TITAN

turnaround integration in trajectory and network

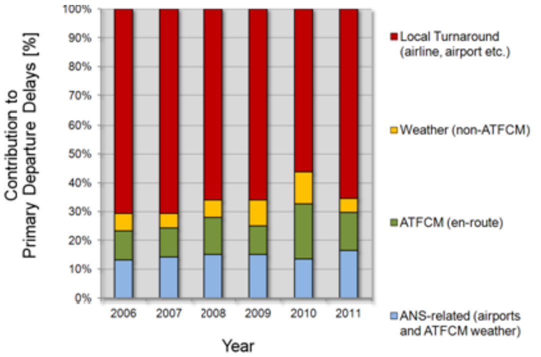
TABLE OF CONTENTS

TITAN: TURNAROUND INTEGRATION IN TRAJECTORY AND NETWORK

Different airport performance review studies identify the aircraft turnaround as the major driver of departure delays that affect the efficient airport and ATM network operation. To mitigate such inefficiencies reliable information sharing between all involved stakeholders is necessary. Analysing in depth the current environment and building on the A-CDM concept the TITAN project proposes an advanced concept of operations to identify improvement opportunities in the information flows between the various stakeholders as well as the potential influence of external processes and to integrate the aircraft turnaround process into the aircraft business trajectory and the ATM network. After its successful validation, the proposed concept was realised by developing a decision-support tool that was subject to a cost-benefit analysis. It defined a service-oriented architecture that enhances sharing of a more predictive common awareness of all relevant influences on the aircraft turnaround. Considerations on how to integrate the project output into the existing ATM system and manage the transition to a future TITAN environment were also made. The project output is summarized hereafter.

Background

Managing efficiently air transport operations is progressively becoming one of the most acute challenges in the transport sector. The difficulty of meeting such a challenge results from the fact that a constantly increasing demand for air transport has to be satisfied by a significantly constrained available airport and airspace capacity with significantly lower growth rate. Delays are the major consequence of this situation. As the Performance Review Commission (PRC) of Eurocontrol reported, turnaround-related delays remain the main driver of departure delays; for 2006-2011 their contribution to primary departure delays[1] fluctuated between 65%-70%. Such delays arise during the aircraft turnaround process which is defined as a sequence of sub-processes required for servicing/handling an aircraft from the moment it arrives at its stand/gate until the moment it leaves it.



In order to reduce turnaround delays several solutions are currently under development. Such solutions focus on ameliorating information sharing between all involved stakeholders so that reliable information is circulated to better coordinate their actions. A promising initiative in this direction is Eurocontrol's Airport Collaborative Decision Making (A-CDM) project. It is an operational concept built of elements aiming to achieve greater operational efficiency through more accurate target times supported by the definition of process milestones. By improving stakeholders' common situational awareness on airport and aircraft operations and implementing a balanced approach that strives for efficient capacity utilisation and delay minimisation, A-CDM can cost-effectively reduce departure delays and their knock-on impact and improve network performance. However, the A-CDM concept has difficulty convincing stakeholders to distribute freely their data and does not take turnaround-external processes such as passenger and baggage flows into account. This is where "Turnaround Integration in Trajectory and Network" (TITAN) project steps in.

The TITAN project

TITAN is a 7th Framework Programme (FP) research project co-funded by the European Commission (EC) and the project partners. The project directly addresses airport operations focusing on the aircraft turnaround process. It analysed it with a view to identifying improvement opportunities as well as the potential influence of the previously mentioned external processes. The validation of the concept and the decision-support tool proved that it can contribute to more predictable, flexible, efficient and cost-effective turnaround performance.

TITAN contributes to SESAR objective of enhancing and refining collaborative airport operations planning by building on a net-centric design principle, using trajectory-based operations (TBO) to integrate airports into the Air Traffic

[1] Primary delays constituted more than 50% of departure delays (53.3% in 2010 and 54.2% in 2011). Remaining delays are attributed to reactionary reasons (46.7% and 45.8% correspondingly).

Management (ATM) network, defining services that act on the analysed processes and making use of A-CDM and System Wide Information Management (SWIM) principles that provide common situational awareness. This approach is limited to turnaround operations addressing landside processes that SESAR does not cover and delivering an expanded version of information sharing.

Considering aircraft progression in time *and* space as a sequence of arrival, turnaround, departure and en-route events, TITAN analyses the aircraft turnaround process as integral part of the ground segment of the aircraft Business Trajectory (BT). BT planning activities are structured by the TITAN information model and facilitated by end-user applications making use of the TITAN information.

The TITAN Concept of Operations

An in depth analysis of the current state of the aircraft turnaround process was established from the key stakeholders involved in it, as a prerequisite for identifying their actual needs and meeting them by developing the TITAN ConOps. With their assistance, the aircraft turnaround process was analyzed with respect to the sequence of its sub-processes (ground operations) required to service the aircraft during the turnaround. Considered were all sub-processes from the moment the aircraft arrives at its stand/gate - Actual In-Block Time (AIBT) - until the moment it leaves it - Actual Off-Block Time (AOBT) - including those external services which have a direct influence on it, such as passenger flows to the airport and within its facilities as well as baggage flows.

According to the stakeholders involved in the analysis, the most relevant reasons for aircraft turnaround delays are:

- *Lack of information sharing*

  Currently, Air Navigation Service Providers (ANSP's), airport operators and airlines use different planning data, do not share a common view of the evolution of the aircraft processing and take their decisions based on different performance data, in spite of managing a single, unique set of aircraft. There is no single partner that has the complete picture; the information systems of the various partners have been developed and built independently.

  During the flight execution phase, overall poor information sharing and management prevent efficient coordination between all stakeholders resulting in a less effective use of available assets and therefore increasing the hidden costs to the airspace users in the form of operational inefficiencies, such as a non-optimised aircraft turnaround process.

- *Deviation from original planning and unexpected events*

  The aircraft turnaround is a process optimised by each stakeholder involved in it. They all optimise their resources to perform their tasks in the agreed time. Delays arise when a deviation from the original schedule occurs, mainly because of the unavailability of required equipment or staff leading to a chain reaction of delays. Deviations refer not only to late arrivals/departures but also to early arrivals. An early arrival is not always desirable as it could cause blockage or contention of resources.

- *Increasing trend of demand for security processes*

  Airport operators have difficulty providing adequate infrastructure and resources to allow for short aircraft turnaround times. While this issue can be resolved only by new and harmonized regulations, it has a direct negative influence on ATM operations.

Beyond that, it is difficult to establish a European standard aircraft turnaround process. Although turnaround activities and actors are, in all European airports, based on European legislation, there are national regulations that make it difficult to unify the different practices and that lead to a different course of activities during the turnaround depending on the country, and sometimes even on different airports within the same country.

Based on the results of the analysis of users' needs, a new advanced operational concept was developed for the aircraft turnaround process fully integrating it into the aircraft BT. The TITAN ConOps describes in a new perspective how the aircraft turnaround can be performed by identifying the functions and processes of the different actors involved in it, as well as their roles and responsibilities including information flows and interactions between them. An important new feature is the inclusion of airport landside processes and their impact on the aircraft turnaround process.

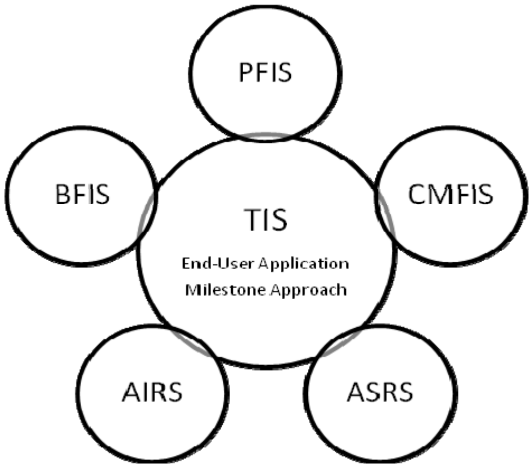
The TITAN ConOps is to be seen as the logical evolution of A-CDM to further improve the collaborative features of SESAR; it addresses some elements not yet considered by A-CDM. TITAN is expected to use the milestones specified for A-CDM and to add new ones that make the aircraft turnaround process even more transparent than before.

TITAN Milestones		Rationale
M17	Close check in	**Boarding can start. Passenger and baggage list are closed.**
M18	Last passenger crossing security control	**Passenger monitoring - arrival at boarding gate on time or not**
M19	Last passenger crossing passport control	**Passenger monitoring - rejected at passport control or not**
M20	End of de-boarding	**Ground handling activities on passenger cabin can start.**
M21	Last baggage delivery to hold baggage bay	**Baggage monitoring**
M22	End of baggage unloading	**Baggage loading can start.**
M23	Close cargo doors	**Baggage monitoring**
M24	Start of fuelling	**Specific processes have to be ready first - inform firemen if needed**
M25	Remove push-back	**Stand and gate available - aircraft can move by itself**
M26	End of de-icing	**Time for take-off is limited.**

All existing and newly added information that is necessary for better managing the aircraft turnaround process is included in the TITAN Information Sharing (TIS) platform, a virtual data repository that centralizes all scheduled, estimated, actual and target (when applicable) time data. Such information items are transferred to and distributed by the TITAN services.

What is fully new in the TITAN ConOps is the definition of a Service-Oriented Architecture (SOA). The term “service” refers here to business services and not to IT services; business services drive the IT services but not the other way around. This new approach focuses on the business aspects of aircraft and airport operations, at the same time laying out clear requirements for the IT support that are necessary for running TITAN in operational use. When running a process, information flows between the different stakeholders involved in the aircraft turnaround process are generated. Each one of these processes requires but also generates information which can be fed to other processes. Such information is circulated through the TITAN Services:

- the Passenger/Baggage/Cargo and Mail Flow Information Services (PFIS, BFIS, CMFIS);
- the Aircraft Status Report Service (ASRS); and
- the Airport Information Report Service (AIRS).



This advanced operational concept proposes the use of end-user applications and interfaces, which provide with more accurate and comprehensive information reducing workload, encouraging interaction and supporting decision-making. The information included deals with the process of:

- getting passengers from their homes or locations of accommodation to their seat in the aircraft;
- carrying baggage from drop-off stations to the aircraft hold;
- updating and informing on the status of the aircraft processed; and
- updating and informing on the status of other flights and airports affected by the processed flight.

The TITAN services monitor the progress of all aircraft turnaround sub-processes. Related information can be categorized in terms of urgency resulting from the definition of different information levels within the TITAN ConOps common to all stakeholders. By this means information can be managed more efficiently, the amount of exchanged information can be reduced to what is actually needed and information overload can be minimized.

Through TITAN, A-CDM can be enhanced as further capabilities can be implemented in the short term. Furthermore, the TITAN ConOps has been fully aligned with the Single European Sky ATM Research (SESAR) Program being based on its net-centric design principles; each information "generator" or "consumer" is considered to be a node of the global A-CDM network and the SWIM platform puts each piece of information into a pool and picks up the one each partner needs.

Through this new system architecture the integration of the turnaround process in the aircraft BT, where up to now all other processes between aircraft landing and take-off for each trajectory cycle are included, is made feasible. The BT can be a continuous process depicting aircraft progression over its intended path for a whole duty cycle with both the air and the ground segment integrated into it. The aircraft turnaround process can be made an integral part of the BT ground segment, as proposed by TITAN, resulting in the definition of the airport BT necessary for integrating the airport into the ATM network.

Validating the Operational Concept

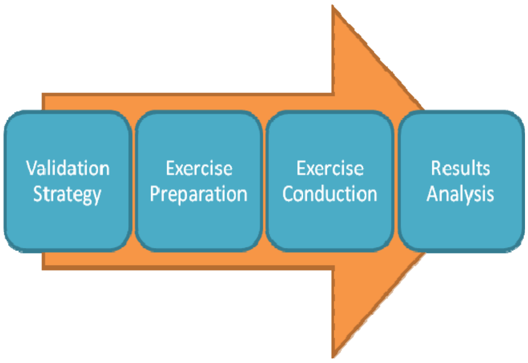
The TITAN ConOps was validated by applying the European Operational Concept Validation Methodology (E-OCVM).

In the TITAN Performance Framework (PF) the following Key Performance Areas (KPAs) were defined:

- predictability (aircraft turnaround process standard deviation);
- efficiency (airline operations punctuality);
- cost-effectiveness (aircraft turnaround operational costs); and
- flexibility (predictability and efficiency in unexpected events or planned changes).

Validation of the TITAN ConOps was about demonstrating that integration of the identified stakeholders' requirements as well as concept's alignment with SESAR will contribute to a performance improvement in the above KPAs. As a transversal activity validation was active during the entire project. The validation activities, through which concept maturity increased, examined whether the proposed concept was defined at the level of detail required for the development of benefit mechanisms and the identification of major R&D needs.

The validation process was based on a 4-step approach; each step provided guidance on goal achievement and fed the subsequent one with relevant information.



Validation Strategy

Goal of this step was to define the validation strategy at a project level. Based on the information contained in the PF, the validation strategy described the activities necessary to validate the TITAN ConOps. The following two validations techniques were chosen:

- Gaming sessions:

  The Human-In-the-Loop (HIL) gaming technique was chosen allowing the definition and exploration of roles and their responsibilities and the interaction of these roles within an automated environment. By focusing on the exploration of the situational awareness and the human-human and human-machine interactions, the feasibility of the information exchange defined in the TITAN ConOps was assessed. Games were played with experts acting according to specific roles and interacting through specific processes.

- Fast time simulation:

  Using the Outcome Driven Distinctive Simulation (ODDS) technique, the TITAN Model was developed to conduct a set of exercises that would evaluate validation objectives achievement through a set of validation scenarios. Two generic scenarios and four situation-specific ones were defined. Each scenario included two sub-scenarios; one representing the current situation and one a future situation with the TITAN ConOps implemented.

Exercise Preparation

This step elaborated the detailed Validation Plan (VP) for each exercise consisting of three parts each time:

- Definition of the exercise scope, the exercise planning and the assessment of the exercise feasibility.
- Analysis specification and identification of the data collection and analysis methods and statistical significance.
- Detailed exercise design, where activity and resource planning and management as well as training and time planning took place.

Exercise Conduction

In this step the validation exercises were performed according to their description in the VP.

Results Analysis

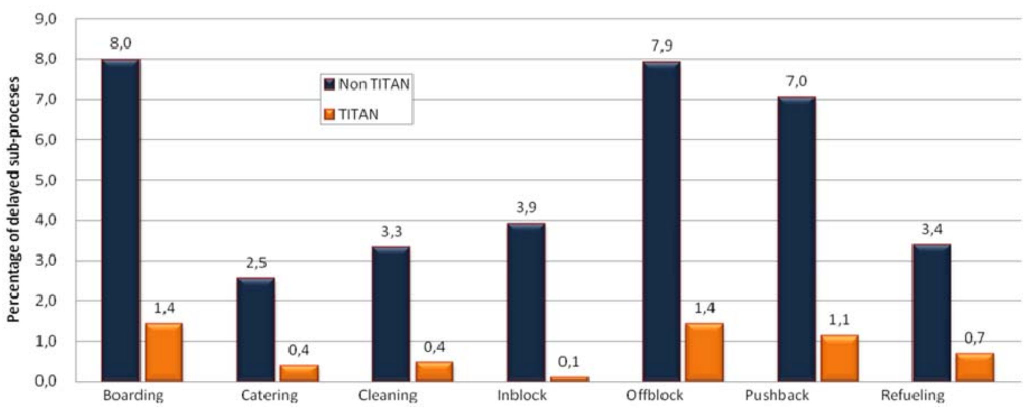
In this step the collected raw data were analysed and the results were synthesized and compared with the validation objectives and exercise hypotheses.

The main results of the gaming exercises can be summarized as follows:

- The defined TITAN information was proved to be sufficiently complete to support the aircraft turnaround sub-processes.
- The definition of the TITAN services was proved to be useful and complete with only few modifications still necessary depending on the actors performing subscriptions to services.
- Particular turnaround activities, such as de-icing, ambulift, and Reduced Mobility Passenger (RMP) service, could be provided by external companies to be included as users of the TITAN services too.
- TITAN information completeness could be still improved by assessing further unexpected or abnormal situations.
- Information level illustration should be carefully designed to facilitate punctual problem identification and solution planning. Attention should be paid to the following areas:
  - Information overload may jeopardize the effective identification of the most crucial problems.
  - The general process of information classification should be further explored.

Using the TITAN model, a total of 330 simulation scenarios were developed and run to validate and analyze the performance of the proposed concept in different situations. A real 24-hours traffic sample was used and considered were the airport layout as well as different types of aircraft turnaround sub-processes. By this means it was possible to quantify the possible impact of different unexpected events such as flight delays, late passenger arrival to check-in desk, security or passport control, increased demand, lack of resources etc., on the predictability of different milestones such as Estimated In-/Off-Block Times (EI/OBT). Apart from this, some forced disruptions were introduced in different aircraft turnaround sub-processes to analyze the resulting knock-on effect and measure the recovery delay factor. Furthermore, in particular scenarios the partial implementation of specific services, such as PFIS and BFIS or AIRS and ASRS, was assumed with the purpose of validating the TITAN services and analysing their benefits.

To estimate the benefits of TITAN implementation, all simulation scenarios were run twice; once with TITAN services activated and interactions with the end-user enabled and once without.



One major finding of the simulation result analysis was that all TITAN services were well defined. Although AIRS and ASRS provide more information, information obtained from PFIS and BFIS has a greater impact on the improvement of the aircraft turnaround process. However, there is a strong need for precisely defining which information should be available to which user depending on their subscription to the TITAN services, as no one wants to get/manage more information than needed.

Based on the simulation output, it can be concluded that the TITAN ConOps has accomplished all expectations as performance in the selected KPAs increase with TITAN implementation. As a result, it can be derived that with the TITAN ConOps implemented:

- the percentage of delayed flights will decrease;
- the aircraft turnaround process duration will decrease;
- the OBT will be more precise.

The main TITAN goals have been achieved as described below:

- Predictability of operations has been improved.
- Efficiency of the aircraft turnaround process has been increased as the number of delayed flights has decreased.
- Flexibility has been enhanced as the balance between predictability and efficiency has proved benefit.
- The cost of the aircraft turnaround process has been reduced as a result of having improved predictability, efficiency and flexibility, although not possible to be proven via the model.

Realising the Operational Concept

To realize the TITAN ConOps, a decision-support tool was developed and delivered as a demonstrator. It provides all information necessary for offering more transparency into the aircraft turnaround process by highlighting any issues that have an impact on it and for facilitating turnaround delays mitigation.

Specification

The TITAN tool was based on a SOA; an information sharing platform in the centre and publicly available services in the periphery.

For the sake of the tool's interoperability and connectivity, industry-standard messaging formats and web service interfaces were used. Specialized user interfaces were introduced for different user classes. Moreover, different client implementations to make the tool more attractive from a business perspective are supported; both thin and thick clients. Existing computing equipment may be used for TITAN with minimal cost (i.e. only maintenance fees) and if necessary dedicated hardware that requires a specific client can be developed.

Airlines, airport operators, and ground handling agents were identified as the main beneficiaries of the TITAN tool. Different levels of information were established to categorize their information needs in terms of urgency for reducing information overload. Information classification can be done independently by the stakeholders through an End User Application (EUA).

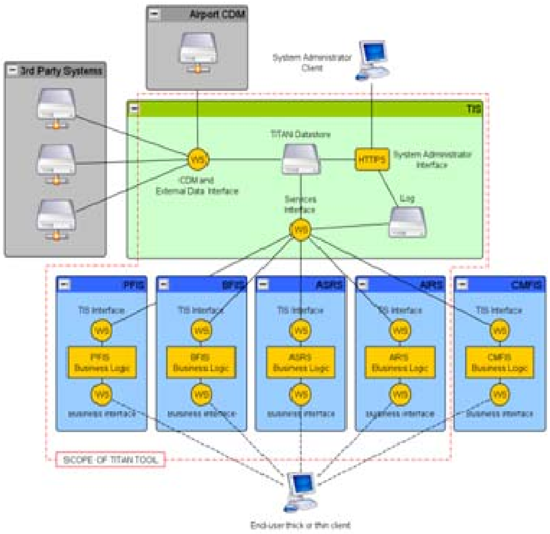
Level of Information	Description
0	A given process is running on time.
1	A process has a delay, but the aircraft turnaround itself is not affected.
2	Immediate intervention is needed to moderate the effects of a process delay.
3	Urgent re-planning of the whole aircraft turnaround process is unavoidable.

Design and Architecture

The TITAN tool design and architecture incorporated the entities identified in the TITAN ConOps, which are:

- TITAN Information Sharing (TIS);
- A-CDM and other external systems;
- TITAN services; and
- customized user interfaces and the system administrator interface.

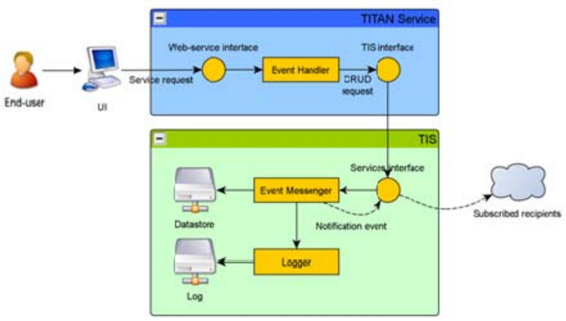
The simple system architecture for a full production system is illustrated below; the red-dashed boundary identifies, however, the components that fall within the scope of the TITAN tool demonstrator.



The TITAN server consists of common endpoints for all clients to connect to, a messaging layer for communication between all components, the TIS, which is the central repository, and the identified services, which read, analyze and write data internally held or externally referenced by TIS. Data are pushed from the server to the clients as they change and messages are passed between TITAN and external systems as well as between TITAN components.

Service-oriented interfaces were designed to allow the flow of external information into and out of the TIS. However, such communication within the demonstrator was emulated due to limited access to such systems for development purposes. A set of interfaces were developed to facilitate intercommunication between A-CDM or any other external tool and a future commercial tool.

An event-driven concept was applied. Events are generated externally, i.e. by the end users, or internally, i.e. through service requests to the TIS. The event handler translates user events into database create, receive, update or delete requests, whereby all relevant events are captured by the event messenger to notify all subscribed parties.



Implementation

Users access the system, with default subscriptions to one or more services that can be then modified by the system administrator. On logging into the system, users' credentials are linked to their role which describes the services, data and milestones they can access, modify or impact. Information on milestone and process progress is easily accessed through the summary view of all flights being processed at an airport. The implemented colour coding informs on delayed flights.

A flight-pair from the summary view can be further selected for an in depth analysis of the aircraft turnaround process. The details view is provided with clickable tab areas to indicate turnaround milestones with active textual content.

The TITAN tool combines a customizable client for the most common role requirements with special clients configurable for special needs. Furthermore, user views and preferences are created and stored server-side so that users can retain them whenever they need to.

Verification

The correct behaviour of the TITAN tool demonstrator - which serves as a subset of a future production-strength tool with enough of the requirements implemented to effectively execute the selected operational scenario - was verified against the specification requirements. The verification results confirmed that the demonstrator is able to push appropriate data to different users in order to support them in decision-making by providing a common situational awareness during the aircraft turnaround process. Specific recommendations on how to upgrade it were also derived, i.e. implementation of further service-specific functionalities.

Cost Benefit Analysis for the TITAN Tool

The cost benefit task for the TITAN tool included the development of the Cost Benefit Analysis (CBA) methodology and the conduction of the CBA. The CBA methodology provided a basis for conducting an economic analysis of the implementation of a future commercial tool based on the TITAN demonstrator and it served as a guide to understand the process and the results derived from the CBA effort. It followed a generic approach on how to conduct a CBA based on the European Model for Strategic ATM Investment Analysis (EMOSIA) and it was tailored specifically to the TITAN project.

The CBA was aiming to determine the value that the investment in a future commercial tool may generate to the involved stakeholders at a generic airport. As key stakeholders were identified airlines, airport operators, ANSPs and ground handling agents. The main assumptions and data used in the analysis were based on:

- the TITAN CBA Methodology;
- existing literature;
- the TITAN tool and its cost estimates;
- the TITAN validation results;
- the feedback obtained during workshops;
- expert judgments; and
- the interviews conducted with the stakeholders.

Two scenarios were developed including a "baseline scenario" with A-CDM implemented but not the Titan tool and a "TITAN scenario" with both implemented. It was assumed that an infrastructure, where the information is located, is provided at the generic airport. The TITAN tool will grant access to it while any stakeholder using it will have to pay. Such costs were split into one-off acquisition cost and recurring costs. Benefits, on the other hand, were broken down following Eurocontrol's guidelines. The key benefits included cost savings or avoidance and additional revenues for each stakeholder. Their main impact was expected to be an increase in the predictability of the aircraft turnaround process. This benefit can be translated into monetary terms through delay reduction savings and operational cost reduction for all stakeholders. The key assumption of the CBA was that the future commercial tool will generate 1% of operational cost reduction (minimum benefit).

Having all necessary assumptions set, the economic models were developed and the scenarios were compared. The output of the CBA can be summarized as an operational cost reduction of 1% and a Net Present Investment Value (NPIV) per stakeholder resulting from delay reductions due to the implementation of the future commercial tool at a generic airport:

Stakeholder	NPIV [€]
Airline	5.261.007,20
Airport Operator	783.455,65
Ground Handling Agent	-46.153,19
ANSP	-126.966,00
All Stakeholders	**5.871.343,66**

The expected benefits from the implementation of a future production-strength TITAN tool outweigh the costs for airlines and airport operators. However, the expected benefits for ground handling agents and ANSPs are smaller than the resulting costs. The NPIV for all the stakeholders combined is positive. The results are, however, highly dependent on the operational cost reduction assumption. If we assume that the TITAN tool generates 2% of operational cost reduction, the NPIV is positive for all stakeholders. Furthermore, the CBA output would change, if the costs distribution assumptions changed. Such sensible issues should be taken into account when deciding to upgrade the TITAN tool demonstrator to a production-strength commercial tool.

Preparing a future TITAN Environment

Integrating TITAN Output into the current ATS Components

For any new procedure, tool or other development in ATM, development and testing is only the first major challenge. Successful integration into the ATM environment is also an important task that involves not only technical but also institutional and in some cases even culture-change elements.

In the specific case of TITAN, integration is made easier by the fact that it builds on the work already performed in the context of A-CDM. Many of the issues involved in information sharing, data ownership and the general change in working methods and thinking required by collaborative decision-making were addressed when A-CDM was implemented. On the other hand, since TITAN involves also totally new partners, and an even more detailed look at the turnaround process as well as the use of new information elements and data sources, compared to A-CDM some additional integration effort will be needed.

When considering the integration challenge, it is important to remember that TITAN will be implemented mainly in the upcoming SESAR environment which is bringing fundamental, paradigm changing developments, such as SWIM and Trajectory-Based Operations.

Since TITAN has been designed from the start to be compatible with TBO and as a result of its SOA, integration into the ATS is relatively straightforward from a technical point of view. Institutional issues remain a problem however.

The TITAN project looked at three integration areas: the airline operations centre, airport operations and the BT. A number of transition considerations have also been made.

The integration requirements were defined along a number of integration vectors; these are in fact specific areas for which the integration considerations and integration activities must be defined. They are called vectors because they indicate the direction of the activities and also their timeframe. The integration vectors are common to each and every partner in as much as they will all have to consider at least the vectors defined by TITAN when planning their specific integration activities on the understanding that some vectors may not be applicable in a given situation while in others, additional vectors may need to be defined to satisfy the prevailing requirements. Examples of integration vectors are; operational procedures; Air Traffic Control (ATC) systems; airport systems; Human Machine Interfaces (HMI); training and reform of thinking; institutional arrangements.

An analysis of the legacy environment showed that relatively few existing systems, particularly airline systems, have a SOA. Furthermore, while existing systems are normally able to receive information from TITAN, passing information in the reverse direction may need workarounds. Another discovery was that some of the information TITAN needs, particularly on the land-side is theoretically available but new sensors may be required to make the information accessible to TITAN.

New partners, some of whom will be involved in collaborative decision-making for the first time ever (e.g. a taxi company or the authority looking after the airport access road network) will need particular attention to ensure their collaboration and avoid reservations arising from concerns about liability issues.

An important conclusion from this analysis was that the engineering aspects of TITAN integration will not pose serious problems. At the same time, the institutional issues (data sharing rules, data ownership, etc.) need to be properly managed; otherwise they can turn out to be real showstoppers. Work already performed in this respect for A-CDM is partially reusable, however, the new partners and new information elements will need to be properly understood and analyzed to ensure their seamless integration into the existing A-CDM environment.

TITAN's success is predicated to a very large extent on the willing and full cooperation of both old and new partners in A-CDM. To ensure this, a well designed and effective sales effort will be needed as part of the overall integration activities. The expertise to successfully complete such an exercise may not be readily available within the ATM organizations concerned. Those are more used to approach things from an engineering and operational perspective, while this sales effort must concentrate mainly on the commercial benefit aspects explaining also why the culture-change is required for success in the future ATM environment.

Managing the Transition into a future TITAN Environment

As mentioned earlier, TITAN assumes that it will be implemented on top of an existing A-CDM infrastructure. As such, TITAN will bring incremental but nevertheless important benefits mainly by enhancing even further the predictability of the aircraft turnaround process.

The transition concept developed originally for A-CDM would appear to be appropriate also for TITAN. In this concept, local transition is planned as the initial step, deploying TITAN at individual airports selected on the basis of their level of A-CDM implementation. It is reasonable to expect that the enhanced benefits demonstrated by A-CDM/TITAN airports will act as a catalyst, urging other airports to become A-CDM compatible so that they too may then implement TITAN; similarly, other airports already using A-CDM will probably want to upgrade to TITAN.

In order to properly manage this upgrade process, a regional implementation plan will also be necessary. Regional in this context may mean a complete or partial International Civil Aviation Organization (ICAO) region, a Functional Airspace Block (FAB) or a number of FABs. Obviously, not all airports in a given region will be candidates for TITAN implementation. In order for partners to be convinced of the resulting benefits, an appropriate business case must be made for each candidate. At the same time it must be remembered that the network benefits of A-CDM and consequently, A-CDM enhanced with TITAN increase exponentially with the number of airports participating. Therefore all airports willing and able to participate in the regional implementation activities should be encouraged to do so.

The extended partner and information set inherent in TITAN works best in a SWIM environment. However, the availability of SWIM with all its features is not a prerequisite for implementing TITAN. This is a very important transition consideration since it highlights the fact that there is no need to delay the transition to TITAN on account of information management considerations.

Having a transition plan with well defined and agreed time-frames is important mainly to speed up transition. There are no specific interdependencies (other than the need to implement A-CDM first) that would require co-ordination of the transition steps. At the same time, the need for educating partners, the development of the sales concept and the sharing of experience as a basis for getting additional partners on board do argue for a plan that results in a structured series of actions, maximizing their effectiveness.

The coming years will bring many important changes in the ATM environment, particularly as the SESAR concept elements come on line. When planning the transition to TITAN, it is worth considering the priorities being given to all the other new elements and finding opportunistic synergies to time the transition so that instead of competing with other projects TITAN is seen as an integral element of the overall development.

In summary, TITAN's integration into the ATS will not be a big challenge from an engineering point of view. Institutional issues, however, need special attention as they may prove showstoppers if not managed properly and early enough. Furthermore, new partners, especially those on the land-side who may be involved in A-CDM for the first time ever, will need special attention to ensure their willing and full cooperation. A well designed and effective sales effort will be required to help TITAN's wide-spread acceptance and implementation.

Conclusions and further Work

The need for a project such as TITAN was justified by the fact that aircraft turnaround delays account for a large percentage of total aircraft delays showing an increasing trend over the last years and making airports the next major bottleneck factor within the ATM network. The performance of every single stakeholder is important as coordination of their (inter)actions has a strong impact on the efficiency of the turnaround process that can be further optimized by implementing a service-oriented approach as the one proposed by the TITAN project.

Aim of this text is to disseminate the TITAN project output to all involved and interested stakeholders such as airport operators, airlines, ground handling agents, and ANSPs providing an insight on the following topics:

- *overview of the current situation and users' requirements* to spot existing bottlenecks, critical paths, and deficiencies of the system as it works today, to identify the main reasons for such problems as well as potential mitigation mechanisms;
- *elaboration of a new operational concept* for an optimised aircraft turnaround process by describing what information should be shared and how it should be shared and proposing a SOA;
- *validation of the proposed concept* for proving accomplishment of specific performance criteria such as predictability, cost-effectiveness, efficiency and flexibility;
- *realisation of the proposed concept* by developing a decision-support tool for monitoring and managing the aircraft turnaround process;
- *a comprehensive CBA* for the implementation of a future commercial tool at a generic airport to assess its impact on the revenues of different types of stakeholders;
- *a plan for the integration of the concept* in the ATS and *the management of the transition* to it.

In alignment with existing concepts, such as A-CDM and SESAR, and building on their principles (milestone approach, SWIM and TBO) the aircraft turnaround process can be further optimised and delays can be reduced. Accessing or providing already existing but also new information through the concept of a common sharing platform enables all involved stakeholders to share common situational awareness of the progress of the turnaround processes their actions have a direct impact on and improve the information flows between them.

With improved management of existing infrastructure resources being the only sustainable solution left for world's largest hubs suffering from delay problems and continuous demand increase, increasing the efficiency and predictability of the aircraft turnaround process can be nothing less than promising; that's where TITAN can efficiently contribute to.

Acknowledgement

Special thanks to the consortium partners (Ineco, Aena, Jeppesen, Crida, Ecorys, Isdefe, Blusky, Boeing, Slot Consulting, ISA SW and RWTH Aachen University) that contributed to the success of the project.

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TITAN

Turnaround **I**ntegration in **T**rajectory **A**nd **N**etwork

Project Number: 233690

Final Progress Report

Period 6 (Jun/12 to Feb/13)

CLASSIFICATION: CO **ISSUE:** 0.3 **DATE:** 29/04/2013

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1 Purpose

In the frame of the European Commission (EC) 7th Framework Programme, the TITAN project proposes to develop a new advanced operational concept for the turnaround process, fully compatible and complementary with the ConOps developed within SESAR, to improve the current process in three main KPAs: predictability, cost-effectiveness and efficiency.

This document constitutes Progress Report number 6 for the period from the 1st of June 2012 to the 28th of February 2013.

1.2 Intended Audience / Classification

This document is internal to the members of the TITAN Consortium and the EC. However, section 2 includes a Public Executive Summary that can be disseminated freely. The first part of the document with other format has the purpose to be used as a public brochure.

1.3 Associated Documentation

[1] TITAN Grant Agreement;

[2] TITAN Consortium Agreement;

[3] TITAN Description of work, Annex I v0.6

1.4 Abbreviations and Acronyms

AIRDEV	Airport Development
ATM	Air Traffic Management
CBA	Cost Benefit Analysis
CDM	Collaborative Decision Making
ConOps	Concept of Operations
D	Deliverable
EC	European Commission
FP	Framework Programme
IPR	Intellectual Property Rights
KOM	Kick-Off Meeting
KPA	Key Performance Area
N/A	Non Applicable
P	Project
pm	person months
PMI	Palma de Mallorca
SESAR	Single European Sky ATM Research Programme

SJU	SESAR Joint Undertaking
SWP	Sub-WP
TITAN	Turnaround Integration in Trajectory And Network
URL	Uniform Resource Locator
WP	Work Package

2. MAIN ACHIEVEMENTS

This Section contains a public executive summary that could be freely disseminated beyond the TITAN Consortium and the EC.

2.1 Objectives

Turnaround delays constitute the origin of a very significant portion of late departures in European airports. The causes are many, including tight scheduling, technical problems, boarding issues, airport equipment, security measures as well as operational difficulties experienced by ground handlers. However, the specific problems affecting turnaround have not so far been analyzed in depth. Clearly there is potential for improving the delay situation by reducing or eliminating the impact of factors adversely affecting the turnaround process.

The TITAN project has developed a new advanced operational concept for the turnaround process, fully compatible and complementary with the ConOps developed within SESAR, while integrating it in trajectory based, net-centric operations. The main objective of the project is to improve the current process in terms of an increase of the predictability, a reduction of the operational costs and an improvement on the airlines operations efficiency.

During the current reporting period, the main objective of the project was to deliver the analysis of results from the validation as well as the second issue of the TITAN ConOps feed by the results of this validation. The TITAN demonstrator tool and the CBA of the envisaged tool developed in the project were also the main outcomes of this period.

The 3 months extension of the project, since December 2012 till February 2013, was focused on further dissemination activities among the stakeholders community.

2.2 Summary of progress

This section details the main events registered in this reporting period:

The TITAN activities undertaken during the last nine months of the project have mostly dealt with the completion of the project technical work: the second issue of the ConOps in WP1 “Concept analysis and definition”, the analysis of validation results in WP3 “Concept validation”, the development and verification of the TITAN demonstrator in WP4 “Development of TITAN tool” and the CBA following the defined methodology in WP5 “Cost Benefit Analysis”. The transversal WPs, WP0 “Project coordination” and WP7 “Exploitation and dissemination”, have continued with their supporting role to the project.

<u>WP1</u>:

The second release of the Operational Concept has been delivered, updated according to the feedback from the validation activities, both the fast time simulations made by TITAN Model and the gaming exercises.

<u>WP3</u>:

D3.4 “Validation Report” was delivered during this period, summarizing the results achieved and the conclusions in respect to the project and validation objectives.

<u>WP4:</u>

The final release of the TITAN Demonstrator tool was developed, verified and delivered.

<u>WP5:</u>

Interviews with stakeholders took place during this reporting period and the conclusions of them were used to make some assumptions for the CBA.

WP6:

The TITAN Air Transport System Integration Documents define the details of integrating the output of TITAN into the information stream of the different partners concerned with the turnaround process as well as TITAN integration with the business trajectory. The TITAN related transition considerations were also described.

WP7:

During this period the main dissemination activities have included the development of a video, the design and printing of the final project leaflets, the update of the project website, the development and publication of several articles in the Roger-Wilco blog and the preparation of the final workshop. After the extension of the project, five other workshops were held in order to disseminate the work done to those who were not able to attend the Final Workshop. A more detailed video of the project and “TITAN The Book. Going beyond CDM” were developed during the last three months of the project.

Regarding management and coordination activities, apart from the normal project coordination issues internal to the Consortium it is worth mentioning the progress made on the coordination activities with the SJU - WP6 “Airport Operations”.

3. MANAGEMENT PROGRESS REPORT

This Section contains the progress of the TITAN WP0 (Project Coordination) during the present reporting period (from the 1st of June 2012 to the 28th of Feb 2013).

3.1 Objectives for Reporting Period

The general objectives for the Period considered in this Sixth Progress Report were:

1. To follow-up on project activities;
2. To prepare and submit the second Amendment Request to the EC;
3. To establish and maintain contacts for external coordination and
4. To close out the project.

3.2 Project Coordination Activities

Project Coordination Activities include the following tasks:

- Meetings;
- Management of Contractual Issues;
- External Coordination;
- Internal Coordination.

3.2.1 Meetings

During this period, the following coordination meetings have been held:

Date	Location	Meeting description
Meetings of the period 5		
21/11/2012	PMI	Final Progress Meeting

Table 1: WP0 meetings

3.2.2 Contractual Issues

An amendment to the Grant Agreement has been requested by the consortium through Ineco as coordinator. The reason for it is the modification of the project duration from 3 years to 3 years and 3 months. The Description of Work (DOW) was modified accordingly to this extension both Part A and Part B.

EC acceptance of this amendment was communicated to the coordinator the 7th February 2013.

3.2.3 Risks Management

Id.	WP	Risk description	Level[2]	Impact	Mitigation / Contingency
01	All	TITAN scope with	M	Overlap of	Preventive: Involve partners

[2] High, medium or low

		respect to SESAR and Airport CDM initiatives		activities	who participate to those initiatives and identify the gaps in all of these projects to build on this project

Table 2: WP0 risks

3.2.4 External Coordination

The main activities regarding External Coordination undertaken during this period have been:

- SJU - WP6 "Airport Operations": INE, CRI and SJU WP6 leader, held a meeting on the 02/11/2012 at CRIDA headquarters to continue monitoring the different aspects of TITAN project that may have an impact on the actual SJU. The objective of the meeting was to show both the TITAN Model and the TITAN Demonstrator Tool and the feedback received was quite positive.
- SJU – P08.01.10 "Information modelling airport domain" contacted TITAN to understand how the project could contribute to the data and information models in support of SESAR Airport Airside processes. A representative of this project attended the Brussels workshop in order to discuss this further integration of TITAN ConOps with SESAR Information Models. Further work will be performed in this field outside TITAN.

3.3 Deliverable Status List

Table 3: Deliverable Status is based on the Deliverables table of the Description of Work (see [3]) and it shows their status at the end of the reporting period.

The table shows the Identification and title of the deliverable, the delivery status, the initially planned date of delivery (as in [3]) and the actual date of the delivery (if delivered). For Draft not delivered, the date of the draft is included in the Comments column.

The colours of the background in the table have the following meaning:

- White: document still not in process;
- Gray: document delivered in previous reporting periods;
- Orange: document delivered in this reporting period but pending on final acceptance;
- Blue: document delivered and accepted in this reporting period;
- Pink: document delayed;
- Yellow: document in preparation.

The only deliverable that is still pending on its delivery to the EC at the closure of this report is the D0.10 "Final Financial Statement" which will be delivered by the end of April (M41).

3.4 Milestone Status List

Table 4: Milestone Status is based on the Milestones table of the Description of Work (see [3]) and it shows their status at the end of the reporting period.

The table shows the Identification and name of the milestone, the involved WPs, the partner responsible, the status, the initially planned date (as in Table 3) and the actual date (if achieved).

The colours of the background in the table have the following meaning:

- White: milestone pending (but not delayed);
- Gray: milestone achieved in previous reporting periods;
- Blue: milestone achieved in this reporting period;
- Pink: milestone delayed.

M13 is considered achieved because all technical and dissemination documents have been delivered and accepted.

3.5 Effort Allocation

This section contains a table giving, per WP and per partner, the planned (P) manpower allocation and actual (A) effort spent up to date, including the present reporting period and the previous ones, so the full project duration. Table 5: Effort allocation status (pm) provides this information and allows quantifying the accomplishment of work with the initially allocated effort. The planned manpower has been estimated considering in a linear way the total effort per partner per WP.

It can be concluded from Table 5 that the total actual effort (310.56 pm) is slightly higher than the total planned effort (293.40 pm). The biggest difference between actual (59.14 pm) and planned (36 pm) effort is in WP2 “Development of TITAN model”. According to that, CRIDA and ISA SW are the partners with the biggest difference between actual and planned manpower. The justification for that is the high effort required to develop and verify the TITAN model due to the complexity of modelling CDM processes and airport resources.

3.6 Updated Project Schedule

Figure 1 provides the updated project schedule by means of a Tracking Gantt chart that includes the planned schedule, the actual schedule and the progress of each task.

Although delays occurred during the project execution in several sub-WPs, the project as a whole has been finished on time: technical activities finished by the end of November 2012 while dissemination and management activities (WP7 and WP0 respectively) continued during the 3-months extension of the project.

Id	Name	Status	Planned delivery	Actual delivery	Comments
MANAGEMENT DELIVERABLES					
D0.1	Project Management Plan	Accepted	M2	22/02/2010	
D0.2	Project Handbook	Accepted	M3	22/02/2010	
D0.3	First Progress Report	Accepted	M7	28/06/2010	
D0.4	Second Progress Report	Accepted	M13	30/12/2010	
D0.5	Third Progress Report	Accepted	M19	14/07/2011	
D0.6	First Financial Statement	Accepted	M18	12/12/2011	
D0.7	Fourth Progress Report	Accepted	M25	04/06/2012	
D0.8	Fifth Progress Report	Accepted	M31	20/07/2012	
D0.9	Final Progress Report		M39		This document
D0.10	Final Financial Statement		M39		In progress
D0.11	Report on External Coordination	Accepted	M36	10/12/2012	
TECHNICAL DELIVERABLES					
D7.1	Dissemination Plan	Accepted	M3	05/03/2010	
D7.3	Initial Project Brochure	Accepted	M3	17/03/2010	
D1.1	Analysis of the current situation	Accepted	M4	25/05/2010	
D7.7	Report on Stakeholder's needs Workshop	Accepted	M4	30/04/2010	
D1.2	High level User requirements	Accepted	M5	14/07/2010	
D1.3	Performance framework	Accepted	M6	25/10/2010	
D7.2	Project website	Accepted	M6	18/05/2010	
D3.1	Validation Strategy	Accepted	M9	16/02/2011	
D1.4	TITAN Operational Concept Document (Issue 1)	Accepted	M9	14/10/2010	

Id	Name	Status	Planned delivery	Actual delivery	Comments
D2.1	Technical requirements document	Accepted	M11	23/05/2011	
D2.2	Single Aircraft Turnaround Model SW Design Document	Accepted	M13	04/06/2012	
D2.3	Single Aircraft Turnaround Model Verification Test Report	Accepted	M14	04/06/2012	
D3.2	Validation Exercise Plan	Accepted	M14	30/11/2011	
D2.4	Single Aircraft Turnaround executable model	Accepted	M14	04/06/2012	
D5.1	CBA methodology for TITAN	Accepted	M14	17/01/2011	
D7.8	Report on Validation Scenarios Workshop	Accepted	M14	23/05/2011	
D2.5	TITAN Model Software Design Document	Accepted	M16	04/06/2012	
D2.6	TITAN Model Verification Test Report	Accepted	M18	04/06/2012	
D2.7	TITAN executable model	Accepted	M18	04/06/2012	
D3.3	Report on Exercise Results	Accepted	M21	04/06/2012	
D4.1	Turnaround tool specification document	Accepted	M23	04/06/2012	
D3.4	Validation Report	Accepted	M23	10/07/2012	
D1.4	TITAN Operational Concept Document (Issue 2)	Accepted	M24	12/09/2012	
D4.2	Turnaround tool design document	Accepted	M27	06/11/2012	
D4.3	Turnaround tool interface document	Accepted	M27	06/11/2012	
D4.4	Turnaround tool Demonstrator	Accepted	M31	06/11/2012	
D4.5	Verification plan	Accepted	M33	04/06/2012	

Id	Name	Status	Planned delivery	Actual delivery	Comments
D4.6	Turnaround tool verification document	Accepted	M33	12/11/2012	
D5.2	CBA for TITAN tool	Accepted	M36	08/11/2012	
D6.1	Integration plan AOC	Accepted	M36	12/11/2012	
D6.2	Integration plan airport operations	Accepted	M36	12/11/2012	
D6.3	Integration plan shared business trajectory	Accepted	M36	12/11/2012	
D6.4	TITAN related transition considerations	Accepted	M36	12/11/2012	
D7.4	Final Project Brochure	Accepted	M36	06/11/2012	
D7.5	Interactive CD	Accepted	M36	06/11/2012	
D7.6	Project video	Accepted	M36	06/11/2012	
D7.9	Report on Final Workshop	Accepted	M36	30/11/2012	
D7.10	Initial Exploitation Plan		M36	10/12/2012	
D7.11	TITAN The Book	Accepted	M39	20/03/2013	
D7.12	Report on Local Workshops	Accepted	M39	20/03/2013	
D7.13	TITAN technical movie	Accepted	M39	20/03/2013	

Table 3: Deliverable Status

Num	Name	Involved WPs	Leader	Planned Date	Actual Date	Comments
1	Overall Project Structure	All	INE	M1	03/12/2009	Kick-Off Meeting
2	Concept Design	WP1	SLO	M6	29/10/2010	Acceptance of D1.2, D1.3 Review meeting
3	Operational Concept and Validation Strategy	WP1, WP3	INE, ISD	M10	30/11/2011	Acceptance of D1.4, D3.1 Review meeting
4	TITAN Single Aircraft Model	WP2	ISA	M14		Software verified
5	TITAN Model	WP2	ISA	M18		Software verified
6	Validation Scenarios	WP3	ISD	M14		Results of 2nd workshop Acceptance of deliverable
7	Validation Results	WP3	AEN	M23		Acceptance of deliverable
8	Refined Operational Concept	WP1	INE	M24		Acceptance of deliverable
9	Tool Design	WP4	JEP	M25		Acceptance of D4.1 Review meeting
10	TITAN Tool	WP4	JEP	M33		Software verified
11	CBA Results	WP5	BRT	M36		Acceptance of deliverable
12	Integration of TITAN in Air Transport System	WP6	BLU	M36		Acceptance of deliverable
13	End of project	All	INE	M36		Acceptance of all deliverables Final Meeting

Table 4: Milestone Status

Full duration project		TOTAL		INECO		AENA		JEPPESEN GmbH		JEPPESEN Australia		CRIDA		ECORYS		ISDEFE		BLUSKY		BOEING		SLOT		ISA SW		AACHEN UNIVERSITY	
WP	***Title***	*P*	*A*	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A
WP0	Project coordination	21,00	19,58	16,00	12,87	0,50	0,62	0,50	0,70	0,00	0,00	0,50	0,91	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,66	0,50	0,55	0,50	1,01	0,50	0,76
WP0.1	Management of the consortium	13,00	15,58	10,00	10,72	0,30	0,43	0,30	0,26		0,00	0,30	0,50	0,30	0,50	0,30	0,30	0,30	0,30	0,30	0,45	0,30	0,35	0,30	1,01	0,30	0,76
WP0.2	External coordination	8,00	5,99	6,00	4,15	0,20	0,19	0,20	0,43		0,00	0,20	0,41	0,20	0,00	0,20	0,20	0,20	0,20	0,20	0,21	0,20	0,20	0,20	0,00	0,20	0,00
WP1	Concept analysis and definition	43,00	42,68	4,00	6,35	3,00	3,11	3,50	3,70	1,50	0,95	7,00	5,26	2,00	1,42	6,00	6,00	3,00	2,95	1,00	0,38	10,00	10,45	0,00	0,00	2,00	2,11
WP1.1	Analysis of the current situation	12,00	11,35	1,00	1,00	0,50	0,50	0,50	1,71	0,50	0,00	2,00	0,80	1,00	0,80	1,00	1,00	1,00	1,00		0,00	4,00	4,00		0,00	0,50	0,54
WP1.2	Stakeholders' needs	12,25	11,11	1,00	1,40	0,50	0,50	2,00	1,04		0,00	2,00	1,80	1,00	0,62	1,00	1,00	0,50	0,50		0,00	4,00	4,00		0,00	0,25	0,25
WP1.3	Performance framework	9,00	7,99	1,00	1,00	0,50	0,50		0,00		0,00	2,00	1,66	0,00	0,00	3,00	3,00	0,50	0,45	1,00	0,38	1,00	1,00		0,00		0,00
WP1.4	Operational concept	9,75	12,23	1,00	2,95	1,50	1,61	1,00	0,95	1,00	0,95	1,00	1,00		0,00	1,00	1,00	1,00	1,00		0,00	1,00	1,45		0,00	1,25	1,32
WP2	Development of TITAN model	36,00	59,16	3,00	3,95	0,00	0,00	1,00	1,00	1,00	1,00	2,00	12,49	0,00	0,00	0,00	0,00	2,00	1,20	0,00	0,00	2,00	2,00	22,50	35,83	2,50	1,69
WP2.1	Model requirements	8,00	11,17	1,00	1,00		0,00		0,00		0,00	2,00	5,91		0,00		0,00	1,00	0,20		0,00	1,00	1,00	2,00	2,00	1,00	1,06
WP2.2	Single aircraft model	11,00	17,49	1,00	1,10		0,00	0,50	0,50	0,50	0,50		5,18		0,00		0,00	0,50	0,50		0,00		0,00	8,00	9,31	0,50	0,40
WP2.3	TITAN model	17,00	30,50	1,00	1,85		0,00	0,50	0,50	0,50	0,50		1,40		0,00		0,00	0,50	0,50		0,00	1,00	1,00	12,50	24,52	1,00	0,23
WP3	Concept validation	51,50	56,13	12,00	12,25	2,00	2,33	0,50	0,50	0,50	0,25	15,50	17,41	0,00	0,00	16,00	16,00	1,00	1,75	0,00	0,00	1,00	2,00	0,00	0,00	3,00	3,64
WP3.1	Validation strategy	7,00	7,61	1,00	1,00		0,00		0,00		0,00	2,00	1,65		0,00	3,00	3,00		0,00		0,00		0,00		0,00	1,00	1,96
WP3.2	Exercise definition/preparation	15,00	16,55	3,00	3,50		0,00		0,00		0,00	5,00	5,69		0,00	6,00	6,00		0,65		0,00		0,00		0,00	1,00	0,71
WP3.3	Conduct exercises	16,50	17,68	6,00	6,00	1,00	1,00		0,00		0,00	5,50	5,50		0,00	4,00	4,00		0,10		0,00		1,00		0,00		0,08
WP3.4	Analysis of results	13,00	14,29	2,00	1,75	1,00	1,33	0,50	0,50	0,50	0,25	3,00	4,57		0,00	3,00	3,00	1,00	1,00		0,00	1,00	1,00		0,00	1,00	0,89
WP4	Development of TITAN tool	54,00	59,33	1,00	1,30	0,00	0,00	3,50	6,59	18,00	18,35	1,00	0,00	0,00	0,00	2,00	2,00	2,00	2,00	0,00	0,00	16,00	17,50	0,00	0,00	10,50	11,60
WP4.1	Tool specification	15,50	23,87	1,00	1,00		0,00	0,60	1,12	3,90	3,80		0,00		0,00		0,00	1,00	1,00		0,00	6,00	12,50		0,00	3,00	4,45
WP4.2	Architecture and design	12,00	13,17		0,10		0,00	1,30	1,30	3,70	8,16		0,00		0,00		0,00	1,00	1,00		0,00	5,00	2,00		0,00	1,00	0,61
WP4.3	Implementation	12,50	11,58		0,00		0,00	0,80	3,92	5,20	6,38		0,00		0,00		0,00		0,00		0,00	3,00	1,00		0,00	3,50	0,28
WP4.4	Verification	14,00	10,70		0,20		0,00	0,80	0,24	5,20	0,00	1,00	0,00		0,00	2,00	2,00		0,00		0,00	2,00	2,00		0,00	3,00	6,26
WP5	Cost Benefit Analysis	20,00	27,27	2,00	2,00	0,00	0,00	2,00	0,33	0,00	0,23	0,00	0,74	6,00	11,33	2,00	2,00	0,00	0,00	8,00	10,65	0,00	0,00	0,00	0,00	0,00	0,00
WP5.1	CBA methodology	5,50	6,11	1,00	1,00		0,00		0,06		0,23		0,00	1,00	1,39	1,00	1,00		0,00	2,50	2,43		0,00		0,00		0,00
WP5.2	CBA	14,50	21,17	1,00	1,00		0,00	2,00	0,27		0,00		0,74	5,00	9,94	1,00	1,00		0,00	5,50	8,22		0,00		0,00		0,00
WP6	Integration in air transport system	24,00	20,18	2,00	2,00	0,50	0,45	2,00	0,74	1,00	0,00	2,00	0,41	0,00	0,00	0,00	0,00	13,00	13,00	0,00	0,00	1,00	2,00	0,00	0,00	2,50	1,58
WP7	Explotaition and dissemination	43,90	45,38	6,20	9,15	0,50	0,50	3,00	0,19	0,00	0,00	2,00	2,92	1,00	1,00	2,00	2,00	17,20	16,67	0,50	0,43	3,70	5,10	1,30	0,75	6,50	6,67
WP7.1	R&D plan	2,40	2,30	0,50	0,50		0,00		0,00		0,00	0,00	0,00	0,00	0,00	1,40	1,40	0,50	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
WP7.2	Project website	5,10	5,10	1,00	1,00		0,00		0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	4,10	4,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
WP7.3	Dissemination material	17,50	25,16	1,20	2,05	0,00	0,00	1,00	0,00	0,00	0,00	1,00	1,67	0,00	0,00	0,30	0,30	11,50	13,39	0,00	0,00	1,00	3,50	0,50	0,00	1,00	4,25
WP7.4	Project workshops	18,90	14,69	3,50	5,60	0,50	0,55	2,00	0,19	0,00	0,00	1,00	1,25	1,00	1,00	0,30	0,30	1,10	0,60	0,50	0,43	2,70	1,60	0,80	0,75	5,50	2,42
	TOTAL	293,40	329,72	46,20	49,87	6,50	7,01	16,00	13,75	22,00	20,77	30,00	40,14	9,50	14,25	28,50	28,50	38,70	38,07	10,00	12,12	34,20	39,60	24,30	37,59	27,50	28,05

Table 5: Effort allocation status (pm)

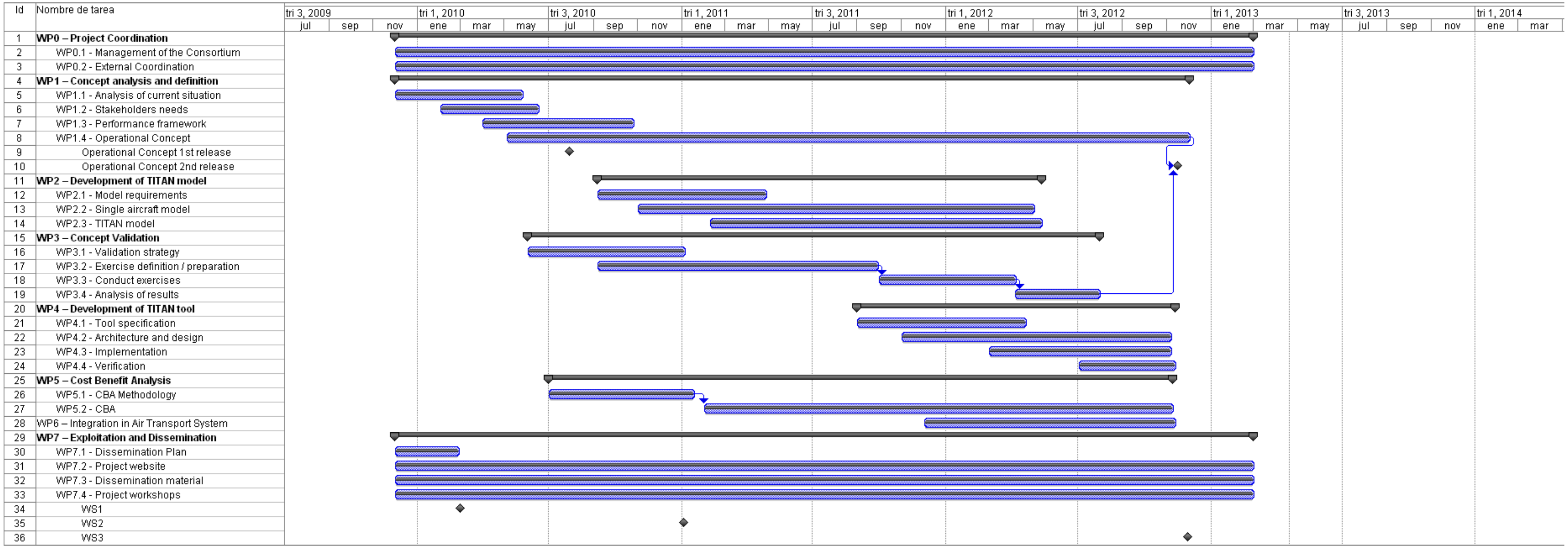


Figure 1: Updated Project Schedule

4. TECHNICAL PROGRESS

This Section contains the technical progress achieved in the TITAN Project during the present reporting period. The following technical Work Packages are considered, as they have been active during the reporting period:

- WP1
- WP3
- WP4
- WP5
- WP6
- WP7

4.1 WP1 – Concept analysis and definition

This Section contains the technical progress achieved in this WP during the present reporting period.

4.1.1 WP objectives of the period

4.1.1.1 WP1.4 – Operational Concept

The objective of WP1.4 during this reporting period was to update the deliverable D1.4 "TITAN Operational Concept Document (Issue 2)" accordingly to the validation results of WP3.3 and WP3.4.

4.1.2 Progress towards objectives

4.1.2.1 WP1.4 – Operational Concept

A continuous update of the TITAN operational concept has been done through these months by working in the levels of information and the set of criteria to identify what is or what is not critical information in the turnaround process. This input came from the WP3.4 after the analysis of the validation results (both gaming and model simulations) out of the WP3.3. Second issue of D1.4 document was delivered the 12th of September.

4.1.3 Meetings

Date	Location	Meeting description
Meetings of the period 6		
22/11/2012	PMI	Final Progress Meeting

Table 6: WP1 meetings

4.1.4 Identified Risks and Problems

This section highlights the risks, problems and/or deviations from the work programme identified during the finished period, as well as the mitigation actions and/or solutions found or proposed.

Id.	WP	Risk description	Level	Impact	Mitigation / Contingency

05	1.4	Late delivery of D3.4	M	Late delivery of D1.4 second issue	Close coordination between WP3.3, 3.4 and 1.4. D1.4 was delayed, but thanks to the close coordination this delay did not affect the global TITAN planning.

Table 7: WP1 risks

4.2 WP3 – Concept validation

This Section contains the technical progress achieved in this WP during the present reporting period.

4.2.1 WP objectives of the period

4.2.1.1 WP3.4 – Analysis of results

The objective of this period was to finalize the analysis of the simulation results as well as to integrate the gaming and simulation results to assess the validation objectives and to consolidate conclusions and recommendations. Analysis of the validation results would be consolidated in the deliverable D3.4 "Validation Report" that would serve as final Validation feedback to the concept development (WP1.4).

4.2.2 Progress towards objectives

4.2.2.1 WP3.4 – Analysis of results

Simulation exercises produced a total of 803 data output files that were statistically analyzed using excel templates adapted to the assessment of the validation objectives. An amount of 66 excel files were used to measure the objectives achievement. Results were then graphically represented and included in the validation report (D3.4) to present the conclusions of the simulation validation activity. Afterwards, consolidated validation results, taking into account gaming and simulation results were elaborated. First draft of the D3.4 "Validation report" including both, gaming and simulation results, was produced to be reviewed by D3.4 participants by the 20th of June. Final D3.4 document including reviews was delivered the 13th of July.

4.2.3 Meetings

Date	Location	Meeting description
Meetings of the period 6		
22/11/2012	PMI	Final Progress Meeting

Table 8: WP3 meetings

4.2.4 Identified Risks and Problems

This section highlights the risks, problems and/or deviations from the work programme identified during the finished period, as well as the mitigation actions and/or solutions found or proposed.

Id.	WP	Risk description	Level	Impact	Mitigation / Contingency
02	3.2	TITAN model from WP2	M	D3.3B was delayed, and	In coordination with the PC, D3.4 was delayed, but in

		not ready		consequently D3.4, which impacted the updating of the Concept Description.	such a manner that it did not affect the global TITAN planning. Important conclusions with respect to the 2nd version of the Concept Description were reported during meetings.

Table 9: WP3 risks

4.3 WP4 – Development of TITAN tool

This Section contains the technical progress achieved in this WP during the present reporting period.

4.3.1 WP objectives of the period

4.3.1.1 WP4.2 – Architecture and design

The objectives of the Architecture and Design during this period were to make iterative progress on the D4.2 “Turnaround Tool Design Document” and on the D4.3 “Turnaround Tool Interface Document” and the design of the interfaces based on the solidified and final requirements from D4.1 “Tool Specification”. The objective was to iteratively update these deliverables in accordance to WP4.3 (Implementation) till the final versions are achieved.

4.3.1.2 WP4.3 – Implementation

The objective of the Implementation phase during this period was to develop the final release of the tool in accordance to WP4.1 requirements and to deliver it to WP4.4 to proceed with its verification.

4.3.1.3 WP4.4 – Verification

In alignment with WP4 coordinator’s tool development and implementation plans, it was agreed in the 5th TITAN Progress Meeting that the intermediate versions of the tool to be delivered could be verified whereby final tool verification would be made possible after the release of the final version of the tool. Taking into account that intermediate versions of the tool were available during this reporting period, verification activities were planned to be completed no later than end of September 2012 (slightly later than initially planned) having no significant delay impact on the project.

4.3.2 Progress towards objectives

4.3.2.1 WP4.2 – Architecture and design

After the final version of the tool was released, D4.2 “Turnaround tool design document” and D4.3 “Turnaround tool interface document” were delivered the 6th November. The delivery was slightly delayed but has no impact on the project.

4.3.2.2 WP4.3 – Implementation

The implementation of the tool mainly took place during this reporting period. It was done in several iterations which resulted in a total of seven releases with minor to medium changes per release.

There were several status phone calls and a total of 2 face-to-face meetings, where the progress of the implementation had been discussed and demonstrated.

The tool itself is composed out of three major modules:

- The TITAN user interface (the end user's tool)
- The TITAN bootstrap
- The TITAN CDM Emulation

It must be noted that the user interface of the tool is far from being operationally usable. The reason for this is that within the TITAN project, the emphasis was put on a functioning server – client architecture to reflect the underlying architecture and associated communication of the modules. An operationally usable interface of the turnaround tool requires a sophisticated analysis of all tasks to be performed and needs to be designed by user interface design specialists. Since this was not within the scope of the TITAN project, the interface was designed to contain the basic information and interaction dialogues to demonstrate the concept feasibility.

By the regular end of the project, all the basic functionalities that were foreseen for the TITAN tool had been implemented. The implementation itself took a little bit longer than originally planned. To overcome any delays that might could have resulted out of this fact, the tool was released in several smaller releases. This allowed the verification to start as planned, but concentrating on the available features from release to release. The final version of D4.4 “Turnaround tool demonstrator” was delivered on the 6th November.

4.3.2.3 WP4.4 – Verification

A hybrid form of testing and demonstration was elicitated to be the most appropriate one for the verification of TITAN tool (tool demonstrator (UI) delivered in testable form by the design team) regarding its conformance to required performance, physical characteristics and design construction features set in the Turnaround Tool Specification Document. Required software operability and meeting of predetermined software responses (based on requirements) under specific scenarios were verified. Where the compliance with requirements was obvious from the design (i.e. system oriented architecture), design as verification method was applied.

As indicated above, the verification was done in several steps according to the availability of the subsequent releases of the tool. Finally, all verification goals have been met and the D4.6 “Turnaround tool verification document” was delivered on the 12th November after carrying out the verification activities described on the D4.5 “Verification plan” on the final release of the TITAN tool.

4.3.3 Meetings

Date	Location	Meeting description
Meetings of the period 6		
26/07/2012	Teleconference	WP4 2st Progress Meeting
04/09/2012	Neu Isenburg	Final Progress meeting
22/11/2012	PMI	Final Progress Meeting

Table 10: WP4 meetings

4.3.4 Identified Risks and Problems

This section highlights the risks, problems and/or deviations from the work programme identified during the finished period, as well as the mitigation actions and/or solutions found or proposed.

Id.	WP	Risk description	Level	Impact	Mitigation / Contingency
1	4	Technical Tools and Environments are not accessible or have downtime	L	Delayed final delivery with o impact in the project	Ensure that there is technical support to help mitigate downtime of tools and able to assist with the infrastructure
2	4	Personnel are not all available	M	Delayed final delivery with no impact in the project	Focus on scope and requirements to ensure that the personnel can fulfill the project scope.
3	4	Implementation does not meet expectations	M	Delayed final delivery with no impact in the project	Frequent releases of 'working' software allow deviations to be identified while there is still a chance to correct them. Demonstration of software during progress meetings allows participants to see the tool without dedicating time/effort to installation and running of the periodic releases
4	4.4	Tool fails testing	M	Delay on test with no impact in the project	Smoke testing of releases reduces the risk of formal test failure

Table 11: WP4 risks

4.4 WP5 – Cost Benefit Analysis

This Section contains the technical progress achieved in this WP during the present reporting period.

4.4.1 WP objectives of the period

4.4.1.1 <u>WP5.2 – CBA</u>

During the current reporting period, the main objective of the WP5 for the period was to complete the deliverable D5.2 "CBA for TITAN Tool ", on November 2012. The Cost Benefit Analysis for the TITAN Tool was based on the CBA methodology developed in the first period.

4.4.2 Progress towards objectives

4.4.2.1 WP5.2 – CBA

The CBA Team built a business model based on the costs – benefits identified and the assumptions agreed by the Consortium in the previous period.

To perform the Cost Benefit Analysis it was necessary to establish a fruitful dialogue amongst the parties involved in the investment decision.

Present the TITAN Concept and Tool, CBA methodology, and share the assumptions and business model to get feedback and more accurate data from their expertise.

The CBA Team put together an information package (“TITAN_TOOL_ Info && Benefits overview” and “CBA_ Assumptions_Interviews”), to facilitate the dialogue between stakeholders, decision makers and CBA team.

The interviews were held during September and October, with three ground handlers (Globalia, Acciona and GlobeGround), one airport (Malpensa) and Eurocontrol. The interviews were conducted by Ecorys, Ineco and BR&T-E.

Based on the feedback received from interviews, the business model, the assumptions, the cost and benefits, were reviewed. The definitive models were created, and the CBA for the TITAN Tool was completed and delivered according to schedule.

4.4.3 Meetings

Date	Location	Meeting description
Meetings of the period 6		
23-23/05/2012	Madrid	WP5.2 Progress meeting
25/07/2012	Madrid	WP5.2 Progress meeting
17/09/2012	Madrid	WP5.2 (Stakeholder interview ANSP)
26/09/2012	PMI	WP5.2 (Stakeholder interview ANSP)
3-4/09/2012	Brussels	WP5.2 (Stakeholder interview)
22/11/2012	PMI	Final Progress Meeting

Table 12: WP5 meetings

4.4.4 Identified Risks and Problems

No risks or problems have been identified during this reporting period.

4.5 WP6 – Integration in Air Transport System

This Section contains the technical progress achieved in this WP during the present reporting period.

4.5.1 WP objectives of the period

The WP objective was to finalize the TITAN Air Transport System Integration Documents (TASID), which define the details of integrating the output of TITAN into the information stream of the different partners concerned with the turnaround process as well integration with the business trajectory. The TITAN related transition considerations are also described.

The TASID comprises four documents as follows:

- D6.1 "Integration plan Airline Operations Centre (AOC)"
- D6.2 "Integration plan airport operations"
- D6.3 "Integration plan business trajectory"
- D6.4 "Transition considerations"

4.5.2 Progress towards objectives

The final versions of all four TASID documents were released on 12 November 2012. These final versions had been reviewed by the other partners, suggestions for improvement were incorporated and several editorial refinements also introduced compared to the earlier, mature draft versions. All four documents were subsequently accepted.

4.5.3 Meetings

Date	Location	Meeting description
Meetings of the period 6		
22/11/2012	PMI	Final Progress Meeting

Table 13: WP6 meetings

4.5.4 Identified Risks and Problems

No risks or problems have been identified during this reporting period.

4.6 WP7 – Exploitation and Dissemination

This Section contains the technical progress achieved in this WP during the present reporting period.

4.6.1 WP objectives of the period

4.6.1.1 <u>WP7.2 – Project website</u>

The main objective of WP7.2 during this period was to maintain and update the project website with information about the project.

4.6.1.2 <u>WP7.3 – Dissemination material</u>

The aim of WP7.3 for this period was to prepare and produce the relevant dissemination material to implement the dissemination strategy established in D7.1 "Dissemination Plan".

4.6.1.3 <u>WP7.4 – Project workshops</u>

The aim of WP7.4 for this period was to prepare and hold the Final project workshop and the five Local workshops that took place during the project extension. The corresponding deliverables describing the main results out of those workshops were also produced.

4.6.2 Progress towards objectives

4.6.2.1 WP7.2 – Project website

The TITAN website is operational since May 2010 and it is running in the following URL: http://www.titan-project.eu

It has been kept running on a basically 24/24 and 7/7 mode (almost 100% availability). The main tasks carried out during this period have been those related to maintenance and the continuous uploading of material (both internal and external).

Some statistics regarding the use of the website are shown in the following figures:

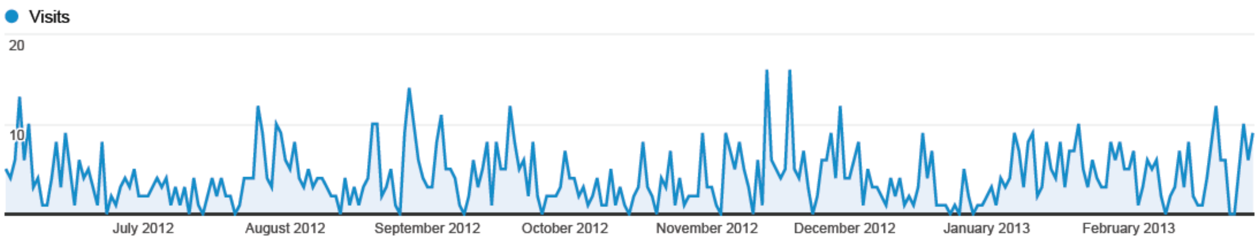
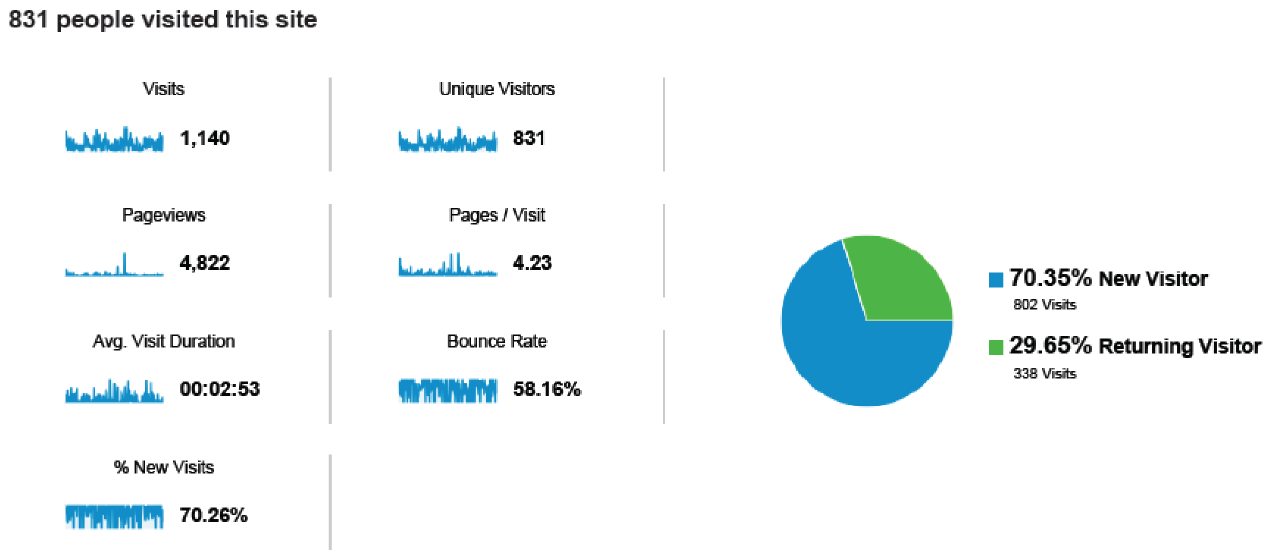


Figure 2: Website visitors' overview

Number of visitors has been increased from the last period. This may be due to the amount of public documents that have been uploaded in the website, as well as the TITAN video and the invitation for the Final Workshop held in Palma de Mallorca.



	Language	Visits	% Visits
1.	en-us	502	44.04%
2.	de-de	98	8.60%
3.	es	83	7.28%
4.	es-es	64	5.61%
5.	fr	57	5.00%
6.	en-gb	51	4.47%
7.	de	47	4.12%
8.	pl	35	3.07%
9.	ru	23	2.02%
10.	it	22	1.93%

Figure 3: Statistics on website visitors

Most visitors were from United States, followed by German, Spanish and then, French and UK. It is also important to highlight that the number of new visitors has increased up to 70,35% of the total visits.

4.6.2.2 WP7.3 – Dissemination material

The following dissemination material was produced during this reporting period:

- D7.4 "Final Project Brochure" as an update of the initial leaflet. New sheets were included with a full description of the main project achievements. This final brochure was provided to the attendees to the different workshops together with a USB in which the public deliverables were available (D7.5).
- D7.6 "Project Video" and D7.13 "TITAN Technical movie". The TITAN video originally foreseen in the project was delivered on time and was shown at the final progress meeting. As planned, it shows a high level description of the principles and features of TITAN, meant for a general audience. When TITAN was extended by three months, a second video was agreed to be delivered. It contains the story part of the original video but is also expanded with more details on the technical features of TITAN and also contains a series of scenes showing the working of TITAN in a real life environment.
- D7.10 "Initial Exploitation Plan" was delivered by 10th December including initial ideas about how to exploit the main results out of the project.
- D7.11 "TITAN - The Book". This deliverable was delivered in March 2013 and contains an easy to read description of the history and current practice of CDM and leads the reader through to why advanced solutions like TITAN are needed, where after it explains the TITAN concept and practice in a way that can be understood also by readers not directly involved in the CDM field. The purpose of the book is to remain a useful reference work even long after the TITAN project has been completed.
- D7.9 "Report on Final Workshop" and D7.12 "Report on Local workshops" were delivered in December 2012 and March 2013 respectively including a description of how those workshops were prepared and held and which were the main outputs out of them.
- Paper "Developing a new ConOps for the a/c turnaround to improve predictability of estimated departure times" for presentation in the ATM Seminar 2013 (June 10-13,

Chicago). This paper has been finally rejected because it did not provide enough analyses for a verification or validation of TITAN.

- Article "Limiting the impact of aircraft turnaround inefficiencies on airport and network operations by channelling turnaround-related information in the aircraft business trajectory processing and the ATM network: Facts and figures from the 7th FP project TITAN" to be published in the Journal of Airport Management that was finally accepted.

4.6.3 Meetings

Date	Location	Meeting description
Meetings of the period 6		
21/11/2012	PMI	Final Workshop
22/11/2012	PMI	Final Progress Meeting
15-16/01/2013	London	META CDM workshop
14/02/2013	Munich	Local workshop
19/02/2013	Budapest	Local workshop
21/02/2013	Milan	Local workshop
25/02/2013	Cologne	Local workshop
28/02/2013	Brussels	Local workshop

Table 14: WP7 meetings

4.6.4 Identified Risks and Problems

No risks or problems have been identified during this reporting period.

5. USE AND DISSEMINATION OF FOREGROUND

This section contains an update of the initial plan for the use and dissemination of foreground included in the Annex I (see [3] with the real dissemination activities undertaken during the project.

5.1 Dissemination of the project results

TITAN intends to advance the research in the turnaround process from a CDM perspective. The operational concept, the TITAN model, the validation results, the TITAN tool demonstrator, the CBA and the integration of TITAN with the air transport system provided by the project have been thoroughly disseminated to the Airport and Air Transport community in order to ensure the success of the work. To reinforce the dissemination of project results, the initial 36-months duration of the project was extended up to 39-months.

A number of activities have been undertaken by the project partners to guarantee that the project results have been properly disseminated:

- Creation and maintenance of the web site (www.titan-project.eu) where all the public documents generated by the project are available to the community.
- Publication of seventeen articles in the Roger-wilco blog where TITAN was established as a separate category in order to make easier the link to the different texts. Those articles have been published all along the duration of the project showing periodically the main achievements to keep the stakeholders' attention on it.
- Participation to conferences and external publications which may be judged as interesting to disseminate the findings of the project. The participation in these events has been closely coordinated with the EC project officer.
- Organization of several workshops to present the results of the project to the community:
    - First workshop in Brussels, March 2010, introduced the project to the attendees and collected some ideas to make up the user's needs;
    - Second workshop in Madrid, February 2011, showed the Concept of Operations (issue 1) to the attendees looking for their feedback and initial validation;
    - Final workshop in Palma de Mallorca, November 2012, showed the whole project results with a positive feedback from the attendees;
    - Five local workshops in February 2013 (Munich, Budapest, Milan, Cologne and Brussels airports) with the aim of disseminating the technical work done during the project and presenting the main outcomes to the relevant stakeholders such as airlines, ground handlers, airport managers or other interested related entities.

      Those Local Workshops attracted a total of 42 qualified attendees demonstrating the industry's interest in the TITAN project results. Besides detailed discussions on the definition of terms (e.g. airside vs. landside) the feedback showed that TITAN managed achieving an important aim: further trustful collaboration of all stakeholders is shared as a prerequisite for improving the turnaround.
- Preparation of two brochures: the first one with the project objectives and the final one including the main findings of the project and an interactive USB with all public deliverables.

- Creation of a Project video and a Technical movie, being the second one a detailed version of the first one with a comprehensive explanation of the Concept of Operations and how it works in a real environment.
- Development of TITAN-The Book which contains an easy to read description of the history and current practice of CDM and leads the reader through to why advanced solutions like TITAN are needed. The purpose of the book is to remain a useful reference work even long after the TITAN project has been completed.

The full list of dissemination activities is included in Table 16 and the list of scientific publications is in Table 15. Only the accepted papers have been included.

5.2 Exploitation of the project results

The work developed in the TITAN project could constitute the basis for future developments aiming at a full operational implementation of the concept. Being aware of this fact, the general specification activities of the project have produced public deliverables which could eventually become public standards when processed through the appropriate channels.

On the other hand, the specific implementation carried out in WP2 "Development of TITAN Model" and WP4 "Development of TITAN tool", envisages certain Intellectual Property Protection (IPR) issues. All these IPR issues, as well as the ownership of the knowledge created by the project (foreground knowledge) and the rules to access background knowledge have been addressed by the Consortium Agreement among project partners.

The D7.10 "Initial Exploitation Plan" can be considered the path to be followed by the results of the TITAN project, both those that are released to the community and those that could become the seed of commercial developments. The different exploitable items such as marketable products, ideas, research results and foreground generated within the project have been identified there. The exploitation plan assesses, for each of these items that are precisely defined, the involved partners and their roles, the exploitation policy (direct, spin-off, license…), the exploitation time frame, technical and economical market considerations as well as further additional research and development activities, intellectual property rights already initiated commercial partnerships and contacts and any other collaborative issues. Table 17 summarizes the content of this deliverable and lists the exploitable foreground of TITAN project.

There is no applicant for patents, trademarks, registered designs, etc. so template B1 is not applicable.

LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES

NO.	Title	Main author	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[3] (if available)	Is/Will open access[4] provided to this publication?
1	Limiting the impact of aircraft turnaround inefficiencies on airport and network operations by channeling turnaround-related information in the aircraft business trajectory processing and the ATM network: Facts and figures from the 7th FP project TITAN	Aachen University, BluSky, Ineco, Isdefe Jeppesen, Slot	2013, Vol. 7.3	Journal of Airport Management		2013			No (journal)
2	Improving Turnaround Predictability: TITAN	Ineco	30th March – 1st April 2011	Aerodays 2011, EC – European Research Area and CDTI	Madrid	2011	10		Yes (book)

[3] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).

[4] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES									
3	Operational Concept Validation Model Based on Performance assessment allowing continuous Outcome monitoring	Crida	6th – 9th July 2011	4th International Conference on Experiments/Process/System Modelling/Simulation/Optimization	Athens	2011			No
4	Benefits of turnaround integration into the airport business trajectory: TITAN	Isdefe	19th – 20th April 2012	Transport NET / AIRDEV Airport Development 2012	Lisbon	2012			No
5	Service-oriented Architecture to improve Efficiency and Predictability of the Turnaround Process at civil airports	Aachen University	4th -6th July 2012	5th international Conference "From Scientific Computing to Computational Engineering" (IC-SCCE)	Athens	2012			No
6	Turnaround integration in trajectory and network: development of an aircraft turnaround Decision-support tool	Aachen University	10th -12th September 2012	61st Detscher Luft-und Raumfahrtkongress (DLRK)	Berlin	2012			No
7	TITAN kicks into gear high gear	BluSky	08/12/2009	Roger-Wilco Blog	Website	2009		www.roger-wilco.net	Yes
8	First TITAN workshops – Brussels 17 March 2010	BluSky	07/04/2010	Roger-Wilco Blog	Website	2010		www.roger-wilco.net	Yes
9	TITAN stakeholder workshop – 17 March 2010	BluSky	31/05/2010	Roger-Wilco Blog	Website	2010		www.roger-wilco.net	Yes

LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES									
10	The TITAN project – one year down the road	BluSky	06/12/2010	Roger-Wilco Blog	Website	2010		www.roger-wilco.net	Yes
11	Second TITAN Workshops – All are welcome!	BluSky	08/02/2011	Roger-Wilco Blog	Website	2011		www.roger-wilco.net	Yes
12	Successful second workshop held by TITAN	BluSky	03/03/2011	Roger-Wilco Blog	Website	2011		www.roger-wilco.net	Yes
13	TITAN – new category on Roger - Wilco	BluSky	26/05/2011	Roger-Wilco Blog	Website	2011		www.roger-wilco.net	Yes
14	TITAN mid-term Progress Meeting	BluSky	10/06/2011	Roger-Wilco Blog	Website	2011		www.roger-wilco.net	Yes
15	The significance of services in TITAN	BluSky	17/06/2011	Roger-Wilco Blog	Website	2011		www.roger-wilco.net	Yes
16	TITAN – a smart layer upon Airport CDN	Slot	17/08/2011	Roger-Wilco Blog	Website	2011		www.roger-wilco.net	Yes
17	TITAN – the best game in town	BluSky	14/11/2011	Roger-Wilco Blog	Website	2011		www.roger-wilco.net	Yes
18	TITAN Kicks-off its "integration in the air transport system" and holds fourth progress meeting	BluSky	31/01/2012	Roger-Wilco Blog	Website	2012		www.roger-wilco.net	Yes
19	The principles of the TITAN tool GUI	BluSky	26/05/2012	Roger-Wilco Blog	Website	2012		www.roger-wilco.net	Yes

Table 15: List of scientific publications

LIST OF DISSEMINATION ACTIVITIES								
NO.	**Type of activities**[5]	**Main leader**	**Title**	**Date/Period**	**Place**	**Type of audience**[6]	**Size of audience**	**Countries addressed**
1	Workshop	Ineco	First TITAN workshop	17th March 2010	Brussels	Airlines, Ground handlers, Airports	Around 15 persons	European Countries
2	Workshop	Ineco	Second TITAN workshop	22nd February 2011	Madrid	Airlines, Ground handlers, Airports, ANSPs	Around 15 persons	European Countries
3	Conference	Ineco	6th European Aeronautics Days (Aerodays)	30th of March 1st of April 2011	Madrid	Stakeholders of transport sector (airports & Airlines), experts form space and security	Around 100 persons	European Countries
4	Workshop	Ineco	6th CEARES Workshop	15th -16th June 2011	Warsaw	Aviation community	Around 50 persons	European Countries
5	Conference	Crida	4th International Conference on Experiments/Process/System Modelling/Simulat./Optimization	6th – 9th July 2011	Athens	Research community		European Countries
6	Users Group	RWTH Aachen	37th ESUG Meeting	14th - 15th April 2011	Toulouse	Simulations Experts, Airbus Airport	Around 20 participants	European Countries

[5] A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.

[6] A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).

LIST OF DISSEMINATION ACTIVITIES

						Operations		
7	Congress	Ineco	III RIDITA Congress of Latin-American Air Transport	19 - 21 October 2011	Madrid	Aviation authorities, aircraft and equipment manufacturers, airlines, airports and ANSPs, consultants.		Latinamerica and Spain
8	Conference	Isdefe	AIRDEV (Airport Development) 2012	19th - 20th April 2012	Lisbon	Academic Audience, Air transport and Airport sectors		Europe & America
9	Users Group	Aachen University	39th ESUG (SIMMOD Users Group)	26th - 27th of April 2012	Munich	Simulation experts, Oslo Airport, Avinor, DGAC, Universities	Around 15 persons	European Countries
10	Conference	Aachen University	5th international Conference "From Scientific Computing to Computational Engineering" (IC-SCCE)	4th – 6th July 2012	Athens	Air transport industry, Airports, airlines		European Countries
11	Congress	Aachen University	61st Detscher Luft-und Raumfahrtkongress (DLRK)	10th – 12th September 2012	Berlin	Transport community		Germany
12	Workshop	Ineco	Final TITAN workshop	21st November 2012	Palma de Mallorca	Airlines, Ground handlers, Airports, ANSPs	Around 15 persons	European Countries
13	Workshop	Ineco	META-CDM workshop	15th – 16th January 2013	London	CDM community		European Countries

LIST OF DISSEMINATION ACTIVITIES								
14	Workshop	Aachen University	Munich TITAN workshop	14th February 2013	Munich	Airport, airlines, ground handlers	Around 10 persons	Germany
15	Workshop	Slot	Budapest TITAN workshop	19th February 2013	Budapest	Airport, airlines, ground handlers	Around 5 persons	Hungary
16	Workshop	Ineco	Milan TITAN workshop	21th February 2013	Milan	Airport, airlines, ground handlers	Around 15 persons	Italy
17	Workshop	Aachen University	Cologne TITAN workshop	25th February 2013	Cologne	Airport, airlines, ground handlers	Around 5 persons	Germany
18	Workshop	Ineco, Blusky	Brussels TITAN workshop	28th February 2013	Brussels	Airport, airlines, ground handlers, EUROCONTROL	Around 10 persons	Belgium

Table 16: List of dissemination activities

Type of Exploitable Foreground[7]	Description of exploitable foreground	Confidential	Foreseen embargo date	Exploitable product(s) or measure(s)	Sector(s) of application[8]	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved[9]
General advancement of knowledge	Research on current turnaround processes	No			Air Transport			Slot
General advancement of knowledge	Operational Concept	No			Air Transport			Ineco
General advancement of knowledge	Operational Concept Validation	No			Air Transport			Isdefe
Commercial exploitation of R&D results	TITAN Model	No		Future versions of the TITAN Model	Air Transport		License needed (to be requested from ISA SW)	ISA SW
General advancement of knowledge	TITAN Tool	No			Air Transport			Jeppesen

[7] A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.

[8] A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

[9] Only the main contributor has been identified. In most cases, the whole consortium has contributed to the development of the foreground.

Type of Exploitable Foreground[7]	Description of exploitable foreground	Confidential	Foreseen embargo date	Exploitable product(s) or measure(s)	Sector(s) of application[8]	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved[9]
General advancement of knowledge	Cost Benefit Analysis	No			Air Transport			Boeing
General advancement of knowledge	Integration in Air Transport System	No			Air Transport			BluSky

Table 17: Exploitable foreground

6. REPORT ON SOCIETAL IMPLICATIONS

A General Information *(completed automatically when **Grant Agreement number** is entered.*

Grant Agreement Number:	233690
Title of Project:	TITAN - Turnaround Integration in Trajectory and Network
Name and Title of Coordinator:	Laura Serrano

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'*	No
2. Please indicate whether your project involved any of the following issues (tick box) :	
RESEARCH ON HUMANS	
• Did the project involve children?	No
• Did the project involve patients?	No
• Did the project involve persons not able to give consent?	No
• Did the project involve adult healthy volunteers?	No
• Did the project involve Human genetic material?	No
• Did the project involve Human biological samples?	No
• Did the project involve Human data collection?	No
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	No
• Did the project involve Human Foetal Tissue / Cells?	No
• Did the project involve Human Embryonic Stem Cells (hESCs)?	No
• Did the project on human Embryonic Stem Cells involve cells in culture?	No
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	No
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	No
• Did the project involve tracking the location or observation of people?	No
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	No
• Were those animals transgenic small laboratory animals?	No
• Were those animals transgenic farm animals?	No
• Were those animals cloned farm animals?	No
• Were those animals non-human primates?	No
RESEARCH INVOLVING DEVELOPING COUNTRIES	

• Did the project involve the use of local resources (genetic, animal, plant etc)?	No
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	No
DUAL USE	
• Research having direct military use	No
• Research having the potential for terrorist abuse	No

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	1	
Work package leaders	3	4
Experienced researchers (i.e. PhD holders)		
PhD Students		
Other	11	11

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	**1**
Of which, indicate the number of men:	1

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?	○ X	Yes 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)?

- ○ Yes- please specify
- X No

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

- X Yes- please specify: Website, brochures, USB
- ○ No

F Interdisciplinarity

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

- ○ Main discipline[10]: 2
- ○ Associated discipline: 2.3
- ○ Associated discipline:

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)*	○ X	Yes No

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

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

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)
- ○ 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?	**4**
To how many of these is open access[11] provided?	
How many of these are published in open access journals?	**0**
How many of these are published in open repositories?	**0**
To how many of these is open access not provided?	**4**
Please check all applicable reasons for not providing open access:	
❑ publisher's licensing agreement would not permit publishing in a repository X no suitable repository available X no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources X lack of information on open access ❑ other[12]: ……………	

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?	
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,	X	None of the above / not relevant to the project

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

[12] For instance: classification for security project.

❑	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: Difficult to estimate / not possible to quantify	*Indicate figure:* X

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?

X Yes ◯ 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?

❑	Press Release	❑	Coverage in specialist press
❑	Media briefing	❑	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?

❑	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]