

# A SCENARIOS STUDY ON FUTURE DEMANDS ON CONTAINER AND TRUCK SIZES OF THE FUTURE

---

JAN JANSEN, BEN KRAAIJENHAGEN, HENRYK GRÄSER, ILONA SZYLAR AND  
STEF WEIJERS

## Abstract

To what extent will future demands of worldwide operating parties, regarding the (tertiary) packaging of their freight flows, determine or influence the future dimensions of freight trucks? That is the question we address to in this paper. In this study we have studied what container sizes may fit in the future demands of world trade and freight flows. We have identified several trends and studied its possible impact on the sizes of the truck of the future. Two serial projects have been carried out within the framework of the HTAS-EMS research program, in which amongst others MAN, University of Technology Eindhoven, TNO and HAN University of Applied Sciences cooperate in order to determine the requirements for the truck of the future. The first two projects of this research program have been carried out in order to determine possible influences of:

- packaging on the requirement of Logistic Service Providers for the next generation of trucks (project I);
- the pallet as an influence on the opportunities for intermodality of transport units, within the context of EU trade with emerging economies (project II).

The first research project was part of a dissertation program for the MSc program in Logistics and Supply Chain management of the University of Westminster (project I); the second, of a BBA program in Logistics of HAN University of Applied Sciences (project II).

## Introduction

Throughout the world, freight flows have been keeping increasing in terms of volumes and distances. In 2001 the European Commission's predicted in its white paper on transport that:

- freight activity will grow by 55% between 2000 and 2020;
- the need for efficiency and sustainability of the growing transport sector will increase.

Our assumption is that both the predicted 55% growth in freight transport, and the increasing urgency for getting more efficiency, and the expected requirements for

sustainable transport, all will require a modular concept of transport, drawing on adapting and rearranging vehicles and loading units to future standards. We name our modular concept the European Modular System (EMS). A use of modular vehicles as dedicated flexible loading units, will result in higher transport efficiency with fewer vehicles required to transport more goods.

In order to develop a new concept for the truck of the future, several universities and business have joined forces, supported by the Dutch Innovation project High Tech Automotive Systems (HTAS). In this HTAS-EMS program we will develop the technical modular outlines for the truck of the future. The starting point of this program is the question what will be the future requirements on the sizes of the trucks that will serve the European market in the future. According to the HTAS EMS project team, the most relevant improvements of the transport industry regarding its efficiency and sustainability, may be achieved by allowing a larger transport capacity per loading unit and the adoption of modular systems (2010).

Our program builds on a group of five companies - MAN, DAF, LAG, D-Tec and Wabco - and three universities - HAN University of Applied Sciences, Eindhoven University of Technology and TNO Industry and Technology. The program is developing in three main phases:

- Defining the future prospects for modular road vehicles. The goal of the first phase is to make an analysis of trends in the requirements on freight flows and freight carriers that may be relevant to the various stakeholders.
- Setting performance and safety assurance requirements for road vehicles. The goal of the second phase is to develop methods and tools to analyze the performance of advanced articulated vehicle concepts.
- Designing and analyzing the future EMS vehicles. The goal of the third phase is to perform a detailed technical analysis of the vehicle concepts based on the requirements of phase 1 and the conditions as formulated in phase 3.

This paper relates to the first phase of the program, studying firstly the requirements of all relevant stakeholders, especially logistics operators. The assumption in this study was that the link between the future logistics requirements and the sizes of the trucks will be mediated by packaging. That was the reason to place the emphasis on the logistics part of this program, the analysis of the future demands of the various stakeholders on packaging.

So, the first main question of this program was:

*‘What are the global developments in the (tertiary) packaging industry and how will they influence the future dimensions of freight carriers?’*

We expected that the answer to this question would help us to define the requirements, which, as a next step, we will translate into a description of fitting sizes and related characteristics of lorries and trailers in the future.

## **Methodology**

Our research is based on an extensive study of literature, in-depth interviews with business and research experts and logistic service providers (LSPs), and a scenario study, supported by a workshop of experts organized by MAN Truck & Bus (Product Strategy Department). On the basis of desk research, a theoretical framework for this project has been developed; as well as a framework for scenario analysis.

### ***Project I (Spring 2011)***

Field research has been carried out, based on a semi-structured interview technique, in order to make way for a qualitative analysis, and at the same time making results comparable. The interviews were held with six business and research experts in packaging and three logistic service providers (LSPs) that operate on a European scale. In order to guarantee the requested anonymity, in this paper the interviewed stakeholders will be referred to as: 1, 2, 3, 4, 5 and 6. One of them is the key stakeholder. The findings from the theoretical part of this study have been matched with the analysis made by the key stakeholder. Based on this matching, several hypothesis have been formulated, and subsequently have been tested in the interviews with business and research experts. The results of the findings of project I have been published in *Vervoerslogistieke Werkdagen 2011 (Antwerp 2011)*.

### ***Results of Project I:***

- Efficiency (through standardization c.q. modularisation) and sustainability are the main drivers in the packaging industry of the B2B segment. For B2C packaging marketing is more important.
- Developments in packaging industry will not really influence the dimensions of pallets and containers.
- The Euro pallet will stay dominant in Europe, the block pallet will be dominant in the USA; but for the BRIC countries (fast developing / emerging economies, like: Brazil, Russia, India, Indonesia, China and South-Africa) it was not clear yet which format will dominate in the future.

### ***Links form project I to project II***

- Establish the influences of a pallet on the transport leading units' dimensions in context

- of bilateral trade of EU27 and BRIC countries;
- Find the potential future dimensions for modular transport loading units.

### **Project II (Spring 2012)**

After performing desk research, based on an extended study of literature, much data have been gathered about trade and freight flows. These have been matched with relevant possible pallet standard and container sizes, resulting in four scenarios, which have been tested in two ways:

- In a workshop with a panel of renowned experts (organized by MAN Truck & Bus);
- By conducting semi structured individual interviews with German experts in the field of logistics.

A market research institute was responsible for the selection of participants of the workshop and the interviews. Participants were CEO's of leading companies in Europe.

## **Approach to Project II**

Part I of the project produced several insights into the opportunities of the container sizes of the future. But still many questions remained unanswered. Especially concerning the possibilities of standardisation. In order to get to grips with possible future developments, we set up a scenario-study, helping us to make a better distinction between the elements that will have an impact and those that will not, and trends that are more probable versus trends that are less.

A scenario study is a helpful instrument for preparing better for the future. Based on desk research four scenarios have been developed, and have been presented to several experts on the CEO level of several large companies, operating on a world wide scale.

In order to get more grip on possible future development we have set up a scenario study. A scenario is not a prediction, but it might act as a contingency plan, sensitivity analysis e.g. (risk assessment) or a source for decision making in public or corporate policy. Scenarios are defined as *a consistent and coherent descriptions of alternative hypothetical futures that reflect different perspectives on past, present, and future developments, which can serve as a basis for action* (Van Notten, 2005).

We based our scenario methodology on the typology of macro and micro characteristics of scenarios by Van Notten (2005) – see table 1.

Macro characteristics	Micro characteristics
<p><b>A. The goals of scenario studies</b>                      Pre-policy research                      Scenarios have to result in concrete options for decisions making. Its outcome will influence the next steps of HTAS EMS.</p>	<p><b>A.1 Product</b>                      The outcome of the scenarios is more important than the process of creation.</p> <p><b>A.2 Assumption</b>                      The scenarios are built on the assumption that certain drivers of change (pallet) will affect the future sizes of modular loading units.</p>
<p><b>B. Design of scenario process</b>                      Scenarios are built on the basis of desk research and the expertise of the coordinators of this project. Therefore the following structure has been applied:</p> <ol style="list-style-type: none"> <li>1. identification of subject or problem area,</li> <li>2. description of relevant factors,</li> <li>3. prioritisation and selection of relevant factors,</li> <li>4. creation of scenarios.</li> </ol> <p>All resulting in a storyline.</p>	<p><b>B.1 Inputs into the scenario process</b>                      Our qualitative input was based on assumptions made on the basis of desk research (e.g. change in legislation, change of standards). The quantitative input concerns trends in pallet versus loading unit efficiency, amongst others.</p> <p><b>B.2 Methods</b>                      The Scenario set-up was an ongoing and lengthy process; it has been amended accordingly to the data and information found.</p>

Table 1: *Our scenario methodology based on the ‘Typology of approaches’ (Van Notten, 2005)*

### Scenario analyses

The overall aim of this research was to diagnose the influences of the pallet as an integral part of the logistics industry on transport loading units, in order to contribute to our research on the transport unit concepts that may become dominant in the future, while considering its compatibility with the dimensions of the modules. The dimensions of loading units are defined by legislation. Nevertheless they are interrelated with tertiary packaging, as the use of the one, defines the efficiency of the other. Tertiary packaging is a focal point of this research, in interaction with future trends in warehouse infrastructures.

Concerning legislation, in the European Directive 96/53/EC the maximum authorized dimensions have been defined for several types of road vehicles that circulate within national and international traffic within the Community, just as the maximum authorized weights in international traffic. In business practise, modularity is possible when the pallet fits with both the warehouse infrastructure and the loading unit, in the most efficient way, and with legislation, as this indirectly determines the loading unit dimensions.

Based on desk research, we defined four scenarios to be discussed in our field research (workshop and interviews); an overview of these scenario's can be found in table 2.

	<b>Scenario I Mix of different standards</b>	<b>Scenario II Block Pallet dominates</b>	<b>Scenario III China Pallet dominates</b>	<b>Scenario IV Euro Pallet dominates</b>
<b>Pallet</b>	Current situation	Anglo Saxon countries	Trade with China	Trade to & from Europe
<b>Loading Unit</b>	ISO	ISO	ISO	Non-ISO PW- container
<b>Modularity</b>	Limited	Limited	Limited	Improved
<b>Matching with current Legislation</b>	No changes required	No changes required	No changes required	Change required
<b>Efficient inter- modality</b>	Limited	Limited	Limited	Improved
<b>Experts' evaluation</b>	Likely	Unlikely	Unlikely	Unlikely

Table 2: *Scenarios are evaluated from European perspective*

The interviewed experts and stakeholders judged the scenarios as following:

- Scenario I 'The mix of different standards' which in fact describes the current situation, i.e. a mix of different pallets – the experts expect that different pallet sizes will continue to coexist also in the future;
- Scenario II 'Block Pallet'. The Block pallet as a leading standard is found by experts to be a good compromise, as it fits in the ISO container, and therefore enhances efficiency. It is unlikely however that only the Block pallet will become dominant in the future, due to the very strong presence of other standards;
- Scenario III 'A new China Pallet'. Experts find this scenario irrelevant. Pallets are generally less used in China. A new Chinese standard is seen as having no influence on the European market;
- Scenario IV 'Euro Pallet'. The Euro pallet is seen as a leading standard is found by the experts. A strong legal pressure would be necessary to force the industry to reuse pallets consequently. It is not expected for the Euro pallet to become more important on a global scale, than the status quo suggests.

### ***Pallet***

The pallet is not applicable to all goods transported. Retail uses the pallet throughout the supply chain, however many non-processed and semi-processed products are rarely transported on pallets. Machinery and clothes are not, for example.

ISO and non-ISO containers are used as a means of transportation throughout the world. It is expected that containerisation will show a further relative growth. Non-containerised goods are grain, minerals, raw materials, etcetera.

Up until now, low-wage countries perceive pallets as less relevant for numerous reasons. They view pallets as an expense, absorbing valuable container space; there is a trade-off between palletized goods and the maximum space used within a container. Pallets shipped from BRIC countries are seen to be one directional, and pallet-related expenses generated by administration, tracking and tracing are considered too great, in comparison to the pallet value itself.

It is expected that the current variety of dimensions will persist in trade with or without minor alterations. There are expected developments in packaging material towards lighter and stackable constructions in order to gain more of an incentive of loading space. Heavy materials on the other hand are not transported on pallets.

### ***Loading unit***

Today pallets in containers creates inefficiencies, due to a lack of modularity and therefore occupying less than maximum loading space. Block and Euro pallets are not as compatible with ISO-containers, as with non-ISO. Although the sizes of pallet-wide containers in specific cases are the most efficient ones, they are not expected to be widely adopted around the world, due to the small share of palletised goods being shipped by sea freight.

Perfect dimensions of containers are seen as those which are easily compatible with other already existent dimensions. Therefore combinations, multiplies and fractions of current dimensions are seen as desired, e.g. 2 x 10'. 45' containers are perceived as spreading generally, and also useful for many industries. The prevalence of 20' and 40' is existent, and is dominating. The use of these container sizes is expected to be ongoing in the future. Standardisation of all freight carriers is impossible at the moment, due to the required immense investments to be made in infrastructure, and it is perceived as very difficult to achieve in the future, due to various, often contradicting, industry specific, demands of stakeholders.

Intermodality may be one of the ways to handle an increasing flow of goods. The current directive 96/53/EC on dimensions of motor vehicle combinations and loading units measures, no longer suits the needs of stakeholders, however a shift to larger units, has met strong social opposition, despite satisfactory trial results.

## Findings

### *I. What are future possible developments in pallet industry and how may they influence the European Modular System dimensions?*

Tertiary packaging appears to be less influential than it was assumed to be at the beginning of this research. In sea freight (intercontinental transport) the pallet is used very infrequently, due to the space that it takes up as well as its associated costs (costs of pallet, administrative, tracking and tracing and opportunity costs of space taken by the pallet and not goods transported). Consumer goods have a relatively small share in total goods transport performed, however consumer goods are the biggest part of the road transport, and cannot be overlooked.

Further development of the ISO container in terms of heterogeneity rather than homogeneity of sizes and perceived dimensions of 10', 20', 45', 60' is seen as desired. Prevalence of the 20' and 40' is existent and dominating. Pallet-wide containers although applicable to intra European transport, are not foreseen to gain similar success worldwide, due to the fact that Euro pallets are being used mostly in Europe, and the strong presence of ISO containers worldwide and the already existent specific infrastructure, ship structure, etcetera.

Therefore in the short to midterm, EMS dimensions should allow for different combinations of standard ISO containers, including fractions of already existent container dimensions, e.g. 2 x 10' as well 'as their multiples, e.g. 60' and other existent dimensions.

### *II. What standards in terms of pallet dimensions will be dominant, in expected increasing bilateral trade of EU and BRIC countries?*

The pallet, apart from standard dimensions, has many non-registered dimensions that are used. Pallet dimensions are often industry specific, and concern only the small share of all goods transported. According to the interviewed experts and our findings, the divergence in different standards (where tertiary packaging applies) is too great worldwide, in order to come to a mutual single consensus and establishment of one dominant size.

Furthermore the BRIC countries are a source of very insignificant amounts of palletised goods shipped and that is not expected to change in the future. Within Europe however currently present standards are foreseen to stay, due to the already existent expensive storage infrastructure, as well as the very active road transportation sector which makes intensive use of tertiary packaging.

*III. Decisive factors, based on the scenario study (performed in project II by Miss Ilona Szylar):*

*1. What are the transport modes and how are they compatible?*

Along with development of ISO container in USA, Europe, although heavily reliant on seaborne transport, did not alter its regulations in the past to make best use of sea shipping by allowing containers of 45' original ISO and longer, on its roads (with minor country specific exceptions). Europe responded to the emergence of the pallet wide container with the European Loading Unit (EILU) which turned out to be a failure, due to the disrespect of the needs of all relevant stakeholders. Rail and inland waterways impose natural constraints of its limited infrastructures, but also by its different structures. For rail, its different gauge span makes intercontinental transport (Europe-Asia) quite difficult. Air transport on its own imposes plenty of constraints related to the nature of the mode itself.

*2. What are the drivers for trends in the pallet sector and loading units industry?*

The drivers for developments in the pallet and loading units industry are to respond to the demands of end-customer that are more diversified than ever before, and ask for very high versatility and flexibility. Years ago the congruence of standards was seen as the ultimate answer to better services, today quite the opposite is the case. The end-consumer imposes specific and strict demands, and the Logistics Service Provider is bound to deliver them in order to stay competitive. On the other hand there is a larger sustainability awareness, and that in itself imposes yet another constraint on Logistics Service Providers. However, that may be an advantage, once the end-consumer makes sustainable decisions. Eco-friendliness, sustainability and recycling are considered as necessary elements of a well integrated supply chain. An increased use of sustainable packaging materials is expected, however there is little chance for homogeneity of the pallet dimensions, unless it becomes strictly enforced by legislation. Trends towards lighter yet stackable pallet materials have also been recognised.

*3. How do the developments in the pallet sector influence costs, efficiency, compatibility, dimensions of modules?*

As converging developments in the pallet dimensions are not foreseen by experts or prove to be unnecessary, it is important to consider the current status quo for European markets, where apart from ISO containers, swap bodies and semi-trailers prove to be more efficient carriers when transporting Euro-pallets. The explanation is that the latter has been designed with the European market in mind. However all ISO containers are inefficient not only in relation with European pallets, but also in relation with the Block-pallet. Both pallet types gain in efficiency when transported in pallet-wide containers. But Asian pallet types applied

in 20' and 45' pallet-wide containers lose on efficiency. In fact, the most efficient solution for goods shipped in ISO containers, is to avoid tertiary packaging, which indeed imposes extra handling at the point of destination, and at the same time it is counterproductive in terms of compatibility. Furthermore the lack of a standardised loading infrastructure, as well as heterogeneous cost structures, will remain a barrier for a wider use of a globally standardised pallet type. Inefficient (dispersed) use of non-unified pallet sizes, will have a direct impact on costs and prevent all relevant stakeholders from possible gains.

*4. What is the influence of BRIC countries with respect to loading unit standards?*

It is likely that future cargo flows will be more one directional than experienced today (e.g. from China to Europe, from Germany to Russia) due to limitations of resources and skills etcetera. Also there will be more regional supply, due to expenses associated with transport. BRIC countries due to their economic state, will tend to make use of infrastructure that is already given, without imposing standards or innovative solutions of their own.

*5. What are likely future scenarios in the pallet sector, loading units and modularity?*

The European perspective may be dramatically different from the one shared by BRIC economies. These are justified for the following reasons: already present and costly infrastructure and investments made and well established intra European standards in terms of pallet standards and loading units. Experts believe that Europe will hold on to this system, however developing greater flexibility and actively participating in worldwide trade on worldwide standards, being ISO containers. It is likely that the different dimensions of ISO containers will further disperse.

## **Overall conclusions**

1. Diversity in standards for pallets will be a fact for the coming years, so systems (packaging, containers and carriers) have to be flexible. Sustainability and efficiency are relevant drivers for the coming decade, so that will have implications for choices of modality and packaging.
2. In order to increase standardization, efficiency and sustainability, a modular system could be of help. For Europe, a modular system must be based on the dimensions of a Euro pallet, and then translates to secondary packaging. In general, the Euro pallet is leading in defining the dimensions of secondary and tertiary packaging, while marketing dictates the dimension rules for primary packaging.

3. Overall, the future developments in the packaging industry will not influence the dimensions of pallets and containers. Here the opposite it is true: the pallet and container will influence packaging. Because, the infrastructure in and outside warehouses is based on the dimensions of these freight carriers. A policy to change these dimensions would involve incredibly high investments with a small grow prospect of profitability. In Europe, the Euro pallet will be leading in defining the dimensions for both packaging and other freight carriers for the next coming decades. Pallets will not influence the majority of ISO containers. It is not clear whether ISO containers are considered to be freight carriers.
4. The Euro pallet is and will be dominant in Europe. No global standard is to be expected in the near future.
5. Within the container sector there is potential for more disparity of dimensions to smaller units (multiples of 10' and 20') however 20' and 40' containers will remain dominant.

This article was also published in the conference volume of the Vervoerslogistieke Werkdagen 2012, in November 2012. For more information, see <http://www.vervoerslogistiekewerkdagen.org/vlw>

## Literature

- HTAS EMS project team (10 September 2010). *Project plan HTAS EMS Greening and safety assurance of future modular road vehicles*. Eindhoven University of Technology. Project plan HTAS EMS V14. Eindhoven: Eindhoven University of Technology.
- Klooster, R. ten, J.M. Dirken, F. Lox & A.A. Schilperoord (2008). *Zakboek verpakkingen*. First edition. Doetinchem: Reed Business.
- Koopmans, F. (2001). *De kracht van verpakking. Wat is de beste verpakking voor mijn merk en hoe creëer ik die?* First edition. Deventer: Kluwer.
- Mühlbacher, H., L. Dahringer & H. Leihs (2006). *International marketing: A global perspective*. Third edition. London: Thomson Learning.
- Meijer, N. (2011). *An Analysis of how Developments in the Packaging Industry will influence the Dimensions of Freight Carriers*, MSc dissertation, University of Westminster, London.

- Meijer, N., J. Jansen, R. Pieters, S. Weijers & A. Woodburn (2011). An analysis of how developments in the packaging industry will influence the dimensions of freight carriers. In S. Weijers & W. Dullaert (Eds.), *Bijdragen Vervoerslogistieke Werkdagen 2011* (Vol. 1, pp. 135–147). Presented at the 18th Vervoerslogistieke Werkdagen.
- Olsmats, C. (2002). *The business mission of packaging. Packaging as a strategic tool for business development towards the future*. First edition. Turku: Åbo Akademi University Press.
- Sjöström, K. (2000). *Packaging logistics review*. First edition. Espoo: Econpap.
- Szylar, I. (2012). *Tertiary Packaging as an influence on intermodality of transport units in context of EU trade with emerging economies*, BBA thesis, HAN University of Applied Sciences, Arnhem.
- Notten, P. van (2005). *Writing on the wall, scenario development in times of discontinuity*, dissertation, DISSERTATION.COM, Boca Raton, USA.

### **Websites**

- European Commission (2001). *White paper- European transport policy for 2010: time to decide*. [online] Brussels: European Commission Available from: <[http://ec.europa.eu/transport/strategies/2001\\_white\\_paper\\_en.htm](http://ec.europa.eu/transport/strategies/2001_white_paper_en.htm)> [Accessed (14 April 2011)].
- Logpackaging (2008). ([http://logpackaging.blogspot.de/2008/01/emerging-trends-in-logistical-packaging\\_04.html](http://logpackaging.blogspot.de/2008/01/emerging-trends-in-logistical-packaging_04.html))