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**Economic Commission for Europe****Inland Transport Committee****Working Party on Transport Trends and Economics****Group of Experts on Benchmarking Transport Infrastructure Construction Costs****Fifth session**

Geneva, 28 June 2018

Item 3 of the provisional agenda

**Transport Infrastructure Construction costs:****Presentations of terminologies used****Transport Infrastructure Construction costs: Presentations  
of terminologies used\*****Submitted by PKP Polish Railway Lines****I. Mandate**

1. In accordance with its Terms of Reference, the Group of Experts is expected to complete its work within two years (2016–2018) and to submit a full report of its accomplishments (ECE/TRANS/WP.5/GE.4/2016/1). The Group of Experts shall assist in:

- (a) identify models, methodologies, tools and good practices for evaluating, calculating and analysing inland transport infrastructure construction costs;
- (b) identify and list terminologies used in UNECE region for construction costs of inland transport infrastructure, if possible, create a glossary of agreed terminologies and related explanations;
- (c) collect and analyse data in order to prepare a benchmarking of transport infrastructure construction costs along the ECE region for each inland transport mode - road, rail, inland waterways - including intermodal terminals, freight/logistics centres and ports. Analyse and describe the conditions / parameters under which these costs have been calculated on.

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\* The document was submitted late due to delayed inputs from other sources.

2. In carrying out its main tasks, the Group of Experts will, among others, also identify suitable methodological approaches, models and tools for gathering and disseminating information, i.e. conducting studies, distributing questionnaires, using existing studies and national strategies, existing best practices in calculating transport infrastructure construction costs, among others.

## **II. Questionnaire guidelines**

3. The questionnaire is based on the ideas of experts monitoring work conducted on railway lines. Its main objective is to collect practical information on the cost of railway infrastructure. However, the questionnaire has been divided into three types of work – construction, upgrade and renewal. It has been decided to take into consideration all three types to build a picture of all investment costs; which will be particularly useful when taking decisions whether to construct or upgrade.

4. The next step was to make a decision on speed limits. The number of categories of speed has been adjusted to each type of work. The largest part of the questionnaire is the one concerning construction work. Thus, the most common speed limits have been included there, whilst only three speed categories are included for upgrade and renewal.

5. If you think any of these speed categories should be changed, please feel free to do so in the column ‘other’.

6. Regarding the scope of work and elements of infrastructure important to construction, as advised by the Group, all categories related to documentation have been removed – feasibility studies, administrative fees and designs. Likewise, if you wish to add any category please write it in the line ‘others’.

7. Respondents can also specify the units of measurement which may differ even within a single category. An example can be found in the category ‘preparatory work’. There are at least two methods of measuring this category: as a square meter of land or a kilometre of line being constructed. It has been decided to use square meters, in the knowledge that in some cases kilometres are more reliable units. We recommend that respondents use the units proposed in the questionnaire when possible. If not possible please propose the units, specify them and write a short explanation.

8. The questionnaire has been divided into three parts:

- (a) for construction work,
- (b) for upgrade work,
- (c) for renewal work.

9. The data is being collected mainly for 2016. However, due to the fact that there might not have been any work conducted in that year, any data for the past decade is also warmly accepted.

### III. Questionnaire

#### A. Questionnaire on the costs of railway infrastructure construction

	$V < 120$	$120 < V \leq 160$ km/h	$160 < V \leq 200$ km/h	$200 < V \leq 250$ 0 km/h	$V > 250$ km/h	other speed limit (please specify)	type of line (electrified, non-electrified, number of tracks, gauge)	organisation responsible for construction
1	preparatory work (removal of trees and bushes, demolition etc.) (US\$/m <sup>2</sup> )							
2	earthwork (US\$/km)							
3	track and track bed (US\$/km)							
4	one-sided turnouts (US\$/unit)							
5	diamond crossing turnouts (US\$/unit)							
6	prestressed concrete turnout sleepers (US\$/unit)							
7	timber turnout sleepers (US\$/unit)							
8	traction electric power engineering (US\$/km)							
9	removal of wired infrastructure collision (US\$/km)							
10	steel bridges (US\$/m)							
11	composite bridges (US\$/m)							
12	reinforced concrete bridges (US\$/m)							
13	single tube tunnels (US\$/m)							
14	twin tube tunnels (US\$/m)							
15	underwater tunnels (US\$/m)							
16	viaducts (US\$/m)							
17	culverts (US\$/m)							

	<i>V &lt; 120</i>	<i>120 &lt; V ≤ 160</i> <i>km/h</i>	<i>160 &lt; V ≤ 200</i> <i>km/h</i>	<i>200 &lt; V ≤ 250</i> <i>km/h</i>	<i>V &gt; 250</i> <i>km/h</i>	<i>other speed limit</i> <i>(please specify)</i>	<i>type of line (electrified,</i> <i>non-electrified, number</i> <i>of tracks, gauge)</i>	<i>organisation</i> <i>responsible for</i> <i>construction</i>
18	retaining structures (US\$/m)							
19	passive level crossings (US\$/unit)							
20	active level crossings – manual (US\$/unit)							
21	active level crossings – automatic with user-side warning (US\$/unit)							
22	active level crossings – automatic with user-side protection (US\$/unit)							
23	active level crossings – rail-side protected (US\$/unit)							
24	pedestrian passages - footbridges (US\$/m)							
25	pedestrian passages - tunnels (US\$/m)							
26	ecopassages (US\$/m)							
27	standard platforms, height ≤ 76 cm (US\$/m)							
28	other platforms (US\$/m)							
29	elevators (US\$/unit)							
30	escalators (US\$/unit)							
31	signalling systems (US\$/km)							
32	signal boxes (US\$/unit)							
33	telecommunications and IT (US\$/km)							
34	passenger information systems (US\$/unit)							
35	lighting installations (US\$/unit)							
36	sidings (US\$/m)							
37	ramps (US\$/m)							
38	marshalling yards (US\$/m <sup>2</sup> )							

	$V < 120$	$120 < V \leq 160$ km/h	$160 < V \leq 200$ km/h	$200 < V \leq 250$ 0 km/h	$V > 250$ km/h	other speed limit (please specify)	type of line (electrified, non-electrified, number of tracks, gauge)	organisation responsible for construction
39	railway infrastructure in ports and terminals (US\$/m)							
40	railway stations (excluding facilities for train operations) (US\$/unit)							
41	other (please specify)							

## B. Questionnaire on the costs of railway infrastructure upgrade

	$V < 120$	$120 < V \leq 160$ km/h	$160 < V \leq 200$ km/h	$200 < V \leq 250$ km/h	$V > 250$ km/h	other speed limit (please specify)	type of line (electrified, non-electrified, number of tracks, gauge)	organisation responsible for construction
1	preparatory work (removal of trees and bushes, demolition etc.) (US\$/m <sup>2</sup> )							
2	earthwork (US\$/km)							
3	track and track bed (US\$/km)							
4	one-sided turnouts (US\$/unit)							
5	diamond crossing turnouts (US\$/unit)							
6	prestressed concrete turnout sleepers (US\$/unit)							
7	timber turnout sleepers (US\$/unit)							
8	traction electric power engineering (US\$/km)							
9	removal of wired infrastructure collision (US\$/km)							
10	steel bridges (US\$/m)							
11	composite bridges (US\$/m)							
12	reinforced concrete bridges (US\$/m)							

	<i>V &lt; 120</i>	<i>120 &lt; V ≤ 160</i> <i>km/h</i>	<i>160 &lt; V ≤ 200</i> <i>km/h</i>	<i>200 &lt; V ≤ 250</i> <i>km/h</i>	<i>V &gt; 250 km/h</i>	<i>other speed limit (please specify)</i>	<i>type of line (electrified, non-electrified, number of tracks, gauge)</i>	<i>organisation responsible for construction</i>
13	single tube tunnels (US\$/m)							
14	twin tube tunnels (US\$/m)							
15	underwater tunnels (US\$/m)							
16	viaducts (US\$/m)							
17	culverts (US\$/m)							
18	retaining structures (US\$/m)							
19	passive level crossings (US\$/unit)							
20	active level crossings – manual (US\$/unit)							
21	active level crossings – automatic with user-side warning (US\$/unit)							
22	active level crossings – automatic with user-side protection (US\$/unit)							
23	active level crossings – rail-side protected (US\$/unit)							
24	pedestrian passages - footbridges (US\$/m)							
25	pedestrian passages - tunnels (US\$/m)							
26	ecopassages (US\$/m)							
27	standard platforms, height ≤ 76 cm (US\$/m)							
28	other platforms (US\$/m)							
29	elevators (US\$/unit)							
30	escalators (US\$/unit)							
31	signalling systems (US\$/km)							
32	signal boxes (US\$/unit)							
33	telecommunications and IT (US\$/km)							

	<i>V &lt; 120</i>	<i>120 &lt; V ≤ 160</i> <i>km/h</i>	<i>160 &lt; V ≤ 200</i> <i>km/h</i>	<i>200 &lt; V ≤ 250</i> <i>km/h</i>	<i>V &gt; 250</i> <i>km/h</i>	<i>other speed limit (please specify)</i>	<i>type of line (electrified, non-electrified, number of tracks, gauge)</i>	<i>organisation responsible for construction</i>
34	passenger information systems (US\$/unit)							
35	lighting installations (US\$/unit)							
36	sidings (US\$/m)							
37	ramps (US\$/m)							
38	marshalling yards (US\$/m <sup>2</sup> )							
39	railway infrastructure in ports and terminals (US\$/m)							
40	railway stations (excluding facilities for train operations) (US\$/unit)							
41	other (please specify)							

### C. Questionnaire on the costs of railway infrastructure renewal

	<i>V &lt; 120</i>	<i>120 &lt; V ≤ 160</i> <i>km/h</i>	<i>160 &lt; V ≤ 200</i> <i>km/h</i>	<i>200 &lt; V ≤ 250</i> <i>0 km/h</i>	<i>V &gt; 250</i> <i>km/h</i>	<i>other speed limit (please specify)</i>	<i>type of line (electrified, non-electrified, number of tracks, gauge)</i>	<i>organisation responsible for construction</i>
1	preparatory work (removal of trees and bushes, demolition etc.) (US\$/m <sup>2</sup> )							
2	earthwork (US\$/km)							
3	track and track bed (US\$/km)							
4	one-sided turnouts (US\$/unit)							
5	diamond crossing turnouts (US\$/unit)							
6	prestressed concrete turnout sleepers (US\$/unit)							
7	timber turnout sleepers (US\$/unit)							
8	traction electric power engineering							

	<i>V &lt; 120</i>	<i>120 &lt; V ≤ 160</i> <i>km/h</i>	<i>160 &lt; V ≤ 200</i> <i>km/h</i>	<i>200 &lt; V ≤ 250</i> <i>0 km/h</i>	<i>V &gt; 250</i> <i>km/h</i>	<i>other speed limit</i> <i>(please specify)</i>	<i>type of line (electrified,</i> <i>non-electrified, number of</i> <i>tracks, gauge)</i>	<i>organisation</i> <i>responsible for</i> <i>construction</i>
(US\$/km)								
9 removal of wired infrastructure collision (US\$/km)								
10 steel bridges (US\$/m)								
11 composite bridges (US\$/m)								
12 reinforced concrete bridges (US\$/m)								
13 single tube tunnels (US\$/m)								
14 twin tube tunnels (US\$/m)								
15 underwater tunnels (US\$/m)								
16 viaducts (US\$/m)								
17 culverts (US\$/m)								
18 retaining structures (US\$/m)								
19 passive level crossings (US\$/unit)								
20 active level crossings – manual (US\$/unit)								
21 active level crossings – automatic with user-side warning (US\$/unit)								
22 active level crossings – automatic with user-side protection (US\$/unit)								
23 active level crossings – rail-side protected (US\$/unit)								
24 pedestrian passages - footbridges (US\$/m)								
25 pedestrian passages - tunnels (US\$/m)								
26 ecopassages (US\$/m)								
27 standard platforms, height ≤ 76 cm (US\$/m)								

	<i>V &lt; 120</i>	<i>120 &lt; V ≤ 160</i> <i>km/h</i>	<i>160 &lt; V ≤ 200</i> <i>km/h</i>	<i>200 &lt; V ≤ 250</i> <i>0 km/h</i>	<i>V &gt; 250</i> <i>km/h</i>	<i>other speed limit</i> <i>(please specify)</i>	<i>type of line (electrified,</i> <i>non-electrified, number of</i> <i>tracks, gauge)</i>	<i>organisation</i> <i>responsible for</i> <i>construction</i>
28	other platforms (US\$/m)							
29	elevators (US\$/unit)							
30	escalators (US\$/unit)							
31	signalling systems (US\$/km)							
32	signal boxes (US\$/unit)							
33	telecommunications and IT (US\$/km)							
34	passenger information systems (US\$/unit)							
35	lighting installations (US\$/unit)							
36	sidings (US\$/m)							
37	ramps (US\$/m)							
38	marshalling yards (US\$/m <sup>2</sup> )							
39	railway infrastructure in ports and terminals (US\$/m)							
40	railway stations (excluding facilities for train operations) (US\$/unit)							
41	other (please specify)							

#### **IV. Terminology on Benchmarking Rail Transport Infrastructure Construction Costs**

10. Active level crossing - automatic with user-side protection - a level crossing where user-side protection is activated by the approaching train. This shall include a level crossing with both user-side protection and warning (1).
11. Active level crossing - automatic with user-side warning - a level crossing where user-side warning is activated by the approaching train (1).
12. Active level crossing - manual - a level crossing where user-side protection or warning is manually activated by a railway employee (1).
13. Active level crossing - rail-side protected - a level crossing where a signal or other train protection system permits a train to proceed once the level crossing is fully user-side protected and is free from incursion (1).
14. Ballast – selected material placed on the subgrade to support and hold the track with respect to its alignment within the bounds of specified top (vertical) and line (horizontal). Ballast preferably consists of accurately graded hard particles, normally stone, easily handled in tamping, which distribute the load, provide elasticity, drain well and resist plant growth. Generally, ballast must consist of broken stones. Granite is a very suitable material thanks to its toughness (2).
15. Branch line – a line carrying trains from the mainline to destinations on lower priority routes than the mainline (2).
16. Bridge - a structure that is built over a river, road, or other railway line to allow trains to cross from one side to the other (3).
17. Broad-gauge - a track wider than the standard gauge of 1435 mm (2).
18. Catenary system - generalised term used to describe the whole overhead line equipment (2).
19. Connected facility - a facility connected to the main railway network, such as a terminal or port. Such facilities are connected to rail transport but lie outside the main railway network (4).
20. Construction of the railway infrastructure - civil engineering, signalling, electrification, telecommunications, plant and electrical distribution and related computer systems (2).
21. Contact wire - the overhead wire touched by an electric train's pantograph in order to draw power (2).
22. Conventional lines - all railway lines that are not classified as 'dedicated high speed lines' or 'upgraded high speed lines' (4).
23. Corridor - a major railway line along a geographical route (4).
24. Culvert – a small bridge or pipe carrying a stream under a railway (3).
25. Dedicated high speed line - a line specially built to allow traffic at speeds generally equal to or greater than 250 km/h for the main segments. High speed line may include connecting lines, in particular connecting segments into town centre stations located on them, on which speeds may take account of local conditions (4).

26. Dedicated line - a rail link used exclusively by one type of traffic (freight or passengers) (4).
27. Development of the railway infrastructure - network planning, financial and investment planning as well as the constructing and upgrading of the infrastructure (5).
28. Diamond crossing turnout – a turnout where two tracks cross (3).
29. Double-track line - a line in which one track is provided for each direction of travel (4).
30. Earthwork – work conducted in order to prepare land for construction work; land grading, soil exchange etc. (3).
31. Ecopassage – a structure which allows animals to cross the railway line safely (3).
32. Electrified line - a line equipped with a power cable providing electric traction power to the trains (6).
33. Elevator – an installation which transports people or goods vertically between specific levels of a railway station (3).
34. Environmental Impact Assessment – the ongoing identification of environmental factors to determine the past, current and potential impact (positive or negative) of an organisation’s activities on the environment. This process includes the identification of the potential regulatory, legal and business exposure, as well as health and safety impacts and environmental risk assessment (2).
35. Escalator - an installation in the form of moving stairs which transports people or goods vertically between specific levels of a railway station (3).
36. European Railway Traffic Management System (ERTMS) - a major industrial project being implemented by the European Union, which will serve to make rail transport safer and more competitive. It is made up of all the train-borne, trackside and lineside equipment necessary for supervising and controlling, in real-time, train operation (4).
37. European Train Control System (ETCS) - this component of ERTMS guarantees a common standard that enables trains to cross national borders and enhances safety. It is a signalling and control system designed to replace the several incompatible safety systems currently used by European railways. As a subset of ERTMS, it provides a level of protection against over speed and overrun depending upon the capability of the line side infrastructure (4).
38. Fastenings - elements such as bolts and springs that fasten rails to a sleeper (3).
39. Feasibility study - a structured process that identifies the engineering options and their implications including environmental issues. It culminates in a feasibility report and a design development (and, sometimes, implementation) proposal (2).
40. Footbridge - an engineering structure designed for pedestrians, constructed over the railway line (3).
41. High speed line - specially built high-speed line equipped for speeds generally equal to or greater than 250 km/h or specially upgraded high-speed lines equipped for speeds of at least 200 km/h (7).
42. Infrastructure manager - any body or firm responsible for the operation, maintenance and renewal of railway infrastructure on a network, as well as responsible for participating in its development within the framework of its general policy on development and financing of infrastructure (5).

43. Interoperability - the ability of a rail system to allow the safe and uninterrupted movement of trains which accomplish the required levels of performance (5).
44. Land grading - work conducted in order to ensure a level base for further construction work (3).
45. Level crossing - any level intersection between a road or passage and a railway, as recognised by the infrastructure manager and open to public or private users. Passages between platforms within stations are excluded, as well as passages over tracks for the sole use of employees (1).
46. Lighting installation - a non-traction installation including lighting of passenger passages, platforms, level crossings, marshalling yards, signal boxes etc. (3).
47. Main line - main inter-city and other main passenger or freight route available for rail services. Main railway lines comprise the high-speed railway lines and important major conventional railway lines (4).
48. Maintenance of the railway infrastructure - works intended to maintain the condition and capability of existing infrastructure (5).
49. Marshalling yard - a railway facility equipped with tracks with special layout and technical facilities, where sorting, formation and splitting-up of trains takes place; wagons are sorted for a variety of destinations, using a number of rail tracks (8).
50. Narrow gauge - a gauge track narrower than the standard gauge of 1435 mm (2).
51. Network - the lines, stations, terminals, and all kinds of fixed equipment needed to ensure safe and continuous operation of the rail system (6).
52. Non-electrified line - line not equipped with a power cable providing electric traction power to the trains; usually trains on such line are driven by diesel engine (3).
53. One-sided turnout – a turnout where from one main track (of a main line), one or two diverted tracks (of a branch line) diverge (3).
54. Overhead power line - an electric power transmission line suspended to towers or poles. Overhead line equipment includes the wires and associated equipment, suspended over or adjacent to the railway line, for supplying electricity to trains (4).
55. Passenger information system - a system presenting all key elements of a railway timetable for passengers at stations (3).
56. Passive level crossing - a level crossing without any form of warning system or protection activated when it is unsafe for the user to traverse the crossing (1).
57. Pedestrian passage - a structure that allows pedestrians to pass the railway without any threat of collision with a train; there are different types of pedestrian passages e.g. footbridges or tunnels (3).
58. Platform - a structure constructed alongside the tracks at a passenger station that allows passengers wait, board and disembark from a train (3).
59. Preparatory work - work conducted in order to prepare land for earthwork; removal of trees and bushes, demolition, etc. (3).
60. Rail - a rolled steel shape designed to be laid end-to-end in two parallel lines on sleepers, to form a track for railway rolling stock (2).
61. Railway infrastructure - railway lines and engineering structures, buildings, and equipment, including grounds on which they are situated, dedicated to management

- passenger and freight services as well as maintenance of the property of the railway manager (3).
62. Railway infrastructure in ports and terminals - line infrastructure in the administrative area of ports and terminals (3).
63. Railway line - one or more adjacent running tracks forming a route between two points (4).
64. Railway station - a building or a building complex designed to provide services for passengers and accompanying persons, i.e. ticket offices, waiting rooms, shops, bars; facilities for train operations are excluded from this definition (3).
65. Ramp - a structure constructed alongside the tracks at a freight station which allows goods to be loaded and unloaded from a train (3).
66. Removal of wired infrastructure collision - removal of any type of cables or wires which were originally installed at the place of construction, upgrade or renewal work, in order to avoid collision with new wired infrastructure to be installed at this place (3).
67. Renewal of the railway infrastructure - major substitution works on the existing infrastructure which do not change its overall performance (5).
68. Retaining structure - an engineering structure used for soil stabilisation, especially at slopes (3).
69. Secondary line - a secondary line (or branch line) is a line of less importance than a main line (or trunk line) (4).
70. Section - railway track between two locations (e.g. between two stations) (6).
71. Siding - a section which is directly or indirectly connected with a railway line, used to perform loading, maintenance, or parking operations of railway vehicles or movement and entering of railway vehicles into operation on a railway network (3).
72. Signal box - a small building near a railway, which contains the switches used to control the signals (9).
73. Signalling system - a system used to control railway traffic safely, essentially to prevent trains from colliding. The main purpose of signalling is to maintain a safe distance at all times between all trains on the running lines (4).
74. Single-track line - where traffic in both directions shares the same track (4).
75. Slab track - a form of railway track comprising a concrete base to which the base plates carrying the rails are secured. It eliminates the need for individual sleepers (2).
76. Sleeper - a wood, concrete or steel object that holds the rails apart and supports the track on the ballast (2).
77. Soil exchange - excavation work conducted in order to remove the original soil and refilling this area with the soil meeting the requirements of the construction work (3).
78. Standard-gauge - a track at the width of 1435 mm (3).
79. Subgrade - the prepared surface of the natural ground or upper surface of fill material (2).
80. Superstructure - a group of track elements that are found above the formation layer, i.e. rails, sleepers, fastenings, ballast (3).
81. Switches and crossings - the specially designed rail components allowing trains to change tracks; any track elements which are not plain line (2).

82. Tamping - compacting ballast under the sleepers to maintain the correct geometry of the track (2).
83. Technical specification for interoperability (TSI) - a specification by which each subsystem or part of a subsystem is covered in order to meet the essential requirements and ensure the interoperability of the European Union rail system (1).
84. Telecommunications and IT - an installation for wireless communications in railway traffic management (3).
85. Terminal - a station where handling of goods takes place (goods are loaded on, or unloaded from, transport vehicles). May also include shunting of wagons between trains, without any loading or unloading (4).
86. Track - an assembly of rail, fastenings and sleepers over which railway carriages, wagons, locomotives and trains are moved (2).
87. Track bed - foundation of the track, adjusted for laying the superstructure (3).
88. Traction current - electric current supplied for the purpose of electric traction, collected by pantograph from the overhead supply (4).
89. Traction electric power engineering - construction of overhead power lines, cable lines, substations, lightning protection, earthing systems etc. (3).
90. Trunk line - a line that is the main route on a railway (4).
91. Tunnel - a structure provided to allow a railway line to pass under higher ground, and which has excavated without disturbing the surface of that ground (2).
92. Turnout - a trackwork element where a track divides into two (2).
93. Turnout sleeper - a special kind of a sleeper laid under a turnout; it is longer than a regular sleeper (3).
94. Upgrade of the railway infrastructure - major modification works to the infrastructure which improve its overall performance (5).
95. Upgraded high speed line - a conventional line specially upgraded to allow traffic at speeds of at least 200 km/h for the main segments (4).
96. Viaduct - a multi-span bridge structure for non-collision traffic across the railway line (3).

#### **IV. References**

- (1) Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety;
- (2) University of Birmingham and Network Rail Railway Lexicon Mk 24, February 2011;
- (3) Definitions compiled by experts of PKP Polish Railway Lines;
- (4) RailNetEurope (RNE);
- (5) Directive (EU) 2016/2370 of the European Parliament and of the Council of 14 December 2016 amending Directive 2012/34/EU as regards the opening of the market for domestic passenger transport services by rail and the governance of the railway infrastructure;
- (6) Infrabel, [www.infrabel.be/en](http://www.infrabel.be/en);

- (7) Directive (EU) 2016/797 of the European Parliament and of the Council of 11 May 2016 on the interoperability of the rail system within the European Union;
  - (8) Eurostat/ITF/UNECE, RNE;
  - (9) Collins Dictionary.
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