Security Policy Fraud Humanitarian aid		Human rights Information Society Institutional affairs Internal Market Justice, freedom and security Public Health Regional Policy Research and Innovation Space Taxation Transport	

13c If Yes, at which level?

- ○ Local / regional levels
- ○ National level
- ○ European level
- ○ International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	**12**
To how many of these is open access[3] provided?	**1**
How many of these are published in open access journals?	**1**
How many of these are published in open repositories?	**0**
To how many of these is open access not provided?	
Please check all applicable reasons for not providing open access:	
❑ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available X no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[4]: ……………	

15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*	**0**

16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	**0**
	Registered design	**0**
	Other	**0**

17. How many spin-off companies were created / are planned as a direct result of the project?	**0**
Indicate the approximate number of additional jobs in these companies:	**0**

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

❑ Increase in employment, or	❑ In small & medium-sized enterprises
❑ Safeguard employment, or	❑ In large companies
❑ Decrease in employment,	❑ None of the above / not relevant to the project
X Difficult to estimate / not possible to quantify	

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:*

[3] Open Access is defined as free of charge access for anyone via Internet.

[4] For instance: classification for security project.

Difficult to estimate / not possible to quantify	❑

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

○ Yes X No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes X No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

X	Press Release	X	Coverage in specialist press
○	Media briefing	X	Coverage in general (non-specialist) press
○	TV coverage / report	○	Coverage in national press
○	Radio coverage / report	○	Coverage in international press
X	Brochures /posters / flyers	X	Website for the general public / internet
X	DVD /Film /Multimedia	X	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

X	Language of the coordinator	X	English
❑	Other language(s)		

Question F-10: Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES
1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]
1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)
1.3 Chemical sciences (chemistry, other allied subjects)
1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)
1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY
2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)
2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]
2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES
3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)
3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)
3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES
4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)
4.2 Veterinary medicine

5. SOCIAL SCIENCES
5.1 Psychology
5.2 Economics
5.3 Educational sciences (education and training and other allied subjects)
5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES
6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)
6.2 Languages and literature (ancient and modern)
6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]

8 Final Report on the Distribution of Financial Contributions

To be completed within 30 days after receipt of the final payment of the European Commission's financial contribution.

Literature

European Environment Agency (2009). Greenhouse gas emission trends and projections in Europe. Nr. 9/2009.

J. Fuglestvedt, T. Berntsen, G. Myhre, K. Rypdal, and R. B. Skeie (2008). Climate forcing from the transport sectors. Proceedings of the National Academy of Sciences of the United States of America 105(2208), pp. 454-458.

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