Aerodynamic and Flexible Trucks for Next Generation of Long Distance Road Transport

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Summary

As one of the main objectives of the AEROFLEX project is to develop a road map to realize an efficiency increase in logistics of up to 33%, subtask 1.2 of working package 1 examined whether savings potentials were to be expected if high capacity vehicles according to the European Modular System (EMS) as currently permitted would be useable in European logistics, i.e. can new vehicle concepts contribute to yielding transport cost and CO_2 emission savings? Technical basis for this approach were the so called Prime Candidates coming from the FALCON project (CEDR - Conference of European Directors of Road, 2018). These vehicle concepts are composed of standard towing vehicles and loading units as they are in use today. In accordance to the European Modular System (EMS) these components are combined to form new vehicle combinations with up to 4 loading units. For each Prime Candidate a new Gross Combination Weight (GCW) is proposed which exceeds the limitations set in the relevant directives (European Union, 1996, 2015) while complying to the maximum permissible axle weights. This was done to optimize the opportunity to consolidate load on the one hand and restricting road wear and tear and strain on bridges to the current level on the other hand. The Prime Candidates were analysed with regard to the KPIs €/tkm, €/tour and CO_2e [kg] emissions Tank-to-Wheel (TTW) and Well-to-Wheel (WTW). The analyses were based on primary data that were collected during an online stakeholder survey and by in-depth expert interviews amongst logistics service providers (LSP) and shippers.

The approach to use EMS vehicles to improve efficiency is based on load consolidation as crucial factor to realize the expected benefits. This can be done either within logistics companies, if the according transport volume is big enough. There are certainly several big market leaders complying with this requirement. On the other hand there is significant number of carriers, LSP and shippers that would lack an according transport volume. For those companies the concept of horizontal collaboration would provide an opportunity for load consolidation and thus benefit from optimized logistics operations. The answers to the online survey's question, if participants would rate horizontal collaboration either as risk or as opportunity showed slight tendency towards collaboration providing an opportunity (Median 4 on a scale from 1-6). This also shows, that there is also a need to communicate the benefits of horizontal collaboration and to explain possible ways to implement such a business model in compliance with the already existing EC directive (European Union, 2011). The finding that high capacity vehicles are a promising concept on the way to optimizing logistics operations is supported by the fact that 62% of the survey's participants stated that they already engaged with high capacity vehicles. 46% expect to benefit from the use of longer vehicles and 39% expect to benefit from heavier vehicles as currently permitted by law.

In order to quantify possible savings for the above mentioned KPIs, use cases were analysed that were collected during expert interviews. The calculations were based on real world tours that were specified by logistics companies, including descriptions of currently used vehicles. This information

was combined with characteristics of Prime Candidates the experts selected to be potentially useful in the according use cases and fuel consumption simulations as well as total cost of ownership (TCO) and transport cost calculations. The results suggest best case scenario potential savings in transport cost (€/tkm and cost/tour) of 23% on average. CO_2 emissions savings resulted at 13% (range -7% to +42%) respectively 16% (range -7% to +71%) on average on TTW and WTW level. This rather large range of values reflects the variability of logistics applications and is probably influenced by the compilation of the sample. As expert interviews are planned to be continued, the scope of examined transports will expand and therefore the additional data are supposed to sharpen the results in respect to what efficiency effects can be expected by the use of EMS vehicles.

Biggest influence on these results for all reported KPIs was exerted by the consolidation factor, the quotient of maximum load of a Prime Candidate and the standard average load of the according reference vehicle that was specified in a use case, i.e. potential for load consolidation. The ratio between weight and volume utilization of a transport, i.e. the classification as tonnage or volume transport, on the other hand did not show any impact on the results. Of course fuel consumption has also major influence on savings potentials. However, the factors fuel consumption depends on are highly variable and specific to a certain route. These are mainly the actual GCW, the vehicle layout and the route profile, e.g. number of stops and route topography.

Though the analyses were conducted on vehicle level per use case, it can be concluded that savings potentials would probably increase on fleet level. This is due to the fact that the three main cost categories of the TCO – fuel consumption, labour cost, invest – would rather benefit from the use of EMS vehicles. Three assumptions form the foundation for this derivation. First, load increase is expected to outgrow fuel consumption increase. Additionally, the introduction of EMS would result in a reduction of the rolling fleet, due to load consolidation, therefore, fewer drivers would be necessary to operate the vehicles. As a consequence of the fleet reduction less towing vehicles for the same number of loading units would mean a decrease in cost.

Additionally to the quantification of potential savings EMS provide, emphasise was put on the requirements and constraints these vehicle concepts are supposed to meet. Therefore, the expert interviews also addressed this subject. These questions yielded a wealth of information about requirements, expectations and concerns of the participants.

Investment costs are not expected to increase significantly as standard components are used to compose EMS concepts. Transport costs are in turn expected to decrease by about 20-30%, which matched the results of the quantitative analyses quite well. Loading and unloading time is seen as crucial factor as well is road accessibility and compatibility with infrastructure. Especially manoeuvre and parking areas are mentioned. Intermodality is considered useful for cases that actually serve intermodal transport. But it is not required as general equipment feature. An important finding was that sustainability and CO_2 emission reduction is not yet prioritized comprehensively. This is certainly

a task to be tackled by authorities, NGO etc. It was stated by a majority of participants that the increase in GCW and volume between current vehicle concepts and EMS concepts need a certain extend to provide savings potentials, which also matches the results of the analyses concern the consolidation factor. The stated requirements however were very versatile.

Another task that was addressed by the expert interviews was to select those Prime Candidates which provide most potential for future cost and CO_2 emissions savings. The experts were asked to select a maximum of three vehicle concepts per market sector (FTL, consolidated cargo/LTL, bulk/silo, CEP, special haulage and heavy haulage) and route type (FTL main run, FTL pre- and onward carriage, LTL, source consolidation and milk run) combination. 24 of the available 27 Prime Candidate received at least one vote. This reflects the versatility of the transport business and the need for customized application specific vehicle concepts. Though there were six Prime Candidates that received 55% of all votes (plus additional 11% for candidate 1.3 which is actually a standard 5-axle semi-trailer combination), there are still 17 vehicle concepts considered as useful as, or even more useful than those focus concepts for some applications. This suggests a necessity for flexible, adjustable and smart vehicle concepts.

Based on the explanations above, the main recommendation from this subtask is to further investigate a possible revokement of the current GCW and measurement limitations for heavy commercial vehicles (European Union, 1996, 2015) to enable the use of EMS vehicles and load consolidation and foster their savings potentials. This includes also the regulation to carry at least 25% of the GCW on driven axles (European Union, 1996). Therefore further in-depth analysis on fleet level are necessary. Allowing field tests in actual transportation businesses on public roads would provide real world data to prove or disprove the results of the simulations mentioned above. These analysis should not only cover the long haul sector as it is stated in the project description of the AEROFLEX project but take into account the entire transport market without limitations, e.g. in trip distances, commodity groups etc. As LSP are free to use vehicles as they suite their business needs, all possible applications should be regarded to facilitate a proper and comprehensive assessment of the impact EMS will have on the European logistics business. The further developments within the other work packages of the AEROFLEX project that impact transport efficiency (smart loading units, advanced energy management power train, optimized aerodynamics and safety improved front end design) should be taken into account, as they are supposed to provide additional savings potential.

In addition to the above explained objectives and proceedings of subtask 1.2, a further in-depth analysis of newly available data were realized to describe the current logistics market complementing the findings, already reported in deliverable 1.1. Also, first data sources providing future projections of the road freight market have been reviewed and the results are also reported in this document

(subtask 1.3). All listed actions were aimed at mapping and quantifying load in road freight transport today and in the future, a first assessment of savings potential, Prime Candidates provide and subsequently at recommendations for the architecture of future towing vehicles. An overview of the structure and how the undertakings have been tackled can be seen in Figure **Error! No text of specified style in document.**-1.

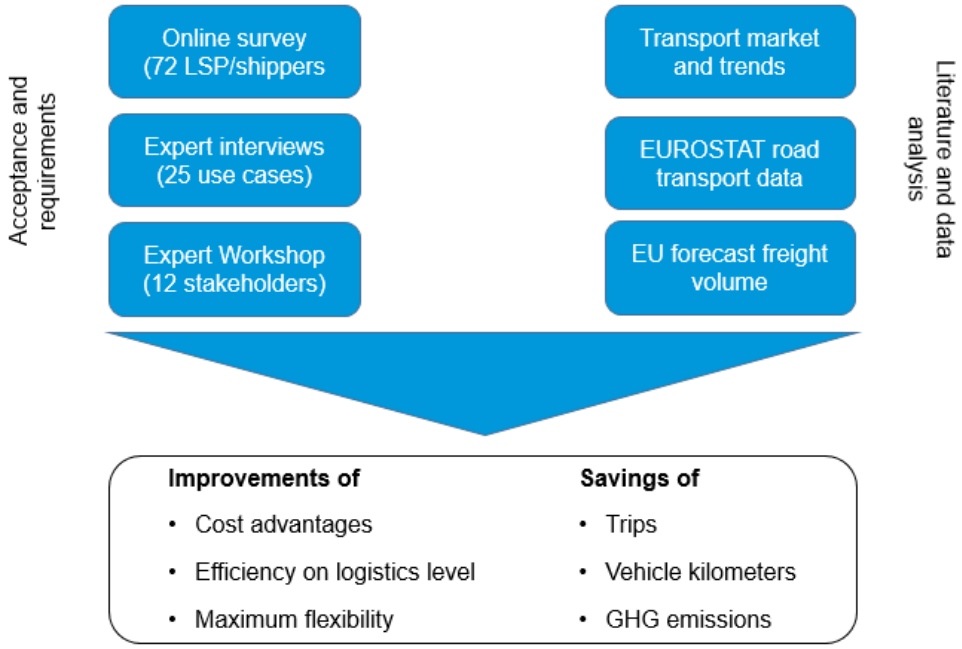

Figure Error! No text of specified style in document.**-1 Overview and structure of the analysis and proceedings used for this document in work package 1**

Amendment to D1.1 - Results from the Eurostat data analysis

The analysis of the Eurostat micro data shows the following results:

- FTL transports are of high importance within the analysed part of the European freight transport.
- The selected commodities groups with high volumes and transport distances above 150 km (see deliverable D1.1) are primarily transported on pallets. Container transports may have a high relevance for intermodal transport chains or hinterland transports.
- The share of fully loaded transports for journeys between 150 and 299 km is about 42 %. The share increases with the transport distances up to 45 %.

The monitoring of European road freight transport micro data of the year 2014 (EUROSTAT, 2011) shows the three categories (i) vehicle-kilometres, (ii) tonnes, and (iii) tonnes-kilometres by a journey based evaluation including all journeys of EU 29 road freight transport. The journey based evaluation was chosen related to the existing data base because a vehicle based evaluation was not available to describe the European long haul road freight transport. It is shown that on one side more than 75% of tonne kilometres are in the group above 150 km transport distances and on the other side 80% of the transport volume is in the transport distance class below 150 km (Figure **Error! No text of specified style in document.**-2 and Figure **Error! No text of specified style in document.**-3). The amount of vehicle kilometres (about 73%) explains the relation between these figures in the distance classes. It can be considered that high capacity vehicles should address not only higher road transport distances but also the high transport volume in shorter distances.

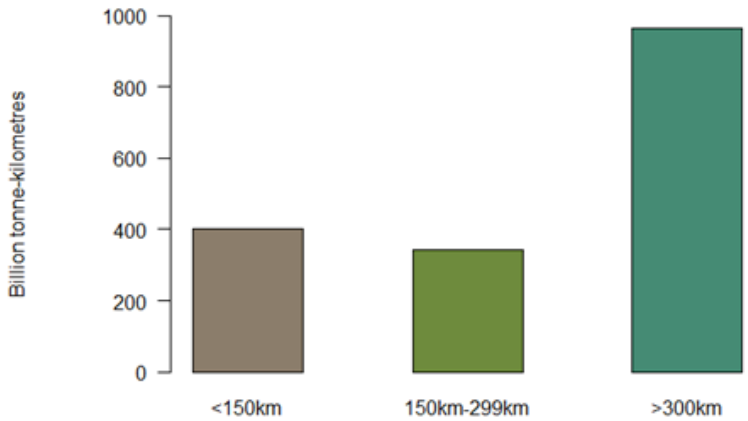

Figure Error! No text of specified style in document.**-2 Tonne-kilometres of European road freight transport related to distance classes (EUROSTAT micro data)**

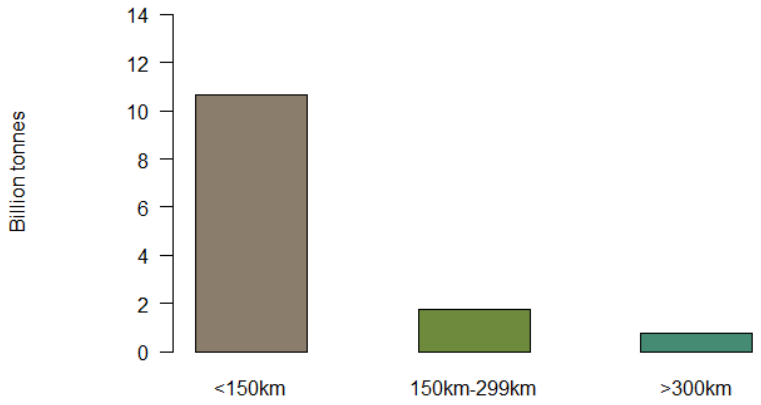

Figure Error! No text of specified style in document.**-3 Transport volume of European road freight transport related to distance classes (EUROSTAT micro data)**

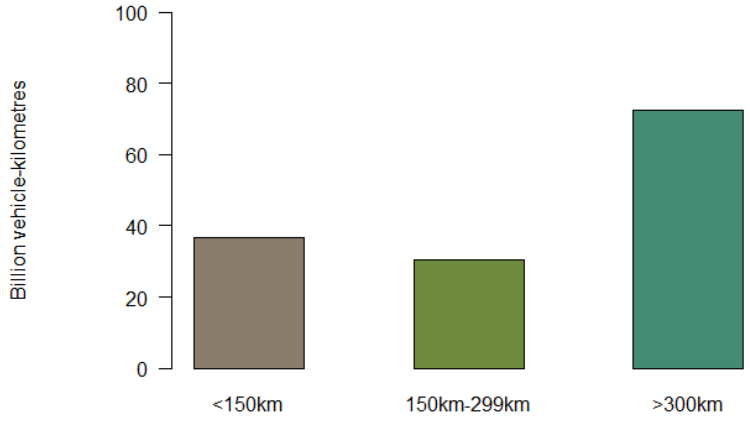

Figure Error! No text of specified style in document.**-4 Annual Mileage (vehicle-kilometres) of European road freight transport related to distance classes (EUROSTAT micro data)**

Preview of deliverable 1.3 - Results from the projections

Projections with regard to average trip distance from four Western European countries indicate that this parameter will increase slightly, with tonne kilometres growth outpacing tonnage growth.

Commodities with the strongest expected growth are grouped and miscellaneous goods, representing e.g. containers and groupage activities, which fits well within the projections of e.g. the ALICE project (more consolidation and horizontal collaboration). Metals and metal products are also projected to see increased transport volumes. Lower or negative growth is to be expected from commodity groups' coal and lignite, and petroleum products.

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Project partners:

#	Partner	Partner Full Name
1	MAN	MAN TRUCK & BUS AG
2	DAF	DAF Trucks NV
3	IVECO	IVECO S.p.A
4	SCANIA	SCANIA CV AB
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