Examination of Likely Consequences of Adapting Weights and Dimensions of Heavy Commercial Vehicles in Europe

Matthieu Bereni

Ministry for Ecology and Sustainable Development and Spatial Planning
Sétra - Technical Department for Transport, Roads and Bridges Engineering
« Everything should be made as simple as possible, but not one bit simpler », Albert Einstein

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>HEIGHT</th>
<th>WIDTH (m)</th>
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<table>
<thead>
<tr>
<th>Country</th>
<th>Weight per bearing axle (tonnes)</th>
<th>Weight per drive axle (tonnes)</th>
<th>Lorry (6 axles) (tonnes)</th>
<th>Articulated Vehicle (5 axles) (tonnes)</th>
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<td>40 40</td>
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<td>11.5</td>
<td>18</td>
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</tr>
</tbody>
</table>

1. For vehicles registered in an EEA member country.
2. Increased values are applicable for certain types of transport (i.e., containers, motorcars, etc.).
3. Refrigerated vehicles = 2.50 m
4. Increased values are applicable for certain types of transport (i.e., containers, motorcars, etc.).
5. Weight per drive axle: national traffic = 10; international traffic = 11.5; Lorry 3 axles: national traffic = 20; international traffic = 20.
6. About 25% of existing roads were constructed based on the axle weight 10; other roads on the weight 8. There is a recommendation of the Ministry of Transport to use all new federal road projects on the maximum axle weight of at least 11.5.
7. National: 300; international: 400, and 440 for 8 axles and +.
8. The conditions laid down in Regulation for type approval.
9. For vehicles engaged in combined transport.
10. 5 axles = 48; 6 axles = 56; 7 axles = 60;
Outline

INTRODUCTION

1 – Context and methodology

2 – The Likely Consequences of Adapting directive 96/53/EC

3 – New technologies for a sustainable transportation of freight by road

CONCLUSIONS
INTRODUCTION

Origins :
- Congested European road network, inconsistent with a continuing increase of freight flows.
- Exceptions allowed by the current directive (several countries have set a maximum GVW that is higher than the one indicated in the directive).
- Update of directive required to meet current market needs.

Objective :
- COM(2006) 336 final – Communication on freight logistics, European Commission: “the rules on the dimensions of vehicles and loading units should match the needs of advanced logistics and sustainable mobility”. 
1 – *Context and methodology* (1/4)

1.a. Protagonists

- Study performed for the European Commission (Directorate-General for Energy and Transport)
- By a consortium composed of 5 members
  - TML (Transport & Mobility Leuven) → consortium leader;
  - TNO (Institute for Applied Scientific Research of the Netherlands);
  - Sétra (Service d'études sur les Transports, les Routes et leurs aménagements);
  - LCPC (Laboratoire Central des Ponts et Chaussées);
  - RWTH Aachen University (Rheinische-Westfälische Technische Hochschule).
- With help/recommendations/expertise from various stakeholders in Europe

1.b. Chronology

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/06/07</td>
<td>Invitation to tender</td>
</tr>
<tr>
<td>10/08/07</td>
<td>Deadline to deliver tenders</td>
</tr>
<tr>
<td>Sept. 07</td>
<td>Choice of the contractor by the EC</td>
</tr>
<tr>
<td>04/03/08</td>
<td>Kick-off meeting in Brussels to present the study to the European stakeholders</td>
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<tr>
<td>10/07/08</td>
<td>Submission of the draft report to the Com. &amp; presentation of results to the stakeholders</td>
</tr>
<tr>
<td>27/07/08</td>
<td>Submission of the final report to the Com.</td>
</tr>
<tr>
<td>Jan. 09</td>
<td>Publishing of the report on the EC website</td>
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</table>

INTRODUCTION

1 – Context and methodology

2 – Likely consequences of adapting directive 96/53/EC

3 – New technologies for a sustainable freight transport

CONCLUSIONS

1 – Context and methodology (2/4)

1.c. Directive 96/53/EC

- **Title**: COUNCIL DIRECTIVE 96/53/EC of 25 July 1996 laying down for certain road vehicles circulating within the Community the maximum authorized dimensions in national and international traffic and the maximum authorized weights in international traffic.

- **Objective**: to harmonise across the EU the maximum dimensions of road vehicles and to set agreed levels for weights that would permit free circulation throughout Europe, in order to avoid distortion of competition between the transport companies registered in the various EU states.

- **Article 4**: « Member States may allow vehicles or vehicle combinations used for transport which carry out certain national transport operations that do not significantly affect international competition in the transport sector* to circulate in their territory with dimensions deviating from those laid down in Annex I […] ».  
  * eg: operations linked to logging and the forestry industry, modular concept

1 – Context and methodology (3/4)

1.d. Using longer and/or heavier vehicles (LHVs)

• The European Modular System or European Modular Concept (aka Gigaliners, Ecocombis, Monster trucks…) :
1 – Context and methodology (4/4)

1.e. Inputs

- Literature review
- Expert consultation (4 workshops in Europe)
- Online questionnaire (136 exhaustive answers).

1.f. Scenarios

| Scénario 2 | « LHV full option » : 25,25 m long and 60 t heavy LHVs * allowed on the main European roads. Access restriction to be decided locally. EMS combinations but not only. |
| Scénario 3 | « Corridor/collation » : some countries allow LHVs on their motorways, possibly putting some restrictions for the usage of regional roads, while the rest stick to the current restrictions (40t 18.75m). In the coalition are included 6 European countries: NL, BE, DE, SE, FI, DK. |
| Scénario 4 | « Intermediate: Europe-wide permission of up to 20.75 m 44 t trucks » : gradual increase in vehicle constraints, namely 10% of carrying capacity. The choice of dimensions and constraints is “realistic” and reflects wishes of car transporters and chemical industry. |

* LHV : longer and/or heavier vehicles
2 – The likely consequences of adapting directive 96/53/EC (1/9)

2.a. Meeting the demand and assessing modal shifts (1/3)

• Approaches:
  – Results expressed in terms of relative changes with respect to a reference scenario 2020
  – 2 approaches performed in parallel for a better understanding of the foreseeable evolutions
  – Results from the modelling approach used as an input for the rest of the calculations due to their exhaustiveness.

• Trans-Tools modelling:
  – Traffic forecasts for 2020 and modal balances
  – Calculation of transported volumes to form an O/D matrix for each mode (from/to 300 regions in Europe)
  – Results: transport flows of freight in tonnes in 2020, for each mode and each country.
2 – The likely consequences of adapting directive 96/53/EC (2/9)

2.a. Meeting the demand and assessing modal shifts (2/3)

• Analytical approach based on transport economics:
  – Examination of coupling/decoupling operations for the various vehicle combinations.
  – Calculation of « intramodal » market shares, i.e. the distribution of freight operations between traditional trucks and LHV's. 3 effects to be taken into account (a. company size effect  b. logistic organisation effect and c. infrastructure effect').
  – Impact of introducing LHV's on road transport price.
  – Calculation of intermodal reports, using a set of direct price elasticities and cross elasticities and a set of demand functions.

• Demand functions:

<table>
<thead>
<tr>
<th>Isoelastic demand functions</th>
<th>Linear demand functions</th>
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<tbody>
<tr>
<td>[ q_R = q_R^\circ \left( \frac{p_R}{p_R^\circ} \right)^{\epsilon_{R/F}} \left( \frac{p_F}{p_F^\circ} \right)^{\epsilon_{F/R}} ]</td>
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<td>[ q_F = q_F^\circ \left( \frac{p_R}{p_R^\circ} \right)^{\epsilon_{F/R}} \left( \frac{p_F}{p_F^\circ} \right)^{\epsilon_{F/R}} ]</td>
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<td>[ q_W = q_W^\circ \left( \frac{p_R}{p_R^\circ} \right)^{\epsilon_{W/R}} \left( \frac{p_W}{p_W^\circ} \right)^{\epsilon_{W/R}} ]</td>
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</table>

Competitiveness between road transport & railway transport    Competitiveness between road transport & inland waterways transport

\( \epsilon_{x/y} \) are elasticities of y with respect to x.

Refers to the reference situation

\( R \) refers to road transport

\( F \) refers to rail transport

\( W \) refers to inland waterways transport

\( \circ \) refers to the reference situation
2 – The likely consequences of adapting directive 96/53/EC (3/9)

2.a. Meeting the demand and assessing modal shifts (3/3)

- Results from the analytical approach: modal shifts (evolution tkm / reference scenario 2020):
2 – The likely consequences of adapting directive 96/53/EC (4/9)

2.b. Road safety

- 3 stages:
  - identifying all relevant variables which are affected by the introduction of LHV across Europe
  - correlating the various detected variables with the different types of LHV and thus drawing a matrix of effects (vehicle/impact)
  - gathering the results of step one and two to a macro level in order to establish a road safety comparison of each scenario.

- 3 components:
  - human
  - vehicle
  - environnement

- Vehicle/impact matrix:

<table>
<thead>
<tr>
<th>Concepts</th>
<th>Gross vehicle weight</th>
<th>Maneuvre behaviour</th>
<th>Scenario</th>
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<tr>
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<tr>
<td>6</td>
<td></td>
<td>further research is needed to assess the driving dynamics and the manoeuvrability of this future option</td>
<td>2 &amp; 3</td>
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</table>

**Combination 5**: extrapolation of available data for a 17,80 m long, 40 t heavy vehicle
2 – The likely consequences of adapting directive 96/53/EC (5/9)

2.c. Emissions and energy efficiency

• Assessing the impact:
  – Impact of each vehicle’s energy efficiency on road transport costs (energy consumed per ton.km).
  – Impact of CO₂ emissions on climate change (equivalence: 1 litre of fuel = 2.67 kg de CO₂).

• Méthodology:
  – Use of COPERT IV software (Computer program to calculate emissions from road traffic).
  – to assess the emissions per:
    • type of vehicle;
    • type of engine;
    • type of road network (urban / interurban / motorways);
    • time (peak time/rest of the day);
    • loading level;
    • average speed;
  – 14 shapes of heavy vehicles (cf. shapes from TREMOVE model);
  – Calculation of the following emissions: CO₂, NOx, PM

Main result: ↑ emissions per vehicle but overall ↓ mileage (in veh.km) thus ↓ of total emissions
2 – The likely consequences of adapting directive 96/53/EC (6/9)

2.d. Infrastructures (1/2)

• Pavements:
  – Calculation of the aggressiveness of the vehicle axles on the road
  – Use of the Alizé software to model the road and to determine the stresses produced by the traffic on each layer of the road (Burmister’s theoretical model, i.e. overlapping layers with constant thickness, supposed to have an elastic, linear and isotropic behaviour).

\[
A_i = \left( \frac{s_i}{s_{\text{ref}}} \right) ^{\alpha}
\]

- \( A_i \): aggressiveness of an axle “i”
- \( s_i \): stress on the base of the layer, under the axle "i" considered, due to all the simulated axles;
- \( s_{\text{ref}} \): stress on the base of the layer due to the reference axle;
- \( \alpha \): Coefficient of fatigue depending on the material of the layer

• Bridges:

Vehicle A – 72 tonnes semi-trailer: 14.40 m wheelbase

\[ M_A = 129 \text{ t.m} \]

Vehicle B – 72 tonnes crane: 9.6 m wheelbase

\[ M_B = 165 \text{ t.m (aggressiveness: +28\%)} \]
2 – The likely consequences of adapting directive 96/53/EC (7/9)

2.d. Infrastructures (2/2)

- **Bridges:**
  - Review of existing studies and modelling of various vehicle combinations
  - Assessing:
    - the ability of bridges to support the passage of a maximum intensity traffic (extreme load).
    - the ability to withstand the repeated passage of traffic (fatigue).
  - Increase in costs of monitoring, maintenance and strengthening.

- **Synthesis →**
2 – The likely consequences of adapting directive 96/53/EC (8/9)

2.e. Cost-benefit analysis (1/2)

• Results:
  – CBA for EU27 and year 2020
  – Scenario 1 = reference for evaluation
  – Positive figures indicate a benefit to society, negative figures a cost

<table>
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<th>Millions €</th>
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<th>Scen. 3 vs. 1</th>
<th>Scen. 4 vs. 1</th>
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<td>Total road expenditures</td>
<td>23 991</td>
<td>5 117</td>
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<td>Total rail expenditures</td>
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<td>Total incl. waterw. expend.</td>
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<td>Noxious emissions: PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low cost</td>
<td>64</td>
<td>22</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Medium cost</td>
<td>186</td>
<td>63</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>CBA total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOW value</td>
<td>24 397</td>
<td>5 737</td>
<td>1 587</td>
<td></td>
</tr>
<tr>
<td>HIGH value</td>
<td>29 228</td>
<td>6 687</td>
<td>8 265</td>
<td></td>
</tr>
</tbody>
</table>
2 – The likely consequences of adapting directive 96/53/EC (8/9)

2.e. Cost-benefit analysis (1/2)

• Results: allowing LHV’s would make freight transport by road
  – cheaper
  – slightly better for environment
  – better for safety
  – worse for infrastructure

In conclusion: generally better for society under certain conditions
2 – The likely consequences of adapting directive 96/53/EC (9/9)

2.e. Cost-benefit analysis (2/2)

• More ton.km but less veh.km travelled thanks to a higher payload if LHV’s were to be introduced.

• Benefits to be expected with regard to:
  – transport costs
  – road safety
  – energy efficiency
  – pollutant emissions

• Costs in terms of:
  – infrastructure strengthening
  – infrastructure maintenance.

Conclusion: the cost-benefit analysis shows that, under certain conditions, adapting directive 96/53/EC, would offer an overall benefit to society.
3 – New technologies for a sustainable transportation of freight by road (1/3)

3.a. Monitoring and optimal use of vehicles thanks to new technologies

• Objectives:
  – limiting modal shifts of freight from rail and inland waterways to road
  – keeping the highest safety level for LHVs and all road users
  – internalising externalities for every road user, especially for the highest vehicles, since they cause
    the highest damages to infrastructure.

• Food for thought regarding a larger use of LHVs:
  – allowing an increase of the GVW, step by step
  – allowing 25,25 m long vehicles, consistent with the European modular system (EMS)
  – assessing the advantages and drawbacks of using these vehicles at the end of a trial period
  – devising the appropriate counter-measures, relying on new technologies as much as necessary.
3 – New technologies for a sustainable transportation of freight by road (2/3)

3.b. Limiting modal shifts of freight from rail and inland waterways to road

• Toll system to allow the payment of a fair price by the different road users (under the control of an independent governmental agency, dedicated to the collecting and redistributing of the road charge)
• Using tested and reliable technologies to identify and monitor heavy vehicles on the road network where they are allowed
• Within the frame of a controlled use of these vehicles (see weigh-in-motion to control overloads and monitor traffic).

3.c. Keeping the highest safety level for LHV s and all road users

• Overtaking bans to be enforced on relevant sections
• Control of interdistances (safety distances)
• Specific signs for LHV s
• On-board technologies to monitor the performance of heavy vehicles
3. New technologies for a sustainable transportation of freight by road (3/3)

3.d. Protecting the infrastructure

- Anti-rollover systems as part of global vehicle-infrastructure interaction.
- Choice of the sections on which LHVs would be allowed, with different access levels if needed, and monitoring of vehicle route compliance.
- Minimum safety distances, in particular on long span bridges (50m and more long spans).
- Enforced overtaking bans (especially on old or damaged bridges)
- Weigh-in-motions systems, using instrumented bridges for instance.

INTRODUCTION

1 – Context and methodology
2 – Likely consequences of adapting directive 96/53/EC
3 – New technologies for a sustainable freight transport

CONCLUSIONS
CONCLUSIONS

• Harmonising weights and dimensions of heavy vehicles in Europe is a real need, in order to avoid a distortion of competition and to ensure an optimal use of heavy vehicles.

• Adapting the directive is therefore an interesting option but further research is needed to assess more fully both the positive and negative consequences of doing so.

• The results of the cost-benefit analysis are sensitive to many parameters but it seems that adapting directive 96/53/EC would offer an overall benefit to society, with the highest benefits resulting from a general authorization of LHV.

• In parallel, it would be relevant to start an open discussion between the different stakeholders to devise the appropriate counter-measures, before launching an experiment.
Thank you for your attention!

Matthieu BERENI - Sétra
matthieu.bereni@developpement-durable.gouv.fr