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Economic Commission for Europe

Inland Transport Committee

Working Party on Customs Questions affecting Transport

Informal Ad hoc Expert Group on Conceptual and Technical Aspects of Computerization of the TIR Procedure

Twenty-first session
Bratislava, 25–26 September 2012
Item 4 of the provisional agenda
Financial implications of the introduction of the eTIR international system

Cost Benefit Analysis of the eTIR system

Note by the secretariat

I. Background

1. At its forty-eighth session, further to requests from the Inland Transport Committee (ITC), WP.30 and Informal Ad hoc Expert Group on Conceptual and Technical aspects of Computerization of the TIR Procedure (GE.1), the TIR Executive Board mandated the secretariat to conduct a cost-benefit analysis of the eTIR Project (TIRExB/REP/2011/48final para. 10). Consequently, taking into account the funds available in the TIRExB consultancy budget line and the task to be undertaken, the TIR secretariat requested the relevant services in the United Nations Office at Geneva (UNOG) to issue a tender. In line with the applicable United Nations procurement principles, rules and procedures, UNOG sent out a request for quotes to five companies. Two companies submitted a bid, which were evaluated. Subsequently, the contract was awarded to the qualified bidder whose bid substantially conformed to the requirements set forth in the solicitation documents and who had been evaluated as being most cost-efficient for the United Nations.

2. At its twentieth session, GE.1 1 welcomed the draft cost-benefit analysis (CBA), presented in Informal documents GE.1 No. 6a, 6b, 6c, 6d and 6e (2012). The Expert Group welcomed the summary presentation by the secretariat, but expressed its regret that the consultants had not been in a position to attend the meeting themselves in order to present the CBA and take part in the ensuing discussions. The Expert Group expressed its general consent with the methodology used by the consultants, while, at the same time, raising

preliminary comments with regard to various assumptions used by the consultants in the course of the CBA. Inter alia, the Expert Group was of the opinion that the two scenarios described in the CBA (gradual introduction of eTIR Carnets versus the one time replacement of the paper TIR system by an electronic system, the so-called "big-bang" scenario were too optimistic and requested the unrealistic "big-bang" scenario, to be replaced by a more pessimistic (read: more realistic) one. In reply to suggestions that the scenarios used should be based on complex forecasts on the long-term development of transport flows between TIR Contracting Parties, the secretariat recalled that the CBA had been adjudged to the consultants on the basis of a clear mandate and with a limited budget and that, therefore, it was unrealistic to expect them to undertake such complex simulation exercise, in addition to their work so far. As a consequence, it should be clearly understood that, although comments to improve quality are most welcome, changes which go beyond the defined scope of the CBA cannot be taken into consideration. To wrap up its initial discussions on the issue, the Expert Group requested additional time in order to provide the secretariat in writing with its comments on the draft CBA and proposed that eTIR focal points would also be given the opportunity to submit their contributions. Further to this request, the secretariat sent an email to eTIR focal points, soliciting their considerations on the draft CBA. Deadline for submission of written contributions for both the Expert Group and eTIR focal points has been set at 15 May 2012. The secretariat stressed the importance that comments, rather than being generic or proposing a substantial or methodological re-assessment of the CBA, be accompanied, to the extent possible, by concrete proposals in order to allow the consultants to improve the final CBA.

II. Disclaimer

3. All parts of the cost-benefit analysis, including but not limited to the various assumptions on which they are based, are the sole responsibility of the authors and do not necessarily reflect the views of the UNECE secretariat. As yet, the UNECE secretariat's contribution to the analysis has been limited to ensuring that the methodologies required for a successful cost-benefit analysis have been properly applied. Considering that the cost-benefit analysis is still under review and may, possibly, be subject to further amendments, the results presented in the annex should be considered as provisional and as merely intended to brief GE.1 on the current state of play with regard to the issue at stake.

III. Further considerations

4. Further to comments by GE.1, eTIR focal points and the secretariat, the consultants prepared a final version of the CBA, which is contained in this Informal document, for consideration by the Expert Group.

Cost Benefit analysis

September 2012

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United Nations

Economic Commission for Europe

Inland Transport Committee

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We will refer to SIVECO Romania SA in the present document by using **SIVECO**.

The current project: the Cost Benefit Analysis of eTIR will be referred to in this document as **eTIR-CBA.**

This document is going to be reviewed by UNECE and accepted.

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0. EXECUTIVE SUMMARY

0.1. ARCHITECTURE ALTERNATIVES

Based on the efforts already made in the Reference Model V3.0, we established the main architecture-related alternatives that will be taken into account in our analysis.

Three major alternatives, each one with several options has been further considered in the evaluation of the cost-benefit analysis:

- Implementation using cloud computing concepts
- Hosting all hardware infrastructure, hardware systems and software systems at the premises of the owner of the eTIR system and using a completely separate environment ;
- Implementation using cloud computing concepts by hosting the eTIR system at the premises of other IT systems. The infrastructure or the platform will be provided by a third party, e.g. UNOG (United Nations Office at Geneva) or UNICC (United Nations International Computing Centre);

From a technical point of view, the classification of solutions (the first is the best one) is the following:

1. Cloud computing implementation on a platform ;
2. UNOG, UNICC;
3. At one's own premises.

0.2. COST, BENEFIT ANALYSIS

The cost analysis was made considering 2 years for the system development and setup, and the following 10 years for operations, and contains the following:

- Costs evaluation for the development and implementation;
- Initial costs necessary for the system setup;
- Operational costs;
- Helpdesk costs;
- Costs necessary for the setup of the national customs IT system.

The cost evaluation for the development and implementation was based on the evaluation of the system's dimensions, performed by using Function Point Analysis and Analogy Estimation.

The development costs are considered to be the same for all architecture alternatives.

This risk ratio was selected as being 20%, based on the risk appetite used by SIVECO and also by other important software development companies, for successful software development projects.

All costs were evaluated for two scenarios:

- Gradual implementation of the eTIR system over a 10 year period (reaching 3 million TIR transports);
- Gradual implementation of the eTIR system over a 10 year period, while only 1.5 million of TIR transports will be computerized.

For each alternative, the architectures considered were: at premises, UNOG/ UNICC and cloud computing implementation.

Subsequently, the Return On Investment (ROI) for individual Customs authorities was computed. This calculation emphasizes that the ROI increases as the number of registered eTIR Carnets increases and become positive as of 30, 000 eTIR Carnets registered per year.

The final and consolidated results indicate that the total costs, benefits, ROI are presented below:

0.2.1. Costs, Benefits and ROI for system launched for eTIR Carnets distributed gradually, finally all TIR Carnets registered in eTIR

			Premises	UNOG	UNICC	PAAS	IAAS	SAAS
Costs	**Total Dev, Operational;**	Development	924,800	924,800	924,800	924,800	924,800	0
		Initial	1,255,000	681,500	632,000	192,000	632,000	60,000
		Operational+Hostin	2,210,000	1,190,000	850,000	1,020,000	680,000	8,500,000
	Total Dev, Operationa;		4,389,800	2,796,300	2,406,800	2,136,800	2,236,800	8,560,000
	Help Desk		1,286,300	1,286,300	1,286,300	1,286,300	1,286,300	1,286,300
	National App		8,550,000	8,550,000	8,550,000	8,550,000	8,550,000	8,550,000
Total Costs			14,226,100	12,632,600	12,243,100	11,973,100	12,073,100	18,396,300
Total Costs (incl. 20% risk factor)			17,071,320	15,159,120	14,691,720	14,367,720	14,487,720	22,075,560
Discounted Costs (incl. risk factor)			13,490,985	12,021,268	11,689,412	11,336,844	11,551,097	16,192,129
Benefits for Customs (incl. 20% risk factor)			19,550,000	19,550,000	19,550,000	19,550,000	19,550,000	19,550,000
Total Benefits (incl. 20% risk factor)			121,210,000	121,210,000	121,210,000	121,210,000	121,210,000	121,210,000
Discounted Customs Benefits (incl.risk factor)			13,255,247	13,255,247	13,255,247	13,255,247	13,255,247	13,255,247
Discounted Overall Benefits (incl.risk factor)			82,182,532	82,182,532	82,182,532	82,182,532	82,182,532	82,182,532
ROI for Customs			-2%	10%	13%	17%	15%	-18%
Overall ROI			509%	584%	603%	625%	611%	408%
Net present value			43,002,042	44,471,759	44,803,614	45,156,183	44,941,930	40,300,898

Table 1. Costs, Benefits (USD) and ROI for system launched for eTIR Carnets distributed gradually, finally all TIR Carnets registered in eTIR

0.2.2. Costs, Benefits, ROI for system launched for eTIR Carnets distributed gradually, half usage of eTIR

			Premises	UNOG	UNICC	PAAS	IAAS	SAAS
Costs	**Total Dev, Operational;**	Development	924,800	924,800	924,800	924,800	924,800	0
		Initial	1,255,000	681,500	632,000	192,000	632,000	60,000
		Operational+Hostin	2,210,000	577,500	412,500	495,000	330,000	4,125,000
	Total Dev, Operationa;		4,389,800	2,183,800	1,969,300	1,611,800	1,886,800	4,185,000
	Help Desk		1,286,300	1,286,300	1,286,300	1,286,300	1,286,300	1,286,300
	National App		8,550,000	8,550,000	8,550,000	8,550,000	8,550,000	8,550,000
Total Costs			14,226,100	12,020,100	11,805,600	11,448,100	11,723,100	14,021,300
Total Costs (incl. 20% risk factor)			17,071,320	14,424,120	14,166,720	13,737,720	14,067,720	16,825,560
Discounted Costs (incl. risk factor)			13,490,985	11,520,977	11,332,061	10,908,023	11,265,216	12,618,620
Benefits for Customs (incl. 20% risk factor)			9,487,500	9,487,500	9,487,500	9,487,500	9,487,500	9,487,500
Total Benefits (incl. 20% risk factor)			58,822,500	58,822,500	58,822,500	58,822,500	58,822,500	58,822,500
Discounted Customs Benefits (incl.risk factor)			6,406,022	6,406,022	6,406,022	6,406,022	6,406,022	6,406,022
Discounted Overall Benefits (incl.risk factor)			39,717,335	39,717,335	39,717,335	39,717,335	39,717,335	39,717,335
ROI for Customs			-53%	-44%	-43%	-41%	-43%	-49%
Overall ROI			194%	245%	250%	264%	253%	215%
Net present value			13,689,953	15,659,961	15,848,877	16,272,916	15,915,722	14,562,318

Table 2. Costs, Benefits (USD) and ROI for system launched for eTIR Carnets distributed gradually, half usage of eTIR

1. INTRODUCTION

1.1. PROJECT OVERALL OBJECTIVE

The overall objective of the eTIR-CBA project is to analyze, from a technical and financial perspective, various technical options for the implementation of eTIR system for two scenarios:

- Gradual implementation of the eTIR system over a 10 year period (reaching 3 million TIR transports);
- Gradual implementation of the eTIR system over a 10 year period, while only 1.5 million of TIR transports will be computerized.

The first step in accomplishing this objective is defining the architecture alternatives, see Annex A.1.

The second step is an estimation of the software development costs for eTIR international system.

The third step is dedicated to the cost analysis (total cost of ownership - TCO) for the various architecture alternatives.

The fourth step is dedicated to the benefits analysis**,** ROI and Cash Flow.

Finally, conclusions and recommendations are formulated.

1.2. BACKGROUND

UNECE administers the TIR Convention, which was established in 1975 and has 68 Contracting Parties. The Convention provides for an internationally recognized procedure for facilitating cross- border transportation of goods in transit through the use of a standard, internationally recognized transit document (TIR Carnet).

For many years, the TIR Convention proved to be an effective facilitation tool. Nowadays, with the progress of technology, the use of the paper –based TIR Carnet seems to be obsolete, in particular when it comes to linking it to the procedures applied by the national Customs administrations.

At each border crossing, Customs officers are faced with the additional work of handling TIR Carnets in their national electronic system, often having to retype up to 50 data elements into the system, not to mention the risk due to human error.

Furthermore, this situation does not enable Customs authorities to effectively apply risk management procedures based on advanced cargo information, as it is demanded by an increasingly security-conscious environment.

In view of the above, the Working Party on Customs Questions affecting Transport has initiated the computerization of the TIR procedure (so-called “eTIR Project”), which aims, inter alia, at developing an information exchange platform for all actors involved in the TIR system, known as the eTIR international system.

Moreover, the introduction of the “TIR system” also implies parallel efforts from the Contracting Parties and the Guarantee Chain to develop or update national or private systems respectively.

The main project beneficiaries will be: Customs administrations of the Contracting Parties to the TIR Convention which use the TIR procedure, transport operators using the TIR procedure and the international Guarantee Chain on a daily basis, providing the required international warranties covering the TIR transports.

The computerization of the TIR procedure requires computerization of the information management by all the players involved in the procedure. Whereas most Customs administrations and the current Guarantee Chain have already partially or totally introduced IT into their part of the

TIR procedure, the functions embedded in the paper-based TIR Carnet are not yet computerized (IT- based).

The eTIR international system will therefore be a platform allowing the management by the Customs authorities of data on guarantees and the secure exchange of data between national Customs systems related to the international transit of goods, vehicles and/or containers according to the provisions of the TIR Convention.

The eTIR international system is involved in two parts of the procedure. On one hand, the Guarantee Chain will transmit information on the guarantees it has issued to the holders, so that those guarantees can be registered in the eTIR international system. On the other hand, the Customs authorities will use the eTIR international system to check the status of guarantees and to exchange information related to the TIR transport and to TIR operations.

Thus, the management by the Customs of the data on guarantees and the secured exchange of data between national Customs systems in relation to TIR transport information are the two basic features of the eTIR international system.

The eTIR project will also provide guidelines for promoting harmonization, especially in the context of the dialogue between the holder and the Customs authorities (standard declarations). Communication, security and fallback solutions constitute other key features of the system.

In view of the cost-benefit analysis of introducing the eTIR system, the financial benefits brought to all the actors (stakeholders) involved are expressed as major cost-reductions regarding operations.

2. DEVELOPMENT COSTS ESTIMATIONS

2.1. INTRODUCTION

This chapter presents a detailed estimation of the system dimensions and also estimates the costs and schedules for development. The final conclusion obtained after the whole estimation process, indicates the following costs for development:

The estimations of the eTIR international system have been performed while taking into account the functional and technical specifications contained in the eTIR Reference Model 3.0.

The estimations were made following several steps:

Step 1: Total Unadjusted Function Points (TUFP) were estimated based on the functional and technical specifications from the eTIR Reference Model using the methodology presented in Annex A.3.

Step 2: Adjusted Processing Complexity (APC) was computed based on the Architecture alternatives presented in Annex A.1.

Step 3: Total Adjusted Function Points (TAFP) were calculated by applying APC to TUFP.

Step 4: Schedule and cost estimations were performed by means of applying the COCOMO II methodology, based on TAFP and environment variables.

2.2. ASSUMPTIONS

2.2.1. Assumptions regarding the quantity and type of data to be processed

The assumptions are based on the document **ECE/TRANS/WP.30/GE.1/2011/5 [R5]** and are reproduced below.

"On the basis of the functional requirements laid down in Chapter 2 and 3 of the eTIR Reference model1 and the available statistics on the distribution of TIR Carnets, the meeting formulated a set of preliminary assumptions with regard to the possible technical specifications of the future eTIR international system, as follows:"

• The eTIR international system should be able to manage approximately 3 million TIR transports per year;

• Each TIR transport consists, on average, of 3 TIR operations;

• 1% of guarantees, issued by the guarantee chain, are cancelled every year;

• 50% of all TIR transports give rise to direct queries of the eTIR international system, from both Customs and the guarantee chain;

• 10% of all initially lodged Customs declarations are later amended.

Estimated number of messages *Various types of eTIR messages*	*No. of messages*
Incoming	
E1 – Register guarantee	3,030,000
E3 – Cancel guarantee	30,000
E5 – Query guarantee	1,515,000
I1 – Accept guarantee	3,000,000
I5 – Query guarantee	1,500,000
I7 – Record Advance Cargo Information	3,300,000
I9 – Start TIR operation	9,000,000
I11 – Terminate TIR operation	9,000,000
I13 – Discharge TIR operation	9,000,000

Total Incoming	**39,375,000**
Outgoing	
I3 – Get holder info	27,375,000
E7 – Notify guarantee chain	33,300,000
I15 – Notify Customs	3,300,000
Total outgoing	**63,975,000**

Table 3. Presents the assumed number of each message, as well as the totals.

2.2.2. Assumptions regarding the eTIR International functional components

Three main functional components of the eTIR International system are considered:

1. eTIR international kernel (called also eTIR kernel). This is the main component responsible for the business logic and data exchange, using web services.
2. eTIR international user interface system. This system is used as fallback procedure, to enter data into the system using a user interface. The business logic used is similar to the one used for the eTIR international kernel.
3. eTIR administration console, which is used in order to:
    a. Manage users, connections, reference data;
    b. Monitor the system;
    c. Audit actions.

The estimations were first performed for each functional component before presenting the aggregated results.

2.3. FPA ESTIMATION RESULTS

The final results after applying the FPA methodology are presented below.

The detailed estimation is presented in Annex A.3.

We present firstly a separated estimation for each functional module, then a consolidated estimation.

2.3.1. Assumptions, limitations

- All answer messages (I2, I4, I14, E2, E4, E10) were considered as just answers given by the system, without persistence in the system and consequently not counted as EO or ILF, but just as a RET for an EI or an EQ;
- Error messages were not counted as EO (just RET for EI);
- The workflow is considered established, and hardcoded. No changes in the messages' workflow are possible without changing the software;
- There is no separate history of actions. All messages are stored, but no separate history mechanism is considered;
- No follow-up of messages is possible, apart from the answer whether a message was received or not;
- There is no browsing mechanism for messages. If such a mechanism is necessary, new external enquiries should be defined;
- No risk analysis checks have been considered. If the checking of risky transactions is necessary, then new external enquiries should be defined;
- No printing mechanism exists for eTIR data;
- No export of data in other formats than the XML native format;
- No queue mechanism is considered.

2.3.2. Estimation results for the eTIR international kernel

Function Point Estimation Worksheet							
Description	Complexity						
	Low		Medium		High		Total
EI	1	x 3	2	x 4	7	x 6	53
EO	0	x 4	1	x 5	1	x 7	12
EQ	1	x 3		x 4	1	x 6	9
ILF	42	x 7	2	x 10	0	x 15	314
EIF	1	x 5	0	x 7	0	x 10	5
Total Unadjusted Function Points (TUFP):							**393**

2.3.3. Estimation results for the eTIR user interface

Function Point Estimation Worksheet							
	Complexity						
Description	Low		Medium		High		Total
EI	1	x 3	2	x 4	7	x 6	53
EO	0	x 4	1	x 5	1	x 7	12
EQ	1	x 3	10	x 4	1	x 6	49
ILF	42	x 7	2	x 10	0	x 15	314
EIF	1	x 5	0	x 7	0	x 10	5
Total Unadjusted Function Points (TUFP):							**433**

2.3.4. Estimation results for the eTIR administration console

Function Point Estimation – eTIR administration console							
	Complexity						
Description	Low		Medium		High		Total
EI	6	x 3	1	x 4	2	x 6	34
EO	8	x 4	1	x 5	0	x 7	37
EQ	1	x 3	6	x 4	0	x 6	27
ILF	8	x 7	0	x 10	0	x 15	56
EIF	6	x 5	1	x 7	0	x 10	37
Total Unadjusted Function Points (TUFP):							**191**

2.3.5. Estimation results for the full eTIR international system

No	Component	TUFP
1	eTIR international kernel	393
2	eTIR user interface	433
3	eTIR administration console	191
	Total	***1,017***

2.3.6. General system characteristics influencing estimations

The general characteristics of the system have been used to compute the Total Adjusted Function Points, which subsequently are the input of the costs estimation.

GENERAL SYSTEM CHARACTERISTICS	Effect (0-5)
Centralized approach	5
Service Oriented Architecture	4
System Performance	5
Heavily Used Configuration, availability	5
Transaction frequencies, scalability	5
Online data entry	5
User-friendly interface, documentation quality	4
Online updates	4
Complexity of processing	4
Reusability of data (non-redundancy)	3
Easy to be installed and configured	4
Integration with third party applications, especially report tools	4
Configurable at runtime, facilitates change	5
Reliability and stability	5

Table 4. General system characteristics

0=no effect on processing complexity;
5=great effect on processing complexity;

Process complexity: 62
Adjusted Processing Complexity (PCA) =1.27

2.3.7. Total Adjusted Function Points (TAFP):

No	Component	TUFP	TAFP
1	eTIR international kernel	393	500
2	eTIR user interface	433	550
3	eTIR administration console	191	243
	Total	***1,017***	***1,293***

Table 5. Total adjusted Function Points

2.3.8. Final remarks on FPA estimation

The estimation considers developing the system from scratch. For this very reason, some efforts could be smaller due to the existence of the eTIR Reference Model, which contains parts of the analysis and design phases.

By using analogy with other Customs systems, for which detailed data on project costs and schedule has been available, the current FPA estimation indicates that

- The overestimation risk is very low (<5%);
- The underestimation risk is acceptable (<20%).

2.4. FINAL RESULTS

Based on the schedule and cost estimations presented in Annex A.4, the development costs for the various implementation types are as follows:

	Development	
Impl. Type	***Current USD***	
	Min	***Max***
On premises	924,800	1,127,000
UNOG	924,800	1,127,000
UNICC	924,800	1,127,000
IaaS	924,800	1,127,000
PaaS	924,800	1,127,000
SaaS	0	0

Table 6. Summary of development costs

The costs are not dependent on the software architecture used.

A shorter development duration, employing a highly experienced team is calculated as follows:
Effort = 115.6 Person-months;
Unit Cost $8,000 man/month;
Schedule = 17.6 Months;

A longer development duration, employing a medium experienced team is calculated as follows:
Effort = 225.4 Person-months;
Unit Cost $5,000 man/month;
Schedule = 21.9 Months;

The above table is computed by summing up the costs estimated in current USD, based on FP.

Minimal values (first column) are computed by considering the minimal costs for development (cost estimations for the development of the full system, employing a highly experienced team)

Maximal values (second column) are computed by considering the maximal costs for development (cost estimates for the development of the full system, employing a medium experienced team).

We do not consider a risk ratio, as the development will be done in the first years and, in this case, the risk is covered by the buffer between the minimal and maximal costs.

2.5. CONCLUSIONS

For the eTIR international system, composed of three functional components (eTIR kernel, eTIR user interface and the eTIR administration console), the cost estimations are as follows:

- Development costs are between $924,800 and $1,127,000, depending on the qualifications of the development team and assuming the resources' costs at European level ;
- Development time varies from 17 to 22 months, depending on the qualifications of the development team;
- The development team can be reasonably small (maximum 9 persons for the highly experienced team and maximum 16 persons for the medium experienced team).

For the eTIR international kernel and administration console:

- Development costs are between $485,000 and $613,000, depending on the qualifications of the development team and assuming the resources' costs at European level;
- Development time varies from 15 to 18 months depending on the qualifications of the development team;
- The development team can be reasonably small (maximum 6 persons for the highly experienced team and maximum 9 persons for the medium experienced team).

For the eTIR international kernel:

- Development costs are between $330,000 and $357,000, depending on the qualifications of the development team and assuming the resources' costs at European level;
- Development time varies from 13 to 16 months depending on the qualification of the development team;
- The development team can be reasonably small (maximum 6 persons for the highly experienced team and maximum 8 persons for the medium experienced team).

3. COST ESTIMATIONS

3.1. INTRODUCTION

The purpose of the Cost Estimation is to present:

- The estimated development costs;
- The costs to support the system operations;
- The costs of a technical helpdesk;
- The costs necessary to adjust the national Customs IT systems to the interface with eTIR;
- The costs for transport operators
- The costs estimate for a 10 years period, for the various architecture options and for the two envisaged scenarios:
    (a) the system is gradually implemented to reach 3 million TIR transports after 10 years
    (b) the system is gradually implemented to reach 1.5 million TIR transports after 10 years;

The estimate error is considered to be less than 5% for over-evaluation and less than 20% for under-evaluation.

For the estimations of the costs to support the system operations, we consider three types of costs:

- Software development and deployment costs;
- Initial infrastructure costs;
- Annual maintenance and operational costs for the next 10 years.

The software development costs are considered identical for each architecture alternative (except for the SaaS option, since the software development would be undertaken by the cloud computing provider).

The helpdesk is foreseen only for assisting the Customs administrations in connecting their national Customs IT systems to the eTIR international system (2 persons during working hours).

Cost estimations for changing the national Customs IT system in order to be interfaced with the eTIR system are computed based on the assumption that each country will implement the system from scratch, and independently, the interface.

The costs estimation for the Trader community reveals there are no important costs to be considered.

3.2. ASSUMPTIONS

The profile for the application being analyzed on the Windows Azure Platform is as follows:

- Application type: Business Management – Other Business Management Application;
- Development of this application / service: new development;
- Size of this application / service by the hardware and software components used: Large (>10 servers/VMs);
- Best method of the integration between this application and other applications, either on

premises or in the cloud: highly integrated (>10 connections to ITDB and national Customs IT Systems);

- Best method of user logins supported by the Business Management Application: Heavy user logins (A high number of login connections has to be considered, as each transaction requests a login);

- Profile of this application / service over time: Steady Growth – Consistent application usage growth over an extended period of time.

Based on the profile of the eTIR application and the type and quantity of data to be processed and exchanged, the system instances are specified as follows:

- Number of instances:
  - Windows Azure instances: 30 (distributed Azure with many instances);
  - Google: 16 (8 back end, 8 front end);
  - Amazon: 16;
  - At premises: 16 (8 back end, 8 front end);
  - UNOG: 16 (8 backend, 8 front end);
- Average use hours per day: 24.0;
- Average use days per year: 365;
- Storage per year for 3 million eTIR Carnets: 1,600GB;
- Transactions (millions) per year for 3 million eTIR Carnets: 150 Million;
- Bandwidth IN per year for 3 million eTIR Carnets: 450GB;
- Bandwidth OUT per year for 3 million eTIR Carnets 650GB.

Average values are used to define the system requirements for 3 million eTIR Carnets, in case the system will start with all TIR Carnets registered. The average values are those considered to date and do not take into account an increased number of registered TIR Carnets.

System workload, based on the assumptions presented in Chapter 2.2:

Characteristics/ Year	1	2	3	4	5	6	7	8	9	10
Number of eTIR Carnets (thousands)	100	700	800	1.200	1,300	2,000	2,500	2,600	2,800	3,000
Storage (GB)	600	700	800	900	1,000	1,200	1,300	1,400	1,500	1,600
Bandwidth IN (GB)	200	250	300	350	400	410	420	430	440	450
Bandwidth OUT (GB)	300	350	400	450	500	600	610	620	630	650
Transactions (Millions)	50	60	70	80	100	110	120	130	140	150

Table 7. Estimated eTIR system workload

Unit prices used are established considering the following:

- Price of labour is based on an average EU workforce price in 2011, published in EU statistics (between $3,000 and $8,000 per month, depending on personnel qualifications);
- Price for training: 1,000 per day/trainee;
- Price of electricity: $0.3 as an average price in the EU;
- Price of storage: $0.1 per GB, as results from a medium price of hard disks (list prices);
- Future scalability is linked to an increase of eTIR usage by circa 10% per year;
- Insurance: 0.1-0.4% for hardware and infrastructure, according to figures provided by representative insurance companies.
- The costs are based on the system's dimensions defined for the actual number of TIR transports.

3.3. DEVELOPMENT COSTS FOR THE ETIR SOLUTION

The costs for developing the eTIR solution are considered the same for each alternative. According to the previously made estimations (see Chapter 2), we have the following figures:

Implementation Type	*Min*	*Max*
At premises	$924,800	$1,127,000
UNOG	$924,800	$1,127,000
UNICC	$924,800	$1,127,000
IaaS	$924800	$1,127,000
PaaS	$924,800	$1,127,000
SaaS	**-**	**-**

Table 8. Total development costs

Minimal values (first column) are computed by considering the minimal costs for development (cost estimations for the development of the full system, employing a highly experienced team).

Maximal values (second column) are computed by considering the maximal costs for development (cost estimations for the development of the full system, employing a medium experienced team).

3.4. ETIR INTERNATIONAL SYSTEM COSTS, WHEN ETIR IS GRADUALLY IMPLEMENTED

On the basis of the detailed cost analysis presented in Annex A.5, the development, initial and operational costs for a 10 years period are as follows:

Option	*Current USD*	
	Min	*Max*
At premises	4,389,800	5,807,000
UNOG	2,796,300	3,224,000
UNICC	2,406,800	3,004,500
IaaS	2,236,800	2,834,500
PaaS	2,136,800	2,364,500
SaaS	8,560,000	17,105,000

Table 9. Development and operational costs, eTIR gradually distributed

(SaaS: minimum $0.5 per TIR Carnet, maximum $1 per TIR Carnet)

3.5. HELPDESK COSTS

Considering that helpdesk is organized at one's premises (2 persons, working hours), the total costs for 10 years are:

	Min	*Max*
Initial	$24,500	$44,000
Operational	$181,800	$576,000
Personnel	$1,080,000	$1,590,000
Total	***$1,286,300***	***$2,210,000***

Table 10. Helpdesk costs

For SaaS, the helpdesk is considered to be included in the costs previously presented.

3.6. NATIONAL COSTS

The costs for adjusting the national Customs IT systems, for all 57 countries, in order to exchange data with eTIR, will be as follows:

	Min	*Max*	*Explanation*
Development	**$6,840,000**	**$8,550,000**	**~15 Man/month * $8,000 minimum costs or 30 Man/Month * $5,000 maximum costs** **57 countries**

Table 11. Adjustment costs of national IT systems

The estimation error is considered to be below 5% for over-evaluation and below 20% for under-evaluation.

The costs are based on the system's dimensions defined for the actual number of TIR transports.

3.7. COSTS FOR TRANSPORT OPERATORS

We consider that there are no real costs involved for the Trader community.

3.8. DISTRIBUTION OF COSTS DURING A 10 YEARS LIFE CYCLE, CURRENT USD

We consider a 10 year usage of the system.

- According to the results of Chapter 3, 2 years of development time are considered. This leads up a total of a 12 years period of analysis.
- The initial costs are distributed as follows:
- 50% development costs in the first year;
- 50% development costs in the second year;
- 50% initial costs in the second year;
- 50% initial costs in the third year, overlapping the first year of operation.

The yearly costs are calculated for the scenario:

  - The eTIR system will be gradually implemented (up to 3 million transports).
  - The eTIR system will be gradually implemented (up to 1.5 million transports).

The costs below are in current USD without taking into consideration the potential risks. These represent the base figures to which discounts and risk rates are applied.

3.8.1. Gradually distributed eTIR usage discounted costs (full usage)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Premises	1,560,762	2,203,583	1,384,567	749,021	808,942	1,449,821	1,392,423	831,834	845,016	814,833	733,433	716,750	13,490,985
UNOG	1,560,762	1,875,869	1,065,928	705,484	761,554	1,382,124	1,322,577	729,496	723,185	694,162	609,668	590,459	12,021,268
UNICC	838,235	838,235	502,941	502,941	586,765	1,257,353	1,257,353	586,765	586,765	586,765	502,941	502,941	8,550,000
PAAS	1,560,762	1,596,155	798,445	698,227	753,656	1,370,841	1,310,936	712,439	702,880	674,051	589,041	569,411	11,336,844
IAAS	1,560,762	1,847,583	1,035,724	683,715	737,860	1,348,276	1,287,654	678,327	662,269	633,827	547,786	527,314	11,551,097
SAAS	1,005,882	992,269	774,499	1,017,502	1,101,166	1,867,284	1,823,138	1,462,919	1,596,308	1,558,970	1,496,650	1,495,543	16,192,129

Table 12. Distribution of costs (USD), per 10 years usage, eTIR gradually distributed, full usage (Discounted costs)
(for SaaS, $0.5 per eTIR Carnet is calculated)

3.8.2. Gradually distributed eTIR usage discounted costs (half usage)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Premisses	1,560,762	2,203,583	1,384,567	749,021	808,942	1,449,821	1,392,423	831,834	845,016	814,833	733,433	716,750	13,490,985
UNOG	1,560,762	1,875,869	1,062,118	676,459	733,911	1,336,053	1,278,699	669,798	649,274	623,771	537,472	516,789	11,520,977
UNICC	1,560,762	1,847,583	1,034,091	670,239	726,013	1,326,650	1,267,954	652,742	629,781	603,659	516,845	495,741	11,332,061
PAAS	1,560,762	1,596,155	795,180	673,349	729,962	1,331,352	1,273,327	661,270	639,528	613,715	527,158	506,265	10,908,023
IAAS	1,560,762	1,847,583	1,033,547	667,129	722,064	1,321,949	1,262,581	644,214	620,035	593,603	506,531	485,217	11,265,216
SAAS	1,005,882	992,269	747,288	810,181	903,717	1,538,203	1,509,728	1,036,510	1,068,373	1,056,175	980,963	969,331	12,618,620

Table 13. Distribution of costs (USD), per 10 years usage, eTIR eTIR gradually distributed, half usage (Discounted costs)
(for SaaS, $0.5 per eTIR Carnet is calculated)

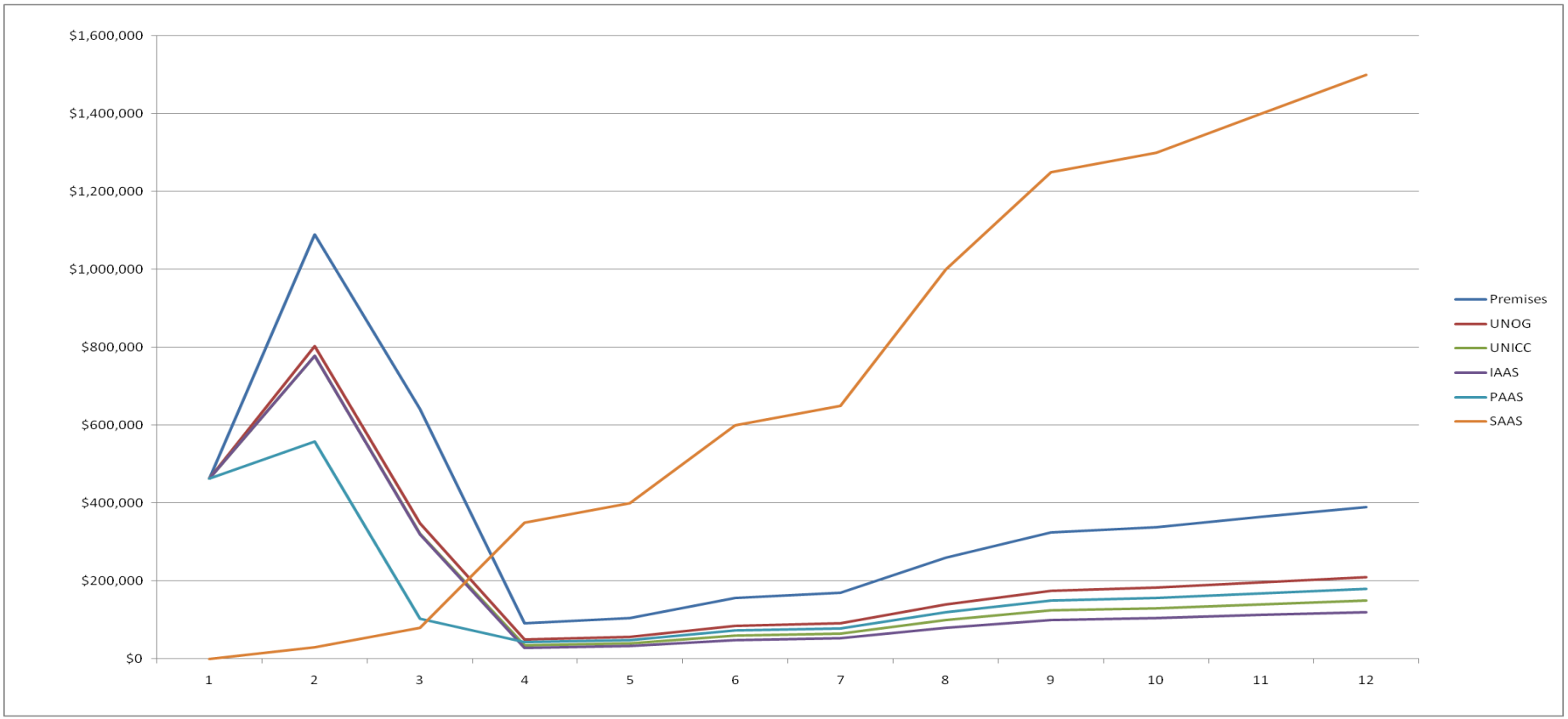

Fig 1. Discounted costs, gradually distributed (full usage)

4. ESTIMATION OF BENEFITS

4.1. INTRODUCTION

The purpose of the Benefit Estimation is to present the benefits of the eTIR international system for:

- National Customs administrations;
- TIR Carnet holders;
- Guarantee chain.

At this stage, only direct benefits are presented. The indirect benefits, resulting from facilitating legal and reducing illegal trade are not part of this analysis.

4.2. ASSUMPTIONS

4.2.1. Assumptions regarding the quantity and type of data to be processed

The assumptions are based on document **ECE/TRANS/WP.30/GE.1/2011/5 [R5]** and are reproduced below.

On the basis of the functional requirements laid down in Chapter 2 and 3 of the eTIR Reference model and the available statistics on the distribution of TIR Carnets, a set of preliminary assumptions with regard to the possible technical specifications of the future eTIR international system have been formulated, as follows:

- The eTIR international system should be able to manage approximately 3 million TIR transports per year;
- Each TIR transport consists, on average, of 3 TIR operations;
- 1% of guarantees, issued by the guarantee chain, are cancelled each year;
- 50% of all TIR transports give rise to direct queries of the eTIR international system, from both Customs and the Guarantee Chain;
- 10% of all initially lodged Customs declarations are later amended.

When computing the benefits, the current costs for using paper-based TIR Carnets are taken into account, as summarized below:

Estimated costs per TIR Carnet (USD)	***Min***	***Max***
Guarantee chain		
Printing of TIR Carnets	1	2
Distribution and issuance	1	2
Archiving costs (TIR Carnets to be stored for 5 years)	1	1
Holder		
Obtaining and filling in the TIR Carnet	1	3
Total	***$4***	***$8***
Estimated handling costs of a TIR Carnet per TIR operation (UDS)		
Filling in and stamping:	1	2
Typing of data in national system	3	5
Total	***$4***	***$7***

Table 14. Estimated costs for paper TIR Carnet

4.2.2. Assumptions on average time spent to fill in a customer request

First, the holder has to get a TIR Carnet from his/her issuing association. TIR Carnets are printed and distributed by an authorized international organization (currently, the International Road Transport Union (IRU)). The time required to obtain a TIR Carnet varies greatly from country to country. The holder fills in the TIR Carnet, which takes around 15-20 minutes. The TIR Carnet is then presented to Customs administrations of departure or entry, where, in most cases, Customs officers will fill-in the paper TIR Carnet and type the data into the national system: this can take up to 10- 15 minutes per operation. At Customs offices of exit and destination, the TIR Carnet will also be presented and filled in. Possibly, the Customs will also enter limited information into their national system. This will take from 5 to 10 minutes. At the end of the transport, the TIR Carnet is returned to the Guarantee Chain. The guarantee chain archives all TIR Carnets.

4.2.3. Assumptions on the average time to fill in the electronic form of eTIR

The assumption is based on the time required by Customs officers to fill in a NCTS TIR form, after being trained in the NCTS-TIR system.

The time was collected from a test done among 240 Customs officers, immediately after the training sessions. The training and the collection of time responses, was done for the Romanian Customs Administration, before launching NCTS in production.

The time spent is presented in the table below:

Time spent (minutes)	Number of users	%
15-20	7	2.92%
10-15	15	6.25%
7-10	35	14.58%
5-7	60	25.00%
4-5	86	35.83%
3-4	30	12.50%
2-3	5	2.08%
1-2	2	0.83%
Total	**240**	**100%**

Table 15. Time spent to fill in a form

It is assumed that TIR Carnet holders will require the same amount of time to fill in the electronic information currently contained in the paper TIR Carnet.

Considering that Customs officers receive the data filled in by the holder and will only be required to input minimal information (seals, control results, ..), the assumption is that 30% of processing time will be saved during Customs clearance. (the figure of 30% is based on the percent of new data necessary to be filled in by Customs Officers. The other 70% is considered to be already filled in).

4.2.4. Weighted Labor costs

In the estimations of benefits, we are using weighted labour costs per month and per person.

The formula used is

$$\text{Wlc} = \sum_{cty=1}^{68} (\text{clc} * \text{pTIR})_{cty}$$

Wlc = weighted labour cost per month, per person

clc = labour costs per month, per person for a country

pTIR = ratio of TIR Carnets used by a country (Number of TIR Carnets used by a country in one year/total number of TIR Carnets used over one year)

cty= country

For EU e considered the labour costs published by EUROSTAT (http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/3-24042012-AP/EN/3-24042012-AP-EN.PDF)

For non-EU countries, we have considered the labour costs published on:

http://www.bls.gov/home.htm

We considered the number of TIR Carnets presented on

http://www.unece.org/fileadmin/DAM/tir/figures/TIRCarnets11.pdf

After applying the formulas above, Wlc has been estimated at $1,600.

4.3. BENEFITS FOR NATIONAL CUSTOMS ADMINISTRATIONS PER YEAR OF FULL USAGE

4.3.1. Benefits from reducing the processing time

Firstly, the costs of using paper –based TIR Carnets versus eTIR are compared.

For a paper-based TIR Carnet, the keying in of data takes 10 to 15 minutes. Therefore, on the basis of 9,000,000 operations per year, Customs officers spend a minimum of 90,000,000 minutes on keying in data.

Considering the statistics on the time required to fill in TIR data electronically as presented in Chapter 4.2.3, the total time required for 9,000,000 eTIR operations is calculated below:

Time (Minutes)	% of users	Total minutes (9,000,000 TIR operations)
15-20	2.92%	3,675,000
10-15	6.25%	5,906,250
7-10	14.58%	9,187,500
5-7	25.00%	11,025,000
4-5	35.83%	11,287,500
3-4	12.50%	3,150,000
2-3	2.08%	393,750
1-2	0.83%	105,000
Total	***100.00%***	***44,730,000***

Table 16. Total time required to fill in eTIR Carnets

Compared to the paper-based TIR Carnet, the results show that the time spent for filling in data electronically represents half of the time required for filling in the paper-based TIR Carnet (45,270,000 minutes less).

Considering labour costs as presented in EUROSTAT, and applying the weight ratio given by the number of TIR Carnets used by each country, an approximate average labour cost of $1600 per month and per person can be computed.

Considering this average labour cost, benefits are estimated at **$7,185,714.29** per year.

It should further be considered that a shorter time required for processing a document does not necessarily lead to a benefit. For example: if there are only two TIR operations processed per day at a specific Customs office, it is not important if the time spent is reduced from 10 to 5 minutes.

Considering that only 60% of such time savings will ultimately lead to actual cost savings for government budget, an annual benefit worth **$4,311,428.57 can still be calculated.**

This is regarded as the direct benefit for Customs administrations, coming from the reduction of staff costs to process TIR operations in electronic form, rather than processing paper-based TIR Carnets. In addition, it should be highlighted that there are also various indirect benefits of obtaining electronic information in advance, e.g. through improved use of equipment, control lanes, infrastructure, etc.

4.4. BENEFITS FOR THE GUARANTEE CHAIN

4.4.1. Benefits due to a paperless environment

Considering that the printing of TIR Carnets is no longer needed and that 3,000,000 TIR Carnets are used each year, benefits worth $3,000,000 per year ($1 printing cost per TIR Carnet) can easily be achieved.

4.4.2. Benefits from reducing the processing time

Considering also that the distribution and archiving is automatically done through the eTIR international system, benefits worth $3,000,000 per year can be achieved.

4.5. BENEFITS FOR THE TRADER COMMUNITY

4.5.1. Benefits resulted from reducing the processing time

Considering that every year, TIR Carnet holders fill in 3,000,000 TIR Carnets and that the average time required per TIR Carnets is 15 minutes, TIR Carnet holders spend a total 45,000,000 minutes per year with filling in paper TIR Carnets.

Taking into account the statistics in Chapter 4.2.3., the total time required to provide the information electronically is calculated as follows:

Time Interval	Percent Users	Time for 3 000 000 TIR Carnets
15-20	2.04%	1,750,000
10-15	4.38%	2,812,500
7-10	10.21%	4,375000
5-7	17.50%	5250000
4-5	25.08%	5375000
3-4	8.75%	1500000
2-3	1.46%	187500
1-2	0.58%	50000
Total		**21,300,000**

Table 17. Total time to fill in eTIR Carnets

This represents a reduction by 23,700,000 minutes, without even taking into account the fact that, in particular, large companies might adapt their IT systems to automatically process data received from their clients in order to generate the required messages.

Taking a weighted average labor costs of $1,600 per month, the benefits resulted by reducing the processing time are worth $3,761,904.76 per year.

4.5.2. Benefits from reducing time spent at the Customs.

As presented in Chapter 4.3.1, the time required to process a TIR operation by Customs decreases by 45,270,000 minutes per year.

Considering that in only 60% of the situations this reduction affects traffic, the total is calculated at 452,700 hours. (in 40% of situations the waiting time is used by traders for other necessary operations)[1]

Considering a weighted average cost of $35 per hour (personnel and means of transport costs), this gives a figure of **$12,675,600.00** per year (considering that all TIR Carnets are registered electronically).

4.6. BENEFITS WHEN eTIR IS GRADUALLY IMPLEMENTED

Considering the benefits calculated for each paper-based TIR Carnet replaced by an eTIR Carnet, we can estimate the yearly benefits when the eTIR system is implemented gradually.

We present the benefits for a period of 12 years. The first two years are dedicated to constructing the system, while no TIR Carnets are registered in the system during that period.

For the following 10 years, we assume that the number of registered TIR Carnets will be, in thousands:

100; 700; 800; 1,200; 1,300; 2,000; 2,500; 2,600; 2,800; 3,000

Benefits in this case will be:

4.6.1. Benefits (no risk ratio applied)

Year	eTIR (thousands)	Total Benefits	Benefits for Customs
1	0	0	$0.00
2	0	0	$0.00
3	100	$891,631.11	$143,714.29
4	700	$6,241,417.78	$1,006,000.00
5	800	$7,133,048.89	$1,149,714.29
6	1200	$10,699,573.33	$1,724,571.43
7	1300	$11,591,204.44	$1,868,285.71
8	2000	$17,832,622.22	$2,874,285.71
9	2500	$22,290,777.78	$3,592,857.14
10	2600	$23,182,408.89	$3,736,571.43
11	2800	$24,965,671.11	$4,024,000.00
12	3000	$26,748,933.33	$4,311,428.57

Table 18. Benefits, eTIR gradually implemented, no risk ratio

By applying a risk ratio of 80%, we obtain the following benefits per year:

Year	eTIR (thousands)	Total Benefits	Benefits for Customs
1	0	0	$0.00

[1] 40% is based on interviews conducted with transit operators, regarding the time spent is customs

2	0	0	$0.00
3	100	$713,304.89	$114,971.43
4	700	$4,993,134.22	$804,800.00
5	800	$5,706,439.11	$919,771.43
6	1200	$8,559,658.67	$1,379,657.14
7	1300	$9,272,963.55	$1,494,628.57
8	2000	$14,266,097.78	$2,299,428.57
9	2500	$17,832,622.22	$2,874,285.71
10	2600	$18,545,927.11	$2,989,257.14
11	2800	$19,972,536.89	$3,219,200.00
12	3000	$21,399,146.66	$3,449,142.86

Table 19. Benefits, eTIR gradually implemented, risk ratio

A more pessimistic scenario considers that a smaller number of TIR Carnets will be registered into the eTIR system.

Such a scenario considers that after 10 year of usage only half of TIR Carnets will be registered in eTIR, the other half being still on paper.

For such a scenario, in the next 10 years we assume that the number of registered TIR Carnets will be, in thousands:

50; 300; 400; 500; 600; 1,000; 1,200; 1,300; 1,400; 1,500

Benefits in this case (after applying the risk factor of 80%) will be:

Year	eTIR (thousands)	Total Benefits	Benefits for Customs
1	0	0	$0.00
2	0	0	$0.00
3	50	$356,652.44	$57,485.71
4	300	$2,139,914.67	$344,914.29
5	400	$2,853,219.56	$459,885.71
6	500	$3,566,524.44	$574,857.14
7	600	$4,279,829.33	$689,828.57
8	1,000	$7,133,048.89	$1,149,714.29
9	1,200	$8,559,658.67	$1,379,657.14
10	1,300	$9,272,963.55	$1,494,628.57
11	1,400	$9,986,268.44	$1,609,600.00
12	1,500	$10,699,573.33	$1,724,571.43

Table 20. Total costs, eTIR gradually implemented

4.7. TOTAL DIRECT BENEFITS PER YEAR OF FULL USAGE

After identifying the possible benefits, and considering that all TIR Carnets are electronically processed, the direct benefits can be summarized as follows:

Type	Normal	Risk ratio (0.8)[2]
Customs (benefits resulted from reducing the processing time for each TIR operation)	4,311,428	$3,449,143
Guarantee Chain (benefits resulted from paperless environment)	6,000,000	$4,800,000
Traders (Benefits resulted from reducing time to fill in documents)	3,761,904	$3,009,524
Traders (benefit resulted from reducing time for document processing by the Customs)	12,675,600	$10,140,480
Total	**26,748,932**	**$21,399,147**

Table 21. Direct benefits of eTIR

The total benefits per TIR Carnet are: $8.92 (global benefit) or $7.13 benefit after risk ratio application.

The benefits for Customs administrations, per TIR Carnet, will be $1.44 (global benefit) or $1.15 after risk ratio applied.

The benefits per TIR Carnet does not depend on the number of TIR Carnets used, and these figures will be used for all scenarios (big-bang, gradually full usage, gradually partial usage or eTIR).

[2] 0.8 risk ratio is considered by consultant as the acceptable risk capacity ratio for successful software projects

4.8. ROI AND CASH FLOW FOR CUSTOMS, ETIR LAUNCHED GRADUALLY

Considering the benefits in Chapter 4.6.1., and the eTIR costs presented in detail, the following tables indicate the ROI and Cash Flow.

The number of TIR Carnets used each year in eTIR is assumed to be as follows:

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
		100,000	700,000	800,000	1,200,000	1,300,000	2,000,000	2,500,000	2,600,000	2,800,000	3,000,000

It is assumed that all EU countries will enter the eTIR system in Year 8 (the increase of eTIR Carnet is from 1,300,000 to 2,000,000, then to 2,500,000).

The cash flows are calculated as follows:

Cash Flow = Discounted Benefits – Net Costs; ROI= (Discounted Benefits-costs)/costs*100;

The summary analysis for this scenario is given below:

			Premises	UNOG	UNICC	PAAS	IAAS	SAAS
Costs	**Total Dev, Operational;**	Development	924,800	924,800	924,800	924,800	924,800	0
		Initial	1,255,000	681,500	632,000	192,000	632,000	60,000
		Operational+Hostin	2,210,000	1,190,000	850,000	1,020,000	680,000	8,500,000
	Total Dev, Operationa;		4,389,800	2,796,300	2,406,800	2,136,800	2,236,800	8,560,000
	Help Desk		1,286,300	1,286,300	1,286,300	1,286,300	1,286,300	1,286,300
	National App		8,550,000	8,550,000	8,550,000	8,550,000	8,550,000	8,550,000
Total Costs			14,226,100	12,632,600	12,243,100	11,973,100	12,073,100	18,396,300
Total Costs (incl. 20% risk factor)			17,071,320	15,159,120	14,691,720	14,367,720	14,487,720	22,075,560
Discounted Costs (incl. risk factor)			13,490,985	12,021,268	11,689,412	11,336,844	11,551,097	16,192,129
Benefits for Customs (incl. 20% risk factor)			19,550,000	19,550,000	19,550,000	19,550,000	19,550,000	19,550,000
Total Benefits (incl. 20% risk factor)			121,210,000	121,210,000	121,210,000	121,210,000	121,210,000	121,210,000
Discounted Customs Benefits (incl.risk factor)			13,255,247	13,255,247	13,255,247	13,255,247	13,255,247	13,255,247
Discounted Overall Benefits (incl.risk factor)			82,182,532	82,182,532	82,182,532	82,182,532	82,182,532	82,182,532
ROI for Customs			-2%	10%	13%	17%	15%	-18%
Overall ROI			509%	584%	603%	625%	611%	408%
Net present value			43,002,042	44,471,759	44,803,614	45,156,183	44,941,930	40,300,898

Table 22. Summary of cost benefit analysis (USD), eTIR gradually used reaching 3 million TIR transports annually

4.9. ROI AND CASH FLOW FOR CUSTOMS, ETIR LAUNCHED GRADUALLY, HALF USAGE OF ETIR SYSTEM

Considering the benefits in Chapter 4.6.1, with only HALF of the total number of TIR Carnets registered in eTIR, the following tables indicates the ROI and Cash Flow.

The number of TIR Carnets used each year in eTIR is assumed to be as follows:

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
		50000	300000	400000	500000	600000	1000000	1200000	1300000	1400000	1500000

Using the same approach as presented in Chapter 4.8, we have obtained the following summary of costs benefits:

			Premises	UNOG	UNICC	PAAS	IAAS	SAAS
Costs	**Total Dev, Operational;**	Development	924,800	924,800	924,800	924,800	924,800	0
		Initial	1,255,000	681,500	632,000	192,000	632,000	60,000
		Operational+Hostin	2,210,000	577,500	412,500	495,000	330,000	4,125,000
	Total Dev, Operationa;		4,389,800	2,183,800	1,969,300	1,611,800	1,886,800	4,185,000
	Help Desk		1,286,300	1,286,300	1,286,300	1,286,300	1,286,300	1,286,300
	National App		8,550,000	8,550,000	8,550,000	8,550,000	8,550,000	8,550,000
Total Costs			14,226,100	12,020,100	11,805,600	11,448,100	11,723,100	14,021,300
Total Costs (incl. 20% risk factor)			17,071,320	14,424,120	14,166,720	13,737,720	14,067,720	16,825,560
Discounted Costs (incl. risk factor)			13,490,985	11,520,977	11,332,061	10,908,023	11,265,216	12,618,620
Benefits for Customs (incl. 20% risk factor)			9,487,500	9,487,500	9,487,500	9,487,500	9,487,500	9,487,500
Total Benefits (incl. 20% risk factor)			58,822,500	58,822,500	58,822,500	58,822,500	58,822,500	58,822,500
Discounted Customs Benefits (incl.risk factor)			6,406,022	6,406,022	6,406,022	6,406,022	6,406,022	6,406,022
Discounted Overall Benefits (incl.risk factor)			39,717,335	39,717,335	39,717,335	39,717,335	39,717,335	39,717,335
ROI for Customs			-53%	-44%	-43%	-41%	-43%	-49%
Overall ROI			194%	245%	250%	264%	253%	215%
Net present value			13,689,953	15,659,961	15,848,877	16,272,916	15,915,722	14,562,318

Table 23. Summary of cost benefit analysis, eTIR gradually used, finally half eTIR Carnets registered

4.10. ROI AND CASH FLOW FOR CUSTOMS, FOR ONE CUSTOMS ADMINISTRATION

Using the approach presented in Chapter 4.6, we are computing the ROI and cash flow for one country considering the following:

- All general costs are equally distributed for each country.
- The initial cost to develop the National Interface to eTIR will be considered once, in the second year of development of eTIR system
- The computations are made for various types of countries, according to the number of eTIR processed per year:
    - 30,000;
    - 100,000;
    - 500,000.

4.10.1. ROI and Cash flow for Customs for one country processing 30 000 TIR Carnets per year

			Premises	UNOG	UNICC	PaaS	IaaS	SaaS
Costs	**Total Dev, Operational;**		$0	$0	$0	$0	$0	$0
	Development		$924,800	$924,800	$924,800	$924,800	$924,800	$0
	Initial		$1,255,000	$681,500	$632,000	$192,000	$632,000	$60,000
	Operational		$2,210,000	$1,190,000	$850,000	$1,020,000	$680,000	$8,500,000
	Total Dev, Operational;		$4,389,800	$2,796,300	$2,406,800	$2,136,800	$2,236,800	$8,560,000
	Help Desk		$1,286,300	$1,286,300	$1,286,300	$1,286,300	$1,286,300	$1,286,300
	National App		$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
Total Costs			$233,472	$210,038	$204,310	$200,340	$201,810	$294,799
Total Costs (including 20% risk factor)			$280,166	$252,046	$245,172	$240,408	$242,172	$353,758
Discounted Costs			$251,086	$229,473	$224,592	$219,408	$222,558	$290,809
Benefits for Customs (including 20% risk factor)			$345,000	$345,000	$345,000	$345,000	$345,000	$345,000
Total Benefits (including 20% risk factor)			$2,139,000	$2,139,000	$2,139,000	$2,139,000	$2,139,000	$2,139,000
Discounted Customs Benefits			$253,714	$253,714	$253,714	$253,714	$253,714	$253,714
Discounted Overall Benefits			$1,573,028	$1,573,028	$1,573,028	$1,573,028	$1,573,028	$1,573,028
ROI for Customs			1%	11%	13%	16%	14%	-13%
Overall ROI			526%	585%	600%	617%	607%	441%
Net present value			$928,347	$949,961	$954,841	$960,026	$956,875	$888,624

Table 24. Summary of cost- benefit analysis, 30 000 eTIR registered per year

4.10.2. ROI and Cash flow for Customs for one country processing 100,000 per year

Using the same approach and the same formulas as in the previous chapter, but using instead a different number of TIR Carnets registered, it results in the following summary of costs, benefits and ROI:

			Premises	UNOG	UNICC	PaaS	IaaS	SaaS
Costs	**Total Dev, Operational;**		$0	$0	$0	$0	$0	$0
	Development		$924,800	$924,800	$924,800	$924,800	$924,800	$0
	Initial		$1,255,000	$681,500	$632,000	$192,000	$632,000	$60,000
	Operational		$2,210,000	$1,190,000	$850,000	$1,020,000	$680,000	$8,500,000
	Total Dev, Operation;		$4,389,800	$2,796,300	$2,406,800	$2,136,800	$2,236,800	$8,560,000
	Help Desk		$1,286,300	$1,286,300	$1,286,300	$1,286,300	$1,286,300	$1,286,300
	National App		$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
Total Costs			$233,472	$210,038	$204,310	$200,340	$201,810	$294,799
Total Costs (including 20% risk factor)			$280,166	$252,046	$245,172	$240,408	$242,172	$353,758
Discounted Costs			$251,086	$229,473	$224,592	$219,408	$222,558	$290,809
Benefits for Customs (including 20% risk factor)			$1,150,000	$1,150,000	$1,150,000	$1,150,000	$1,150,000	$1,150,000
Total Benefits (including 20% risk factor)			$7,130,000	$7,130,000	$7,130,000	$7,130,000	$7,130,000	$7,130,000
Discounted Customs Benefits			$845,714	$845,714	$845,714	$845,714	$845,714	$845,714
Discounted Overall Benefits			$5,243,426	$5,243,426	$5,243,426	$5,243,426	$5,243,426	$5,243,426
ROI for Customs			237%	269%	277%	285%	280%	191%
Overall ROI			1988%	2185%	2235%	2290%	2256%	1703%
Net present value			$3,680,358	$3,701,972	$3,706,852	$3,712,037	$3,708,886	$3,640,636

Table 25. Summary of cost benefit analysis, 100 000 eTIR registered per year

4.10.3. ROI and Cash flow for customs for one country processing 500 000 per year

Using the same approach and the same formulas as in the previous chapter, with a different number of TIR Carnets registered, it results in the following summary of costs, benefits and ROI:

		Premises	UNOG	UNICC	PaaS	IaaS	SaaS
Costs	**Total Dev, Operational;**	$0	$0	$0	$0	$0	$0
	Development	$924,800	$924,800	$924,800	$924,800	$924,800	$0
	Initial	$1,255,000	$681,500	$632,000	$192,000	$632,000	$60,000
	Operational	$2,210,000	$1,190,000	$850,000	$1,020,000	$680,000	$8,500,000
	Total Dev, Operation;	$4,389,800	$2,796,300	$2,406,800	$2,136,800	$2,236,800	$8,560,000
	Help Desk	$1,286,300	$1,286,300	$1,286,300	$1,286,300	$1,286,300	$1,286,300
	National App	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
Total Costs		$233,472	$210,038	$204,310	$200,340	$201,810	$294,799
Total Costs (including 20% risk factor)		$280,166	$252,046	$245,172	$240,408	$242,172	$353,758
Discounted Costs		$251,086	$229,473	$224,592	$219,408	$222,558	$290,809
Benefits for Customs (including 20% risk factor)		$5,750,000	$5,750,000	$5,750,000	$5,750,000	$5,750,000	$5,750,000
Total Benefits (including 20% risk factor)		$35,650,000	$35,650,000	$35,650,000	$35,650,000	$35,650,000	$35,650,000
Discounted Customs Benefits		$4,228,569	$4,228,569	$4,228,569	$4,228,569	$4,228,569	$4,228,569
Discounted Overall Benefits		$26,217,129	$26,217,129	$26,217,129	$26,217,129	$26,217,129	$26,217,129
ROI for Customs		1584%	1743%	1783%	1827%	1800%	1354%
Overall ROI		10341%	11325%	11573%	11849%	11680%	8915%
Net present value		$19,406,136	$19,427,750	$19,432,630	$19,437,815	$19,434,664	$19,366,414

Table 26. Summary of cost benefit analysis, 500 000 eTIR registered per year

5. RECOMMENDATIONS AND CONCLUSIONS

Considering the technical characteristics, and the cost- benefit analysis, our recommendations are as follows:

A. It is better to implement eTIR as soon as possible, in order to increase the benefits it can offer.
B. Given the cost- benefit analysis presented above, we can classify the architecture alternatives, by their order of importance:
    1. Implementation of eTIR using Microsoft PaaS (The best from a technical point of view, and the best from ROI point of view);
    2. Implementation of eTIR using UNOG IT services (places 2nd,and 3rd from a technical point of view, places 2nd, 3rd from ROI point of view);
    3. Implementation of eTIR using UNICC IT services (places 2nd, and 3 rd from a technical point of view, places 2nd, 3 rd from ROI point of view).
C. The gradually distributed alternative is more convenient from the cost point of view;
D. If the eTIR is used for half of the TIR Carnets, ROI for Customs is negative;
E. A minimal usage of eTIR system is recommended to have a positive ROI for Customs, as described in the third scenario.
   This minimal usage could be, in thousands of eTIR Carnets:

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
		200	500	800	1,000	1,100	1,200	1,700	2,000	2,200	2,500

The benefits of implementing eTIR system are very important for all the stakeholders involved in the eTIR procedure: Customs, that benefits from reducing the processing time for each TIR operation, Guarantee Chain that benefits from using paperless environment, the Traders benefiting from reducing time to fill in TIR Carnets and from the time reduction for Customs' processing of the TIR Carnets.

For one country, the minimum number of eTIR Carnets to be registered in eTIR, so that ROI becomes positive, is around 30,000.

Moreover, the implementation of the eTIR system offers benefits also to all Customs administrations, providing numerous possibilities for risk management, based on the advance cargo information, thus reducing the fraud risk.

In conclusion, we consider that it is highly important for the project's success that all the stakeholders become involved in the implementation of the eTIR project from the very beginning.

A. ANNEXES

A.1. ARCHITECTURE ALTERNATIVES

A.1.1. *Introduction*

The present document presents different architectures that could be envisaged for the implementation of the eTIR international system. This document does not present use cases, processes and activity diagrams as they are described in detail in the eTIR Reference Model v3.0 [R1-R5]. It is assumed that the system will cover ALL the functionalities described in the eTIR Reference Model v3.0.

This chapter is organized as follows:

First, we recall the eTIR objectives and boundaries, as contained in the eTIR Reference Model v3.0. Then, we present the technical requirements that have been taken into account for the eTIR-CBA.

This is followed by the conceptual architecture, which is based on four system tiers (Security, Management, Access, Kernel) and is independent of any hardware and software platform. In continuation, we introduce the logical architecture, in which all main logical components are presented.

Starting with the conceptual and logical architecture, we formulate proposals for two main categories of system solutions:

- Solutions based on clouds: Infrastructure as a Service (IaaS), Platform as a Servive (PaaS) and Software as Service (SaaS);

- Solution based on implementation at premises (Premises) (either a new environment or by means of using an existing environment).

For architectures based on clouds, a technical comparison is made between the three main cloud providers: Amazon, Google and Microsoft.

Finally, a technical comparison of the various architectural alternatives is made.

A.1.2. *eTIR Objectives and boundary*

A.1.2.1 eTIR Objectives

According to what has been established in the eTIR Reference Model [R1-R5], the objectives of eTIR are described below:

The final objectives of the eTIR Project are:

- Integrating the computerized TIR procedure in the overall process of technological development in international transport, trade and Customs procedures:
  - Simple and cost effective data capture and data transmission;
  - Facilitation of global intermodal application of the TIR Procedure;
  - Real time exchange of information among actors;
- Improving the efficiency and quality of the TIR procedure:
  - Reduction of processing times at border crossings and final destination;
  - Increased efficiency of internal administrative and control procedures;

- Increased accuracy and reduction of errors;
- Reduction of costs;
- Progressive replacement of paper TIR Carnet;
- Full use of international standard codes in order to eliminate language barriers;
- Availability of advance cargo information;

- Reducing the risk of fraud and improving security:
  - Automatic generation of data for risk assessment;
  - Facility to implement early-warning system;
  - Easy access to information for control and risk management purposes.

A.1.2.2 Boundary of the eTIR Project

The final objective of the eTIR project encompasses the computerization of the whole TIR Carnet life cycle (from issuance and distribution via the TIR transport to return and repository) and is ultimately aimed at replacing the current paper TIR Carnet. However, the eTIR Project will inevitably have repercussions on other parts of the TIR Procedure. Therefore, it is important to identify the boundaries of the project in order to realize the full impact the project may have and to ensure that the views of all stakeholders are taken into due account. The boundaries are defined along two axes: stakeholders and information.

A.1.2.3 Stakeholders

A stakeholder is defined as someone (or something) who is materially affected by the outcome of the system but may or may not be an actor of the system. Actors are stakeholders who are involved in the specific project as users and are thus part of the Reference Model. Stakeholders inside the boundary of the system are involved in the project as active participants in the work and/or members of decision-making bodies; those outside the boundary may participate in meeting to ensure any future compatibility where necessary.

Figure 1 shows the stakeholders inside and outside the boundaries of the project and emphasizes those who are also actors.

Stakeholders and actors

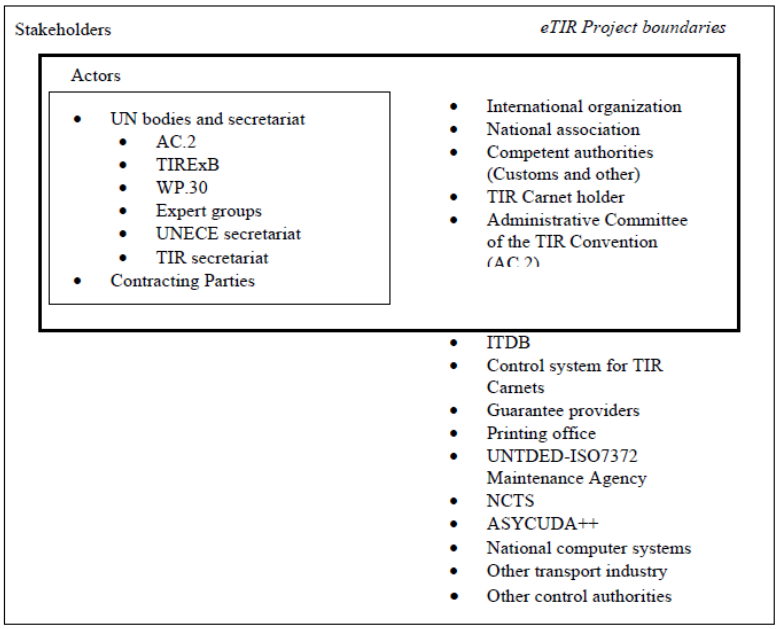

Fig 2. Stakeholders and actors[R1]

A.1.2.3.1 Information

The data elements inside the boundaries have been identified and are listed in Annex A.3 of the eTIR Reference Model. These data elements reflect the information contained in the current, paper-based, TIR Carnet and provide the basis for the elaboration of a minimal set of data to be computerized.

A.1.3. *Technical Characteristics*

A.1.3.1 Centralized approach

The eTIR international system will be fully centralized, both from a data and application point of view. Centralization of data will be accomplished by:

- Storage of all main information in only one central database;
- Access to external modules via a single communication interface, based on XML format.

Centralization of application will be accomplished by:

- Development of a dispatcher mechanism, used to orchestrate message exchange between actors involved (mainly Customs administrations). Exchange of messages will be done using web services. Both the synchronous and asynchronous mode will be used. In synchronous mode, notifications of data reception will be sent in response to a message. In asynchronous mode, more complicated notifications or messages will be sent as a result of status change of a document;
- Development of a web based system, with clients on web browsers used to view or update data. View of data will be accessible any time, under any circumstances. Process data in a web based centralized system will be possible as a fallback procedure, when the systems linked in the Service Oriented Architecture (SOA) environment do not work properly, or for situations when such systems do not provide a good data entry mechanism.

A.1.3.2 Web-based system, online data entry

The eTIR international system will be fully WEB based. It will follow J2ee or .NET organization. The servers will be J2ee servers, or Microsoft .NET.

Clients will be:

- Customs IT applications, connected to the central system using web services;
- Web browsers or smart clients accessing the main server, for data view or fallback procedures.

A.1.3.3 Service Oriented Architecture (SOA)

Service-Oriented Architecture (SOA) is defined as “the policies, practices, and frameworks that enable application functionalities to be provided and consumed as sets of services published at a granularity relevant to the service consumer. Services can be invoked, published and discovered and are abstracted away from the implementation by means of using a simple, standard-based forms of interface.”

The eTIR architecture will be compliant with the above definition of SOA. Web-services protocols will be “standard-based forms of interface” for eTIR. The eTIR functionality that is deemed to be of interest to other applications from Customs, from the External Domain or from other Government Agencies will be exposed at appropriate granularity levels via standards-based interfaces. New software applications (even in the next 10 or 20 years) will be able to consume these services and

integrate with the eTIR international system because their interfaces are based on standards and are not proprietary.

A.1.3.4 Data exchange using XML and Web Services

Data exchange will be possible in the following ways:

- **Web Services: users (IT systems of national/regional Customs administrations) use web service to exchange data with the eTIR international system.**
- **Web application: users (Customs officers) access the eTIR international system by means of a secure web application that allows them to view and change data (according to roles). This option is mainly envisaged as a fallback solution.**

A.1.3.5 Integration with third party applications, in particular reporting tools

The system will have also a layer of **web services** offering data to external modules.

A.1.3.6 Reusability of data

Data will be registered by each Customs administration which will be the owner and the responsible entity for it.

All exchanged messages will also be stored in the central eTIR international system with their full history.

A.1.3.7 Scalability

The system will have a completely scalable architecture, both horizontally and vertically. The system will be able to handle larger volumes of data and users in a cost-effective manner by adding more processors and/or memory to the existing machines or by employing multiple servers without changes in the application code or general architecture.

The system will be modular and be prepared to be implemented in a scalable environment.

To cope with larger numbers of users, or increased calculation complexity, the system should also be able to scale with only configuration changes or/and additional hardware.

A.1.3.8 System Performance

The response time of the application will be closely monitored and optimized throughout all phases during the system life cycle.

The system will have the capability to handle an unlimited number of registered users.

This will be achieved using an extensible user management solution, either a Lightweight Directory Access Protocol (LDAP) or a customized security module, neither having any limitations in the number of users that can be stored.

To address the problem of concurrent sessions, the application will use software clustering on the existing hardware to improve availability and scalability. Similar application solutions have shown to support an almost linear dependency between the number of cluster nodes and the number of supported concurrent sessions.

The system should provide acceptable data exchange response times. For Customs-to-Customs (C2C) connections, in synchronous mode, the response time should be less than 1 second;

The system should provide acceptable screen response times in case the web user's interface is used (less than 3 seconds per page view during normal working hours, and less than 5 seconds per page view at peak time). Peak hours will be established depending on the maximum number of

operations at a specific hour. Considering the actual statistics, peak time will be considered for time zones between GMT+1 (Central Europe) and GMT+3(Russia).

A.1.3.9 High availability

The application will be designed to allow all the tiers to run on clustered hardware and be deployed on a virtual cluster of one node. This will allow clustering without changing the application code.

The system is considered to be a mission critical application and, thus, should be 99.99% available. For calculation purposes, the maximum allowed downtime will be 1 hour per week.

A.1.3.10 Reliability and stability

The system should support advanced mechanisms to ensure reliable data delivery and processing, such as durable topics, local transactions, message expiration and acknowledgement.

- The system should support an initial capability of 80 concurrent system- to-system connections, exchanging data by means of using web services (57 possible Customs systems, plus possible other actors and a reasonable free number of connections);
- The system should support an initial capability of 1000 concurrent users accessing the web interface. The web user interface is developed as an alternative for a C2C system, for situations such as fallback procedures, or in case Customs systems do not yet provide sufficient services for the electronic treatment of TIR Carnets.

A.1.3.11 Expansibility, configurable at runtime

Modules can be easily added, with or without minimal changes in the current architecture. Also because of the common Application Programming Interfaces (API) used: Simple Object Access Protocol (SOAP), Remote Method Invocation (RMI), Java Naming and Directory Interface (JNDI), etc. Third party software will be able to integrate seamlessly.

A.1.3.12 General technical requirements

Below follows a list of general technical requirements that need to be met by the eTIR international system:

- Unicode compliance;
- For all documents: history of operations as well as owner of the document will be stored in the database.

A.1.4. *The eTIR international context*

The eTIR international system is a centralized system, which will be responsible for data exchange between the IT systems of different national Customs administrations

Data exchange will be possible via two channels:

- Via web services. There will be system-to-system connections between national Customs administrations and the eTIR international system;
- On a web interface (usually on https) where users enter and view data in a web user interface. This is mainly designed for fallback procedures.

The relation between the eTIR international system and other IT systems is presented in the figure below:

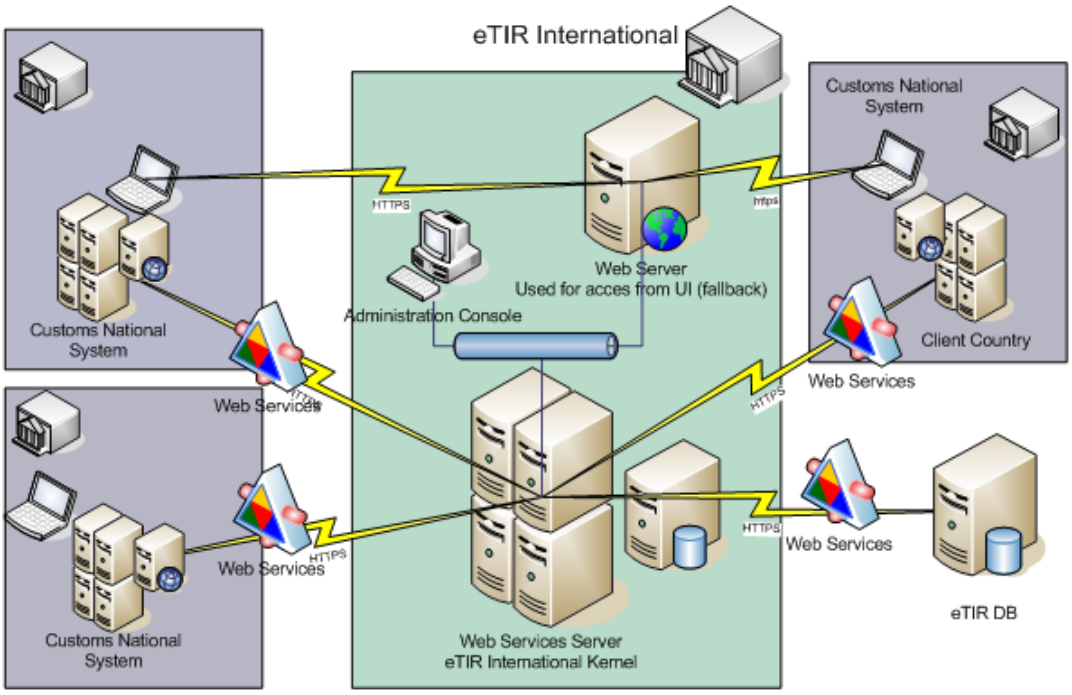

Fig 3. eTIR international context

A.1.5. *Conceptual architecture*

The eTIR system will integrate several multi-tier architecture systems in a global SOA concept. Each particular system will have a very well-defined functionality and will work both integrated, in the global SOA architecture, and separately, as a stand-alone application.

The conceptual architecture, presented in the figure below, is built up of several layers:

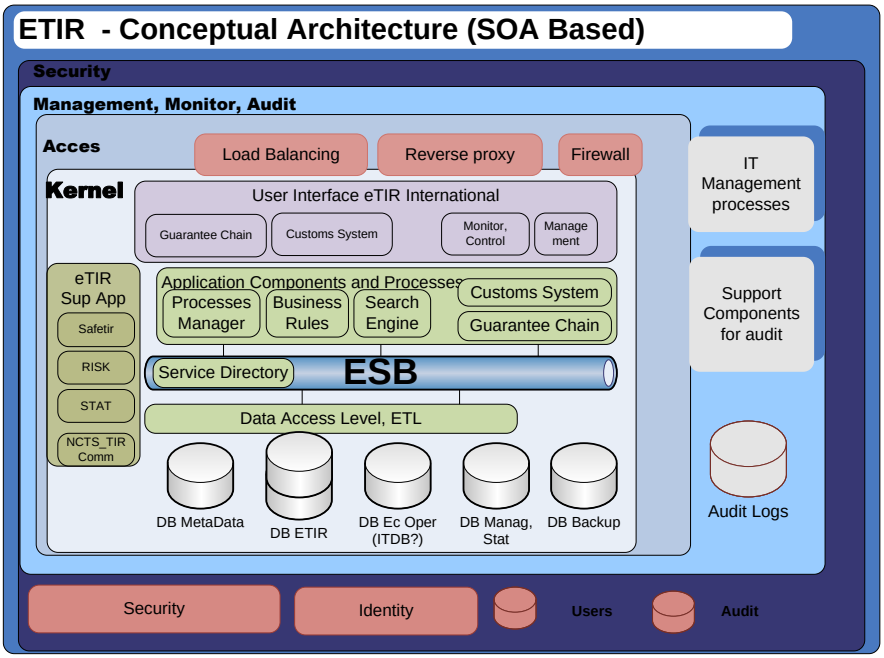

Fig 4. eTIR Conceptual Architecture

The following main layers are considered:

- Solution Security Layer;
- Software infrastructure, IT Management, Monitor, Audit Layer;
- Access Management and Load Balancing Layer;
- Kernel Layer.

A.1.5.1 Solution Security Layer

Due to the fact that, in any modern application, security is paramount, a complex security solution will be implemented, which will ensure data confidentiality in each application layer (Cross-layer security). All access information will be stored in a central repository, which will be implemented either as a Customs secure repository implementation or using LDAP.

The security system will implement both data security and functional security.

The application will be compliant with EU regulation EU 1663/95 and will follow the directives stated in ISO Standard No. 17799.

The application will use the principle of Single Sign-On and, once a user is authenticated, he will not be required to re-enter his credentials during the on-going session.

Data sent via Web Services will be signed and encrypted, using a private public pair key. Access to web services will be allowed only for well-known secured IPs. Firewalls and reverse proxy will protect system from not authorized access.

A.1.5.2 Software infrastructure, IT Management, Monitor, Audit Layer

IT Management, Monitoring and Auditing systems will be set up in order to avoid potential problems of the system in reporting incomprehensible or incoherent errors.

Two main aspects will be considered:

- The management and monitoring of Software systems;
- Error treatment.

A.1.5.2.1 Management and monitoring

A comprehensive, integrated management solution that helps businesses achieve high levels of performance and availability and reduce the costs of managing applications is required. This should, proactively, monitor the health of all application components, the hosts that they run on and the key business processes that they support.

Besides monitoring and diagnostics, management of the configuration of application environments through its integrated configuration management tool is also required. Management will include:

- Ensuring performance and availability;
- Resolving problems quickly if they occur in order to minimize their impact;
- Containing the on-going costs associated with managing the applications;
- Aligning IT and line-of-business priorities so that the resources are deployed towards those activities which generate the greatest benefits for business.

A.1.5.2.2 Error detection and recording

Errors, displayed to the system users, will have defined error types identified by appropriate numbers. Additionally, each error type reported by the application will be recorded with a unique number, enabling its identification by the system administrator.

The application will provide detailed error handling regarding two types of errors that may occur: business and application errors.

A.1.5.3 Access Layer

The Access Layer will be based on Application Server components and clusters. Also at the access layer, the following is necessary:

- Web server load balancing - to load-balance transactions to the least-highly-loaded HTTP server (HS);
- Cluster instance load balancing;
- Automated Storage Load balancing. Shared disk storage resources can alternatively be assigned to individual databases and easily be moved from one database to another as processing requirements change;
- Data Guard Load Balancing - load balancing between standby databases.

A.1.5.4 Kernel Layer

The **Kernel Layer is responsible for the business process in the eTIR international system.** It is also composed of several tiers:

UI (Presentation) Tier;

Application Tier;

Persistence Tier.

The **UI** (**Presentation) Tier** contains the user interface and is responsible for the interaction between the end user and the application. The client will use a standard Web Browser (Microsoft Internet Explorer, Mozilla Firefox, Apple Safari, Opera, etc.) to interact with the application. Every modern operating system has a Web Browser, so no additional software will be needed in order to use the application. On the server side, this tier will be composed of a Web Server, which will serve the static content and will act as a reverse proxy for the Application Server. It should be noted that the presentation tier will follow the Single Access Window concept. This allows users to use the same entry point for data in all system modules.

This User interface is for fallback procedure, as the main functionality of the system is based on data exchange via web services.

The **Application (Middle) Tier** will encapsulate the application logic and behavior and will be based on a standard JEE application server or .NET application Server.

The proposed application server is able to run in a clustered environment and to load balance requests to all the nodes, share state information between nodes and recover from server failure.

The **Persistence Tier** is responsible for data storage and retrieval and will be an Relational Database Management System (RDBMS) instance.

A.1.5.4.1 Presentation Tier

The presentation tier contains the user interface and exposes the services of the system to the user. The client will access the application using a standard Web Browser, which will require JavaScript.

The HTML pages displayed by this tier will be generated in the application tier. Simple validation will be carried out on the client side (through a browser using JavaScript), but the final data validation will be done in the application tier.

For security reasons, some, or all, communications will be done through HTTPS, a protocol which adds a layer of Secure Socket Layer (SSL) encryption over standard HTTP. The use of this protocol will ensure confidential communication between the server and the client.

The web application will use a single point of authentication. The user will be authenticated only once per session. The user interface is generated dynamically and the user will see and have access only to the functionalities for which he is authorized.

A.1.5.4.2 Application (Middle) Tier

The Application Tier is divided into two distinct but interconnected parts: the domain logic and the application logic. The domain logic models the processes of the business, while the application logic models the aspects of this software implementation.

The domain logic will be implemented using simple domain objects and business objects. The domain objects will be simple objects, which do not contain any business logic; they merely hold the state of the application. These domain objects will be shared between the three layers of the application. The business objects will encapsulate the business rules and are responsible for the business logic. The core business logic will be encapsulated in packages and Java distinct classes, which will allow a consistent implementation across the different modules and promote code re-usability.

The application logic boundary will be defined using a Service Layer, a layer of services that establishes a set of available operations and coordinates the application response to each operation. The service layer will coordinate the persistence but will not persist the objects.

In this way, the modules could work in a SOA environment, as orchestrated services or as a choreography established by the process manager. They could also work separately, with very well-defined functionalities, to couple to the SOA architecture, when necessary.

The Application Tier will contain the business logic for the following modules:

- eTIR Main business:
  - eTIR transport (registration and exchange of declaration information);
  - eTIR operations;
  - Enquiry and recovery;
  - Reference data and authorizations.
- Guarantee management.
- Management and monitoring modules:
  - Management and administrations;
  - Monitoring system;
  - Knowledge base.
- eTIR Sub modules:
  - SafeTir communications;
  - NCTS_TIR data exchange module;
  - Reports, Statistics.
  - Connectivity to the ITDB. This might be a submodule tp be developed.

A.1.5.4.3 Persistence (Data Source) Tier

This tier will be responsible for storing and retrieving the data processed by the Business Tier. The data will be stored in an Relation Database Management System (DBMS). The database should be compatible with the platform chosen, such as, for instance, Oracle Database. But in a cloud of type PaaS, other options are available, like Microsoft Azure. The business layer will access the data source tier through the persistence layer located in the Business Tier.

The database should offer centralized administration and built-in validation, data protection and disaster recovery facilities, through the use of standard management tools.

Employing data constraints like foreign keys, unique keys and field constraints will ensure information integrity. The database should support internationalization, and will use the UTF-8 Character set, which provides support for almost any alphabet and language.

The database should refer to the following logical components:

- DB Metadata – will contain the metadata used to define all configurations of the eTIR international system. Also Reference tables will be stored there;
- DB eTIR – will contain the main data used by the eTIR international system operational. Messages received via web services, or sent via web services, with all history and accompanying information will be stored there;
- DB Ec Operator – will contain information about TIR Carnet holders. It is recommended to use the International TIR Database (ITDB), but if this tool is not available online, it is recommended to use a local database for this purpose;
- DB Management and Statistics – this will be a staging database used to store data for Data Warehouse purpose, reports, statistics;
- DB Backup – this will be a staging database used for backups.

In order to integrate different data sources, a Data ETL (Extract, Transform, Load) module will be available.

A.1.6. *Logical architecture*

The components described in the conceptual model could logically be grouped, based on their main functionality, in:

- **eTIR international kernel. (called also eTIR kernel)**

  This part is responsible for:

  - business logic implementation;
  - communication management using web services or web access;
  - data persistence;
  - public interfaces to other modules or systems.

- **eTIR user interface**

  This part will be responsible for data viewing and processing, via a web user interface.

  It will call processes defined in eTIR Kernel and will be used mainly as a fallback procedure, when system-to-system communications between the eTIR kernel and other participants in the eTIR life cycle will not work properly.

- **eTIR administration console**

  This part has functions for system administration and monitoring. It will be used by the system administrator to manage users, roles, reference data, to monitor system functionality and to audit the processes.

  The distribution of logical components and the relation with external interfaces is presented in the figure below.

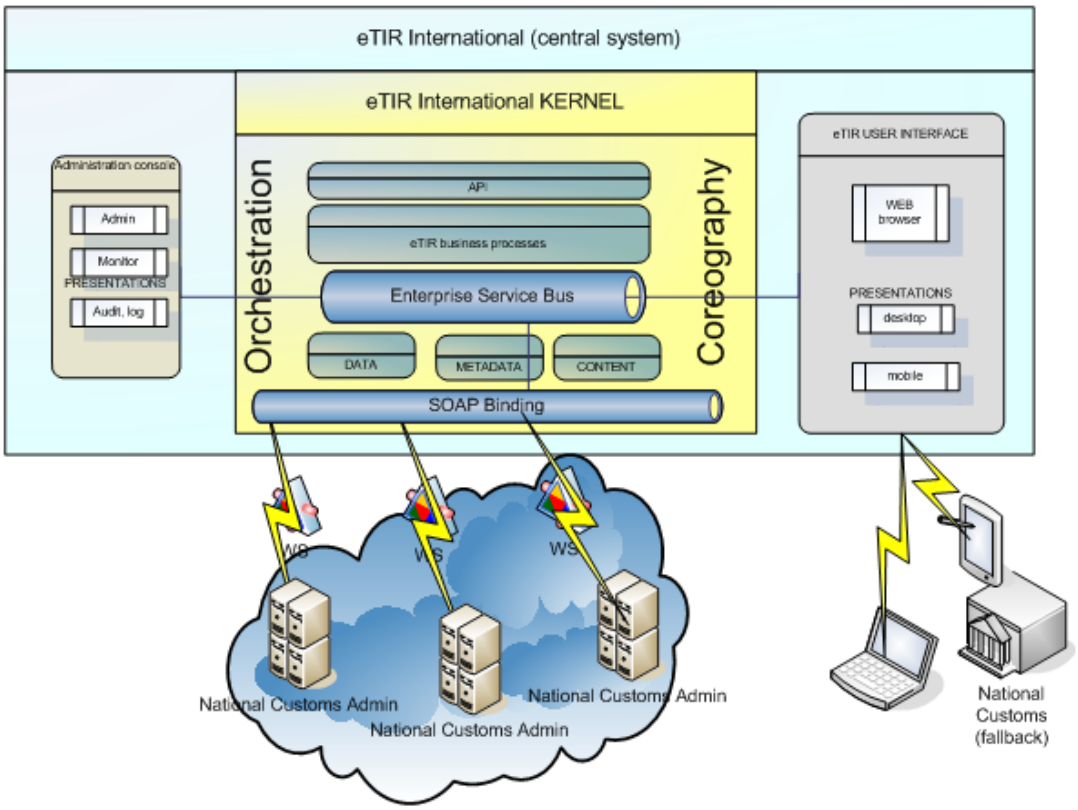

Fig 5. eTIR logical architecture

A.1.7. *Solutions Overview*

This section presents the envisaged solutions. Based on the efforts already made in the eTIR Reference Model V3.0, it has been established that the analysis will include the following architectural alternatives.

Three major alternatives, each one with several options will be considered in the evaluation of the cost-benefit analysis:

- Implementation using cloud computing concepts (described below):
    a. Infrastructure as a Service (IaaS);
    b. Platform as a Service (PaaS);
    c. Software as a Service (SaaS);
- Hosting all hardware infrastructure, hardware systems, software systems at the premises of the owner of the eTIR system and using a completely separate environment ('Premises', described below).
- Implementation using cloud computing concepts by hosting the eTIR system at the premises of other IT systems ('UNICC/UNOG', described below). This alternative is similar to IaaS or PaaS, but the infrastructure or the platform will be provided by a third party, e.g.UNOG (United Nations Office at Geneva) or UNICC (United Nations International Computing Center);

The next chapters will present a detailed description of all alternatives to be considered.

A.1.8. *Clouds for eTIR*

A.1.8.1 Clouds definitions[1]

As defined by American National Institute for Standards and Technology (NIST),

“Cloud computing is a pay-per-use model for enabling available, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. “

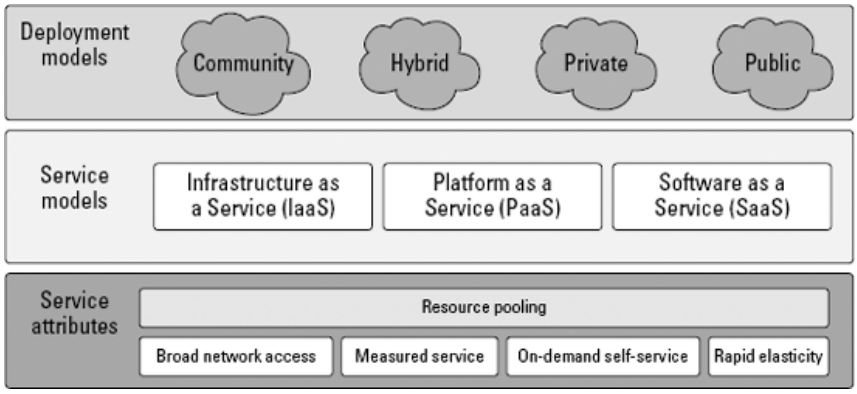

Fig 6. Clouds defined by NIST[1]

A.1.8.2 Clouds implementations

There are several implementations of the concept of cloud computing. Mainly they could be categorized in:

- *Private cloud.* The cloud infrastructure is owned or leased by a single organization and is operated solely for that organization;
- *Community cloud.* The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations);
- *Public cloud.* The cloud infrastructure is owned by an organization selling cloud services to the general public or to a large industry group;
- *Hybrid cloud.* The cloud infrastructure is a composition of two or more clouds (internal, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting).

Each deployment model instance has one of two types: internal or external.

Internal clouds reside within an organization’s network security perimeter and external clouds reside outside the same perimeter.

This will be the first architectural option described and analyzed.

A.1.8.3 Clouds alternatives[1][3][6][7]

When discussing alternatives for clouds, the following sub-alternatives will be presented:

- Infrastructure as a Service (IaaS);
- Platform as a Service (PaaS);
- Application as a Service (AaaS) or Software as a Service (SaaS).

The proposed implementation of the eTIR international system by means of clouds alternatives will have the following characteristics:

A.1.8.3.1 Infrastructure as a Service (IaaS)

For this alternative:

- The hardware and infrastructure are owned and maintained by a **cloud provider**. (for example: Amazon). For the purpose of this analysis, a private cloud is necessary (dedicated hardware owned by a cloud provider and used only by UNECE). The costs are per usage of data storage, processor operations and network traffic;
- Platforms are owned, installed, configured and maintained by **UNECE;**
- The eTIR international system is developed, owned, installed, configured and maintained by **UNECE;**

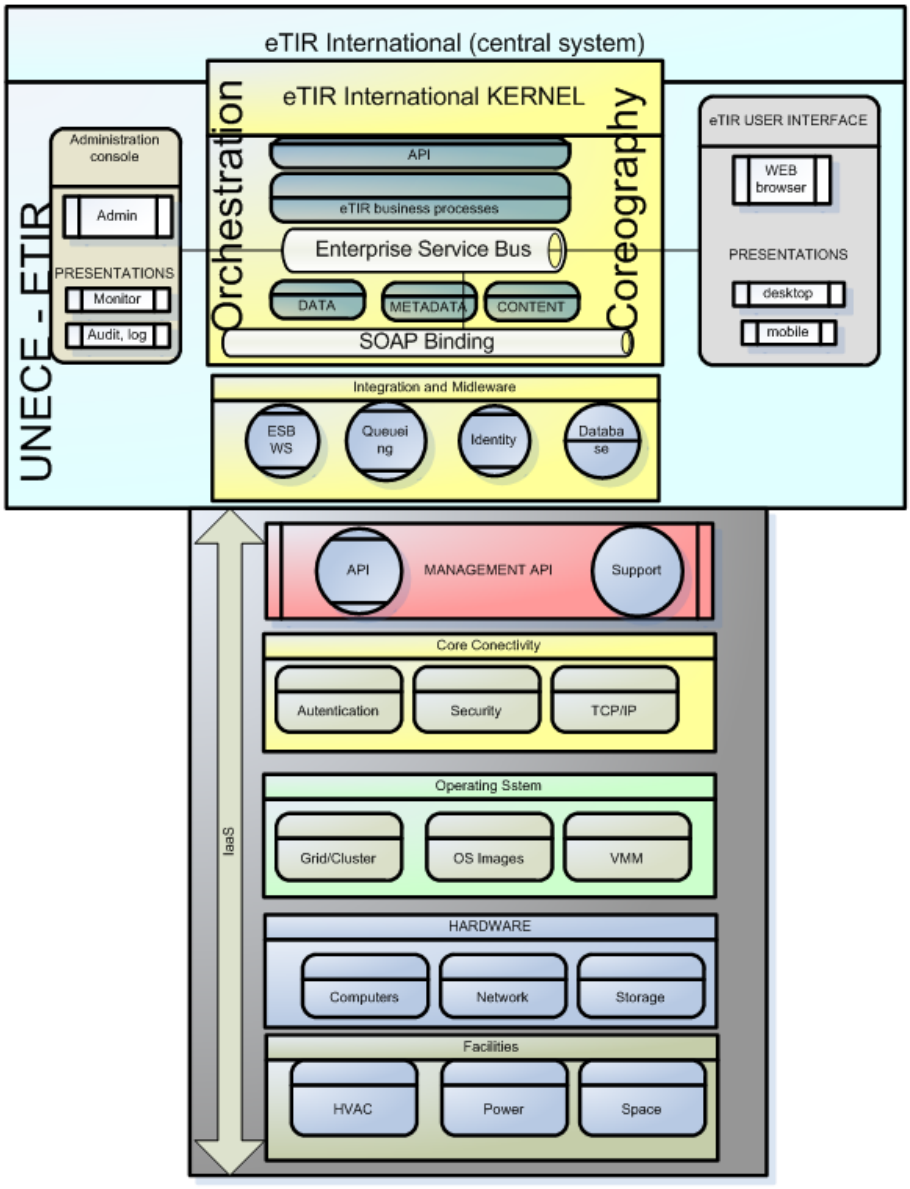

Fig 7. eTIR in IaaS

A.1.8.3.2 Platform as a Service (PaaS)

For this alternative:

- The hardware and infrastructure are owned and maintained by a **cloud provider** (for example: Google or Microsoft). The cloud should be a private cloud (dedicated hardware for UNECE usage only);
- Platforms are owned, installed, configured and maintained by a **cloud provider. Platforms are defined by UNECE.** The costs are per usage of data storage, processor operations and network traffic;
- The eTIR international system is developed, owned, installed, configured and maintained by **UNECE**;

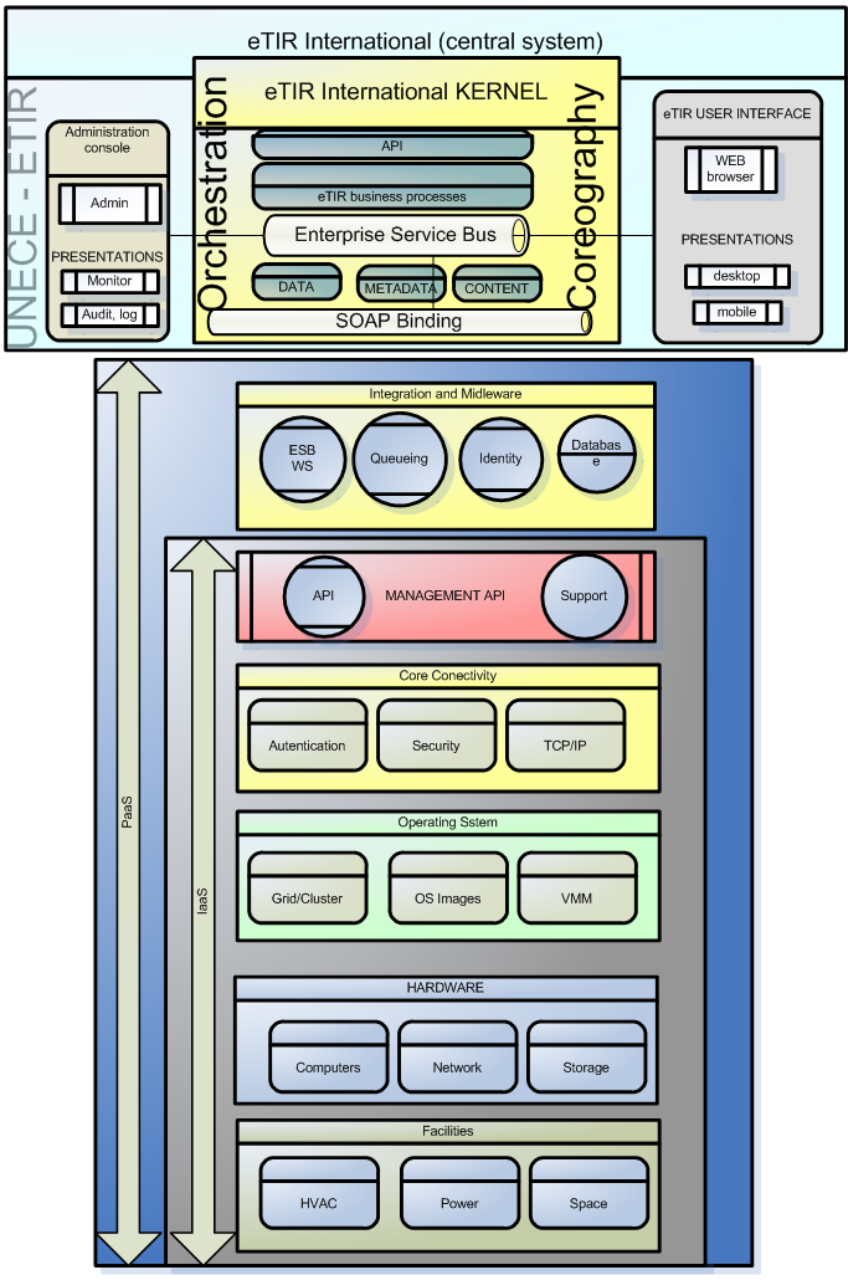

Fig 8. eTIR in PaaS

A.1.8.3.3 Software as a Service (SaaS)

For this alternative:

- The hardware and infrastructure are owned and maintained by a **cloud provider** (for example: a private company able to develop Customs software services). The cloud should be a private cloud (dedicated hardware for UNECE usage only). It might also be obtained from another provider, like for PaaS or Iaas;
- Platforms are owned, installed, configured and maintained by a **cloud provider;**
- The eTIR international system is developed, owned, installed, configured and maintained by a **cloud provider contracted by UNECE according to strict criteria and conditions.** The costs are per guarantee;

From an architectural point of view, the implementation is similar to the at premises alternative. The big difference resides in the fact that at premises everything (hardware, software) is owned, maintained and operated by UNECE, whereas in SaaS everything (hardware, software) is owned, maintained and operated by the SaaS provider.

A.1.9. *New hardware and software environment*

This option considers building the whole system from scratch: from building space, facilities, up to the eTIR software system.

The architecture considers a fully web-based centralized system, accessible from any place. High availability, scalability and high performance are the most important requirements for such a system.

For this alternative:

- The hardware and infrastructure are owned and maintained by **UNECE;**
- Platforms are owned, installed, configured and maintained by **UNECE;**
- The eTIR system is developed, owned, installed, configured and maintained by **UNECE;**

For this alternative, the following items will be taken into account:

  - Infrastructure (buildings, heating, power supply, facilities, backups, etc);
  - Hardware environment (computers, networks);
  - Software environment (operating systems, databases, frameworks, monitoring systems);

All expenses for buying, installing and maintaining the components will be considered.

The architecture is presented in the figure below:

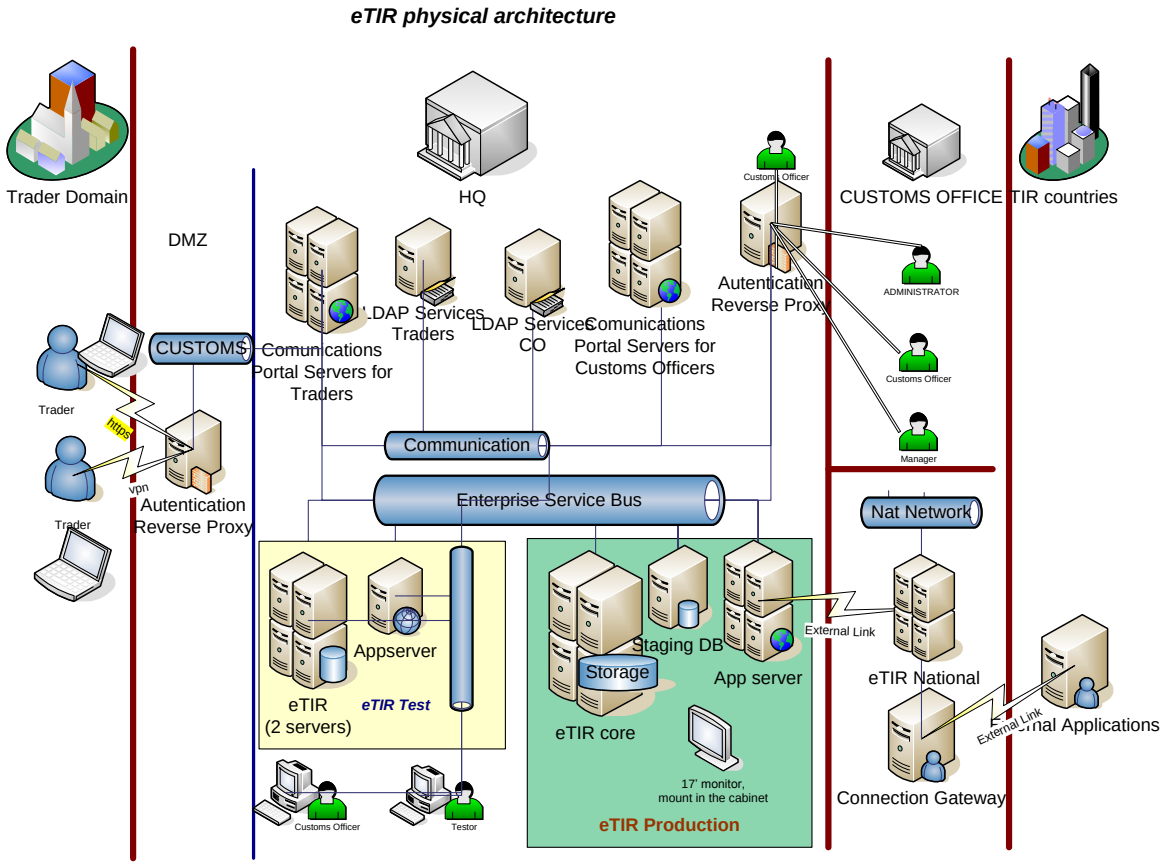

Fig 9. Hosting eTIR on own premises

A.1.10. *Hosting the eTIR system at the premises of other IT systems*

This option might be similar to a private cloud. The eTIR (IaaS) will be hosted in the environment of an existing IT system, like UNOG or UNICC. The difference between cloud-PaaS and this approach refers to the owner of the infrastructure and the relation between the eTIR owner and the infrastructure owner.

This option assumes that the eTIR international system will be installed using the hardware and software infrastructure of an organization involved in the eTIR international system or a specialized company.

From a technical point of view, this solution is similar with cloud-PaaS. For this reason, all elements of PaaS will be considered as part of its assessment. It offers a platform where the system could be developed.

Differences might also occur when we refer to the quality of service. But such differences exist between all PAAS providers.

Especially is important to notice that the mentioned providers (UNOG, UNICC) are strongly linked to the eTIR community

For this alternative:

- The hardware and infrastructure are owned and maintained by **UNICC/UNOG;**
- Platforms are owned, installed, configured and maintained by **UNICC/UNOG;**
- The eTIR system is developed, owned, installed, configured and maintained by **UNECE;**

The deployment schema is similar to the one for PaaS (fig 6), with the difference that the hosting is done at UNUG premises.

A.1.11. *Solution Comparison.*

This paragraph contains a review of the solution comparisons, with explanations of the criteria used.

Qualitative points are given from 1 to 5, where 1 means that the solution is not considered appropriate for the eTIR system and 5 means that the solution is considered as very appropriate for the eTIR system.

The more points in a specific category means the higher the implementation of the alternative is recommended.

No	Category	IaaS	PaaS	SaaS	UNOG/ UNICC	Premises
1	24/7 Reliability (Uptime is Imperative)	4	5	5	4	3
2	Performance	4	5	3	3	2
3	Security	1	3	3	4	5
4	Scalability	4	5	2	3	3
5	Availability/Access From Anywhere	4	5	5	4	3
6	Flexibility & Customization	4	3	2	3	5
7	Mental Blocks / Culture	3	3	2	4	5
8	Administration	3	4	5	4	1
9	Maturity of technology	3	2	1	4	5
	Total	***30***	***35***	***27***	***33***	***32***

In conclusion, from a technical point of view, the best solutions are PaaS and UNOG/UNICC

It should, however, be noted that clouds are evolving very rapidly and that, in the near future, good solutions for current weak points could very well be found.

A.1.11.1 Explanations regarding categories

A.1.11.1.1 24/7 Reliability

Reliability : the ability of the system or components to perform the required functions under stated conditions for a specified period of time.

SaaS/Cloud computing is going to be housed in a data centre usually staffed around the clock, with redundant power, air-conditioning, etc.

Premises servers can be accessed from anywhere with a stable, high-bandwidth Internet connection, but most privately owned data centres do not have the redundancy that a cloud provider data centre has, nor do they have 24/7 support staff. The latter can be mitigated by engaging a managed IT service provider.

The scale of cloud computing networks and their ability to provide load balancing and failover makes them highly reliable, often much more reliable than can be achieved in a single organization.

From a reliability point of view, considering the above PaaS and SaaS are classified most reliable (5 points)

IaaS is given 4 points next, as it offers only the hardware solution. The software platform should be maintained by the user The same is true for UNOG/UNICC.

Premises qualifies as the weakest in this category, because it is difficult to achieve the redundancy of a data centre, nor does it have 24/7 support staff (3 points).

A.1.11.1.2 Performance:

System performance is measured in number of transactions per second, medium time to view a page and medium time to call a web service.

For cloud systems, performance could be obtained as defined in Service Level Agreements (SLA). For on premises performance, this is dependent on the hardware and platform installed.

It is easier to define a SLA for a better performance than to install a very good platform on premises.

In PaaS, a SLA can be defined according to requirements. Hardware and software will be updated by the provider in line with the SLA. This is regarded as the best solution (5 points).

For IaaS, the SLA can be defined only at the hardware level. For this reason, it is considered less appropriate than PaaS (4 points).

As UNOG/UNICC is not specialized in cloud, it is not certain that a SLA with high requirements could be established. For this reason, it gets 3 points.

Regarding SaaS, considering that the whole system is outsourced to a cloud provider, the contract is usually based on the services, not on the performance. For this reason, it also gets 3 points.

Premises is the weakest in this category, because it has to be computed from scratch and is not adjustable to the real system needs. Thus, it gets 2 points.

A.1.11.1.3 Security.

This aspect refers to computer security, network security, and, more broadly, information security.

There are a number of security issues/concerns associated with cloud computing, but these issues fall into two broad categories: Security issues, faced by cloud providers (organizations providing SaaS, PaaS or IaaS via a cloud) and security issues faced by their customers.

Compared with Premises, cloud implementations are considered less secure. The characteristics of private clouds offer good solutions to address security issues.

Premises is considered the most secure solution, because it provides full control (5 points), followed by the use of UNOG/UNICC (4 points) and Paas (3 points) where both hardware and software are maintained by the cloud provider, which in turn could define a dedicated cloud. SaaS is considered just as secure as PaaS as it resides entirely with the cloud provider and a dedicated cloud could be attributed to it (3 points). IaaS is considered least secure; even if dedicated clouds are used, this is not a usual approach (1 point).

A.1.11.1.4 Scalability.

This is the ability of a system, network, or process, to handle growing amounts of work in a capable manner or its ability to be enlarged to accommodate that growth. Cloud implementations are much more scalable, as more computing power could be added as needed.

Scalability is important in the eventuality of an increasing number of ETIR carnets added for processing in the next years (more than planned initially).

The risk of not being scalable is materialized in the necessity to redesign the system.

PaaS is considered as most scalable; resources (hardware and software)are allocated as they are needed (5 points), followed by IaaS, because only hardware resources can be added as needed. Software resources might be not scalable (4 points). SaaS is awarded 2 points, because the cloud provider is developing a solution which might or might not be scalable. The risk of SAAS not being scalable is materialized in the availability of the system or more costs per processing unit. Premises could be scalable if so designed, but the risk of not being well-scalable is greater than for the other solutions. On premises there is a limited amount of resources and, usually, systems are designed to fit the existing resources. Thus, compared to SaaS, it also gets 3 points. UNOG/UNICC is considered as scalable, as at premises (3points).

A.1.11.1.5 Availability/Access From Anywhere

Availability is the degree to which a system, subsystem, or equipment is in a specified operable and committable state at the start of a mission, when the mission is called for at an unknown, i.e., a random, time. Simply put: availability is the proportion of time that a system is in a functioning condition.

Availability depends on the redundancy of the system, on the time balancing or restoration is done, on the way the system is monitored, on the way the system is configured to perform critical operations, etc.

Access From Anywhere refers to the availability of the system from any place, which needs the system functions.

Bearing the above in mind PaaS and SaaS are considered as most accessible (5 points). IaaS and UNOG/UNICC come next, as it offers only the hardware solution, whereas the software platform needs to be maintained by the user (4 points). Premises is the weakest in this category (high costs are involved to increase this characteristic under this solution) (3 points).

A.1.11.1.6 Flexibility & Customization

While SaaS vendors generally come out with updates far more frequently than server-based applications, they cannot be customized easily, or not at all, in some cases. The business will generally align its processes around how the product functions versus making the SaaS behave as desired. This also means that there will be significantly less third-party add-ons, especially if the vendor has not made his APIs Application Programming Interfaces (API) available.In other words: a SAAS is made for initial specifications. Subsequent changes in business processes are difficult to implement.

Premises is considered as the most flexible as this process of customization could be performed immediately (5 points). IaaS comes next, as only hardware infrastructure is from the cloud provider. All the other parts are under control of the eTIR owner and could be immediately customized (4 points). PaaS and UNOG/UNICC are less customizable, because the whole platform is owned by a cloud provider and customizations are limited (3 points). SaaS is considered least flexible, because everything is owned and maintained by a cloud provider and customizations depend entirely on the cloud SaaS provider (2 points).

A.1.11.1.7 Mental Blocks & Culture

Hosting any kind of data or business process off-premises is a big leap of faith for business owners, especially ones who are not yet comfortable with information technology.

For these reasons, Premises is awarded 5 points, whereas UNOG/UNICC gets 4 because it is a well-known organization. 3 points are given equally to IaaS and PaaS, because there is limited access to resources and 1 point to SaaS because there is no access to resources.

A.1.11.1.8 Administration.

This aspect counts the effort necessary to administer the system. No administration is necessary for SaaS. (5 points). PaaS and UNOG/UNICC only require application administration (4 points). Application and platform administration are necessary in IaaS (3 points). Because premises requires full administration, it only gets 12 point.

A.1.11.1.9 Maturity of technology

For a system where time is critical and subject to aligned to technological constraints, like the eTIR system, it is important to use a mature technology, with proven results in other systems.

Mature technology is used to buit the system. For example an operating system which was in use for at least 5 years, a developing environment version older that a number of years.

When developing at premises one has the full possibility to choose. In other situations, the technology should be chosen from a limited list of possibilities, and usually is the latest, and not necessarily proven as stable. From this point of view, Premises is regarded as the most mature solution, obtaining 5 points. The others are in decrease order of points: UNOG/UNICC (4 points) IaaS (3 points), PaaS (2 points), SaaS (1 point)

A.2. CLOUD PROVIDERS

At the moment of creating the present document, many cloud providers offer their services.

Below a comparison of the solutions of three main providers (Amazon, Google, Microsoft)

	Amazon AWS	Google App Engine	Windows Azure
Cloud Services	*Paas* *Iaas*	*Paas*	*Paas* *Iaas*
Platforms supported	Operating systems Red Hat Enterprise Linux Windows Server 2003/2008 Oracle Enterprise Linux OpenSolaris OpenSUSE Linux Ubuntu Linux Fedora Gentoo Linux Debian Software IBM DB2 IBM Informix Dynamic Server Microsoft SQL Server Standard 2005 MySQL Enterprise Oracle Database 11g Hadoop	Runtime Java Runtime Environment Python Runtime Environment Features Integration with Google Accounts URL Fetch Mail Memcache Image Manipulation Scheduled Tasks and Task Queues XMPP Blobstore (which supports objects upto 50MB in size) Software External software like AppServers Databases cannot be installed	Operating systems Windows 7 Windows Server 2008 Windows Vista
Cloud services and tools	Amazon CloudWatch API Tools Auto Scaling API Tools Elastic Load Balancing API Tools AWS Toolkit for Eclipse AWS Management Console Amazon EC2 API Tools Amazon EC2 AMI Tools Elasticfox Firefox Extension for Amazon EC2 Javascript Scratchpad for Amazon EC2 Amazon S3 Authentication Tool for Curl CloudBerry Explorer for Amazon S3 and CloudFront Manager for Amazon CloudFront Firefox Organizer for Amazon S3 and Amazon CloudFront (S3Fox) AWSzone.com Javascript Scratchpad for Amazon SQS Amazon Mechanical Turk Developer Sandbox Amazon Mechanical Turk Command Line Tools	Google Secure Data Connector Private gadgets Google Visualization API Google Apps APIs Google web toolkit IDE support	Windows Azure Platform Training Kit Windows Azure Software Development Kit Microsoft Visual Studio 2008 Service Pack 1 Windows Azure platform AppFabric SDK V1.0 Windows 7 Training Kit For Developers
Integrated DB supported	MySql	GAE doesn't support external databases; it provides a data store of its own which can be accessed through standard JDO and JPA APIs.	Sql azure
Maximum limits	Amazon S3 - Store object up to 5 GB Amazon EC2 [Elastic Block storage] - Volume sizes ranging from 1GB to 1TB (20 TB/account limit while in	Automatic scaling is built in with App Engine No matter how many users you have or how much data your application stores, App Engine can scale to meet your needs	Azure has a 64MB limit on individual blobs and also allows you to split a blob into blocks of 4MB each

	beta)		
Service Level Agreements availability	Amazon S3 - available with a Monthly Uptime Percentage of at least 99.9% during any monthly billing cycle Amazon EC2 - available with an Annual Uptime Percentage of at least 99.95% during the Service Year	100% Uptime	99.9% uptime
Support Pricing Policy	Premium Support - Silver and Gold support available and are charged accordingly	Free Support is available 24x7x365 from on-site cloud hosting experts	Developer support is charged on a per incident basis. However, you are able to utilize support incidents that you already have from existing programs such as the Microsoft Developer Network (MSDN) and the Microsoft Partner Network (MPN).
Support response time	Severity level vs response time Urgent - 1 hour (available for Gold subscribers only) High - 4 business hours Normal - 1 business day Low - 2 business days	Not available	Not available
Service credit for an outage	Monthly uptime percentage vs Service credit percentage Amazon S3 Equal to or greater than 99% but less than 99.9% - 10% less than 99% - 25% Amazon EC2 If the Annual Uptime Percentage for a customer drops below 99.95% for the Service Year, that customer is eligible to receive a Service Credit equal to 10% of their bill (excluding one-time payments made for Reserved Instances) for the Eligible Credit Period	Not available	Microsoft will provide a 10 percent credit if compute connectivity falls below 99.95 percent uptime; a 10 percent credit if role-instance uptime or storage falls below 99.9 percent uptime. If it falls below 99 percent availability across anything, 25 percent credit will be provided
Incidence notification approach	Amazon Web Services publishes the most up-to-the-minute information on service availability in Service Health Dashboard Amazon Web Services keeps a running log of all service interruptions	The user should subscribe to this announcement-only list to receive updates on system outages, maintenance periods, and other service disruptions. Go to the group: google-appengine-downtime-notify Subscribe via email: google-appengine-downtime-notify-subscribe@googlegroups.com Apart from the above,when there is a scheduled down time, GAE puts the data store in read-only mode. During that time any attempt to write data to the data store will throw an exception which can be caught in the application to show a user friendly message to the user	Microsoft may send periodic e-mails informing you of technical service issues related to a product or service you requested
Access/usage reports	Amazon Cloud watch	The Administrative console provides the following details, view access data and error logs, and analyze traffic browse the application's datastore and manage indexes view the status of the application's scheduled tasks	"Dallas" Features allows users to get detailed access report containing the services/datasets that were accessed, grouped by date and by account key
Community News/Blogs	http://aws.typepad.com	http://code.google.com/appengine/community.html http://googleappengine.blogspot.com	http://blogs.technet.com/microsoft_blog/archive/tags/Azure/default.aspx

Data backup	Amazon RDS automatically patches the database software and backs up the database, storing the backups for a user-defined retention period Amazon AWS may delete, without liability of any kind, any of the Amazon SQS Content that sits in a queue or any queue that remains inactive for more than the number of days specified in the user documentation. Amazon SimpleDB, in during the previous six (6) months you if there are no incurred fees for SimpleDB and have registered no usage of the Amazon SimpleDB Content, Amazon AWS may delete, without liability of any kind, the Amazon SimpleDB Content upon thirty (30) days prior notice to you. Amazon S3 versioning provides an additional layer of protection for your S3 objects. You can	The user is solely responsible for securing and backing up the Application and any Content. Google has no responsibility or liability for the deletion or failure to store any Content and other communications maintained or transmitted through use of the Service.	The user is solely responsible for securing and backing up the data.
Data after termination	Amazon will not take any action to intentionally erase any of the data stored on the Services for a period of thirty (30) days after the effective date of termination Post termination retrieval of data stored on the Services will be conditioned on the payment of Service data storage charges for the period following termination, payment in full of any other amounts due Amazon,and the compliance with terms and conditions Amazon may establish with respect to such data retrieval	If Google suspends or terminates the use of the Service with cause (or if the user voluntarily discontinues the use of the Service), the user will have access to, and the ability to export, the Content for a period of ninety (90) days following such suspension or termination. Fees will continue to be assessed for usage of the Service in excess of any portion of the Fee Threshold during the 90 day period	Upon expiration or termination of your online service subscription, you must contact Microsoft and tell whether to: (1)disable your account and then delete your subscriber data; or (2) Retain your subscriber data in a limited function account for at least 90 days after expiration or termination of your subscription (the ―retention period‖) so that you may extract the data. If you indicate (1), you will not be able to extract your subscriber data from your account. If you indicate (2), you will reimburse Microsoft for any applicable costs. If you do not indicate (1) or (2), Microsoft will retain your subscriber data in accordance with (2). Following the expiration of the retention period, Microsoft will disable your account and then delete your subscriber data.
Data security	Amazon Elastic Compute Cloud (EC2) provides Host Operating System,Guest operating system and a complete firewall solution. It also provides a way to encrypt the API calls in transit with SSL to maintain confidentiality.AWS network provides significant protection and also enables customer to implement futher protection Amazon Simple Storage Service (Amazon S3):Amazon S3 is accessible via SSL encrypted endpoints. Data stored within Amazon S3 is not encrypted at rest by AWS. However, users can encrypt their data before it is uploaded to Amazon S3 so that the data cannot be accessed or tampered with by unauthorized parties. SimpleDB APIs provide domain-level controls that only permit	App Engine runs Java applications using the Java 6 virtual machine (JVM). The JVM runs in a secured "sandbox" environment to isolate your application for service and security. The JVM can execute any Java bytecode that operates within the sandbox restrictions The Python interpreter also runs in a secured "sandbox" environment to isolate your application for service and security	Filtering Routers Firewalls Cryptographic Protection of Messages Software Security Patch Management centralized monitoring, correlation, and analysis systems Network Segmentation Service Administration Access Physical Security limited number of Microsoft personnel may access customer information to respond to support requests and as part of incident response Windows Azure compute provides optional sandboxing technology and mandatory sandboxing features that attempts to limit the harm to the infrastructure and all other

	authenticated access by domain creator, therefore the customer maintains full control over who has access to their data.SimpleDB access can be granted based on an AWS Account ID.SimpleDB is accessible via SSL-encrypted endpoints.		customers from such bugs. Windows Azure provides virtual machines to customers, giving them access to most of the same security options available in Windows Server. Updates to the software and configuration are
Virtualization platform	EC2 uses modified Xen virtualization	Not available	Modified Hyper-V hypervisor
Control Panel	Web based Interface	Web based Interface	Web based Interface
Age of Service	Since early 2006	Since July 2008	Since October 2008

A.3. FPA METHODOLOGY

In order to apply FPA, the following references have been used:

- Use cases described in the **eTIR Reference Model [R2**], Chapter 2.3 pg. 89-116;
- Activity analysis described in the **eTIR Reference Model [R2]**, Chapter 3.1 pg 117-128;
- Data model described in the **eTIR Reference Model [R2]**, Chapter 3.1 pg 117-128;
- Management by Customs of data on guarantees class diagram in the **eTIR Reference Model [R2]**, Chapter 3.2.1 pg. 136;
- Declaration class diagram in the **eTIR Reference Model [R2]**, Chapter 3.2.2 pg. 137;
- TIR operations class diagram in the **eTIR Reference Model [R2]**, Chapter 3.2.3 pg. 138;
- eTIR declaration mechanism described in the **eTIR Reference Model [R2],** Annex VI, pg. 501-515.
- Data element definitions (the Ix messages and Ex messages) as defined in the **eTIR Reference Model [R2**], Chapter 3.2.5 pg. 141-279.).
- The general system characteristics, as defined in Annex A.1 Chapter A.1.5.

Use cases and sequence diagrams have been used to identify the required functionalities of the eTIR international system. Based on the identified functionalities and data processing involved, we have computed the **Total Unadjusted Function Points (TUFP).**

Based on the required technical characteristics, we have computed the **Total Adjusted Function Points (TAFP).**

When computing TUFP, we have used the following elements:

- External Inputs (EI);
- External Outputs (EO);
- External Inquiry (EQ);
- Internal Logical Files (ILF);
- External Interface Files (EIF).

The relationship between these elements is based on the following matrix:

Entity	RETs	FTRs	DETs
EI	Not counted	To be counted	To be counted
EO	Not counted	To be counted	To be counted
EQ	Not Counted	To be counted	To be counted
EIF	To be counted	Not Counted	To be counted
ILF	To be counted	Not Counted	To be counted

When computing TUFP and TAFP, the following definitions have been applied:

- **External Inputs (EI)** – is an elementary process in which data crosses the boundary from outside to inside. This data is external to the application. The data may come from a data input screen or another application. The data may be used to maintain one or more internal logical files. The data can be either control information or business information. If the data is control information it does not have to maintain an internal logical file.

FTRs and DETs are used to determine EI.

- **External Outputs (EO)** – it is an elementary process in which derived data passes across the boundary from inside to outside. Additionally, an EO may update an ILF. The data creates reports or output files sent to other applications. These reports and files are created from information contained in one or more internal logical files and external interface files.

FTRs and DETs are used to determine EO.

- **External Inquiry (EQ)** – is an elementary process with both input and output components that result in data retrieval from one or more internal logical files and external interface files. The input process does not update or maintain any FTR's (Internal Logical Files or External Interface Files) and the output side does not contain derived data.

FTRs (File Type Referenced) and DETs (Data Element Type) are used to determine EQ.

- **Internal Logical Files (ILF)** – a user identifiable group of logically related data that resides entirely within the application boundary and is maintained through External Inputs. An internal logical file has the inherent meaning that it is internally maintained, has some logical structure and is stored in a file.

- **External Interface Files (EIF)** – a user identifiable group of logically related data that is used for reference purposes only. The data resides entirely outside the application boundary and is maintained by another application' external inputs. The external interface file is an internal logical file for another application. An application may count a file as either an EIF or ILF, but not both. An external interface file has the inherent meaning that it is externally maintained (probably by some other application), that an interface has to be developed to get the data and that it is stored in a file.

Record Element Type (RET): A RET is a user recognizable subgroup of data elements within an ILF or an EIF. It is best to look at logical groupings of data to help identify them.

c. Classes and attributes (English Only)

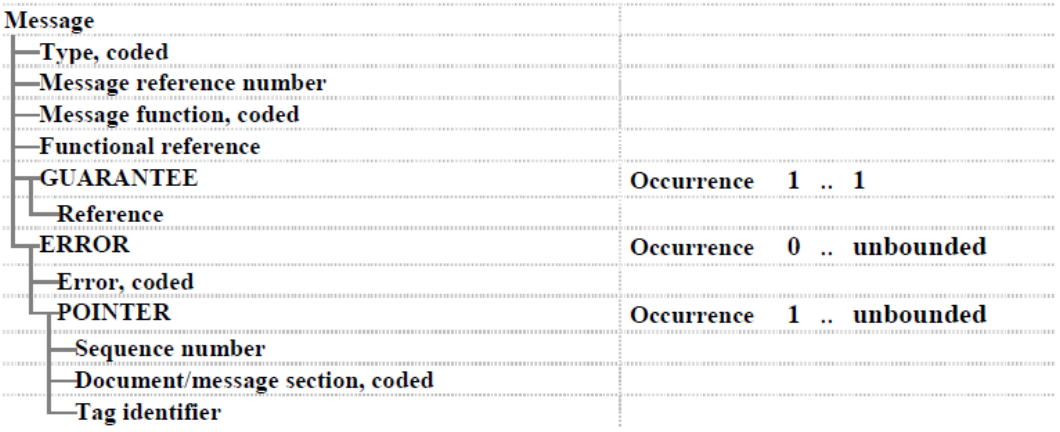

Fig 10. Definition of eTIR message

File Type Referenced (FTR): A FTR is a file type referenced by a transaction. An FTR must also be an internal logical file or an external interface file.

Data Element Type (DET): A DET is a user field recognized as being unique, non-recursive (non-repetitive). A DET is information that is dynamic and not static. A dynamic field is read from a file or created from DETs contained in a FTR. Additionally, a DET can invoke transactions or can be additional information regarding transactions.

A.4. SCHEDULE AND COSTS ESTIMATION

A.4.1. *Introduction*

Based on the estimated Function Points (described in Chapter 2.3. and Annexes A.3. and A.5.), the COCOMO II methodology [2][8] has been applied to estimate the schedule and the cost for the development of the eTIR international system.

It should be noted that the estimations only apply to the development and implementation phases.

The following costs are NOT included: Training, maintenance, technical support, consultancy on legal aspects, helpdesk, changes (if any) in national Customs IT systems, changes (if any) in trader IT systems, changes (if any) for ITDB, changes (if any) requested by guarantee chain systems.

There are two alternatives (options):

- The first variant is based on a medium qualified and experienced team;
- The second variant is based on the assumption that the eTIR international system is developed and implemented by a highly qualified and experienced team.

A.4.2. *Assumptions*

The assumptions used when computing the schedule and cost estimates are those presented in the table below:

For a medium qualified team we assume that:

Development style	
Precedence	Medium
Development Flexibility	Medium
Software Cost Drivers	
Required Software Reliability	Medium
Data Base Size	Medium
Product Complexity	Medium
Developed for Reusability	Medium
Documentation Match to Lifecycle Needs	Medium
Architecture / Risk Resolution	Medium
Personnel	
Team Cohesion	Medium
Analyst Capability	Medium
Programmer Capability	Medium
Personnel Continuity	Medium
Application Experience	Medium
Platform Experience	Medium
Language and Toolset Experience	Medium
Process Maturity	Medium
Platform	

Time Constraint	Medium
Storage Constraint	Medium
Platform Volatility	Medium
Project	
Use of Software Tools	Medium
Multi-site Development	Medium
Required Development Schedule	Medium

Cost per Person-Month (Dollars): $5,000

For a highly experienced team we assume that:

Development style	
Precedence	Medium
Development Flexibility	Medium
Software Cost Drivers	
Required Software Reliability	High
Data Base Size	Medium
Product Complexity	High
Developed for Reusability	Medium
Documentation Match to Lifecycle Needs	High
Architecture / Risk Resolution	High
Personnel	
Team Cohesion	High
Analyst Capability	High
Programmer Capability	High
Personnel Continuity	Very High
Application Experience	Very High
Platform Experience	High
Language and Toolset Experience	High
Process Maturity	High
Platform	
Time Constraint	Medium
Storage Constraint	Medium
Platform Volatility	Medium
Project	
Use of Software Tools	High
Multi-site Development	Medium
Required Development Schedule	Medium

Cost per Person-Month (Dollars): $8,000

A.4.3. Costs and schedule for the full system when employing a medium experienced *development team*

Software Engineering

Effort = 225.4 Person-months
Schedule = 21.9 Months
Cost = $1,127,000
Total Equivalent Source Lines of Code =51,720

Phase Distribution

Phase	Effort (Person-months)	Schedule (Months)	Average Staff	Cost (Dollars)
Inception	9.4	2.7	4.9	$47,000
Elaboration	47	8.2	6.6	$235,000
Construction	147	13.7	12.5	$735,000
Transition	22	2.7	9.9	$110,000
Total	225.4			$1,127,000

Software Effort Distribution for RUP/MBASE (Person-Months)

Phase/Activity	Inception	Elaboration	Construction	Transition	Total
Management	1	5.5	15	3	24.5
Environment/CM	0.8	4.3	8	1	14.1
Requirements	3	7.7	11	1	22.7
Design	2.2	16.5	22	1	41.7
Implementation	1	6	45	4	56
Assessment	1	5.4	41	5	52.4
Deployment	0.4	1.6	5	7	14
Total	9.4	47	147	22	

A.4.4. *Costs and schedule for the full system when employing a highly experienced development team*

Software Engineering

Effort = 115.6 Person-months
Schedule = 17.6 Months
Cost = $924,800
Total Equivalent Source Lines of Code = 51,720

Phase Distribution

Phase	Effort (Person-months)	Schedule (Months)	Average Staff	Cost (Dollars)
Inception	5.6	2.2	3.2	$44,800
Elaboration	24	6.6	4.2	$192,000
Construction	75	11	8	$600,000
Transition	11	2.2	6.3	$88,000
Total	115.6			$924,800

Software Effort Distribution for RUP/MBASE (Person-Months)

Phase/Activity	Inception	Elaboration	Construction	Transition	Total

Management	1	3	5	1	10
Environment/CM	0.5	2	3	0.5	6
Requirements	2	4	7	0.5	13.5
Design	1	8	14	0.5	23.5
Implementation	0.5	3.5	24	2.5	30.5
Assessment	0.4	2.5	20	3	25.9
Deployment	0.2	1	2	3	6.2
Total	5.6	24	75	11	

A.4.5. *Costs and schedule for the eTIR international kernel when employing a medium experienced team*

Software Engineering

Effort = 71.3 Person-months
Schedule = 15.0 Months
Cost = $356,500
Total Equivalent Source Lines of Code =20,000

Phase Distribution

Phase	Effort (Person-months)	Schedule (Months)	Average Staff	Cost (Dollars)
Inception	3	1.9	2.3	$15,000
Elaboration	14	5.6	3	$70,000
Construction	48	9.4	5.8	$240,000
Transition	6.3	1.9	4.6	$31,500
Total	71.3			$356,500

Software Effort Distribution for RUP/MBASE (Person-Months)

Phase/Activity	Inception	Elaboration	Construction	Transition	Total
Management	0.5	1.5	4	1	7
Environment/CM	0.2	1	2.5	0.2	3.9
Requirements	1.2	3	4	0.2	8.4
Design	0.5	5	8	0.3	13.8
Implementation	0.3	1.5	16	1.1	18.9
Assessment	0.2	1.5	12	2	15.7
Deployment	0.1	0.5	1.5	1.5	3.6
Total	3	14	48	6.3	

A.4.6. *Costs and schedule for the eTIR international kernel when employing a highly experienced team*

Software Engineering

Effort = 41.2 Person-months
Schedule = 12.5 Months
Cost = $329,600
Total Equivalent Source Lines of Code = 20,000

Phase Distribution

Phase	Effort (Person-months)	Schedule (Months)	Average Staff	Cost (Dollars)
Inception	2	1.6	1.6	$16,000
Elaboration	8.2	4.7	2.1	$65,600
Construction	27	7.8	4	$216,000
Transition	4	1.6	3.2	$32,000
Total	41.2			$329,600

Software Effort Distribution for RUP/MBASE (Person-Months)

Phase/Activity	Inception	Elaboration	Construction	Transition	Total
Management	0.1	1	2	0.2	3.3
Environment/CM	0.2	0.5	1.5	0.2	2.4
Requirements	0.7	1.5	2	0.2	4.4
Design	0.5	3	4	0.2	7.7
Implementation	0.2	1	10	0.7	11.9
Assessment	0.2	1	7	1	9.2
Deployment	0.1	0.2	0.5	1.5	2.3
Total	2	8.2	27	4	

A.4.7. *Costs and schedule for the eTIR kernel and administration when employing a medium experienced development team*

Software Engineering

Effort = 122.5 Person-months
Schedule = 17.9 Months
Cost = $612,500
Total Equivalent Source Lines of Code =29,720

Phase Distribution

Phase	Effort (Person-months)	Schedule (Months)	Average Staff	Cost (Dollars)
Inception	7.5	2.2	3.3	$37,500
Elaboration	23	6.7	4.4	$115,000
Construction	80	11.2	8.3	$400,000

Transition	12	2.2	6.6	$60,000
Total	122.5			$612,500

Software Effort Distribution for RUP/MBASE (Person-Months)

Phase/Activity	Inception	Elaboration	Construction	Transition	Total
Management	1	2	7	1.5	11.5
Environment/CM	0.7	2	4	0.5	7.2
Requirements	3	4	8	0.5	15.5
Design	1.4	9	12	0.5	22.9
Implementation	0.6	3	25	3	31.6
Assessment	0.6	2	21	2	25.6
Deployment	0.2	1	3	4	8.2
Total	7.5	23	80	12	

A.4.8. *Costs and schedule for the eTIR kernel and administration when employing a highly experienced development team*

Software Engineering

Effort = 60.7 Person-months
Schedule = 14.2 Months
Cost = $485,600
Total Equivalent Source Lines of Code= 29,720

Phase Distribution

Phase	Effort (Person-months)	Schedule (Months)	Average Staff	Cost (Dollars)
Inception	3	1.8	2	$24,000
Elaboration	11	5.3	2.7	$88,000
Construction	40	8.9	5.2	$320,000
Transition	6.7	1.8	4.1	$53,600
Total	60.7			$485,600

Software Effort Distribution for RUP/MBASE (Person-Months)

Phase/Activity	Inception	Elaboration	Construction	Transition	Total
Management	0.2	1	3	0.5	4.7
Environment/CM	0.4	1	1	0.4	2.8
Requirements	1.2	2	3	0.3	6.5
Design	0.6	4	7	0.3	11.9
Implementation	0.3	1.6	14	1.4	17.3
Assessment	0.2	1	11	1.6	13.8
Deployment	0.1	0.4	1	2.2	3.7

Total	3	11	40	6.7	

A.5. DETAILED FUNCTION POINT ANALYSIS

A.5.1. *What we count and how we count it*

We consider hereby the three main functional components of eTIR international system:

1. eTIR international kernel (also called eTIR Kernel). This is the main component responsible for the business logic and data exchange using web services.
2. eTIR international USER INTERFACE system. This is to be used as fallback procedure, to enter data into the system using a user interface. The business logic used is that from the eTIR international kernel.
3. eTIR administration console. Used to:
    a. Manage users, connections, reference data,
    b. Monitor the system
    c. Audit actions

Estimation was done for each functional component, and finally the results were aggregated.

A.5.1.1 Estimations for eTIR kernel

eTIR international kernel is responsible for

- Data storage and transport;
- Business process management;
- Data exchange between eTIR actors.

The whole estimation process is based on the eTIR messages defined in the reference Model.

A.5.1.2 Estimations for eTIR Administration console

We consider that the administration console is used to administer the main elements in the system.

The following actions are considered as a minimum

1. Administer Users and roles
2. Administer Guarantee chain data
3. Administer Holder data
4. Administer Customs Office Data
5. Administer Reference data
6. Configuration of communication channels
7. Monitor the system
8. Administer general parameters
9.Loging and auditing

For each action we have considered one entity defined by:

EI: A page used to manage the corresponding data. In the case of monitoring we consider one page per each chart graph displayed in real time;

EO. Error message;

EQ. We consider that for each entity administered, there should be a query with at least 3 parameters in filter and at least 3 elements in answer;

ILF. We consider that for each EI an ILF is used (same number of DET);

EIF. We consider the printing of entities (in row format just for administration purposes).

A.5.2. *FPA-eTIR International kernel*

A.5.2.1 FPA Summary results

Function Point Estimation Worksheet

Description	Complexity Low		Medium		High		Total
EI	1	x 3	2	x 4	7	x 6	53
EO	0	x 4	1	x 5	1	x 7	12
EQ	1	x 3		x 4	1	x 6	9
ILF	42	x 7	2	x 10	0	x 15	314
EIF	1	x 5	0	x 7	0	x 10	5

Total Unadjusted Function Points (TUFP): 393

A.5.2.2 FPA Detailed results

3.1.1.1.2 Register guarantee, Request	**EI**	**E1**		2	7	**0**	**1**	**0**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.1.3 Cancel guarantee, request	**EI**	**E3**		**2**	**7**	**0**	**1**	**0**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.1.4 Accept guarantee, Request	**EI**	**I1**		**3**	**9**	**0**	**0**	**1**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.1.5 Get holder information	**EI**	**I3**		**1**	**2**	**1**	**0**	**0**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.2.1 Record consignment information, Invoke	**EI**	**I7**		**38**	**100**	**0**	**0**	**1**
	EO			0	0	**0**	**0**	**0**
	EQ			0	0	**0**	**0**	**0**
3.1.1.2.2 Update consignment information, Invoke	**EI**	**I7**		**38**	**100**	**0**	**0**	**1**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.2.3 Start of TIR operation, Invoke	**EI**	**I9**		**13**	**35**	**0**	**0**	**1**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**

3.1.1.2.4 Terminate TIR operation,, Invoke	**EI**	**I11**		**12**	**33**	**0**	**0**	**1**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.2.5 Discharge TIR operation, Invoke	**EI**	**I13**		**6**	**17**	**0**	**0**	**1**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.2.6 Notify guarantee chain, Invoke	**EI**					**0**	**0**	**0**
	EO	**E7**		2	7	**0**	**1**	**0**
	EQ					**0**	**0**	**0**
3.1.1.2.7 Notify subsequent countries, Invoke	**EI**					**0**	**0**	**0**
	EO	**I15**		61	100	**0**	**0**	**1**
	EQ					**0**	**0**	**0**
3.1.1.2.7 Notify subsequent countries, Response	**EI**	**I16**		**8**	**23**	**0**	**0**	**1**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.1.6 Query guarantee	**EI**					**0**	**0**	**0**
	EO					**0**	**0**	**0**
	EQ	**E5**		38	100	**0**	**0**	**1**
Authentication	**EI**					**0**	**0**	**0**
	EO					**0**	**0**	**0**
	EQ			1	1	**1**	**0**	**0**

ILF		40 ILF low complexity	Low					
		I user data	Medium					
		1 Reference data	Medium					
		1 Log data	Medium					
		System Parameters	Low					
EIF		ITDB	Medium					

A.5.3. *FPA-eTIR International USER INTERFACE*

A.5.3.1 FPA-Summary results

Function Point Estimation Worksheet

Description	Complexity						Total
	Low		Medium		High		
EI	1	x 3	2	x 4	7	x 6	53
EO	0	x 4	1	x 5	1	x 7	12
EQ	1	x 3	10	x 4	1	x 6	49

ILF	42	x 7	2	x 10	0	x 15	314	
EIF	1	x 5	0	x 7	0	x 10	5	

Total Unadjusted Function Points (TUFP): 433

A.5.3.2 FPA-Detailed results

	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.1.3 Cancel guarantee, request	**EI**	**E3**		**2**	**7**	**0**	**1**	**0**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.1.4 Accept guarantee, Request	**EI**	**I1**		**3**	**9**	**0**	**0**	**1**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.1.5 Get holder information	**EI**	**I3**		**1**	**2**	**1**	**0**	**0**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.2.1 Record consignment information, Invoke	**EI**	**I7**		**38**	**100**	**0**	**0**	**1**
	EO			0	0	**0**	**0**	**0**
	EQ			0	0	**0**	**0**	**0**
3.1.1.2.2 Update consignment information, Invoke	**EI**	**I7**		**38**	**100**	**0**	**0**	**1**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.2.3 Start of TIR operation, Invoke	**EI**	**I9**		**13**	**35**	**0**	**0**	**1**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.2.4 Terminate TIR operation, Invoke	**EI**	**I11**		**12**	**33**	**0**	**0**	**1**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.2.5 Discharge TIR operation, Invoke	**EI**	**I13**		**6**	**17**	**0**	**0**	**1**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.2.6 Notify guarantee chain, Invoke	**EI**					**0**	**0**	**0**
	EO	**E7**		2	7	**0**	**1**	**0**
	EQ					**0**	**0**	**0**
3.1.1.2.7 Notify subsequent countries, Invoke	**EI**					**0**	**0**	**0**
	EO	**I15**		61	100	**0**	**0**	**1**
	EQ					**0**	**0**	**0**

3.1.1.2.7 Notify subsequent countries, Response	**EI**	**I16**		**8**	**23**	**0**	**0**	**1**
	EO					**0**	**0**	**0**
	EQ					**0**	**0**	**0**
3.1.1.1.6 Query guarantee	**EI**					**0**	**0**	**0**
	EO					**0**	**0**	**0**
	EQ	**E5**		38	100	**0**	**0**	**1**
Authentication	**EI**					**0**	**0**	**0**
	EO					**0**	**0**	**0**
	EQ			1	1	**1**	**0**	**0**

ILF		40 ILF low complexity	Low				
		I user data	Medium				
		1 Reference data	Medium				
		1 Log data	Medium				
		System Parameters	Low				
EIF		ITDB	Medium				
EQ		10 Queries to fill in Popup	Medium				

A.5.4. *FPA-eTIR International Administration Console*

A.5.4.1 FPA-Summary results

Function Point Estimation Worksheet							
	Complexity						
Description	**Low**		**Medium**		**High**		**Total**
EI	6	x 3	1	x 4	2	x 6	34
EO	8	x 4	1	x 5	0	x 7	37
EQ	1	x 3	6	x 4	0	x 6	27
ILF	8	x 7	0	x 10	0	x 15	56
EIF	6	x 5	1	x 7	0	x 10	37
		Total Unadjusted Function Points (TUFP):					191

A.5.4.2 FPA-Detailed results

(ILF/EIF/EI/EO/EQ)		RET	FTR	DET	Complexity			FTR Detailed	DET Detailed
					Low	Medium	High		
1. Administer Users and roles	**EI**		2	10	**0**	**1**	**0**	User data, Roles	User fields (6), Roles fields(4)
	EO		1	1	**1**	**0**	**0**	Error message	Error message content
	EQ		2	6	**0**	**1**	**0**	Query on Users and roles filter, User and roles report	Holder data, Cargo Info, Risk Data
	ILF	2		10	**1**	**0**	**0**	User record, Roles record	User and role elements
	EIF	1		1	**1**	**0**	**0**	Printing users and roles	
2. Administer Guarantee chain data	**EI**		**1**	**10**	**1**	**0**	**0**	Guarantee chain page	Guarantee chain info on page
	EO		1	1	**1**	**0**	**0**	Error message	Error message content
	EQ		2	6	**0**	**1**	**0**	Query filter, Report	minimum 3 elements in filter, minimum 3 element in report
	ILF	1		10	**1**	**0**	**0**	Guarantee chain record	Guarantee chain elements
	EIF	1		1	**1**	**0**	**0**	Print guarantee chain data	
3. Administer Holder data	**EI**		**1**	**10**	**1**	**0**	**0**	Holder page	Holder info on page
	EO		1	1	**1**	**0**	**0**	Error message	Error message content
	EQ		2	6	**0**	**1**	**0**	Query filter, Report	minimum 3 elements in filter, minimum 3 element in report
	ILF	1		10	**1**	**0**	**0**	Holder record	Holder elements
	EIF	1		1	**1**	**0**	**0**	Print holder data	
4. Administer Customs Office Data	**EI**		**1**	**20**	**0**	**0**	**1**	Customs Office page	Customs Office info on page
	EO		1	1	**1**	**0**	**0**	Error message	Error message content

	EQ		2	6	**0**	**1**	**0**	Query filter, Report	minimum 3 elements in filter, minimum 3 element in report
	ILF	1		20	**1**	**0**	**0**	CUO record	CUO elements
	EIF	1		1	**1**	**0**	**0**	Print CUO data	
5. Administer Reference data	**EI**		**1**	**5**	**1**	**0**	**0**	25 Code lists, 5 elements in each code list (treated as one type)	At least code, value, type, start valid, end valid
	EO		1	1	**1**	**0**	**0**	Error message	Error message
	EQ				**0**	**0**	**0**	Query filter, Report	minimum 3 elements in filter, minimum 3 element in report
	ILF	1		5	**1**	**0**	**0**		
	EIF				**0**	**0**	**0**		
6. Configuration of communication channels	**EI**		**1**	**10**	**1**	**0**	**0**	Configuration setup page	At least 10 elements define the configuration (address, port, protocol, etc)
	EO		1	1	**1**	**0**	**0**	Error message	Error message content
	EQ		2	5	**1**	**0**	**0**	Query filter, Report	minimum 3 elements in filter, minimum 3 element in report
	ILF	1		10	**1**	**0**	**0**	Configuration parameters	
	EIF				**0**	**0**	**0**		
7. Monitor the system	**EI**		**6**	**5**	**0**	**0**	**1**	6 Monitoring charts	Monitoring data
	EO		4	5	**0**	**1**	**0**	Error message	Error Message
	EQ		2	6	**0**	**1**	**0**	Query filter, Report	minimum 3 elements in filter, minimum 3 element in report
	ILF				**0**	**0**	**0**		
	EIF	6		2	**0**	**1**	**0**	Chart graphs	at least two elements each

8. Administer general parameters	**EI**		**1**	**5**	**1**	**0**	**0**	One page with a list of parameters	Each parameter is defined by at least 5 elements (Name, Value, Period, type)
	EO		1	1	**1**	**0**	**0**	error message	error message
	EQ				**0**	**0**	**0**		
	ILF	1		5	**1**	**0**	**0**	Parameters record	
	EIF	1		1	**1**	**0**	**0**	Print Parameters	
9.Log recording and audit	**EI**		**1**	**5**	**1**	**0**	**0**	One page with a list logs	Each log entry is defined by at least 5 elements (type, severity, short description, timestamp, place)
	EO		1	1	**1**	**0**	**0**	error message	error message
	EQ		2	6	**0**	**1**	**0**	Filter record and report record	Filter record contains at least 3 elements, record report contains at least 3 elements
	ILF	1		5	**1**	**0**	**0**	Log record	
	EIF	1		1	**1**	**0**	**0**	Print Log report	

A.6. DETAILED COST ANALYSIS

A.6.1. *Initial costs*

We present hereby the costs expressed in current USD. Initial costs on premises implementation are as follows:

Cost Type	**At premises**		
	Min	***Max***	***Comments***
Purchasing research	10,000	15,000	2 month, 1-1.5 persons
Setup, Organization (eTIR system)	30,000	40,000	3-4 month, 2 persons
Facilities (HVAC, Power Supply, Space)	190,000	200,000	As presented in **R[5]-ECE/ /TRANS/WP.30/GE.1/2010/05**
Hardware(Computers, Networks, Storage)	430,000	500,000	As presented in R[5]-
Software (OS, Database Servers, Core Connectivity)	370,000	400,000	As presented in R[5]-
Integration Middleware	120,000	160,000	As presented in R[5]-
Technology training (200-250 days/person)	100,000	125,000	200-250 days/person X 500$
Personnel recruitment	5,000	10,000	5-10 Persons X 1,000$
Total	**$1,255,000**	**$1,450,000**	

Table 27. Initial costs, at premises implementation

A.6.1.1 Initial costs when implementing eTIR at UNOG premises

Cost Type	**At premises**		
	Min	**Max**	**Comments**
Purchasing research	10,000	15,000	2 month, 1-1.5 persons
Setup, Organization (eTIR system)	30,000	40,000	3-4 month, 2 persons
Facilities (HVAC, Power, Space)			No initial costs
Hardware(Computers, Networks, Storage)	49,500	49,500	Initial supplementary storage and setup costs
Software (OS, Database Servers, Core Connectivity)	370,000	400,000	As presented in R[5]-
Integration Middleware	120,000	160,000	As presented in R[5]-

Technology training (100-125 days/person)	100,000	125,000	100-120 days/person X 500$ - administrators of eTIR
Personnel recruitment	2,000	3,000	2-3 Persons X 1,000$
Total	**$681,500**	**$792,500**	

Table 28. Initial costs, UNOG implementation

A.6.1.2 Initial costs when implementing eTIR at UNICC premises

	Initial Costs, UNICC		
	Min	**Max**	**Comments**
Purchasing research	10,000	15,000	2 month, 1-1.5 persons
Setup, Organization (eTIR system)	30,000	40,000	3-4 month, 2 persons
Facilities (HVAC, Power Supply, Space)			No initial costs
Hardware(Computers, Networks, Storage)			No initial costs
Software (OS, Database Servers, Core Connectivity)	370,000	400,000	As presented in R[5]-
Integration Middleware	120,000	160,000	As presented in R[5]-
Technology training (100-125 days/person)	100,000	125,000	100-120 days/person X 500$ - administrators of eTIR
Personnel recruitment	2,000	3,000	2-3 Persons X 1,000$
Total	**$632,000**	**$743,000**	

Table 29. Initial costs UNICC implementation

A.6.1.3 Initial costs when implementing in IaaS

Cost Type	IaaS		
	Min	**Max**	**Comments**
Purchasing research	10,000	15,000	2 month, 1-1.5 persons
Setup, Organization (eTIR system)	30,000	40,000	3-4 month, 2 persons
Facilities (HVAC, Power, Space)			No initial costs
Hardware(Computers, Networks, Storage)			No initial costs
Software (OS, Database Servers, Core Connectivity)	370,000	400,000	As presented in R[5]-
Integration Middleware	120,000	160,000	As presented in R[5]-
Technology training (100-125 days/person)	100,000	125,000	100-120 days/person X 500$ - administrators of eTIR
Personnel recruitment	2,000	3,000	2-3 Persons X 1,000$
Total	**$632,000**	**$743,000**	

Table 30. Initial costs IaaS

A.6.1.4 Initial costs when implementing in PaaS

Cost Type	PaaS		
	Min	**Max**	**Comments**
Purchasing research	10,000	15,000	2 month, 1-1.5 persons
Setup, Organization (eTIR system)	30,000	40,000	3-4 month, 2 persons
Facilities (HVAC, Power, Space)			No initial costs
Hardware(Computers, Networks, Storage)			No initial costs
Software (OS, Database Servers, Core Connectivity)			No initial costs
Integration Middleware			No initial costs
Technology training (100-125 days/person)	100,000	125,000	100-120 days/person X 500$ - administrators of eTIR
Migration expenses (50-60 man/days)	50,000	60,000	50-60 man/days X 500$ (Migration of software from local test environment to Cloud, and test)
Personnel recruitment	2,000	3,000	2-3 Persons X 1,000$
Total	**$192,000**	**$243,000**	

Table 31. Initial costs, PaaS implementation

A.6.1.5 Initial costs when implementing SaaS

Cost Type	SaaS		
	Min	***Max***	***Comments***
Purchasing research	10,000	15,000	2 month, 1-1.5 persons
Setup, Organization (eTIR system)			No initial costs
Facilities (HVAC, Power, Space)			No initial costs
Hardware(Computers, Networks, Storage)			No initial costs
Software (OS, Database Servers, Core Connectivity)			No initial costs
Integration Middleware			No initial costs
eTIR International development and implementation			No initial costs
Technology training (100-125 days/person)			No initial costs
Personnel recruitment			No initial costs
Total	**$10,000**	**$15,000**	

Table 32. Initial Costs SaaS implementation

A.6.1.6 Initial costs, Summary (current USD)

Initial Total	Min	Max
At premises	**$1,255,000**	**$1,450,000**
UNOG	**$681,500**	**$792,500**
UNICC	**$632,000**	**$743,000**
IaaS	**$632,000**	**$743,000**
PaaS	**$192,000**	**$243,000**
SaaS	**$10,000**	**$15,000**

Table 33. Initial Costs, Summary

A.6.2. *Costs of operations per year*

We consider hereby the usage of the system, in the first year, in the situation where all TIR Carnets are registered in the system. The evolution of costs per year depending on the number of TIR Carnets registered in the system will be presented later.

We hereby present the costs expressed in current USD. Operations costs per year, at premises are:

On premises			
	Minimum	***Maximum***	***Explanations***
Operation expenses			
Infrastructure (floor space maintenance) (man/days)	$7,200	$9,600	240 days, 30-40 $ per hour, one hour per day

Electricity (for related equipment, cooling, backup power supply)120 kW/Day*$0.3	$11,680	$14,600	96-120 kW/Day*$0.3 or 4-5 kW per hour
Internet access	$20,000	$30,000	64 M
Testing costs for new releases.	$10,000	$20,000	Two new releases per year, each one tested 5-10 days by two persons
Backup and recovery process(space and processing time)	$12,739	$13,259	Medium space 1,000 GB for all data, Medium processing time 2 hours, price per space=0.1$; price per processing hour=0.3$. Backup incremental weekly (10-20GB x 52 weeks), monthly full (1,000G x 12 month).
Disaster recovery costs (external storage space)	$300	$600	1,000-2,000G per year, 0.3$ per GB storage
Technology training for SE and DBA	$8,000	$20,000	Training for SE and DBA (4-6 persons trained, 5 days training each)
System operations Audit (internal and external)-	$10,000	$15,000	Internal audit 2*5 days * 500$.- External audit 1*5 days X 1,000$ - 2*5 days X 1,000$
Security audit	$4,000	$6,000	Internal audit 2*2 days * 500$.- External audit 1*2 days X 1,000$ - 2*2 days X 1,000$
Insurance 0.1% from hardware (100,000)	$5,000	$20,000	0.1%-0.4% from hardware (500,000$)
Information technology personnel (Only for general operations not related to business process)	$180,000	$300,000	minimum 3 SE (24 hours), Maximum 3 SE, 2DBA X 5,000$ a month
Corporate management time (50 days)	$50,000	$52,000	50-52 Days * 1,000 $
Long term expenses			
Replacement (5% from hardware per year)	$21,500	$25,000	
Total	***$340,419***	***$526,059***	

Table 34. Costs of operations, implementation On premises

Operations costs per year, UNOG implementation

UNOG			
	Min	***Max***	***Explanations***
Operation expenses			
Infrastructure (floor space maintenance) (man/days)			No costs

Electricity (for related equipment, cooling, backup power supply)120 kW /Day*$0.3			No costs
Testing costs for new releases.	$10,000	$20,000	Two new releases per year, each one tested 5-10 days by two persons
Backup and recovery process(space and processing time)	$12,739	$13,259	Medium space 1,000 GB for all data, Medium processing time 2 hours, price per space=0.1$; price per processing hour=0.3$. Backup incremental weekly (10-20GB x 52 weeks), monthly full (1,000G x 12 month).
Disaster recovery costs (external storage space)			No costs
Technology training for SE and DBA	$8,000	$12,000	Training for SE and DBA (4-6 persons trained, 5 days training each)
System operations Audit (internal and external)-			No costs
Security audit	$4,000	$6,000	Internal audit 2*2 days * 500$.- External audit 1*2 days X 1,000$ - 2*2 days X 1,000$
Insurance 0.1% from hardware (100,000)			No costs
Information technology personnel (Only for general operations not related to business process)			No costs
Corporate management time (50 days)	$50,000	$52,000	50-52 Days * 1,000 $
Long term expenses			
Replacement (5% from hardware per year)			
Total	***$84,739***	***$103,259***	

Table 35. Costs of operations, UNOG implementation

Operations costs per year, UNICC implementation

UNICC			
	Min	***Max***	***Explanations***
Operation expenses			
Infrastructure (floor space maintenance) (man/days)			No costs
Electricity (for related equipment, cooling, backup power supply)120 kW/Day*$0.3			No costs

Testing costs for new releases.	$10,000	$20,000	Two new releases per year, each one tested 5-10 days by two persons
Backup and recovery process(space and processing time)	$12,739	$13,259	Medium space 1,000 GB for all data, Medium processing time 2 hours, price per space=0.1$; price per processing hour=0.3$. Backup incremental weekly (10-20GB x 52 weeks), monthly full (1,000GB x 12 month).
Disaster recovery costs (external storage space)			No costs
Technology training for SE and DBA	$8,000	$12,000	Training for SE and DBA (4-6 persons trained, 5 days training each)
System operations Audit (internal and external)-			No costs
Security audit	$4,000	$6,000	Internal audit 2*2 days * 500$.- External audit 1*2 days X 1,000$ - 2*2 days X 1,000$
Insurance 0.1% from hardware (100,000)			No costs
Information technology personnel (Only for general operations not related to business process)			No costs
Corporate management time (50 days)	$50,000	$52,000	50-52 Days * 1,000 $
Long term expenses			
Replacement (5% from hardware per year)			
Total	***$84,739***	***$103,259***	

Table 36. Costs of operations, UNICC implementation

Operations costs per year, IaaS implementation

IaaS			
	Min	***Max***	***Explanations***
Operation expenses			
Infrastructure (floor space maintenance) (man/days)			No costs
Electricity (for related equipment, cooling, backup power supply)120 kW /Day*$0.3			No costs
Testing costs for new releases.	10,000	20,000	Two new releases per year, each one tested 5-10 days by two persons

Backup and recovery process(space and processing time)	12,739	13,259	Medium space 1,000 GB for all data, Medium processing time 2 hours, price per space=0.1$ price per processing hour=0.3$. Backup incremental weekly (10-20GB x 52 weeks), monthly full (1,000GB x 12 month).
Disaster recovery costs (external storage space)			No costs
Technology training for SE and DBA	8,000	12,000	Training for SE and DBA (4-6 persons trained, 5 days training each)
System operations Audit (internal and external)-			No costs
Security audit	4,000	6,000	Internal audit 2*2 days * 500$.- External audit 1*2 days X 1,000$ - 2*2 days X 1,000$
Insurance 0.1% from hardware (100,000)			No costs
Information technology personnel (Only for general operations not related to business process)			No costs
Corporate management time (50 days)	50,000	52,000	50-52 Days * 1,000 $
Long term expenses			
Replacement (5% from hardware per year)			
Total	***$84,739***	***$103,259***	

Table 37. Costs of operations, IaaS implementation

Operations costs per year, PaaS implementation

PaaS			
	Min	***Max***	***Explanations***
Operation expenses			
Infrastructure (floor space maintenance) (man/days)			No costs
Electricity (for related equipment, cooling, backup power supply)120 kW /Day*$0.3			No costs
Testing costs for new releases.	10,000	20,000	Two new releases per year, each one tested 5-10 days by two persons
Backup and recovery process(space and processing time)			Medium space 1,000 GB for all data, Medium processing time 2 hours, price per space=0.1$ price per processing hour=0.3$. Backup incremental weekly (10-20GB x 52 weeks), monthly full (1,000GB x 12 month).
Disaster recovery costs (external storage space)			No costs

Technology training for SE and DBA			Training for SE and DBA (4-6 persons trained, 5 days training each)
System operations Audit (internal and external)-			No costs
Security audit	4,000	6,000	Internal audit 2*2 days * 500$.- External audit 1*2 days X 1,000$ - 2*2 days X 1,000$
Insurance 0.1% from hardware (100,000)			No costs
Information technology personnel (Only for general operations not related to business process)			No costs
Corporate management time (50 days)	50,000	52,000	50-52 Days * 1,000 $
Migration			
Long term expenses			
Replacement (5% from hardware per year)			
Total	***$64,000***	***$78,000***	

Table 38. Costs of operations, PaaS implementation

Each line in the table below represents the last one (Total line) in the above mentioned tables. The values represent current USD.

Implementation	*Min*	*Max*
At premises	$340,419	$526,059
UNOG	$84,739	$103,259
UNICC	$84,739	$103,259
IaaS	$84,739	$103,259
PaaS	$64,000	$78,000
SaaS	$0	$0

Table 39. Total operations costs, all implementations

A.6.3. *Clouds and hosting costs*

Variable costs, for a full system workload, are computed for the following providers and types:

1. Microsoft PaaS on Azure platform;
2. Google PaaS on Google App Engine platform;
3. Amazon IaaS;
4. UNOG (IaaS type);
5. UNICC (IaaS type);
6. SaaS.

The price model is very different for each of the mentioned providers. However, at this stage, the total costs of such service per year are important.

For all providers, the costs of services have been computed considering a system workload as presented in Chapter 3.2.

It is considered that this is the first year of operation, having all eTIR Carnets registered in the system.

Solution	*Current USD*
Microsoft (PaaS):	$102,816 / year
Google (PaaS)	$95,116 / year
UNOG	$110,000 / year
UNICC	$82,980-$118,400 / year
Amazon IaaS	$28,663-$49,867 / year
SaaS	$0.5 - $1 / TIR Transport

Table 40. Cloud Costs

A.6.4. *Helpdesk costs*

A helpdesk is provided for both business and technical related assistance for connections with the national Customs IT systems.

The helpdesk is functioning during normal working hours (8 hours a day, 2 system engineers).

With regard to the helpdesk, we consider three categories of costs:

- Initial costs;
- Operation costs per year (personnel costs not included);
- Personnel costs.

A.6.4.1 Initial costs

Cost Type	**Help Desk**		
	Min	***Max***	***Comments***
Setup, Organization (eTIR system)	$5,000	$6,000	1 month, 1 person
Hardware(Computers, Networks, Storage)	$5,000	$10,000	2 servers, 3 desktop computers, phone lines and equipment,
Software (OS, Database Servers, Core Connectivity)	$5,000	$10,000	OS, Database, Helpdesk Software
Technology training (200-250 days/person)	$7,500	$15,000	15-30 days/person X 500$ (3 persons trained)
Personnel recruitment	$2,000	$3,000	2-3 Persons X 1,000$
Total	**$24,500**	**$44,000**	

Table 41. Helpdesk detailed costs

A.6.4.2 Operating costs per year

Help desk			
	Min	**Max**	***Explanations***
Operational expenses			
Infrastructure (floor space maintenance) (man/days)	$15,000	$30,000	50 square meters office
Electricity (for related equipment, cooling, backup power supply)120 kW /Day*$0.3	$11,680	$14,600	96-120 kW/Day*$0.3 (4-5 kW per hour)
Phone and internet lines	$6,000	$12,000	Corporate subscription 1,000-2,000 per month
Other expenses (spared parts)	$500	$1000	paper, CDs, replacement of equipment (10% of hardware)
Total	**$18,180**	**$57,600**	

Table 42. Help Desk costs per year

A.6.4.3 Personnel costs per year

Personnel costs			
	Min	**Max**	***Explanations***
Helpdesk level 1			
Helpdesk level 1 personnel	$96,000	$144,000	2-3 operators * 4,000 per month * 12 month
Managers	$12,000	$15,000	1 manager 1 day per week, 5,000-6,000 per month
Total	***$108,000***	***$159,000***	

Table 43. Personnel costs per year

A.6.4.4 Total helpdesk costs, 10 years

The table below contains the total data from the previous tables, multiplied by 10 (10 years).

	Min	**Max**
Initial	$24,500	$44,000
Operational	$181,800	$576,000
Personnel	$1,080,000	$1,590,000
Total	$1,286,300	$2,210,000

Table 44. Total helpdesk costs per year

A.6.5. *Costs to adjust the national system interfaces*

A.6.5.1 Assumptions

Currently, TIR Carnet data is entered in and processed by all national IT systems (If this is not the case, the eTIR User Interface module is an option, which could be considered).

The EU countries and candidate countries, signatories of the CTC (Common Transit Convention) are using the Common Transit System /NCTS system to key in the TIR Carnet data; while Turkey (a candidate country, not yet member of CTC), is using its national IT system (BILGE).

In Russia and Ukraine similar systems are used. The systems are well-known and cover all processes. We consider that there will be no changes in the current way of working with the system, but personnel training will be involved. Only the development costs are considered important and, thus, presented hereby.

Developing interfaces between the actual national Customs IT systems and the eTIR international system requires the following:

- Changes in the actual national systems, so that all information required by the eTIR international system can be entered;
- Changes in the actual national systems, so that the business processes which interfere with TIR Carnets are able to exchange data with the eTIR international system;
- Development of software interfaces (web services) for the eTIR international system.

The interfaces are the same for all eTIR implementations (at premises, UNOG, IaaS, PaaS).

For the evaluation of the costs of the eTIR national interfaces, we are using the analogy with the development of similar systems used in this case:

The development of the NCTS-TIR and its integration into the full NCTS system.

In order to develop this system in 3 countries, we consider that the whole development process, using RUP methodology involves 3 persons for a period of 3- 6 month, (10-20 man /month) depending on the team qualifications and its knowledge of the national Customs IT systems.

We present the costs in current USD.

A.6.5.2 Cost evaluation

For the estimation, we consider the following development schedule:

Name	Duration	Scheduled Work
eTIR National Interfaces	82 days	309 days
Inception	6 days	12 days
Startup	1 day	2 days
Prepare Inception report	5 days	5 days
Project Quality Plan	5 days	5 days
Elaboration	20 days	90 days
Specifications	20 days	60 days
Application Specifications Document	10 days	10 days
Technical Specifications Document	10 days	10 days
Security Specifications Document	10 days	10 days
Interoperability Specifications	10 days	10 days
Business Process Modeling	10 days	10 days
Acceptance Test Scenarios Document	10 days	10 days

eTIR Interfaces System Design	5 days	20 days
Service Model	5 days	5 days
Data Model	5 days	5 days
Technical design document	5 days	5 days
Business Processes treatment	5 days	5 days
eTIR Interfaces Proof Of Concept	5 days	10 days
Construction	45 days	165 days
Specifications	10 days	40 days
Detailed Application Specifications Document	5 days	10 days
Detailed Technical Specifications Document	5 days	10 days
Detailed Security Specifications Document	5 days	10 days
Detailed Interoperability Specifications	5 days	10 days
eTIR Interfaces Detailed Design	5 days	15 days
Data Model	5 days	5 days
Communication Model	5 days	5 days
Interface specifications	5 days	5 days
eTIR Interfaces Development	20 days	80 days
Changes in Data Capture and presentation	10 days	20 days
XML parsing and processing	10 days	20 days
Business process treatment	10 days	20 days
Web Services	10 days	20 days
Unit and Integration Testing	10 days	30 days
Test Data entry system	5 days	10 days
Test Business Process system	5 days	10 days
Tests web (WS) Interfaces	5 days	10 days
Transition	10 days	40 days
Update specifications and design documents	5 days	10 days
Changes in the system, as required by the tests' results	5 days	10 days
Acceptance tests	10 days	20 days
Close –up	1 day	2 days

Table 45. Effort estimation for National IT system

Based on the schedule previously presented (which is considered as minimum and requiring the employment of a highly qualified team), we have the following costs for each national system:

	Min	*Max*	*Explanation*
Development	$120,000	$150,000	~15 Man/month * $8,000 minimum costs or 30 Man/Month * $5,000 maximum costs

Table 46. Cost per country, to adapt National IT system

Considering the 57 countries of the TIR convention where the TIR system is active, the total costs might be as follows:

	Min	*Max*	*Explanation*
Development	$6,840,000	$8,550,000	~15 Man/month * $8,000 minimum costs or 30 Man/Month * $5,000 maximum costs 57 countries

Table 47. Total costs to adapt all National IT systems

A.6.6. *Costs for transport operators*

A.6.6.1 Assumptions

Transport agents (carriers) are supposed to be in one of the situations:

A. They already have their own system where they register data. Using a system-to-system connection, they are exchanging data with the national Customs IT systems;
B. They are using a third party system (like IRU's TIR-EPD) to exchange data with the national Customs IT systems;
C. They are using declaration mechanisms of national Customs IT systems to exchange data directly with Customs;
D. They do not register TIR data in any system.

A.6.6.2 Costs for eTIR adoption

For categories A, B and C, we consider there are no necessary costs, as they will continue to work as they currently do. It will be the national Customs IT applications which will be interfaced with the eTIR international system. Changes, if any, are small and not relevant for the present cost estimations.

Transport operators belonging to D category will have the possibility to use solutions B and C for free.

In conclusion, we consider that there are no real costs involved for the Trader community.

A.6.7. *Total costs per 10 years of usage, Current USD*

The total costs for 10 years of usage are presented below.

The following costs will be taken into consideration:

- Development of the eTIR solution;
- Initial costs;
- Operations costs (maintenance, daily operations, etc);
- Cloud usage costs.

The minimum and maximum costs are presented for the following types of implementation:

- At premises;
- UNOG;
- UNICC;
- IaaS;
- PaaS;
- SaaS.

In this distribution of costs, helpdesk costs and national Customs system interfaces are not included, as they are the same for all implementations and are equally distributed.

The costs distribution for changing the national Customs IT systems is not relevant, as different countries use a very different number of TIR Carnets. However, the effort to adjust the national IT systems is almost the same for all the countries.

The costs below are expressed in terms of current USD. No discounts and/or risk rates are applied. This is the base input for next chapter where discounts and risk rates are applied.

A.6.8. *Total costs per 10 years of gradually usage table (helpdesk not included)*

The first two columns of this table reflect the development costs, presented in Table 8, Chapter 3.3;

The columns 3 and 4 reflect the initial costs estimations, as presented in Table 33, Annex A.6.;

The columns 5 and 6 reflect the estimation of operational costs gradually distributed, as presented in detail in Table 12, Annex A.6.

Columns 7 and 8 reflect the estimation of cloud costs gradually distributed, as presented in detail in Table 12

	Development		**Initial costs**		**Operations total**		**Cloud year X 10**		**Total**	
Impl. Type	***Min***	***Max***	***Min***	***Max***	***Min***	***Max***	***Min***	***Max***	***Min***	***Max***
At premises	924800	1127000	1255000	1450000	2210000	3230000	0	0	4389800	5807000
UNOG	924800	1127000	681500	792500	1190000	1360000	1100000	1400000	2796300	3224000
UNICC	924800	1127000	632000	743000	850000	1360000	829800	1538000	2406800	3174500
IaaS	924800	1127000	632000	743000	680000	1020000	286626	498675	2236800	2834500
PaaS	924800	1127000	192000	243000	1020000	1020000	951160	1028160	2136800	2364500
SaaS			60000	75000			8560000	17105000	8620000	17180000

Table 48. Total costs in USD per 10 years of gradually usage table (helpdesk not included)

A.7. DETAILED COST-BENEFIT TABLES

A.7.1. *Full usage of eTIR system*

A.7.1.1 At premises implementation, eTIR Carnets distributed gradually

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Costs	Total Dev, Operationa;														
		Development	462,400	462,400											924,800
		Initial		627,500	627,500										1,255,000
		Operational			13,000	91,000	104,000	156,000	169,000	260,000	325,000	338,000	364,000	390,000	2,210,000
	Total Dev, Operationa;		462,400	1,089,900	640,500	91,000	104,000	156,000	169,000	260,000	325,000	338,000	364,000	390,000	4,389,800
	Help Desk				128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	1,286,300
	National App		838,235	838,235	502,941	502,941	586,765	1,257,353	1,257,353	586,765	586,765	586,765	502,941	502,941	8,550,000
Total Costs			1,300,635	1,928,135	1,272,071	722,571	819,395	1,541,983	1,554,983	975,395	1,040,395	1,053,395	995,571	1,021,571	14,226,100
Total Costs (incl. 20% risk factor)			1,560,762	2,313,762	1,526,485	867,085	983,274	1,850,380	1,865,980	1,170,474	1,248,474	1,264,074	1,194,685	1,225,885	17,071,320
Discounted Costs (incl. risk factor)			1,560,762	2,203,583	1,384,567	749,021	808,942	1,449,821	1,392,423	831,834	845,016	814,833	733,433	716,750	13,490,985
Benefits for Customs (incl. 20% risk factor)					115,000	805,000	920,000	1,380,000	1,495,000	2,300,000	2,875,000	2,990,000	3,220,000	3,450,000	19,550,000
Total Benefits (incl. 20% risk factor)					713,000	4,991,000	5,704,000	8,556,000	9,269,000	14,260,000	17,825,000	18,538,000	19,964,000	21,390,000	121,210,000
Discounted Customs Benefits (incl.risk factor)					104,308	695,389	756,886	1,081,266	1,115,592	1,634,567	1,945,913	1,927,381	1,976,801	2,017,144	13,255,247
Discounted Overall Benefits (incl.risk factor)					646,712	4,311,413	4,692,695	6,703,850	6,916,671	10,134,316	12,064,662	11,949,760	12,256,164	12,506,290	82,182,532
ROI for Customs															-2%
Overall ROI															509%
Cash Flow for customs			-1,560,762	-2,203,583	-1,280,259	-53,632	-52,055	-368,555	-276,831	802,733	1,100,897	1,112,548	1,243,367	1,300,394	-235,738
Overall Cash Flow			-1,560,762	-2,313,762	-879,773	3,444,328	3,709,421	4,853,470	5,050,691	8,963,842	10,816,188	10,685,686	11,061,479	11,280,405	65,111,212
Discounted CF			-1,560,762	-2,203,583	-797,980	2,975,340	3,051,750	3,802,821	3,768,903	6,370,435	7,320,822	6,888,089	6,790,788	6,595,419	43,002,042
Net present value															43,002,042

Table 49. Costs, benefits, all eTIR Carnets registered gradually, for at premises implementation

A.7.1.2 UNOG implementation, eTIR Carnets distributed gradually

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Costs	Total Dev, Operationa;														
		Development	462,400	462,400											924,800
		Initial		340,750	340,750										681,500
		Operational			7,000	49,000	56,000	84,000	91,000	140,000	175,000	182,000	196,000	210,000	1,190,000
	Total Dev, Operationa;		462,400	803,150	347,750	49,000	56,000	84,000	91,000	140,000	175,000	182,000	196,000	210,000	2,796,300
	Help Desk				128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	1,286,300
	National App		838,235	838,235	502,941	502,941	586,765	1,257,353	1,257,353	586,765	586,765	586,765	502,941	502,941	8,550,000
Total Costs			1,300,635	1,641,385	979,321	680,571	771,395	1,469,983	1,476,983	855,395	890,395	897,395	827,571	841,571	12,632,600
Total Costs (incl. 20% risk factor)			1,560,762	1,969,662	1,175,185	816,685	925,674	1,763,980	1,772,380	1,026,474	1,068,474	1,076,874	993,085	1,009,885	15,159,120
Discounted Costs (incl. risk factor)			1,560,762	1,875,869	1,065,928	705,484	761,554	1,382,124	1,322,577	729,496	723,185	694,162	609,668	590,459	12,021,268
Benefits for Customs (incl. 20% risk factor)					115,000	805,000	920,000	1,380,000	1,495,000	2,300,000	2,875,000	2,990,000	3,220,000	3,450,000	19,550,000
Total Benefits (incl. 20% risk factor)					713,000	4,991,000	5,704,000	8,556,000	9,269,000	14,260,000	17,825,000	18,538,000	19,964,000	21,390,000	121,210,000
Discounted Customs Benefits (incl.risk factor)					104,308	695,389	756,886	1,081,266	1,115,592	1,634,567	1,945,913	1,927,381	1,976,801	2,017,144	13,255,247
Discounted Overall Benefits (incl.risk factor)					646,712	4,311,413	4,692,695	6,703,850	6,916,671	10,134,316	12,064,662	11,949,760	12,256,164	12,506,290	82,182,532
ROI for Customs															10%
Overall ROI															584%
Cash Flow for customs			-1,560,762	-1,875,869	-961,619	-10,094	-4,668	-300,858	-206,985	905,071	1,222,728	1,233,218	1,367,132	1,426,684	1,233,979
Overall Cash Flow			-1,560,762	-1,969,662	-528,473	3,494,728	3,767,021	4,939,870	5,144,291	9,107,842	10,996,188	10,872,886	11,263,079	11,496,405	67,023,412
Discounted CF			-1,560,762	-1,875,869	-479,341	3,018,877	3,099,138	3,870,518	3,838,749	6,472,773	7,442,653	7,008,760	6,914,553	6,721,710	44,471,759
Net present value															44,471,759

Table 50. Costs, benefits all eTIR Carnets registered gradually, UNOG implementation

A.7.1.3 UNICC implementation, eTIR Carnets distributed gradually

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Costs	Total Dev, Operationa;														
		Development	462,400	462,400											924,800
		Initial		316,000	316,000										632,000
		Operational			5,000	35,000	40,000	60,000	65,000	100,000	125,000	130,000	140,000	150,000	850,000
	Total Dev, Operationa;		462,400	778,400	321,000	35,000	40,000	60,000	65,000	100,000	125,000	130,000	140,000	150,000	2,406,800
	Help Desk				128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	1,286,300
	National App		838,235	838,235	502,941	502,941	586,765	1,257,353	1,257,353	586,765	586,765	586,765	502,941	502,941	8,550,000
Total Costs			1,300,635	1,616,635	952,571	666,571	755,395	1,445,983	1,450,983	815,395	840,395	845,395	771,571	781,571	12,243,100
Total Costs (incl. 20% risk factor)			1,560,762	1,939,962	1,143,085	799,885	906,474	1,735,180	1,741,180	978,474	1,008,474	1,014,474	925,885	937,885	14,691,720
Discounted Costs (incl. risk factor)			1,560,762	1,847,583	1,036,812	690,971	745,758	1,359,559	1,299,295	695,383	682,575	653,939	568,413	548,362	11,689,412
Benefits for Customs (incl. 20% risk factor)					115,000	805,000	920,000	1,380,000	1,495,000	2,300,000	2,875,000	2,990,000	3,220,000	3,450,000	19,550,000
Total Benefits (incl. 20% risk factor)					713,000	4,991,000	5,704,000	8,556,000	9,269,000	14,260,000	17,825,000	18,538,000	19,964,000	21,390,000	121,210,000
Discounted Customs Benefits (incl.risk factor)					104,308	695,389	756,886	1,081,266	1,115,592	1,634,567	1,945,913	1,927,381	1,976,801	2,017,144	13,255,247
Discounted Overall Benefits (incl.risk factor)					646,712	4,311,413	4,692,695	6,703,850	6,916,671	10,134,316	12,064,662	11,949,760	12,256,164	12,506,290	82,182,532
ROI for Customs															13%
Overall ROI															603%
Cash Flow for customs			-1,560,762	-1,847,583	-932,504	4,418	11,128	-278,292	-183,703	939,184	1,263,339	1,273,442	1,408,387	1,468,781	1,565,835
Overall Cash Flow			-1,560,762	-1,939,962	-496,373	3,511,528	3,786,221	4,968,670	5,175,491	9,155,842	11,056,188	10,935,286	11,330,279	11,568,405	67,490,812
Discounted CF			-1,560,762	-1,847,583	-450,225	3,033,390	3,114,934	3,893,083	3,862,031	6,506,886	7,483,263	7,048,983	6,955,808	6,763,807	44,803,614
Net present value															44,803,614

Table 51. Costs, benefits, all eTIR Carnets registered gradually, UNICC implementation

A.7.1.4 PaaS implementation, eTIR Carnets distributed gradually

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Costs	Total Dev, Operationa;													
	Development	462,400	462,400											924,800
	Initial		96,000	96,000										192,000
	Operational			6,000	42,000	48,000	72,000	78,000	120,000	150,000	156,000	168,000	180,000	1,020,000
	Total Dev, Operationa;	462,400	558,400	102,000	42,000	48,000	72,000	78,000	120,000	150,000	156,000	168,000	180,000	2,136,800
	Help Desk			128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	1,286,300
	National App	838,235	838,235	502,941	502,941	586,765	1,257,353	1,257,353	586,765	586,765	586,765	502,941	502,941	8,550,000
Total Costs		1,300,635	1,396,635	733,571	673,571	763,395	1,457,983	1,463,983	835,395	865,395	871,395	799,571	811,571	11,973,100
Total Costs (incl. 20% risk factor)		1,560,762	1,675,962	880,285	808,285	916,074	1,749,580	1,756,780	1,002,474	1,038,474	1,045,674	959,485	973,885	14,367,720
Discounted Costs (incl. risk factor)		1,560,762	1,596,155	798,445	698,227	753,656	1,370,841	1,310,936	712,439	702,880	674,051	589,041	569,411	11,336,844
Benefits for Customs (incl. 20% risk factor)				115,000	805,000	920,000	1,380,000	1,495,000	2,300,000	2,875,000	2,990,000	3,220,000	3,450,000	19,550,000
Total Benefits (incl. 20% risk factor)				713,000	4,991,000	5,704,000	8,556,000	9,269,000	14,260,000	17,825,000	18,538,000	19,964,000	21,390,000	121,210,000
Discounted Customs Benefits (incl.risk factor)				104,308	695,389	756,886	1,081,266	1,115,592	1,634,567	1,945,913	1,927,381	1,976,801	2,017,144	13,255,247
Discounted Overall Benefits (incl.risk factor)				646,712	4,311,413	4,692,695	6,703,850	6,916,671	10,134,316	12,064,662	11,949,760	12,256,164	12,506,290	82,182,532
ROI for Customs														17%
Overall ROI														625%
Cash Flow for customs		-1,560,762	-1,596,155	-694,136	-2,838	3,230	-289,575	-195,344	922,128	1,243,033	1,253,330	1,387,760	1,447,733	1,918,404
Overall Cash Flow		-1,560,762	-1,675,962	-233,573	3,503,128	3,776,621	4,954,270	5,159,891	9,131,842	11,026,188	10,904,086	11,296,679	11,532,405	67,814,812
Discounted CF		-1,560,762	-1,596,155	-211,858	3,026,134	3,107,036	3,881,800	3,850,390	6,489,830	7,462,958	7,028,871	6,935,181	6,742,758	45,156,183
Net present value														45,156,183

Table 52. Costs, benefits, all eTIR Carnets registered gradually, PaaS implementation

A.7.1.5 IaaS implementation, eTIR Carnets distributed gradually

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Costs	Total Dev, Operationa;														
		Development	462,400	462,400											924,800
		Initial		316,000	316,000										632,000
		Operational			4,000	28,000	32,000	48,000	52,000	80,000	100,000	104,000	112,000	120,000	680,000
	Total Dev, Operationa;		462,400	778,400	320,000	28,000	32,000	48,000	52,000	80,000	100,000	104,000	112,000	120,000	2,236,800
	Help Desk				128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	1,286,300
	National App		838,235	838,235	502,941	502,941	586,765	1,257,353	1,257,353	586,765	586,765	586,765	502,941	502,941	8,550,000
Total Costs			1,300,635	1,616,635	951,571	659,571	747,395	1,433,983	1,437,983	795,395	815,395	819,395	743,571	751,571	12,073,100
Total Costs (incl. 20% risk factor)			1,560,762	1,939,962	1,141,885	791,485	896,874	1,720,780	1,725,580	954,474	978,474	983,274	892,285	901,885	14,487,720
Discounted Costs (incl. risk factor)			1,560,762	1,847,583	1,035,724	683,715	737,860	1,348,276	1,287,654	678,327	662,269	633,827	547,786	527,314	11,551,097
Benefits for Customs (incl. 20% risk factor)					115,000	805,000	920,000	1,380,000	1,495,000	2,300,000	2,875,000	2,990,000	3,220,000	3,450,000	19,550,000
Total Benefits (incl. 20% risk factor)					713,000	4,991,000	5,704,000	8,556,000	9,269,000	14,260,000	17,825,000	18,538,000	19,964,000	21,390,000	121,210,000
Discounted Customs Benefits (incl.risk factor)					104,308	695,389	756,886	1,081,266	1,115,592	1,634,567	1,945,913	1,927,381	1,976,801	2,017,144	13,255,247
Discounted Overall Benefits (incl.risk factor)					646,712	4,311,413	4,692,695	6,703,850	6,916,671	10,134,316	12,064,662	11,949,760	12,256,164	12,506,290	82,182,532
ROI for Customs															15%
Overall ROI															611%
Cash Flow for customs			-1,560,762	-1,847,583	-931,415	11,674	19,026	-267,010	-172,062	956,240	1,283,644	1,293,554	1,429,015	1,489,830	1,704,150
Overall Cash Flow			-1,560,762	-1,939,962	-495,173	3,519,928	3,795,821	4,983,070	5,191,091	9,179,842	11,086,188	10,966,486	11,363,879	11,604,405	67,694,812
Discounted CF			-1,560,762	-1,847,583	-449,137	3,040,646	3,122,832	3,904,366	3,873,672	6,523,942	7,503,568	7,069,095	6,976,436	6,784,855	44,941,930
Net present value															44,941,930

Table 53. Costs, benefits, all eTIR Carnets registered gradually, IaaS implementation

A.7.1.6 SaaS implementation, eTIR Carnets distributed gradually

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Costs	Total Dev, Operationa;													
	Development													0
	Initial		30,000	30,000										60,000
	Operational			50,000	350,000	400,000	600,000	650,000	1,000,000	1,250,000	1,300,000	1,400,000	1,500,000	8,500,000
	Total Dev, Operationa;	0	30,000	80,000	350,000	400,000	600,000	650,000	1,000,000	1,250,000	1,300,000	1,400,000	1,500,000	8,560,000
	Help Desk			128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	1,286,300
	National App	838,235	838,235	502,941	502,941	586,765	1,257,353	1,257,353	586,765	586,765	586,765	502,941	502,941	8,550,000
Total Costs		838,235	868,235	711,571	981,571	1,115,395	1,985,983	2,035,983	1,715,395	1,965,395	2,015,395	2,031,571	2,131,571	18,396,300
Total Costs (incl. 20% risk factor)		1,005,882	1,041,882	853,885	1,177,885	1,338,474	2,383,180	2,443,180	2,058,474	2,358,474	2,418,474	2,437,885	2,557,885	22,075,560
Discounted Costs (incl. risk factor)		1,005,882	992,269	774,499	1,017,502	1,101,166	1,867,284	1,823,138	1,462,919	1,596,308	1,558,970	1,496,650	1,495,543	16,192,129
Benefits for Customs (incl. 20% risk factor)				115,000	805,000	920,000	1,380,000	1,495,000	2,300,000	2,875,000	2,990,000	3,220,000	3,450,000	19,550,000
Total Benefits (incl. 20% risk factor)				713,000	4,991,000	5,704,000	8,556,000	9,269,000	14,260,000	17,825,000	18,538,000	19,964,000	21,390,000	121,210,000
Discounted Customs Benefits (incl.risk factor)				104,308	695,389	756,886	1,081,266	1,115,592	1,634,567	1,945,913	1,927,381	1,976,801	2,017,144	13,255,247
Discounted Overall Benefits (incl.risk factor)				646,712	4,311,413	4,692,695	6,703,850	6,916,671	10,134,316	12,064,662	11,949,760	12,256,164	12,506,290	82,182,532
ROI for Customs														-18%
Overall ROI														408%
Cash Flow for customs		-1,005,882	-992,269	-670,191	-322,112	-344,279	-786,017	-707,546	171,648	349,605	368,411	480,151	521,601	-2,936,881
Overall Cash Flow		-1,005,882	-1,041,882	-207,173	3,133,528	3,354,221	4,320,670	4,473,491	8,075,842	9,706,188	9,531,286	9,818,279	9,948,405	60,106,972
Discounted CF		-1,005,882	-992,269	-187,912	2,706,859	2,759,526	3,385,358	3,338,188	5,739,350	6,569,530	6,143,952	6,027,571	5,816,626	40,300,898
Net present value														40,300,898

Table 54. Costs, benefits, all eTIR Carnets registered gradually, SaaS implementation

A.7.2. *Half usage of eTIR system*

A.7.2.1 At Premises implementation, eTIR Carnets distributed gradually, half usage

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Costs	Total Dev, Operationa;														
		Development	462,400	462,400											924,800
		Initial		627,500	627,500										1,255,000
		Operational			13,000	91,000	104,000	156,000	169,000	260,000	325,000	338,000	364,000	390,000	2,210,000
	Total Dev, Operationa;		462,400	1,089,900	640,500	91,000	104,000	156,000	169,000	260,000	325,000	338,000	364,000	390,000	4,389,800
	Help Desk				128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	1,286,300
	National App		838,235	838,235	502,941	502,941	586,765	1,257,353	1,257,353	586,765	586,765	586,765	502,941	502,941	8,550,000
Total Costs			1,300,635	1,928,135	1,272,071	722,571	819,395	1,541,983	1,554,983	975,395	1,040,395	1,053,395	995,571	1,021,571	14,226,100
Total Costs (incl. 20% risk factor)			1,560,762	2,313,762	1,526,485	867,085	983,274	1,850,380	1,865,980	1,170,474	1,248,474	1,264,074	1,194,685	1,225,885	17,071,320
Discounted Costs (incl. risk factor)			1,560,762	2,203,583	1,384,567	749,021	808,942	1,449,821	1,392,423	831,834	845,016	814,833	733,433	716,750	13,490,985
Benefits for Customs (incl. 20% risk factor)					57,500	345,000	460,000	575,000	690,000	1,150,000	1,380,000	1,495,000	1,610,000	1,725,000	9,487,500
Total Benefits (incl. 20% risk factor)					356,500	2,139,000	2,852,000	3,565,000	4,278,000	7,130,000	8,556,000	9,269,000	9,982,000	10,695,000	58,822,500
Discounted Customs Benefits (incl.risk factor)					52,154	298,024	378,443	450,528	514,889	817,284	934,038	963,690	988,400	1,008,572	6,406,022
Discounted Overall Benefits (incl.risk factor)					323,356	1,847,749	2,346,347	2,793,271	3,192,309	5,067,158	5,791,038	5,974,880	6,128,082	6,253,145	39,717,335
ROI for Customs															-53%
Overall ROI															194%
Cash Flow for customs			-1,560,762	-2,203,583	-1,332,413	-450,997	-430,499	-999,293	-877,534	-14,550	89,022	148,857	254,967	291,822	-7,084,963
Overall Cash Flow			-1,560,762	-2,313,762	-1,203,129	980,663	1,363,074	942,891	1,326,330	3,896,684	4,542,564	4,710,806	4,933,397	5,027,260	22,646,015
Discounted CF			-1,560,762	-2,203,583	-1,091,274	847,134	1,121,404	738,780	989,728	2,769,301	3,074,586	3,036,628	3,028,678	2,939,335	13,689,953
Net present value															13,689,953

Table 55. Costs, benefits, eTIR Carnets registered gradually half usage and at premises implementation

A.7.2.2 UNOG implementation, eTIR Carnets distributed gradually, half usage

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Costs	Total Dev, Operationa;														
		Development	462,400	462,400											924,800
		Initial		340,750	340,750										681,500
		Operational			3,500	21,000	28,000	35,000	42,000	70,000	84,000	91,000	98,000	105,000	577,500
	Total Dev, Operationa;		462,400	803,150	344,250	21,000	28,000	35,000	42,000	70,000	84,000	91,000	98,000	105,000	2,183,800
	Help Desk				128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	1,286,300
	National App		838,235	838,235	502,941	502,941	586,765	1,257,353	1,257,353	586,765	586,765	586,765	502,941	502,941	8,550,000
Total Costs			1,300,635	1,641,385	975,821	652,571	743,395	1,420,983	1,427,983	785,395	799,395	806,395	729,571	736,571	12,020,100
Total Costs (incl. 20% risk factor)			1,560,762	1,969,662	1,170,985	783,085	892,074	1,705,180	1,713,580	942,474	959,274	967,674	875,485	883,885	14,424,120
Discounted Costs (incl. risk factor)			1,560,762	1,875,869	1,062,118	676,459	733,911	1,336,053	1,278,699	669,798	649,274	623,771	537,472	516,789	11,520,977
Benefits for Customs (incl. 20% risk factor)					57,500	345,000	460,000	575,000	690,000	1,150,000	1,380,000	1,495,000	1,610,000	1,725,000	9,487,500
Total Benefits (incl. 20% risk factor)					356,500	2,139,000	2,852,000	3,565,000	4,278,000	7,130,000	8,556,000	9,269,000	9,982,000	10,695,000	58,822,500
Discounted Customs Benefits (incl.risk factor)					52,154	298,024	378,443	450,528	514,889	817,284	934,038	963,690	988,400	1,008,572	6,406,022
Discounted Overall Benefits (incl.risk factor)					323,356	1,847,749	2,346,347	2,793,271	3,192,309	5,067,158	5,791,038	5,974,880	6,128,082	6,253,145	39,717,335
ROI for Customs															-44%
Overall ROI															245%
Cash Flow for customs			-1,560,762	-1,875,869	-1,009,964	-378,435	-355,468	-885,525	-763,811	147,485	284,764	339,919	450,928	491,782	-5,114,955
Overall Cash Flow			-1,560,762	-1,969,662	-847,629	1,064,663	1,454,274	1,088,091	1,478,730	4,124,684	4,831,764	5,007,206	5,252,597	5,369,260	25,293,215
Discounted CF			-1,560,762	-1,875,869	-768,825	919,696	1,196,435	852,548	1,103,451	2,931,336	3,270,328	3,227,690	3,224,639	3,139,295	15,659,961
Net present value															15,659,961

Table 56. Costs, benefits, eTIR Carnets registered gradually, UNOG implementation, half usage

A.7.2.3 UNICC implementation, eTIR Carnets distributed gradually, half usage

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Costs	Total Dev, Operationa;														
		Development	462,400	462,400											924,800
		Initial		316,000	316,000										632,000
		Operational			2,500	15,000	20,000	25,000	30,000	50,000	60,000	65,000	70,000	75,000	412,500
	Total Dev, Operationa;		462,400	778,400	318,500	15,000	20,000	25,000	30,000	50,000	60,000	65,000	70,000	75,000	1,969,300
	Help Desk				128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	1,286,300
	National App		838,235	838,235	502,941	502,941	586,765	1,257,353	1,257,353	586,765	586,765	586,765	502,941	502,941	8,550,000
Total Costs			1,300,635	1,616,635	950,071	646,571	735,395	1,410,983	1,415,983	765,395	775,395	780,395	701,571	706,571	11,805,600
Total Costs (incl. 20% risk factor)			1,560,762	1,939,962	1,140,085	775,885	882,474	1,693,180	1,699,180	918,474	930,474	936,474	841,885	847,885	14,166,720
Discounted Costs (incl. risk factor)			1,560,762	1,847,583	1,034,091	670,239	726,013	1,326,650	1,267,954	652,742	629,781	603,659	516,845	495,741	11,332,061
Benefits for Customs (incl. 20% risk factor)					57,500	345,000	460,000	575,000	690,000	1,150,000	1,380,000	1,495,000	1,610,000	1,725,000	9,487,500
Total Benefits (incl. 20% risk factor)					356,500	2,139,000	2,852,000	3,565,000	4,278,000	7,130,000	8,556,000	9,269,000	9,982,000	10,695,000	58,822,500
Discounted Customs Benefits (incl.risk factor)					52,154	298,024	378,443	450,528	514,889	817,284	934,038	963,690	988,400	1,008,572	6,406,022
Discounted Overall Benefits (incl.risk factor)					323,356	1,847,749	2,346,347	2,793,271	3,192,309	5,067,158	5,791,038	5,974,880	6,128,082	6,253,145	39,717,335
ROI for Customs															-43%
Overall ROI															250%
Cash Flow for customs			-1,560,762	-1,847,583	-981,937	-372,215	-347,570	-876,123	-753,065	164,541	304,257	360,031	471,556	512,831	-4,926,040
Overall Cash Flow			-1,560,762	-1,939,962	-816,729	1,071,863	1,463,874	1,100,091	1,493,130	4,148,684	4,860,564	5,038,406	5,286,197	5,405,260	25,550,615
Discounted CF			-1,560,762	-1,847,583	-740,798	925,916	1,204,333	861,950	1,114,197	2,948,392	3,289,821	3,247,802	3,245,266	3,160,343	15,848,877
Net present value															15,848,877

Table 57. Costs, benefits, eTIR Carnets registered gradually, UNICC implementation, half usage

A.7.2.4 PaaS implementation, eTIR Carnets distributed gradually, half usage

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Costs	Total Dev, Operationa;														
		Development	462,400	462,400											924,800
		Initial		96,000	96,000										192,000
		Operational			3,000	18,000	24,000	30,000	36,000	60,000	72,000	78,000	84,000	90,000	495,000
	Total Dev, Operationa;		462,400	558,400	99,000	18,000	24,000	30,000	36,000	60,000	72,000	78,000	84,000	90,000	1,611,800
	Help Desk				128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	1,286,300
	National App		838,235	838,235	502,941	502,941	586,765	1,257,353	1,257,353	586,765	586,765	586,765	502,941	502,941	8,550,000
Total Costs			1,300,635	1,396,635	730,571	649,571	739,395	1,415,983	1,421,983	775,395	787,395	793,395	715,571	721,571	11,448,100
Total Costs (incl. 20% risk factor)			1,560,762	1,675,962	876,685	779,485	887,274	1,699,180	1,706,380	930,474	944,874	952,074	858,685	865,885	13,737,720
Discounted Costs (incl. risk factor)			1,560,762	1,596,155	795,180	673,349	729,962	1,331,352	1,273,327	661,270	639,528	613,715	527,158	506,265	10,908,023
Benefits for Customs (incl. 20% risk factor)					57,500	345,000	460,000	575,000	690,000	1,150,000	1,380,000	1,495,000	1,610,000	1,725,000	9,487,500
Total Benefits (incl. 20% risk factor)					356,500	2,139,000	2,852,000	3,565,000	4,278,000	7,130,000	8,556,000	9,269,000	9,982,000	10,695,000	58,822,500
Discounted Customs Benefits (incl.risk factor)					52,154	298,024	378,443	450,528	514,889	817,284	934,038	963,690	988,400	1,008,572	6,406,022
Discounted Overall Benefits (incl.risk factor)					323,356	1,847,749	2,346,347	2,793,271	3,192,309	5,067,158	5,791,038	5,974,880	6,128,082	6,253,145	39,717,335
ROI for Customs															-41%
Overall ROI															264%
Cash Flow for customs			-1,560,762	-1,596,155	-743,025	-375,325	-351,519	-880,824	-758,438	156,013	294,511	349,975	461,242	502,307	-4,502,001
Overall Cash Flow			-1,560,762	-1,675,962	-553,329	1,068,263	1,459,074	1,094,091	1,485,930	4,136,684	4,846,164	5,022,806	5,269,397	5,387,260	25,979,615
Discounted CF			-1,560,762	-1,596,155	-501,886	922,806	1,200,384	857,249	1,108,824	2,939,864	3,280,075	3,237,746	3,234,952	3,149,819	16,272,916
Net present value															16,272,916

Table 58. Costs, benefits, eTIR Carnets registered gradually, PaaS implementation, half usage

A.7.2.5 IaaS implementation, eTIR Carnets distributed gradually, half usage

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Costs	Total Dev, Operationa;														
		Development	462,400	462,400											924,800
		Initial		316,000	316,000										632,000
		Operational			2,000	12,000	16,000	20,000	24,000	40,000	48,000	52,000	56,000	60,000	330,000
	Total Dev, Operationa;		462,400	778,400	318,000	12,000	16,000	20,000	24,000	40,000	48,000	52,000	56,000	60,000	1,886,800
	Help Desk				128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	1,286,300
	National App		838,235	838,235	502,941	502,941	586,765	1,257,353	1,257,353	586,765	586,765	586,765	502,941	502,941	8,550,000
Total Costs			1,300,635	1,616,635	949,571	643,571	731,395	1,405,983	1,409,983	755,395	763,395	767,395	687,571	691,571	11,723,100
Total Costs (incl. 20% risk factor)			1,560,762	1,939,962	1,139,485	772,285	877,674	1,687,180	1,691,980	906,474	916,074	920,874	825,085	829,885	14,067,720
Discounted Costs (incl. risk factor)			1,560,762	1,847,583	1,033,547	667,129	722,064	1,321,949	1,262,581	644,214	620,035	593,603	506,531	485,217	11,265,216
Benefits for Customs (incl. 20% risk factor)					57,500	345,000	460,000	575,000	690,000	1,150,000	1,380,000	1,495,000	1,610,000	1,725,000	9,487,500
Total Benefits (incl. 20% risk factor)					356,500	2,139,000	2,852,000	3,565,000	4,278,000	7,130,000	8,556,000	9,269,000	9,982,000	10,695,000	58,822,500
Discounted Customs Benefits (incl.risk factor)					52,154	298,024	378,443	450,528	514,889	817,284	934,038	963,690	988,400	1,008,572	6,406,022
Discounted Overall Benefits (incl.risk factor)					323,356	1,847,749	2,346,347	2,793,271	3,192,309	5,067,158	5,791,038	5,974,880	6,128,082	6,253,145	39,717,335
ROI for Customs															-43%
Overall ROI															253%
Cash Flow for customs			-1,560,762	-1,847,583	-981,393	-369,105	-343,621	-871,422	-747,693	173,070	314,004	370,087	481,869	523,355	-4,859,194
Overall Cash Flow			-1,560,762	-1,939,962	-816,129	1,075,463	1,468,674	1,106,091	1,500,330	4,160,684	4,874,964	5,054,006	5,302,997	5,423,260	25,649,615
Discounted CF			-1,560,762	-1,847,583	-740,253	929,026	1,208,282	866,651	1,119,569	2,956,921	3,299,567	3,257,858	3,255,580	3,170,868	15,915,722
Net present value															15,915,722

Table 59. Costs, benefits, eTIR Carnets registered gradually, IaaS implementation, half usage

A.7.2.6 SaaS implementation, eTIR Carnets distributed gradually, half usage

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Costs	Total Dev, Operationa;													
	Development													0
	Initial		30,000	30,000										60,000
	Operational			25,000	150,000	200,000	250,000	300,000	500,000	600,000	650,000	700,000	750,000	4,125,000
	Total Dev, Operationa;	0	30,000	55,000	150,000	200,000	250,000	300,000	500,000	600,000	650,000	700,000	750,000	4,185,000
	Help Desk			128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	128,630	1,286,300
	National App	838,235	838,235	502,941	502,941	586,765	1,257,353	1,257,353	586,765	586,765	586,765	502,941	502,941	8,550,000
Total Costs		838,235	868,235	686,571	781,571	915,395	1,635,983	1,685,983	1,215,395	1,315,395	1,365,395	1,331,571	1,381,571	14,021,300
Total Costs (incl. 20% risk factor)		1,005,882	1,041,882	823,885	937,885	1,098,474	1,963,180	2,023,180	1,458,474	1,578,474	1,638,474	1,597,885	1,657,885	16,825,560
Discounted Costs (incl. risk factor)		1,005,882	992,269	747,288	810,181	903,717	1,538,203	1,509,728	1,036,510	1,068,373	1,056,175	980,963	969,331	12,618,620
Benefits for Customs (incl. 20% risk factor)				57,500	345,000	460,000	575,000	690,000	1,150,000	1,380,000	1,495,000	1,610,000	1,725,000	9,487,500
Total Benefits (incl. 20% risk factor)				356,500	2,139,000	2,852,000	3,565,000	4,278,000	7,130,000	8,556,000	9,269,000	9,982,000	10,695,000	58,822,500
Discounted Customs Benefits (incl.risk factor)				52,154	298,024	378,443	450,528	514,889	817,284	934,038	963,690	988,400	1,008,572	6,406,022
Discounted Overall Benefits (incl.risk factor)				323,356	1,847,749	2,346,347	2,793,271	3,192,309	5,067,158	5,791,038	5,974,880	6,128,082	6,253,145	39,717,335
ROI for Customs														-49%
Overall ROI														215%
Cash Flow for customs		-1,005,882	-992,269	-695,134	-512,157	-525,274	-1,087,675	-994,839	-219,226	-134,335	-92,484	7,437	39,241	-6,212,598
Overall Cash Flow		-1,005,882	-1,041,882	-500,529	909,863	1,247,874	830,091	1,169,130	3,608,684	4,212,564	4,336,406	4,530,197	4,595,260	22,891,775
Discounted CF		-1,005,882	-992,269	-453,995	785,974	1,026,629	650,398	872,423	2,564,625	2,851,229	2,795,286	2,781,148	2,686,753	14,562,318
Net present value														14,562,318

Table 60. Costs, benefits, eTIR Carnets registered gradually, SaaS implementation, half usage

A.8. REFERENCES

A.8.1. *Referenced Documents*

The following documents are not contractually binding but they provide useful information for the successful outcome of this Project.

	Title	Date	Version	Author(s)
R1	eTIR Reference Model – Version 3.0 • Revision of the Convention – Preparation of Phase III of the TIR revision process	June 2011	ECE/TRANS/ WP.30/2011/ 3	Economic Commission for Europe Inland Transport Committee Working Party on Customs Questions affecting Transport
R2	eTIR Reference Model – Version 3.0 • Reference Model of the TIR Procedure Design	March 2011	ECE/TRANS/ WP.30/2011/ 4	Economic Commission for Europe Inland Transport Committee Working Party on Customs Questions affecting Transport
R3	eTIR Reference Model – Version 3.0 • Reference Model of the TIR Procedure XML	September 2011	ECE/ /TRANS/WP. 30/GE.1/201 1/10	Economic Commission for Europe Inland Transport Committee Working Party on Customs Questions affecting Transport
R4	eTIR Reference Model – Version 3.0 • Amendment proposal on the introduction of international declaration mechanisms	September 2011	ECE/ /TRANS/WP. 30/GE.1/201 1/09	Economic Commission for Europe Inland Transport Committee Working Party on Customs Questions affecting Transport
R5	Findings of the Ankara meeting (19–20 October 2010)	October 2010	ECE/ /TRANS/WP. 30/GE.1/201 0/05	Economic Commission for Europe Inland Transport Committee Working Party on Customs Questions affecting Transport
R6	The International Road Transport Union's contribution to the assessment of the financial implications of the introduction of the eTIR international system	September 2011	ECE/ /TRANS/WP. 30/GE.1/201 1/11	Economic Commission for Europe Inland Transport Committee Working Party on Customs Questions affecting Transport
R7	Financial implications of the	March 2011	Informal	Economic Commission for

	introduction of the eTIR international system; informal input paper of UNCTAD ASYCUDA programme to the 18th session of the UNECE Informal Ad-hoc Expert Group on Conceptual and Technical Aspects of Computerization of the TIR Procedure		document GE.1 No. 2 (2011)	Europe Inland Transport Committee Working Party on Customs Questions affecting Transport
R8	Report of the Informal Ad hoc Expert Group on Conceptual and Technical Aspects of Computerization of the TIR Procedure on its seventeenth session (8–9 March 2010)	8–9 March 2010	ECE/TRANS/ WP.30/GE.1/ 2010/4	Economic Commission for Europe Inland Transport Committee Working Party on Customs Questions affecting Transport
R9	IRU B2C B2C-C2B AskTIR Presentation Presentation to GE.1Belgrade, 13-14 September 2011	September 2011		IRU
R10	TIR B2C/B2B Computerization Status and Cost Considerations Geneva, March 9-10th2011	March 2011		IRU
R11	IRU B2C--C2B TIRCUTE web Presentation Presentation to GE.1 Belgrade, 13 13-14 September 2011	September 2011		IRU
R12	IRU B2C B2C-C2B TIR TIR-EPD and RTS Progress Presentation to GE.1 Belgrade, 13 13-14 September 2011	September 2011		IRU
R13	French Customs IT system : recent developments concerning TIR and transit	March 2011	GE1 08/03/2011	French Customs
R14	SEED Project – Cost of Implementation	March 2011		Serbian Customs
R15	TR-eTIR Computerization of TIR Procedure TCA approach	March 2011	V01	Turkish Customs Administration
R16	TR-eTIR Computerization of TIR Procedure TCA approach	September 2011	V02	Turkish Customs Administration

A.8.2. *Applicable Documents*

This refers to the list of existing or future documents, binding in the project, by order of seniority:

- Invitation to Tender (with all annexes);
- SIVECO Offer submitted on December 2011;
- Purchase Order ps-17976 /16 12 2011;
- Inception Report.

A.8.3. *Bibliography*

[1] Barrie Sosinsky – **Cloud Computing Bible** - John Wiley & Sons – 2011

[2] Barry Boehm, Chris Abts, A. Winsor Brown, Sunita Chulani, Bradford K. Clark, Ellis Horowitz, Ray Madachy, Donald J. Reifer, and Bert Steece**, 'Software cost estimation with COCOMO II**, Englewood Cliffs, NJ:Prentice-Hall, 2000.

[3] David S. Linthicum - **Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide** - Addison-Wesley Professional – 2009

[4] Frederick P. Brooks Jr.- **The Mythical Man-Month: Essays on Software Engineering, Anniversary Edition** - Addison-Wesley Professional – 1995

[5] Jibitesh Mishra; Ashok Mohanty - **Software Engineering -** Pearson Education India - 2011

[6] John Rhoton and Risto Haukioja – **Cloud Computing Architected** – Recursive Press – 2011

[7] John Rhoton and Risto Haukioja – **Cloud Computing Explained** – Recursive Press – 2011

[8] Steve McConnell - **Software Estimation: Demystifying the Black Art** (Best Practices (Microsoft)) - 2006

[AC] Amazon.com - Amazon clouds documentation

[GC] Google.com – Google clouds documentation

[MC] Microsoft.com - Microsoft Azure documentation

[OC] Oracle – Oracle clouds documentation

[DGTAXUD] NCTS documentation

TABLE OF FIGURES

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