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**Customs Convention on the International Transport of Goods
under Cover of TIR Carnets (TIR Convention, 1975):**

Revision of the Convention –

Preparation of Phase III of the TIR revision process

Cost Benefit Analysis of the eTIR system: summary, limitations and recommendations

Note by the secretariat

I. Background

1. At its forty-eighth session, further to requests from the Inland Transport Committee (ITC), the Working Party on Customs Questions affecting Transport (WP.30) and the Informal Ad hoc Expert Group on Conceptual and Technical aspects of Computerization of the TIR Procedure (GE.1 or “Expert Group”), the TIR Executive Board (TIRExB) mandated the secretariat to conduct a Cost Benefit Analysis (CBA) 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 of 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 bids, which were evaluated. 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, the Expert Group welcomed the draft CBA, presented in Informal documents GE.1 Nos. 6a, 6b, 6c, 6d and 6e (2012). The Expert Group expressed its general consent with the methodology used by the consultants, while, at the same time, raising preliminary comments on 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 (i.e.: 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 a complex simulation exercise, in addition to their work so far. 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 e-mail to eTIR focal points, soliciting their considerations on the draft CBA.

3. On the basis of all comments received, the consultants prepared an updated version of the CBA, which was presented as Informal document No. 12 at the Expert Group’s twenty-first session. The Expert Group took note that, apart from apparent mistakes in the calculations and lack of textual consistency, the CBA was final. The Expert Group agreed on the methodology used by the consultants, but felt that some costs, e.g. training, and indirect benefits were missing from the calculations. The Expert Group agreed with the proposal by the secretariat to prepare a revision of Informal document No. 12, correcting all remaining mistakes, for circulation among the network of eTIR focal points. Furthermore, it requested the secretariat to prepare a document, for consideration at its twenty-second session, containing a summary of the consultants’ CBA, in combination with an assessment of the limitations of the analysis, i.e. the missing costs and benefits, as well as recommendations.

4. At its twenty-second session, the Expert Group welcomed Informal document GE.1 No. 2 (2013), discussed it and slightly revised the wording of the recommendations. The IRU expressed reservations with regard to the final CBA, the corresponding assessment made by the TIR secretariat and the recommendations by the Expert Group (see ECE/TRANS/WP.30/2013/10, para. 16). After responding to the IRUs reservations (see ECE/TRANS/WP.30/2013/10, para. 17), the Expert Group requested the secretariat to include a revised version of Informal document GE.1 No. 2 (2013) as an annex to the eTIR Reference Model and submit it to WP.30 for consideration.

II. Summary of the Cost Benefit Analysis

A. Disclaimer

5. The CBA, as contained in Informal document GE.1 No. 12 Rev.1 (2012), reflects the views of the consultants and not those of the UNECE secretariat. The UNECE secretariat’s contribution has been limited to ensuring that the CBA methodology has been properly applied and preparing the underlying summary.

B. Objective and methodology

6. The main objective of the eTIR CBA is to compare the costs and the benefits of the implementation of an eTIR system under various assumptions, exploring different technological options and assuming different scenarios over a period of twelve years, i.e. two years for the development and deployment of a centralized exchange platform (the “so-called” eTIR international system), followed by ten years of progressively increased usage. In line with standard CBA methodology, costs and benefits are discounted to allow their

comparison at present value. For the purpose of the eTIR CBA, a discount rate of 5 per cent is used. Returns on investment (ROI) and Net Present Values (NPV) are used to compare the various technological options.

7. The assumptions are based on various sources, e.g. the eTIR Reference Model, as well as the consultants' expertise in the field of information and communication technology (ICT) projects, in particular software development projects.

C. Technological options

8. The CBA identifies six technological options to implement a centralized eTIR international system.

- At premises: a new data centre will be established to host the eTIR international system. This implies the purchase and maintenance of a completely new data centre (space, network, hardware and software).
- UNOG: the eTIR international system will run on machines hosted and maintained at the United Nations at Geneva (UNOG) data centre.
- UNICC: the eTIR international system will run on machines hosted and maintained at the United Nations International Computing Center (UNICC) data centre.
- IaaS (Infrastructure as a Service): the eTIR international system will run on a shared infrastructure in cloud.¹
- PaaS (Platform as a Service): the eTIR international system will run on a shared platform in cloud.
- SaaS (Software as a Service): the eTIR international system will be provided as a service by a cloud provider.

9. The technical assessment, presented in Annex of the CBA, identifies PaaS as the best option, followed by UNOG and UNICC.

D. Scenarios

10. The CBA considers two different scenarios over a period of 12 years. It is assumed that, at the end of this period, all 57 Contracting Parties (CP) to the TIR Convention would have upgraded their Customs IT systems to ensure the connectivity with the eTIR international system, according to the following schedule:

Table 1

Annual number of Contracting Parties upgrading their IT system

<i>Year</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>
No. of Contracting Parties		3	3	3	5	10	10	5	5	5	4	4

11. The two scenarios differ from each other by the number of TIR transports that would be handled solely electronically every year, i.e. making full use of the eTIR international system. In the first scenario, the number of computerized TIR transports would gradually reach the current annual number of TIR Carnets used (approx. 3 million). In the second

¹ The term "cloud" refers to cloud computing, i.e. the usage of (shared) computing resources (hardware and software) made available by specialized companies as services over the Internet.

scenario, only half of those would be computerized after the twelfth year. The following table shows the annual number of computerized TIR transports for both scenarios.

Table 2

Number of fully computerized TIR transports (thousands)

<i>Year</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>
Scenario 1		100	700	800	1 200	1 300	2 000	2 500	2 600	2 800	3 000	
Scenario 2		50	300	400	500	600	1 000	1 200	1 300	1 400	1 500	

E. Costs

12. The following costs categories are considered:

- Development costs
- Initial costs
- Operational and hosting costs
- Helpdesk costs
- Costs to adapt national applications

13. For each cost category, minimal and maximum costs are estimated.

1. Development costs

14. The development costs of the three components of the eTIR international system have been estimated separately:

- (a) the kernel (ensuring the electronic exchange of eTIR messages);
- (b) the web base user interface, which would serve as backup to the kernel, and
- (c) the administration console.

15. The system dimension of each component has been estimated by means of a function point analysis (FPA) and adjusted on the basis of an estimated processing complexity. On that basis (and by using the Constructive Cost Model (COCOMO) II methodology), the development costs and schedule have been estimated. The development costs of the entire eTIR international system range between 924,800 and 1,127,000 US\$.

2. Initial Costs

16. Setting up the eTIR international system will require different costs, depending on the technological options selected. Table 3 presents the minimum and maximum estimated initial costs for each option. They include, but are not limited to, purchasing facilities, hardware and software, as well as training and recruitment activities.

Table 3

Initial costs

(United States dollars)

	<i>Min</i>	<i>Max</i>
At premises	1 255 000	1 450 000
UNOG	681 500	792 500
UNICC	632 000	743 000

	<i>Min</i>	<i>Max</i>
IaaS	632 000	743 000
PaaS	142 000	183 000
SaaS	10 000	15 000

3. Operational and hosting costs

17. Operating and maintaining the eTIR international system will imply annual costs. Most of those costs depend on the number of TIR transports that will be handled by the system. The costs will also vary greatly, depending on the technological options selected. Table 4 presents the minimum and maximum estimated annual variable costs for each option, in case 3 million TIR transport would be handled by the system. Variable costs include, depending on the option, costs for testing, backup, staff, training, audit, insurance and management as well as fees paid to cloud operators.

Table 4

Annual operational and cloud costs

(United States dollars)

	<i>Min</i>	<i>Max</i>
At premises	340 419	526 059
UNOG	194 739	243 259
UNICC	167 719	257 059
IaaS	113 402	153 126
PaaS	159 116	180 816
SaaS	1 500 000	3 000 000

18. By dividing the above-mentioned costs by 3 million, a unit cost operational and cloud cost per TIR transport has been calculated. On that basis, the annual variable costs for each scenario have been estimated.

4. Helpdesk costs

19. The eTIR Reference Model requires only a minimal helpdesk, the main function of which it is to assist countries in connecting their IT systems to the eTIR international system. Such a helpdesk would be composed of 2 IT specialists, working 40 hours a week. The initial costs to establish such a helpdesk would range from 24,500 to 44,000 US\$. The operating and personnel costs have been estimated between 126,180 and 216,600 US\$ per annum.

5. Costs to adapt national applications

20. It is assumed that countries already have, or will, develop IT systems that process TIR operations nationally or regionally. Therefore, the only costs that have been assessed are aimed at;

- (a) ensuring that all information required by the eTIR international system can be entered and stored in the national IT system;
- (b) integrating eTIR web services in the national applications handling TIR operations and
- (c) developing the interfaces (web services) required by the eTIR international system.

On the basis of an estimated project plan, adapting national Customs IT system would cost between 120,000 and 150,000 US\$ per country.

6. Other costs

21. The consultants have considered that there would be no other costs, including from the trader/transport community.

F. Benefits

22. A fully computerized TIR system will generate direct annual benefits for Customs, the guarantee chain and holders. The various benefits have been estimated independently, before calculating the average benefits of computerization per TIR transport.

1. For Customs

23. The direct benefits for Customs have been derived from the comparison between the time required to process a paper based TIR Carnet and the estimated time it would take to process the equivalent electronic information, once the system would be fully computerized. Taking also into account that some Customs administrations already receive information in an electronic form and that not all time reductions lead to actual saving in personnel costs, the savings for Customs administrations are estimated at 4,311,428 US\$ per annum, if 3 million TIR transports are computerized.

2. For the guarantee chain

24. The guarantee chain's costs related to printing, distribution and archiving of TIR Carnets are estimated at 2 US\$ per TIR Carnet, resulting in potential savings of 6 million US\$ per year, in case the entire TIR system becomes paperless.

3. For the holders

25. The benefits for the holders, resulting from the reduction in time to begin a TIR transport (i.e. difference between the time to fill in a paper TIR Carnet and the time to input data electronically) as well as the reduction in time spent at borders could reach 16,437,504 US\$ per annum.

G. Results of the CBA

26. In order to include a factor of incertitude (inherent to such a large scale project) into the analysis, a 20 per cent risk ratio to both costs and benefits has been introduced, i.e. costs have been increased by 20 per cent and benefits decreased by 20 per cent. On the basis of the risk-adjusted and discounted costs and benefits, the annual cash flows, ROI and NPV have been calculated for each technological option and for both scenarios over a 12-years period. Tables 5 and 6 present the final results of the CBA of the eTIR system.

Table 5
Costs, Benefits, ROI and NPV for scenario 1
 (United States dollars)

	<i>Premises</i>	<i>UNOG</i>	<i>UNICC</i>	<i>PAAS</i>	<i>IAAS</i>	<i>SAAS</i>
Development costs	1 127 000	1 127 000	1 127 000	1 127 000	1 127 000	–
Initial costs	1 450 000	792 500	743 000	183 000	743 000	15 000
Oper. + Hosting costs	2 981 001	1 378 468	1 456 668	1 024 624	867 717	17 000 000
Sub-total costs	5 558 001	3 297 968	3 326 668	2 334 624	2 737 717	17 015 000
Help Desk costs	2 210 000	2 210 000	2 210 000	2 210 000	2 210 000	2 210 000
National App costs	8 550 000	8 550 000	8 550 000	8 550 000	8 550 000	8 550 000
Total Costs	16 318 001	14 057 968	14 086 668	13 094 624	13 497 717	27 775 000
Total Costs (incl. 20% risk factor)	19 581 601	16 869 561	16 904 001	15 713 549	16 197 260	33 330 000
Discounted Costs (incl. risk factor)	14 979 069	12 941 676	12 950 077	12 391 640	12 470 894	23 464 073
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	-12%	2%	2%	7%	6%	-44%
Overall ROI	449%	535%	535%	563%	559%	250%
Net present value	67 203 464	69 240 856	69 232 456	69 790 892	69 711 639	58 718 460

Table 6
Costs, Benefits, ROI and NPV for scenario 2
 (United States dollars)

	<i>Premises</i>	<i>UNOG</i>	<i>UNICC</i>	<i>PAAS</i>	<i>IAAS</i>	<i>SAAS</i>
Development costs	1 127 000	1 127 000	1 127 000	1 127 000	1 127 000	–
Initial costs	1 450 000	792 500	743 000	183 000	743 000	15 000
Oper. + Hosting costs	2 981 001	668 962	706 912	497 244	421 098	8 250 000
Sub-total costs	5 558 001	2 588 462	2 576 912	1 807 244	2 291 098	8 265 000
Help Desk costs	2 210 000	2 210 000	2 210 000	2 210 000	2 210 000	1 286 300
National App costs	8 550 000	8 550 000	8 550 000	8 550 000	8 550 000	8 550 000
Total Costs	16 318 001	13 348 462	13 336 912	12 567 244	13 051 098	18 101 300
Total Costs (incl. 20% risk factor)	19 581 601	16 018 155	16 004 295	15 080 693	15 661 317	21 721 560
Discounted Costs (incl. risk factor)	14 979 069	12 362 151	12 337 675	11 543 030	12 523 940	15 492 843
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	-57%	-48%	-48%	-45%	-49%	-59%
Overall ROI	165%	221%	222%	244%	217%	156%
Net present value	24 738 266	27 355 184	27 379 660	28 174 305	27 193 395	24 224 492

27. Finally, the profitability of the project for single Customs administration has been assessed, indicating that, from when approximately 30,000 TIR operations per year are fully computerized, the investment in both the eTIR international system and the costs to adapt a national IT system become profitable.

H. Conclusions and recommendations

28. Combining their technical assessment with the results of the CBA, the consultants have made the following conclusions and recommendations:

- The eTIR system should be implemented as soon as possible to maximize its benefits;
- The best technical option to implement the eTIR international system is to use a Platform as a Service (cloud solution), closely followed by IaaS, UNICC and UNOG options;
- In scenario 2, even if the project does not have a positive ROI for Customs alone, it remains a very profitable project overall.
- Processing annually 30,000 TIR operations electronically is sufficient to justify the investment in eTIR for any single Customs administration.

III. Assessment of the Cost Benefit Analysis by the secretariat

A. Scope

1. General

29. As highlighted by the Expert Group, when analysing earlier versions, the CBA does, unfortunately, not take into account any indirect benefits from the computerization of the TIR system. Indirect benefits can range from increased transport facilitation (due to the availability of advance information) to, ultimately, increased security of the TIR system, which is beneficial to both Customs and the guarantee chain.

30. Furthermore, contrary to the consultants' assumption, both transport operators and the guarantee chain may incur costs from the introduction of the eTIR system.

2. Technological options

31. The technological options in the CBA allow for a good comparison of the various hosting possibilities of the eTIR international system. Nevertheless, all analysed technological options are based on the development of the eTIR international system from scratch. The use (and configuration) of "off the shelf" solutions has not been considered, neither in the technical evaluation nor in the CBA.

3. Scenarios

32. The two scenarios analysed by the consultants are relatively straightforward as they do not take into account any future political or economic developments. Over a decade, many factors may have a significant influence on the annual number of TIR transports. The following, non-exhaustive list, contains an overview of potential events, which may significantly influence the use of the TIR system and, thus, the eTIR international system:

- The ratification and use of the TIR Convention by new countries (e.g. China, Pakistan);

- The extension or creation of other transit agreements as alternatives to the TIR system (e.g. Turkey joining the Common Transit Convention);
- The creation or extension of Customs Unions (e.g. the Russian Federation-Belarus-Kazakhstan Customs Union);
- Variations in trade flows, which could significantly affect international road transport patterns;
- The fluctuation in energy prices, which has direct repercussions on the modal split of international transport.

33. It should be stressed that, although possibly important, the probabilities as well as the effects of such events occurring (as well as others) remain very difficult to estimate and require dedicated studies. The combined effects are even more difficult to analyse and, thus, it seems understandable that the consultants have not taken them into account in the CBA. However, the two scenarios proposed by the consultants allow comparing two significantly different patterns in the usage of the eTIR international systems and their influence on the profitability of the project.

B. Assumptions

34. The consultants' assumptions are sound and generally based on concrete reference material.² However, considering that some of the favoured options envisage that the eTIR international system be hosted in an international data centre in Geneva, the labour costs, calculated as a weighted average of European wages, seem too low.

C. Methodological aspects

1. Function point analysis

35. The FPA, used for the estimation of the development costs of the three components of the eTIR international system, allows for a realistic assessment of the complexity of each function to be performed by each component and allows, therefore, a realistic estimation of the development efforts for the whole system.

2. Costs

36. The consultants have undertaken a very detailed analysis of the costs attributable to the various technological options. They thoroughly listed and priced development, equipment, helpdesk and maintenance costs for a system that can handle 3 million TIR transport per year. On the basis of optimistic and pessimistic assumptions, they have calculated minimum and maximum costs. Yet, to be on the safe side, they considered only maximum costs and have increased them by a 20 per cent risk factor.

37. However, the assumption that total variable costs can be divided by the number of TIR transports in order to calculate unitary costs is questionable. Indeed, this may be a valid assumption for cloud solutions, but it does not take into account that, for some options, the

² The functionalities of the eTIR system, taken into account by the consultants in the CBA, are those described in version 3.0 of the eTIR Reference Model (ECE/TRANS/WP.30/2011/4). In case Contracting Parties, when preparing for the introduction of a legal framework to enable the eTIR system, decide to introduce requirements which are new to or different from those described in the eTIR Reference Model, the results of the CBA might change or even lose relevance.

variable costs are not fully scalable (e.g. personnel or infrastructure costs). Furthermore, some costs may be missing or underestimated, in particular those that relate to personnel costs (see III.2), as well as training costs.

3. Benefits

38. The consultants' estimation of the benefits is purely based on the difference in time required to provide and process electronic information compared to paper, together with the consequences of reducing the processing time for Customs officers and the time spent at Customs offices for transport operators. To be on the safe side, any benefits have been decreased by a 20 per cent risk factor. Therefore, the consultants did indirectly take into account that the benefits of a computerized system may not automatically lead to savings in personnel costs and that some benefits are already present today, e.g. the obligation to provide advance information on incoming TIR transports in the EU.

39. Considering that providing advance information to Customs and increasing security are major objectives of the eTIR project, it is unfortunate that the consultants have not even made an attempt to estimate those benefits. Those missing benefits would, most likely, largely offset the costs which remain missing or are underestimated.

4. CBA

40. The consultants have used a standard cost benefit methodology, calculating the present value of future costs and benefits with a 5 per cent discount rate. The use of both ROI and NPV gives an approximate idea of the profitability and the actual value of the project, taking into account the various technological options. Most importantly, the ROI and NPV allow for an adequate comparison of the technological options for both scenarios.

D. Conclusions

41. The CBA provides, for the various technological options, a good estimation of the profitability of the eTIR project as well as an approximation of the amounts that would be required to develop and maintain it. It shows that the profitability of the project for Customs alone depends significantly on the future usage of the system, but that the overall ROI remains highly positive, even if the system would only be used for a limited number of TIR transports.

42. Despite the fact that some assumptions of the CBA can be criticized for underestimating some costs and benefits, the methodology used remains solid and, therefore, the CBA demonstrates that the eTIR project could be greatly beneficial for all the actors involved in the TIR procedure, in particular transport operators.

IV. Recommendations

43. On the basis of the results of the CBA and its own expertise, the Expert Group is of the view that:

(a) Considering that the eTIR project seems to be highly profitable for all parties involved in the TIR procedure, it is recommended that the eTIR system should be implemented, including at national level, as soon as the legal provision would be prepared and ratified, the technical specification completed and a project road map agreed on;

(b) Considering the large benefits for TIR Carnet holders, a potential avenue to explore for the financing of the eTIR international system seems to be through a contributory system per TIR transport, similar to the one used for TIRExB;

(c) Considering the commercial sensibility of the data that will be handled by the eTIR international system and in view of the relatively small costs differences with the cloud solution recommended in the CBA, it is recommended that the eTIR international system be hosted at UNICC or UNOG data centres;

(d) Considering the availability of message broker software on the market, it is recommended to consider the use of “off the shelf” solutions, including open source, for the development of the eTIR international system.
