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## **Economic Commission for Europe**

### **Inland Transport Committee**

#### **Working Party on Transport Trends and Economics**

##### **Twenty-fifth session**

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Item 9 of the provisional agenda

##### **Transport and Competitiveness**

### **Transport Development Index (TDI)**

#### **Note by the secretariat**

1. Transport Development Index (TDI) is developed by the Transport Division of the United Nations Economic Commission for Europe (UNECE). The TDI is developed as a result of the UNECE Transport Division project “Supply chain challenges for transport”. The project was initiated by the UNECE Working Party on Transport Trends and Economics (WP.5) in September 2008 and accepted by the Inland Transport Committee (ITC) in 2009. The UNECE Transport Division organized a round table with experts in December 2009. Based on the feedback provided by the experts and demand expressed in this round table an audit report on measurement methods for transport systems was developed by the Transport Division and presented at the ITC session in 2011. Following-up on the conclusions of this document, a Task Force was established by the ITC. In 2012 the Task Force presented its conclusions to the ITC. The Task Force stressed the need and expressed the demand for a simple methodology which would be able to measure the performance of national transport systems. The methodology presented in TDI report and in the complementary technical notes is response to this request.

2. The project “Supply chain challenges for transport” is an important element in UNECEs 360 degree approach to transport. The UNECE Transport Division has reviewed the role of transport for sustainability through the three-pillar approach: economic, social and environmental sustainability in the publication “Transport for Sustainable Development in the ECE region”.

3. The UNECE Transport Division works for environmental sustainability by ensuring reduced emissions of local and global pollutants through the Working Party on Vehicle Regulations (WP. 29) and – in cooperation with the World Health Organization (WHO) – the Transport Health and Environment – Pan-European Program (THE PEP). Social sustainability is considered in UNECEs work on road safety (WP.1), as well as in the Working Party on Vehicle Regulations, in THE PEP and the Working Party on Transport

Trends and Economics. The report “Transport for Sustainable Development” is also an important element in UNECE’s effort to improve economic sustainability, in which the present project is an important element. The UNECE furthermore provides unique statistics on transport and road safety trends.

4. The objective of the TDI is to provide a measurement of the performance of national transport systems bearing in mind its importance for overall sustainable development. The TDI is developed by aggregation from the set of indicators used to quantify the effectiveness of national transport systems – in light of the three pillar approach for sustainable development

5. The UNECE Task Force specified that the performance indicator should provide “a simple, yet evidence-based, indication of the contribution of a transport sector to competitiveness of a national economy”. The choice of the set of indicators and aggregation method is thus based on the role of transport for national competitiveness.

Following the descriptions provided by the UNECE Task Force, the TDI should:

- be simple.
- be transparent.
- accommodates situation which varies from one country to another.
- allows that the situation in transport sector in different countries could be adequately reflected.
- be evidence-based.

6. The TDI methodology is developed with the UNECE member states as a point of departure, but as it should be a general and systematic methodology, there is nothing that prevents its global use. Quite contrary, the methodology is constructed so that all countries, independent of the state of their economic development or geographic characteristics, could apply it.

7. The methodology also takes the availability of data into account. Optimally the measurement should be based on publicly available data. When defining the indicators it is important to keep in mind that even within the UNECE the data availability varies considerably.

8. The methodology is transparent in the sense, that all documentation, calculations and results are publicly available. The methodology is developed so that it can be calculated for the same country for different years. Variations in the outcome from year to year should have evidence based explanation and be meaningful.

9. The need for the TDI was identified by the UNECE Task Force following the conclusions of the audit report mentioned earlier. The TDI should thus fill the gaps identified in the existing literature and practice:

- There is no meso-level benchmarking system with a supply chains in focus.
- The role of TDI: to provide an indicator consisting of several dimensions and allowing for cross-national comparisons.
- The administrative/legal and sustainable dimensions are widely ignored in measurements of the role of transport.
- The role of TDI: provide an indicator that contains sustainability and administrative dimensions.
- Balance between hard and soft data is poor in the existing studies.

- The role of TDI: only publicly available data and indicators should be used in the TDI. The scope of soft indicators is therefore limited. But this issue should nevertheless be considered.
- Presentation of ranking outcomes with alternative aggregation methods is missing.
- The role of TDI: a clear, transparent, adjustable and well documented aggregation method will be used.
- None of the existing studies apply country-specific dimension weights that for example account for the special needs of land-locked countries.
- The role of TDI: a weighting function that handles the geographic characteristics of the individual country will be used.
- The measurement methodology in academic studies is mostly based on either a monetary estimate of the value of public capital or it only considers the physical attribute of one aspect of infrastructure.
- The role of TDI: in the best case scenario, the TDI should be usable in the assessment exercises and research as a proxy for the performance of the overall transport system.

10. In the case of the TDI, it has been chosen to base the choice of aggregation method and set of indicators on the understanding of the role of transport for national competitiveness through supply chain efficiency. This has been described in detail in Informal document No. 6 of the 2011 session of the Working Party on Transport Trends and Economics, but in order to make the TDI empirically feasible and fulfil the requirement of simplicity, a number of simplifying assumptions have been made.

11. The importance of transport for economic development has been acknowledged at least since “The Wealth of Nation” by Adam Smith. There are several mechanisms through which transport affects the competitiveness and thus the economic development of a country. The link between transport and competitiveness/private sector productivity is sound: (i) firms receive intermediate goods, share knowledge and cooperate with business partners and employ a labor force; good transport performance attracts more firms, subcontractors and a qualified labor force; these dynamic effects lead to increased performance for the individual firm; (ii) there is a direct effect of better transport services, if the employees, intermediate goods and business partners can reach the firm quicker, safer and more reliable through improved infrastructure; (iii) transport efficiency may affect the firms’ internal structure; it may for instance be possible to operate with a headquarter and plant structure or to organize all activities in one location depending on a type of production process; (iv) customers can be served at lower costs, more reliable and faster; this leads to direct cost reductions; (v) improved connections to markets through better infrastructure leads to better market access, so that the firm can operate with lower stocks and avoid overproduction.

12. It is without question that transport is of major importance for national competitiveness. In 2001 the European Commission stated that:

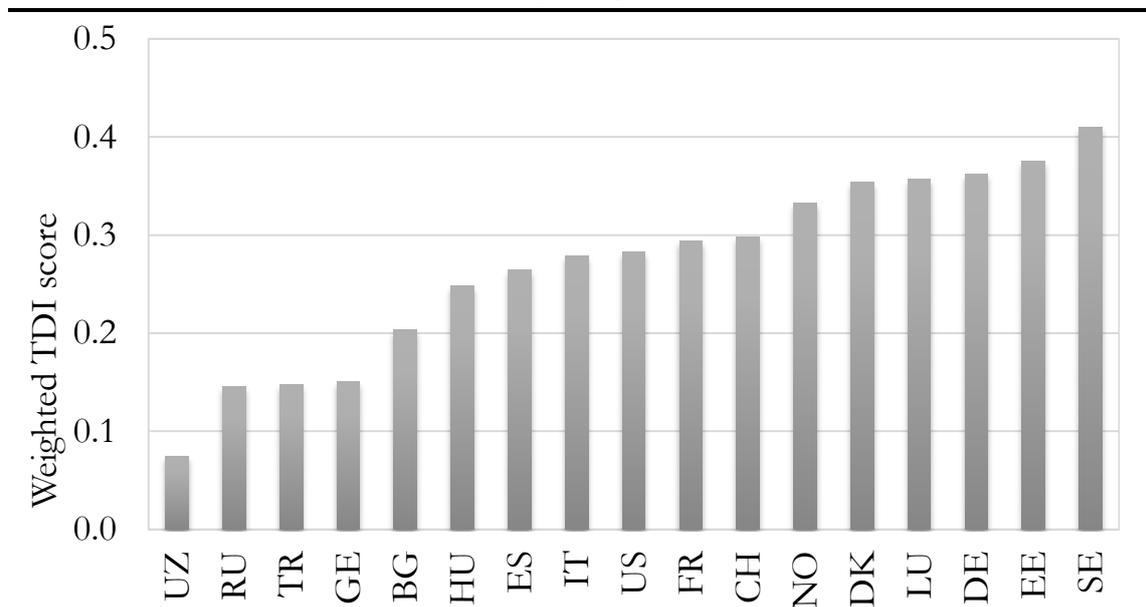
*“Networks are the arteries of the single market. They are the life blood of competitiveness, and their malfunction is reflected in lost opportunities to create new markets and hence in a level of job creation that falls short of our potential.”*

It is therefore of great interest for policy makers to know how the transport system performs. But transport systems are complex. The efficiency of each transport mode depends not only on the quality of the infrastructure, but certainly also on the integration with the other modes. The efficiency of national transport systems is also dependent on its integration with international networks.

13. By aggregating simple and publicly available key indicators on national transport systems, the Transport Development Index (TDI) summarizes the performance of transport systems in one informative indicator. This key indicator allows policy makers to compare the quality of performance of one national transport systems over time and with other national transport systems. The TDI combines traditional infrastructure supply measures with operational measures of transport to give up-to-date information on the state of the transport system. These measures are used together with an innovative inter-modal dimension that measures transparency, good governance, international cooperation, sustainability and safety. The TDI gives a unique summary of the functioning of the overall transport system, by taking a 360 degree approach and considering several dimensions of transport.

14. The analysis using the suggested methodology has shown that north and central European-countries appear to have the best performing transport systems as shown by the figure below. Uzbekistan and the Russian Federation appear to have the poorest performing indicator. The best performing country appears to be Sweden followed by Estonia, Germany and Luxembourg. The low performance of the Russian Federation is primarily caused by a low score on the sea and air transportation sub-indicator. Figure 1 shows the average Transport Performance Index Score 2000–2010. The eleven years average can be used to get a more robust and consistent estimate of the transport performance index, while the year to year graphs give less solid but more up-to-date information on trends and developments. Results are quite robust over time, and year to year fluctuations give some indication of trends.

*FIGURE 1: THE TRANSPORT DEVELOPMENT INDEX SCORE, 2000 – 2010  
AVERAGE*



15. Transport sector is divided into following modes: air and sea transport, inland transport (road, rail, and inland waterway transport) and a third, cross-modal, dimension was added to the model. This dimension combines real-time information on transport flows; environmental sustainability; social responsibility; transport security; transport safety; and,

good governance and transparency. Access to real-time information on transport flows allows supply chain managers to continuously update their transport plans. Environmental and social responsibility is becoming increasingly important for the value of the final good, while transport security and safety is essential for reliable and socially responsible transport. A new dimension that has been recognized is the importance of good governance and transparency in the transport sector. Especially on the financing side, this is important: “The ability to develop successfully efficient and stable funding for transportation relies much on the establishment of an appropriate governance structure”.

16. After a wide range of characteristics that describe transport performance have been identified, the performance of transport systems was evaluated by looking at indicators that represent each of these characteristics. As this would easily result in more than ten indicators, the number of indicators would become unmanageable and it would become difficult to get a total overview about the performance. In order to be able to manage a large number of indicators, the methodology reduces the indicators to only a few, created by a set of variables. In other words the number of dimensions had to be reduced and if reduced to one dimension, comparing two countries would become easy.

17. Transport performance is a term covering a number of observable and unobservable aspects. These observable and unobservable aspects have – to a large extent – been explained on an abstract level in earlier documents and in part two of TDI Report.

18. It was for instance concluded that transport performance covers safety. In theory it is straightforward to measure safety in transport. Once this is done, it can be included in a model and used for measuring transport performance. The idea was therefore to build a mathematical model that is based on understanding of the role of transport.

19. Characteristics of transport system can be divided into two transport modal groups and one inter-modal dimension. The two transport modal groups are based on the common characteristics of these modes, while the third dimension includes issues that affect the performance of transport systems across mode. If there is performance measure for each of these three dimensions, there will be three values. This implies that within each dimensions intra- and inter country comparisons can be made. In order to make an overall assessment of the transport system, these three values have to be reduced into one value, as inter- and intra-country comparisons are not possible in three dimensions. Before this can be done, the performance within each dimension had to be identified. This required that factors that affect transport were taken into account and translated into one number.

20. Reducing the dimensions is not straightforward and can lead to arbitrary results if one does not maintain a strict logical reasoning. Assume, for example, that indicators for transport costs and transport network size have been identified. How can these two indicators be reduced to one single number? There are a several problems: (1) difference in scale, (2) difference in direction and (3) choice of weight. The size of transport network is typically measured in length, while transport costs are measured in monetary units. How can these numbers be aggregated? Secondly, for transport costs a lower value is preferred; while for transport network a higher density is desirable. Thirdly, should transport costs and network density be weighted equally? The choice of weights and aggregation method has a huge impact on the overall outcome.

21. Box 1 is a simple illustration of how a list of indicators is reduced in dimension, first to number of sub-scores, and then to one final metric. The indicators should be selected based on the description provided in the TDI Report.

22. The next phase of the project included aggregation and standardization. It was decided that the TDI will be based on the same strategy as the Human Development Index (HDI), because such methodology ensures transparency and that the results can be obtained relatively easily. The drawback is that the model developer has to set the weights. In the

case of TDI, the strategy of the HDI was followed and equal weights were specified for each dimension. These can of course be adjusted.

23. Four transport modes are making up transport sector: air, sea, inland and inter-modal transport. For simplicity the two first modes are combined to one sub-indicator in this approach, as they are similar in characteristics, and complementary in use. Geometric mean was chosen to be the aggregation method, which is also seen in the recent editions of the HDI. Each variable is standardized to be between 1 (the best performing country) and 0 (the worst performing country). These methods are described in detail in TDI Report. An alternative method for aggregation would be the principal component analysis, but this method has not been chosen for the TDI, as it is regarded as less transparent and less user friendly.

24. The next meeting of the Task Force will be held pending the completion of the draft methodology (possibly in the spring 2014).

**Box 1: REDUCING THE DIMENSIONS - FROM KEY VARIABLES TO ONE KEY INDICATOR**

