ASPECTS OF DEVELOPMENT OF CONTINENTAL COMBINED TRANSPORT IN THE CZECH REPUBLIC

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Abstract: This paper describes the current state of combined transport, and especially continental transport, in the Czech Republic, and aspects of its potential further development. The role of continental CT is particularly important in logistics chains, mainly in transporting palletised goods.

Keywords: combined transport, continental transport, logistics chains, development.

1. Current state of CT in the Czech Republic

Currently, only unaccompanied combined transport ("CD") is operated in the Czech Republic, mainly using ISO 1A containers due to the subsequent maritime transport. Moreover, swapbodies and intermodal road semitrailers are operated in the Czech Republic as well. However, their share in the total volume of CT is low. Statistical transport yearbooks show that the share of swapbodies and intermodal road semitrailers in CT in the Czech Republic in 2015 was 7.3% by gross tonnage transported (see Table 1 and Fig. 1).
It is the continental transport performed by other systems (not containers) that has a great potential. Since 2005, national transport of woodchips has been performed in special inland containers by integrated trains, and in 2012, sludge started to be transported in this way from North Moravia to Bohemia. In October 2005, international continental CT routes Lovosice–Duisburg were introduced, and in June 2006, Lovosice–Hamburg–Billwerder; these are mainly suitable for the transport of swapbodies and intermodal road semitrailers. Since 2010, CT transport operations with a regular transport of containers, swapbodies and intermodal road semitrailers have started to be performed on the routes Ostrava–Lovosice–Duisburg, Ostrava–Verona, Brno–Rostock as well. In 2012, transport started to be performed on another route Praha–Uhříněves–Duisburg, where ISO 1 containers are transported.

Table 1 Total volume of CT in the Czech Republic between 1995–2014 [thousand GT]

Year	**1995**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Unaccompanied total	1.224	2.971	3.127	3.651	4.250	4.690	5.338	5.937
Accompanied by rail Ro-La	2.557	3.122	2.463	2.149	2.784	837	0	0
CT TOTAL	3.781	6.093	5.590	5.800	7.034	5.527	5.338	5.937
Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Unaccompanied total	7.155	7.614	6.818	8.352	9.380	10.212	11.155	12.387
Accompanied by rail Ro-La	0	0	0	0	0	0	0	0
CT TOTAL	7.155	7.614	6.818	8.352	9.380	10.212	11.155	12.387

Source: Transport yearbooks 1995–2014, MD, adapted by authors

The ISO 1 containers are frequently used in continental CT transport, where it is necessary to change the gauge on the route. The ISO 1 containers are deployed on regular routes between ŠKODA AUTO Mladá Boleslav and Kaluga and Nizhny Novgorod (Russian Federation) – integrated trains. Moreover, ISO 1 containers are transported from the Paskov container freight station to Kazakhstan – groups of wagons. The results of these container continental transports cannot be established as carriers and CT operators consider these results for individual years as their trade secrets (ŠKODA AUTO Mladá Boleslav, Express-Interfracht, etc.). These national transport operations, not only those performed by ISO 1 containers, account for as much as 10% of CT, as estimated by the research team.
For the use of swapbodies and intermodal road semitrailers in CT to be significantly greater, there is no efficient incentive for road carriers and shippers. Even though road carriers own swapbodies (albeit often without rail transport authorisation[2]) and operate them in the Czech Republic, they only use them in the regular road freight transport. Moreover, road carriers mostly own shorter series C swapbodies, which is not ideal for CT due to higher reloading costs (one reloading of a series A swapbody corresponds to reloading of two series C swapbodies). The number of swapbodies used in the territory of the Czech Republic cannot be established; these are not freight vehicles and there is no national register and statistics. In CT, these transport units are mainly used by foreign road carriers and shippers (for instance DB Schenker, LKV Walter, DSV, DHL), even though swapbodies are very advantageous for CT (mainly for

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[2] UIC railways and UIRR operators approved a plan of attributing ILU-Codes to transport units (swapbodies, intermodal road semitrailers). The plan started to be performed in July 2011, when UIRR started giving out ILU-Codes for marking these units with code stamps. Since July 2014, only ILU codes (swapbodies, intermodal road semitrailers) and BIC (ISO 1 containers) have been accepted. It is expected that after a 8-year transition period since the introduction of ILU-Codes (July 2019), all transport units are to be equipped with the new code stamps. Presently (March 2016), 7 Czech entities are registered in the ILU register.

palletised goods). Due to their dimensions and construction, they cannot be transported on sea-going vessels – i.e. in maritime (intercontinental) transport.

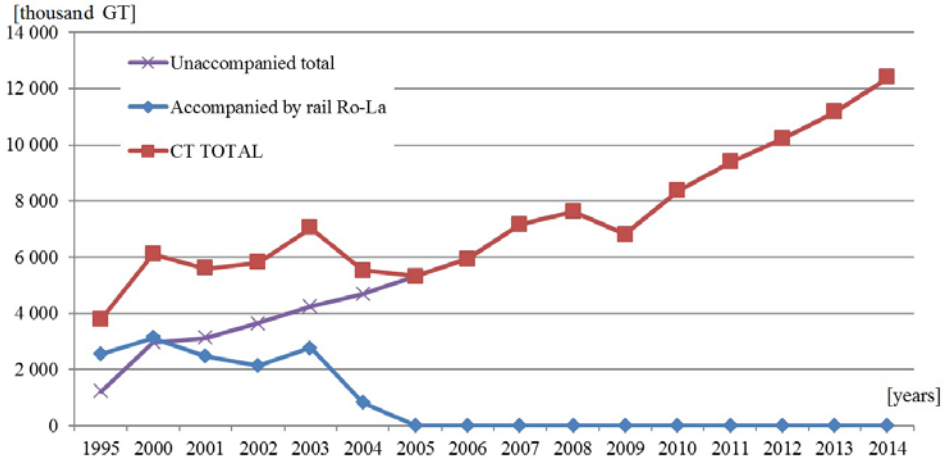

Fig. 1. Total volume of CT in the Czech Republic between 1995–2014 [thousand GT]
Source: Transport yearbooks 1995–2014, MD, adapted by authors

The development of unaccompanied CT can be assessed as very positive. Its gradual increase is closely connected with the increase of world trade and the ever increasing maritime transport of ISO 1 containers mainly from/to Asia. As a result, the transport of containers by rail from/to large European ports (mainly Hamburg, Bremerhaven, Rotterdam, Koper, to a lesser extent also Rostock, Pireus and Trieste) increases as well, these cities being the key source and target points for international CT (see Fig. 2). That is why the number of direct integrated trains on the routes from/to ports is increasing and other subsequent routes are introduced from hub container freight stations in the Czech Republic by significant CT operators.

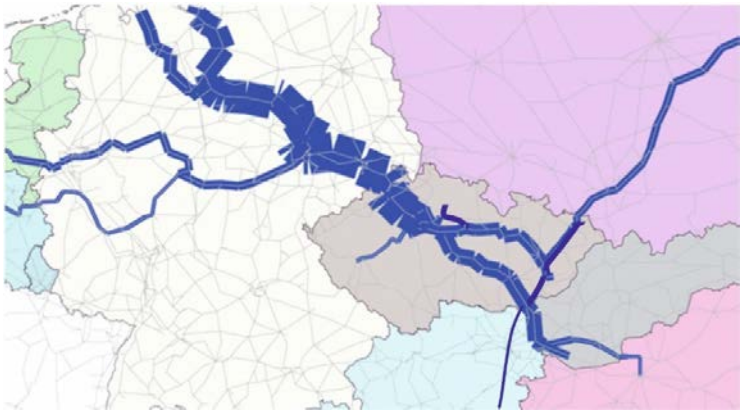

Fig. 2. Main streams of goods in CT in the Czech Republic
Source: DIOMIS project, adapted by authors

Table 2 Transport of full and empty transport units in CT by rail between 2000–2014 [thousand GT]

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Containers	2.651	2.773	3.410	4.052	4.556	5.355	6.061	7.442	8.001	7.129	8.597	9.406	9.999	11.252	12.127
Swapbodies	450	491	480	420	363	277	187	170	167	137	230	296	353	156	159
Intermodal semitrailers	0	0	0	0	0	2	24	24	25	49	102	304	493	715	802
TOTAL	**3.101**	**3.264**	**3.891**	**4.493**	**4.919**	**5.634**	**6.272**	**7.636**	**8.193**	**7.315**	**8.929**	**10.006**	**10.845**	**12.123**	**13.088**

Source: Transport yearbooks 2000–2014, MD, adapted by authors

The use of individual CT systems is described in Table 2 and Table 3, showing the number of full and empty transport units in CT by rail in thousand GT and thousand TEU. It shows that the support of transport unit purchase between 2005–2010 resulted in an increase of transport mainly of intermodal road semitrailers by rail of several dozens of percent. Therefore, there is room for the use of transport units used in continental CT, especially intermodal road semitrailers or swapbodies. That is why the aim of this project is to provide methodology to further support the development of these CT systems.

2. Aspects of further development of continental combined transport

To achieve a greater use of CT, it is necessary to at least partially compensate the price differences compared to road

transport. Before the costs for using a transport route are harmonised, a transport policy should be implemented that would at least in part eliminate these disproportions, ensuring more comparable conditions for CT. This is also in full accord not only with the White Paper on European transport policy (support of competitiveness of rail transport), but also with the results of the RECORDIT project (Real Cost Reduction of Door-to-Door Intermodal Transport) as part of the EU Fifth Framework Programme.
Yet another reason is the fact that the projects are not profitable in the initial phase as CT can only be efficient in directions where the streams of traffic are concentrated, and therefore it takes some time for a new system or CT route to gain market share. Only an integrated train with a capacity of 40 to 60 transport units usually starts to be profitable, its average utilization being at least 80% in both route directions.
It is not possible to make customers use a certain type of transport. For customers ordering shipping, several criteria may be of importance (speed of transport, shipment arriving in time, safety and reliability of transport, related services and their frequency); however, what is important is usually the price. Customers usually don't care that the safety of rail traffic is many times higher and most emissions are on a much lower level. This is related to the fact that these external costs are not internalised. In accordance with the White Paper, the average ratio of externalities in road and rail freight transport is about 4.5: 1. The internalisation of externalities is one of the most problematic issues in transport, and due to its complexity it has not been satisfactorily resolved either in the Czech Republic, or in any other EU state.
Not only the government, but also municipalities, regions, non-governmental organisations and other entities aim to support such types of transport that have the lowest negative impact on the environment. That is why the development of CT is supported, as emphasised by the EU White Paper as well. Therefore it is necessary to ensure a better integration of individual types of transport and at the same time, to provide for a significant potential transport capacity serving as connections in an efficiently managed logistics chain connecting all individual transport services.
The support of transport unit purchase depends on several other factors, dealt with by the authors separately below.

2.1. Reloading equipment for transport units in continental CT

Another significant factor is the high cost of investment necessary for implementing new CT system technologies and for construction or modernisation of infrastructure necessary for its further development. The modernisation of existing and construction of new CT container freight stations (meeting the requirements of the AGTC Agreement, Regulation of the European Parliament and Council 913/2010, 1315/2013, and 1316/2013), either independent or as part of public logistics centres, renewal or completion of rail fleet for CT, purchase of transport units and reloading equipment, and ship modification entirely depend on business plans; however, these are influenced by framework conditions.
It is to be noted that the development of continental CT systems is also related to technical and technological equipment of public CT container freight stations in the Czech Republic. Most publicly accessible container freight stations in the Czech Republic are equipped with reloading equipment including both spreaders for the reloading of ISO 1 containers, and spreaders with collets for vertical reloading of swapbodies and intermodal road semitrailers (see Table 3). Adding collets to reloading equipment is not very costly, as their price is around CZK 800,000[3] (purchase price of the Kalmar reloading equipment being around CZK 9 million). Considering the newly arranged supplier-customer relationships and the increasing number of transport operations, the price of collets as an addition to the reloading equipment is rather negligible.

Table 3 Overview of publicly accessible container freight stations with reloading equipment with collets in the Czech Republic (as of 06/ 2016)

Operator/owner	Container freight station	Number of reloading mechanisms with collets
ČD-DUSS, Terminál, a.s.	Lovosice	2
Rail Cargo Operator – CSKD s.r.o.	Mělník port	3
	Přerov	1
Terminal Brno	Brno-Horní Heršpice	2
METRANS, a.s., Praha	Česká Třebová	1
	Nýřany (near Plzeň)	1
	Praha-Uhříněves	2
	Šenov (near Ostrava)	1
	Želechovice (near Zlín)	1
	Ústí nad Labem	1
Star Container s.r.o., Mělník	Mělník port	1
AWT, a.s., Ostrava	Paskov (near Ostrava)	3

Source: Rail Authority, adapted by authors

The equipment of container freight stations for reloading of not only containers, but also swapbodies and intermodal

[3] It is very demanding to operate the additional collets – the reloading equipment is not fully synchronised to manipulate with the device, i.e. the reloading must be performed by more workers and it takes a longer time. Additional collets reduce the carrying capacity of the reloading equipment by 1–1.5 t. It also usually takes several weeks to equip the reloading equipment with these additional collets. The purchase of a new reloading equipment is much more costly and the purchase time is very long (several months), as it not only depends on the manufacturing of the equipment, but also on the delivery, mounting and putting into operation.

road semitrailers is very important. The use of the particular transport unit is related to the number of manipulations during reloading at container freight stations (see Table 4). To compare the prices of reloading, articulated vehicles and road trains are considered. For containers, the use of articulated vehicles is considered (one ISO 1 A container or two ISO 1 C containers) or road trains for two ISO 1 C containers. For swapbodies, articulated vehicles are considered (one A swapbody – very rarely transported in the Czech Republic) or road trains for two C swapbodies. During reloading at the container freight station, the road set brings the transport units to a lay-by, and then the reloading from the lay-by to railway wagons takes place (or reversely). At the container freight station, the transport unit is thus reloaded twice. For C swapbodies and 1C ISO containers, it is necessary to account for a double number of manipulations (for road sets). Therefore even the number of manipulations in these types of transport unit is an important factor as the price of reloading increases. For intermodal road semitrailers, only one manipulation is considered[4] during reloading at the CT container freight station, whereas for ISO 1 A containers[5] or A swapbodies, there are two manipulations[6]. In collection or distribution of transport units to/from the container freight station, the types of manipulations with the individual units are not recorded for statistical purposes. Therefore in determining the price of manipulation, the above mentioned numbers of manipulations are taken into account.

Table 4 Number of manipulations at CT container freight stations for selected transport units

Transport unit	Number of manipulations at container freight station	Costs of one manipulation [EUR]	Costs of reloading of transport unit for articulated vehicle / road train [EUR]
ISO 1 A container	2	23	46
ISO 1 C container	4	23	92
A swapbody	2	25	50
C swapbody	4	25	100
Intermodal road semitrailer	1	32	32

Source: authors

2.2. Length and capacity of CT train

It is also necessary to point out the influence of CT train length and capacity. Presently, CT trains being around 550–630 m long (including the length of the power unit – 20 m) have a capacity of around 71–92 TEU. However, this value depends on the number of individual railway wagon series and their combinations. Individual CT operators in the Czech Republic use different series of railway wagons (for the transport of containers, swapbodies, intermodal road semitrailers). The following Table 5 illustrates the main series of railway wagons used in CT in the Czech Republic and shows the capacities of train sets in TEU for train length of 550–750 m (taking into account the recommended length of train of 740 m in accordance with Regulation 1315/2013).

Table 5 Capacity of CT train of a length of 550–750 m in different railway wagon series [TEU]

Railway wagon			Length of train [m]					
series	length [m]	capacity [TEU]	550	600	650	700	740	750
Sggrss	26.4	4	80	88	96	104	112	112
Sgnss	19.7	3	81	90	96	105	111	114
Sggmrss	29.6	4	72	80	84	92	100	100
Sggnss 80´	25.9	4	84	92	100	108	112	112
Sdggmrs	34.2	4.8*	76	81	91	96	100	100
Sdggmrss TWIN	34.2	4.8*	76	81	91	96	100	100

* *Note: the capacity of 4.8 TEU corresponds to transportation of 2 intermodal road semitrailers on 1 railway wagon.*
Source: authors

The length of train stated above includes the length of the power unit of 20 m. The individual combinations are not mentioned here as they are different for different CT operators. It is obvious from the overview that using a train with a length of up to 750 m (in accordance with AGTC Agreement recommendations), or 740 m (in accordance with Regulation 1315/2013), the capacity of the train set increases by approximately 30 TEU, which is very positive in

[4] During reloading of intermodal road semitrailers at the container freight station, the semitrailer is put on the lay-by upon arrival of the articulated vehicle at the container freight station. The actual reloading of the intermodal road semitrailer on a railway wagon (and reversely) is performed using reloading equipment, being considered by the container freight station operator as one manipulation.
[5] As it is possible to store ISO 1 A containers (or ISO 1 C containers), they are sometimes manipulated with at the container freight station. These technological manipulations are not counted as manipulations.
[6] During reloading of ISO 1 A containers or A swapbodies at the container freight station, the transport unit is put on the lay-by by the reloading mechanism upon arrival of the articulated vehicle at the container freight station. The actual reloading of the transport unit to a railway wagon is performed by the reloading mechanism and is counted as another manipulation (i.e. there are two manipulations).

economic terms. However, it is necessary to take into account that using a 750 m long train is very advantageous from the economic perspective, but very problematic from the operational point of view as in the Czech railway network, there are very few intermediate railway stations, at which overtaking or crossing of trains of such length would be possible on running tracks. That is why trains of such length cannot be counted on as of yet. The researchers suggest to use trains with a length of 650–700 m.

2.3. Support of CT abroad

In the EU, the support of combined transport is established by the Combined Transport Directive (Council Directive 92/106/EEC). The Directive aims to support certain types of combined transport eliminating authorisation procedures and quantitative restrictions for certain types of combined transport, clarifies the non-application of restrictions on road cabotage in road transport, and provides financial support for certain types of CT by means of tax incentives. In accordance with the provisions of the Combined Transport Directive, the combined transport of goods is to meet several specific criteria, mainly as to the type of transport units and distances.
The Combined Transport Directive is complemented by several other EU provisions, such as the directive regulating the weights and dimensions (Directive (EU) 2015/719 amending Council Directive 96/53/EC) laying down for member states to allow the movement of heavy duty intermodal transport units on the road, where they are used in CT. Moreover, the EU provides financial support to projects related to combined transport.
In line with the general EU transport policy, the aim of the provisions is to reduce the share of road freight transport and to support more environmentally friendly modes of transport with better energy efficiency. CT is supported in four main areas:

1. Internalisation of external costs in all modes of transport to provide adequate price signals to users, operators and investors. Social and environmental costs of transport should be paid taking into account its polluters.
2. Greater share of targeted investments in infrastructure to allow for better links between individual modes of transport.
3. Better use of information (on transport, capacity, availability of infrastructure, cargo and vehicle position).
4. Direct support of intermodal transport, as laid down in the Combined Transport Directive (Council Directive 92/106/EEC) aiming at increasing the competitiveness of combined transport.

What plays a crucial role in the development of CT in individual EU member states are the legislative regulations of this support, i.e. either laws or regulations. Before these provisions are issued, they are usually discussed with EU institutions. Even though the form and content of the individual ways of support are different, there is one common aim: to harmonise costs between direct road transport and CT.
In 2011, the European Commission presented a new plan of the European core multimodal network (it is to present instructions, schedules /road maps/ and financing plan of the TEN-T Trans-European network). EU financial means from TEN-T funds, cohesion fund and structural funds are to be used conceptually, and therefore they will be provided within a single framework.
In January 2015, the final report of project FV355/2012/MOVE/D1/ETU/SI2.659386 (Analysis of the EU Combined Transport[7]) was presented in Frankfurt am Main. Besides the actual analysis of CT systems in individual EU member states, the report also covered the support of CT in individual states. The support of CT was treated from two perspectives. The first one was the history of support in different countries or different projects and its impacts on the development of CT. The second one were recommendations for further support of CT development in the EU. The support should be provided in the following areas:

- subventions for the construction and modernisation of CT terminal infrastructure;
- subventions for the purchase and modernisation of CT reloading equipment;
- subventions for the construction of CT terminal allowing for non-discriminatory access of the operator to individual terminal users;
- creation of the Single European Transport Area as the core network of strategic infrastructure;
- moreover road vehicle parameters in different member states should be harmonised so that it is possible to use the option of a greater weight of shipments in international transport than in national transport (increase from 40 t to 44 t). Borderland areas will have better access to terminals abroad;
- long stays caused by transition to a different railway network will be eliminated using interoperable power units;
- harmonization of costs of access to transport infrastructure in the whole of Europe.

2.4. Logistics use of transport units in CT

In terms of transport of palletised goods (goods on Euro-pallets of 800 mm x 1200 mm) in continental CT, it is the A and C swapbodies or intermodal road semitrailers that are most advantageous for these, due to the inner space of the transport units (see Table 6). In both these transport units, it is possible to load up to 33 Euro-pallets (in one layer). It is

[7] Project FV355/2012/MOVE/D1/ETU/SI2.659386 called Analysis of the EU Combined Transport was carried out by KombiConsult GmbH (Frankfurt am Main), Intermodality Ltd (Lewes), PLANCO Consulting GmbH (Essen) and Gruppo CLAS S.p.A. (Milan). The complete final report is available at: http://ec.europa.eu/transport/themes/strategies/studies/doc/2015-01-freight-logistics-lot2-combined-transport.pdf

by 37.5% more compared to the ISO 1 A container, even though in transporting these units by rail, an equivalent number of railway wagons is necessary. That is why for customers requiring the transport of palletised goods, these transport units suitable for continental CT are more advantageous than the use of regular maritime containers. Comparing these transport units, we can see that goods transported in three ISO 1 A containers[8] can be transported in only two A swapbodies or two intermodal road semitrailers. This results in a significant reduction of the number of transport units transported, and also the number of railway wagons used.

Table 8 Comparison of selected technical specifications in transport units

Transport unit	ISO 1 A container	Inland 45' PW container	C swapbody	A swapbody	Intermodal road semitrailer
length [mm]	12.192	13.716	7.820	13.600	13.600
width [mm]	2.438	2.500	2.550	2.500	2.500
height [mm]	2.896	2.896	2.700	3.000	3.005
number of Euro-pallets [pieces]	24	33	17	33	33
internal volume [m^3]	68	84	42	90	100
Empty weight [kg]	4.200	5.870	2.400	4.900	6.500–7.500
Maximum net weight [kg]	28.100	28.130	13.600	29.100	26.500–27.500
Maximum gross weight [kg]	30.500	34.000	16.000	34.000	34.000
Purchase price [CZK]	42.000	220.000	350.000	450.000	800.000

Source: CARU, Kögel, authors

At depots and logistics centres, terminal tractors are often used for the manipulation of swapbodies from lay-bys to loading platforms. These terminal tractors have to be purchased (the price of these tractors is around CZK 2 million). However, these tractors are not used in all depots or logistics centres. That is why the whole road train (lorry + trailer) is driven to the loading platform. However, this offsets the significant advantage of swapbodies (saving the driver's waiting time during unloading or loading).
On the other hand, when using the intermodal road semitrailers, the tractor drives the semitrailer to the loading platform and leaves it there. As in swapbodies, it then drives to the lay-by (or to another platform) and loads another intermodal road semitrailer. That is why there is no waste of time for the driver (tractor) during the loading or unloading. This is one of the significant advantages compared to ISO 1 containers that are mounted on the road semitrailers and can't be manipulated with during loading or unloading.
What also plays a crucial role is the purchase price of individual transport units suitable for continental CT. Table 6 describes basic technical specifications together with price for these transport units. For comparison, ISO 1A container parameters are mentioned here as well. In terms of price and inner volume, it is best to use A swapbodies. However, the companies using swapbodies asked mostly use C swapbodies (C745 or C782).

3. Conclusion

This paper describes the current state of combined transport, and especially continental transport, in the Czech Republic and aspects of its potential further development. The role of continental CT is particularly important in logistics chains, mainly in transporting palletised goods. This is also the main output of this paper. Within the Operational Programme of the Ministry of Transport, support will be granted for the construction of CT infrastructure (mainly CT terminals) and also for the purchase of new transport units for continental CT. There are many other factors that can influence the use of CT in the Czech Republic; however, these are beyond the scope of this paper.

Acknowledgements

This paper has been supported as part of the TAČR TB0500MD004 “Proposed system of support of continental combined transport – transport units” project and SG540001/20/51030 ”Student grant competition“ project.

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