Effects of standardized cargo units

Deliverable D2.2 - Version Final – 2021-12-13

Advanced, Efficient and Green Intermodal Systems

http://aegis.autonomous-ship.org/

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Definitions and abbreviations

AG: Advisory Group

AGV: Automated Guided Vehicle

ALICE: Alliance for Logistics Innovation through Collaboration in Europe

EU: European Union

FEU: Forty-foot Equivalent Unit

GHG: GreenHouse Gas

H2020: Horizon 2020

HC: High-cube

ILU: Intermodal Loading Unit

IWW: Inland Water Way

LoLo: Lift-on Lift-off

OOG: Out of Gauge

RoRo: Roll-on Roll-off

SSS: Short Sea Shipping

TEU: Twenty-foot Equivalent Unit

UC: Use Case

WP: Work Package

Executive Summary

This document is AEGIS deliverable D2.2, *Effects of standardized cargo units*, which is the end result of work package 2 (WP2) task 2.2. This task focuses on analysing possibilities for more use of standard cargo units in maritime transport and, specially, in the AEGIS proposals. In order to do so, a questionnaire to all AEGIS partners and advisory group members was circulated with a few key questions. The main outcome of this was as follows:

- The types of loading units which are candidates/most attractive for the solutions envisaged in AEGIS are both trailers and containers. For use case A, LoLo would be a suitable ship candidate. For use case B, RoRo. And, for use case C, both.
- The 45 ft container is found to be relevant for the AEGIS solutions since they can fit trucks and can be the perfect alternative to road freight. In addition, 20 and 40 ft containers, which are easier to handle and automatize, are also relevant.
- Cost and standardization are the key determinants for a more efficient cargo handling operational system.

In addition to the questionnaire, an online workshop was co-organized together with the European technology platform ALICE (for Alliance for Logistics Innovation through Collaboration in Europe) and the MOSES H2020 EU project. The aim of the workshop was to discuss the standardization of cargo units in Short-Sea Shipping (SSS) and inland waterways transport (IWT), and how the technology developed in the AEGIS and MOSES projects could be better introduced in the logistics and supply chain of the European transport sector. The key comments in the ensuing discussion are also presented in this deliverable. Moreover, a literature review of the European status of the standardization of cargo units that are involved in intermodal transport, and especially in SSS, is presented in this deliverable.

The deliverable concludes that the AEGIS proposed case studies will ensure that the sizes allow fast and easy loading and unloading of the cargo at each port, and that the size of the container permits its transportation with all available modes in the European network. It is also crucial that most (if not all) of the available cargo space on the AEGIS vessels is occupied by the loading units. Using containers of the same width is important to maximize the utilization of the cargo space (so that these can placed one after another), and that the width of the cargo space on the ship allows placing containers next to each other with minimal lost space in-between.

1 Introduction

1.1 Background

Waterborne transport modes are generally considered greener and more fuel efficient, mainly due to the economies of scale that they offer. This is particularly true for longer voyages, although there are some benefits also in shorter distances sailed.

Short-sea shipping (SSS) competes heavily with land-based transport options and can offer some significant advantages in reducing externalities of road transport, particularly with regards to safety, congestion, emissions, as well as total transportation costs. SSS has been defined in several different ways, but in the context of this deliverable we consider SSS as “the transportation of goods and/or people via sea along a coast without crossing an ocean” as defined by Bjornland (1993) [1].

The European Union (EU) has long sought to move cargo away from road-based and towards more fuel-efficient transport modes such as rail and waterborne. Perhaps the most notable documentation of this ambition, is in the form of the White Paper entitled “Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system» (EU, 2011) [2]. In this White Paper, a clear set of ten goals for a competitive and resource efficient transport system is presented, alongside benchmarks to achieve a 60 % greenhouse gas (GHG) emissions reduction. One of these ten goals refers to modal shifts towards more energy-efficient modes, including a target that 30 % of road freight over 300 km should shift to rail or waterborne modes by 2030, surpassing 50 % by 2050. The White Paper also mentioned the need to further develop seaports as logistics centres and improve their hinterland connections in order handle the sought-after increased transport volumes. It is therefore important to invest in seaports to facilitate connections and enhance their role as intermodal hubs.

More recently, and in the context of the European Green Deal (EU, 2019) [3], “sustainable mobility” has been selected as the main philosophy of development of the European transport sector, with specific actions planned so as to make sure that the above philosophy gets implemented in practice and is not just a theoretical construct. Even more recently, in the context of the “Fit for 55” package, the European Commission adopted a package of proposals to make the EU's climate, energy, land use, transport and taxation policies fit for reducing net GHG emissions by at least 55 % by 2030, as compared to 1990 levels.

Despite such ambitious goals, transport statistics paint a rather disturbing picture, to the effect that the total number of road transport tonne-kilometers is increasing faster than the other options. This can be seen in Figure 1.

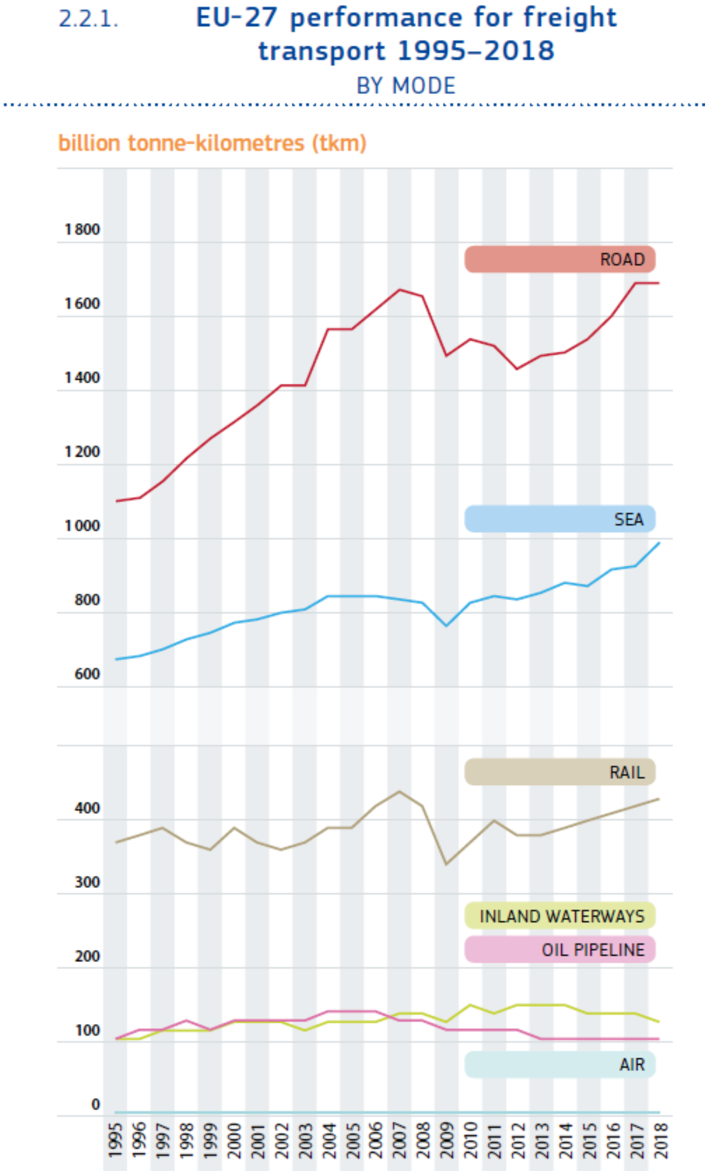

Figure 1: Intra-EU-27 freight transport by mode. Source: EU Statistical Pocketbook 2020

Indeed, and in the period 1995 to 2018, road transport grew by 51.6 %, as compared to 45.8 % for SSS and only 12.9 % for rail. According to the same source, GHG emissions from road transport account for 71.8 % of all transport GHG emissions, compared to 14.1 % for navigation (SSS plus inland navigation) and 0.5 % for rail (aviation being 13.2 %). These statistics confirm that, at least for the above period, the policy of shifting cargo from road to greener modes so as to reduce GHG emissions from transport has not worked very well.

1.2 Objectives of work package 2 (WP2) and of Task 2.2

AEGIS will develop user-centred logistics systems with new components, better service quality and much lower impact on environment and society. The main objective of WP2, named "Logistics system redesign and resilience", is to develop methods to describe and improve logistics chains with high degrees of automation and apply these on the three use-cases for validation. The methods will focus on:

- Minimizing terminal storage.

- Making better use of remote terminals and complement it with small urban and rural terminals.
- Maximizing automated cargo handling, including standardization of cargo units.
- Increasing frequency and overall speed of waterborne transport.
- Introducing new automated work processes for digital exchange of data.

WP2 is expected to address the previous objectives in the following deliverables:

- D2.1 Logistics analysis tool initial version
- D2.2 Logistics analysis final test version
- *D2.3 Effects of standardized cargo units (the present document)*
- D2.4 Handling export, import and security constraints
- D2.5 Resilience in automated transport systems
- D2.6 Roadmap for automated waterborne transport

The present document reports on Task 2.2, *Effects of standardized cargo units*, and focuses on analysing possibilities for more use of standard cargo units in maritime transport. To keep cargo handling equipment costs down, the maximum total weight of each container may need to be reduced, and heavier cargo may need to be handled as special cargo. The issue is that storage efficiency has historically declined, but more efficient and lower-cost automated freight handling could overcome this disadvantage sufficiently to make it a better economic and societal option. This task estimates the positive and negative effects of substantially higher cargo unit standardization using the three use-cases as examples. Small shuttles and small terminals are the most affected. This will be viewed in the context of novel terminal designs as well as, when possible, automated last-mile transportation, e.g. with automated guided vehicles (AGVs). This task cooperates with WP7, which performs the cost benefit analysis (CBA) and with WP3 on cargo handling, and the result will be a public report describing the total economic and societal costs of such measures. This will be used by WP6 in their work on policy improvements.

1.3 Organization of the rest of this document

The rest of this document is organized as follows. Section 2 presents the legislative status of the standardized cargo units in the EU. Section 3 describes the questionnaires issued and circulated to receive input from AEGIS partners, Advisory Group members and other stakeholders on this topic, together with their responses. Section 4 presents the workshop that was organized with ALICE members and other H2020 projects. Finally, Section 5 presents a summary and conclusions.

2 Status in the EU

The considerable growth of unitized transport can be attributed, to a significant extent, to the standardization of cargo units that are involved in intermodal transport. Such a standardization has evolved over a rather long period of time, starting from the concept of containerization as first introduced by Malcom Mclean in the 1950s. The commercial use of containers of standard size was seen as a way of increasing the turnaround time of loading and unloading of cargo from vessels. As containerization steadily took over general cargo and breakbulk, the first standard dimensions of containers came into play. Today, the standard containers are the TEU (twenty-foot equivalent unit) and FEU (forty-foot equivalent unit), while there are also 45’ (45 foot) containers. The latter are more common in North America, with some containers at 48’ or even 53’ length. There are also ISO standards for the dimensions of intermodal containers (ISO 668:2020 is the latest document). In terms of width and height, there are some slight variations. For example, the majority of 40’ and 45’ containers produced today are high-cube containers with an increased external height of 9’ 6’’ (one foot higher compared to standard containers) that allows additional storage capacity without needing to increase the length of the container. For illustrative purposes we show the most common accepted dimensions in Table 1 below through a compilation of online sources, although we stress that the list is not exhaustive

Table 1: Dimensions of intermodal containers used in shipping. Source: compilation of online sources

		20′ container		**40′ container**		**45′ high-cube container**	
		imperial	**metric**	**imperial**	**metric**	**imperial**	**metric**
external	**length**	20′ 0″	6.096 m	40′ 0″	12.192 m	45′ 0″	13.716 m
dimensions	**width**	8′ 0″	2.438 m	8′ 0″	2.438 m	8′ 0″	2.438 m
	height	8′ 6″	2.591 m	8′ 6″ - 9′ 6′′	2.591 m	9′ 6″	2.896 m
interior	**length**	18′ 10 5/16″	5.758 m	39′ 5 45/64″	12.032 m	44′ 4″	13.556 m
dimensions	**width**	7′ 8 19/32″	2.352 m	7′ 8 19/32″	2.352 m	7′ 8 19/32″	2.352 m
	height	7′ 9 57/64″	2.385 m	7′ 9 57/64″	2.385 m	8′ 9 15/16″	2.698 m
door aperture	**width**	7′ 8 ⅛″	2.343 m	7′ 8 ⅛″	2.343 m	7′ 8 ⅛″	2.343 m
	height	7′ 5 ¾″	2.280 m	7′ 5 ¾″	2.280 m	8′ 5 49/64″	2.585 m
volume		1,169 ft^3	33.1 m^3	2,385 ft^3	67.5 m^3	3,040 ft^3	86.1 m^3
maximum gross mass		52,910 lb	24,000 kg	67,200 lb	30,480 kg	67,200 lb	30,480 kg
empty weight		4,850 lb	2,200 kg	8,380 lb	3,800 kg	10,580 lb	4,800 kg
net load		48,060 lb	21,600 kg	58,820 lb	26,500 kg	56,620 lb	25,680 kg

The variations in existing containers are not an issue for container shipping, provided that these can still be stacked on the ship. Typically, two TEUs can be stacked with an FEU container, and the differences in height are not an issue. Liner shipping companies are charging by the TEU slots occupied on the vessel.

Similar considerations pertain to trailers. On the RoRo side, ship operators usually charge based on the total length of cargo occupying the ship holds. This is usually expressed in lane meters of cargo, where each lane has a conventional width of 2 meters, wide-enough for any trailer or vehicle transported on the ship. The typical car would occupy six lane meters, whereas an unaccompanied trailer is typically occupying 18 lane meters. A semi-trailer is usually between 48 and 53 feet long. As a result of the charging mechanism, the ship operator charges based on volume occupied on the holds, and not actual weight transported, with some consequences on the emissions intensity of each voyage.

The competitiveness of SSS has been a recurring subject in research, with several studies considering case studies for potential modal shifts between land-based modes and SSS (Sambracos and Maniati, 2012) [7], as well as the role of the port function in facilitating such shifts (Ng, 2009) [6].

The targets and goals set out in the White Paper were not binding, and there is no regulation stipulating that these modal shifts must happen. However, there have been some environmental regulations that had the potential to affect the modal balance of transportation in Europe. For example, the lowering of the maximum allowable sulphur content in fuel used by ships inside and outside Sulphur Emission Control Areas (SECA) would constitute shipping more expensive as a transportation mode which could in turn lead to undesirable modal shifts towards land-based alternatives. Zis and Psaraftis (2017) [8] showed that these shifts were not realized merely due to the unexpected low fuel prices observed in the aftermath of 2015, a picture that was also repeated following the global sulphur cap in 2020. Zis et al. (2019) [9] examined potential policy measures that could be considered as mitigation measures in case bunker prices would increase and threaten the viability of SSS.

Some observations are necessary considering the environmental benefits of SSS vs land-based alternatives. SSS is mainly served by ferries (Ro-Ro and Ro-Pax) vessels, but there is also container shipping through feeder services. Between the two sectors there are certain similarities, but also important differences. Ferries require little port infrastructure for the loading and unloading of vessels, as cargo is “rolled on and rolled off”, and typically the port stay can be very short if necessary. For the Lo-Lo case, there is a requirement for a crane to “lift-on and lift-off” the cargo. Sailing speeds for ferries are generally higher, and particularly for the Ro-Pax case (where there are also passengers onboard) the speeds are not changing significantly over the years. For containerships, the speed is usually a function of freight rates and bunker price, and as a result over the last decade there has been a drop in sailing speed, particularly with the resurfacing of slow steaming. This has also constituted this transport option as more environmentally friendly. For ferries, there are some concerns that it is actually not as green as generally perceived. This was first stated in the work of Hjelle (2011) [5] who noted the so-called “double load factor problem”, where if the ship is not fully loaded, and at the same time the trailer is also not fully loaded, the actual emissions intensity (emissions per transport work) is very poor. In addition, when trucks (accompanied trailers) are loaded on the ship, the ship is also carrying the weight of the chassis which decreases the environmental efficiency of the voyage.

While there is no legislation on modal shifts, there are some concrete targets set by the IMO on its so-called “Initial IMO strategy” for the decarbonization of international shipping. Relevant to this deliverable, is the goal to reduce GHG emissions intensity by at least 40 % by 2030 compared to 2008 levels. This target affects all shipping sectors, but in a different manner. As regards SSS, considering that reducing speed may not be an option (particularly for Ro-Pax ships), improving the emissions intensity can be achieved by increasing the total weight transported during each voyage, or by simply increasing the utilization capacity of the vessel at each voyage.

Cargo that is loaded on a SSS route is rarely starting and finishing its journey from the port of origin to the port of destination. More often than not, it is originating from a hinterland location, and is destined to another hinterland location, and thus an intermodal change is necessary at each port. To facilitate intermodality, it is important the cargo that cargo be loaded on containers or trailers of acceptable standard units, that would not hinder its onward transportation.

There have been some efforts for the harmonization and standardization of intermodal cargo in the European Union. The first effort was in 1995 with “a proposal for a European Parliament and Council directive on intermodal loading units” (ILU). This standardization would be very important, as it would allow the further transportation of containers (and trailers) carried in ships, also in roads for the next part of their voyage. For example, a 53’ container that can travel in roads in North America could in theory be loaded onto a containership and moved to a European port, but it would not be allowed to travel on European roads. Ensuring a European standard can facilitate the intermodality of transport. A relevant directive was the Council Directive 96/53/EC which laid down the maximum authorized dimensions in national and international traffic and the maximum authorized weights in international traffic. There are however some additional complexities. A 13.6 meter trailer (45’) is able of carrying 33 pallets, and several shortsea shipping lines had began investing in these containers. Under the proposed new regulations in 2007 it would not be possible to transport these containers by road within the EU. Two large shortsea shipping operators at the time (Bell Lines and Geest North Sea Line) tried to secure that containers built before 1996 would still be allowed access to road for another ten years. Gharehgozli et al (2019) [4] surveyed relevant literature on standardization of intermodal units and noted that there is very limited research on the subject. In addition, they interviewed stakeholders who agreed that official European standards are needed, in the three main areas of intermodal transport, namely; infrastructure, loading units, and information exchange.

3 Questionnaire

In order to analyse possibilities for more use of standard cargo units in maritime transport, a first questionnaire to all AEGIS partners was circulated on the 3rd of December 2020. After receiving their input, a second questionnaire was issued and circulated to the AEGIS Advisory Group (AG) on the 4th of June 2021.

The questions presented in the first **AEGIS partners' questionnaire** were the following:

a. What types (LoLo/RoRo/other) of loading units are candidates/most attractive for the solutions envisaged in AEGIS?

b. What sizes (20/40/45/other) are relevant? Is there an initial preference for any of the above?

c. Any other relevant information?

For the **AG members' questionnaire**, the following questions were asked:

a. What types (LoLo/RoRo/other) of loading units are candidates/most attractive for the solutions envisaged in AEGIS?

b. What sizes (20/40/45/other) are relevant? Is there an initial preference for any of the above?

c. What are the key determinants of storage/cargo handling efficiency? Which are the key parameters that should be studied to make the new AEGIS cargo handling a better solution?

d. Is cargo unit standardization key for a more efficient cargo handling operational system? Who would benefit the most from it (small/big terminals...)?

e. Any other relevant information?

f. Anybody else we should contact (e.g. shippers associations, others…)?

All AEGIS partners' and AG's input was integrated into a document. From the AG questionnaire last question input, the ALICE platform was selected as a potential source to address these questions and get valuable input. Discussions with ALICE resulted in the decision to co-organize a workshop on this subject (of which more in Section 4).

All input received from the questionnaires is presented in the following subsections.

3.1 AEGIS Partners

AEGIS Partners provided the following input on the questionnaire.

QUESTION A: What types (LoLo/RoRo/other) of loading units are candidates/most attractive for the solutions envisaged in AEGIS?

- We should probably focus our concept on containers, and both LoLo and RoRo are applicable, depending on location. Mostly LoLo in UC-A and RoRo in UC-B.
- For the three use-cases investigated, different cargo types have been found to be relevant.

  UC-A: LoLo (containers) of the three common sizes – 20, 40, 45 ft.

  UC-B: RoRo (trailers) – although, DFDS has no RoRo operation at the moment, they want to investigate this business case, and RoRo is also defined in the AEGIS proposal.

UC-C: mixed cargo – for Vordingborg with focus on bulk and future option for RoRo; for Aalborg Havn with no special focus (today mainly bulk, but also interest in RoRo; two external companies there operate LoLo); lots of heavy cargo, i.e. wind mill blades.

- Possible route to another Danish port/city (Zealand?) could be considered with RoRo and maybe also LoLo.
- 20’ containers and trailers. Lightweight containers that can be stacked are being developed. They could be designed for smaller shipments (because of stacking height limitations) on smaller ships. An advantage could be that lightweight containers could be used by smaller electric driven truck.
- CO_2 emission are much higher for RoRo compared to LoLo/Container. Hence, more emphasis to RoRo should be given as it has more potential for improvement.
- In the use case A the reefer containers are very relevant and these containers are mostly 45’ and 40’. However, in the global shipping, the 45" footers are only ~1 % of the total amount of containers, which are mostly used in the United States in Rail&Truck. From a global perspective, use case A could be considered an anomaly as the use of 45’ is excessive.

QUESTION B: What sizes (20/40/45/other) are relevant? Is there an initial preference for any of the above?

- Trend is increasing use of 45’, but that is mostly because it fits the trucks. However, from a waterborne perspective it does not necessarily make sense to go bigger than 20’, as it is easier to automize the cargo handling for the 20’. AEGIS partner NCL sees that the 45’ are a bit challenging since their vessels are tailored for 20 and 40 ft. However, it is too early to conclude, since many factors play a role here. Should be tested with the tool in D2.2 and different vessel and cargo handling concepts. The preference is 20’ from a waterborne perspective; less wind area, easier automized cargo handling among other things; and 45’ because of compatibility with trucks, if thinking intermodal concepts.
- All three container sizes (20, 40, 45 ft) are relevant – mainly for UC-A.
- RoRo: Any size. Container Terminal: Preferably 20 and 40 ft. Bulk: Not applicable. The preference is 20 and 40 ft because of equipment.
- 20’ autonomy handling, preferably lightweight containers in the future.
- 20’ is for heavy and more dense cargo. 40’ is for lighter cargo. 45’ is common in road transport (max volume). Reefers are high-cube 40’. 30’ is for bulk transport where density meets the volume of 30’ to be avoided. In addition, other sizes makes things difficult, as number is less. Out-of-gage cargo should be limited. Now shipper decides what size of container is used. Is it possible to restrict the use of other than 20 and 40 ft from one customer? What is the benefit? The dream would be only 20 and 40 ft. Might be only possible within dedicated business case as Yara-Birkeland.

QUESTION C: Any other relevant information?

- Stuffing and sharing of containers, could clients share? In this way, we could utilize the containers in a more efficient way. NCL states that 45’ containers are suboptimal for stacking on their existing vessels. As you can see from our answer, we do not have any clear preferences at this point. However, we should aim at thinking a new whole transportation system, and not adapt the concept to fit today's suboptimal solutions. Of course, there is a trade-off there as well.

- In former discussions, we found that there is a trend to “containerization” of bulk cargo, especially for IWW transportation (maybe the same for short sea shipping?).
- Conversion of road cargo to either RoRo or container can be a driver for more automated solutions.
- Palletized cargo is interesting since warehousing is automated and pallets/packages have been handled autonomously for long. Could some of this technology be transferred to/used in shipping for (lightweight) container handling and/or pallets on board ships and in port?
- To speed up operation use of twist locks to be avoided. That is possible only when using cell guides. Above might be problematic as converting old vessels to purpose is costly but, on the other hand, also building a new one is. If more explicit solution is applied, the whole supply chain needs to be involved, not just sea voyage, for instance. Enough volume from one customer is needed to start with.
- From a container vessel perspective, the width of the container is more or less standardized. There are some oversized containers but these OOG's are rather rare and need very little attention on the vessel design as they can be placed on deck as the topmost container.
- The length of the container is more troublesome as if one designs a vessel with cargo hold for 45’s it means that if carrying 40’ the unused space is excessive. Hence, with this thinking, to ensure the space utilization of the vessel it should be designed so that the hold length is according to 40’ and the 45’s are designed on deck. The problem is then with the automation as it was mentioned in AEGIS D3.1 where it was noted that the use of cell guides from the tank top to the up most container gives the best operational setup for the automation equipment. So this means that the vessel design, today, is with both solutions; the mid of the vessel should be with cell guides (= without hatch covers) and the front with HC so that 45’s can be designed but also because there is a need to prevent water to enter to the cargo hold in the bow area (according to class rules).

3.2 Advisory Group (AG)

The AG provided the following input on the questionnaire.

QUESTION A: What types (LoLo/RoRo/other) of loading units are candidates/most attractive for the solutions envisaged in AEGIS?

- LoLo: containers for long haul. Forget RoRo - RoRo vessels; they are unsustainable as half of their cargo is tare. Pallet and pallet sized containers for urban logistics.
- Since you are asking about specific loading units the answer, while not very informative, is that they are each attractive for a particular type of cargo. Pallets, because of their pervasive use and simplicity in stacking and handling, are generally easiest to employ for “general cargo.” They suffer from not providing much protection to the items stacked on them.

  LoLo is not a loading unit per se, but a handling approach. The loading unit in this instance can be just about anything as long as the onboard and dock side cranes can lift them on or off. This approach to moving freight is very old and, unfortunately, still quite common for bulk materials and for shipments to ports that don't have real container handling equipment available. From a shipper's perspective, this is the least desirable type of loading unit as goods damage is very likely.

RoRo is again not a loading unit, but a loading approach. If you can find a wheeled system to load your shipments into, then this is quite a convenient means of moving and handling goods. It works best for automotive and trailer type loads, but other wheeled container systems exist. Properly secured, this is a convenient and safe way to transport goods.

Other systems: The "Box" approach is, in my mind, always the best approach. I really don't care about the size of the box so long as I can put goods into it and it can be safely handled. Containers protect the goods, allow for efficient handling, and optimize unit shipment processes.

QUESTION B: What sizes (20/40/45/other) are relevant? Is there an initial preference for any of the above?

- 20' with limited weight. 45' for alternative to road freight.
- All these sizes are relevant depending on what is being shipped and where it is going. Smaller sizes are easier to handle, particularly for small ports. However, larger sizes are more efficient if you have the volume.

QUESTION C: What are the key determinants of storage/cargo handling efficiency? Which are the key parameters that should be studied to make the new AEGIS cargo handling a better solution?

- Cost.
- You have identified the key issue, standard containers. If you can standardize the containers, then you can begin to automate the handling, which in turn creates huge efficiencies. If you can go one step further and standardize the boxes that go into the boxes you have a huge efficiency multiplier because the container loading itself can now be automated. Standards, standards, standards, that should be the motto.

QUESTION D: Is cargo unit standardization key for a more efficient cargo handling operational system? Who would benefit the most from it (small/big terminals...)?

- Yes, as it allows automatization.
- It is certainly the major productivity and efficiency driver. We can all improve handling operations, but we quickly approach a limit if what we are handling varies all the time. Through standardization of all boxes we could automate, in theory, every loading process, which brings huge efficiency gains.

QUESTION E: Any other relevant information?

- Keeping weights low allows for less expensive equipment; vessels should also be limited in size
- Just my message about standardizing all of the boxes. This would be very interesting.

QUESTION F: Anybody else we should contact (e.g. shippers associations, others…)?

- Reach out to the ALICE consortium and see if they might be able to get their members to address these questions.

4 Workshop with ALICE members

ALICE is an European technology platform which is set-up to develop a comprehensive strategy for research, innovation and market deployment of logistics and supply chain management innovation in Europe. The platform supports and assists the implementation of the EU Programs for research such as H2020. ALICE is based on the recognition of the need for an overarching view on logistics and supply chain planning and control, in which shippers and logistics service providers closely collaborate to reach efficient logistics and supply chain operations.

On 8th November 2021, an online workshop co-organized together with ALICE and H2020 project MOSES took place. The aim of the workshop was to discuss the standardization of cargo units in short-sea shipping and inland waterways transport, and how the technology developed in the AEGIS and MOSES projects can be better introduced in the logistics and supply chain of the European transport sector.

The agenda of the workshop was as follows:

Time	Title	Presenter
10:00	Welcome and introduction; the overall purpose of the workshop.	Ørnulf J. Rødseth/SINTEF Ocean (AEGIS)
10:05	ALICE: A broader perspective, new constraints because of autonomy and green initiatives	Fernando Liesa/ALICE
10:15	The AEGIS project: Discussion on standardisation needs	Harilaos Psaraftis/DTU
10:30	The MOSES project: What are the possibilities within freight transport, how can autonomy attract cargo to waterborne transport?	Nikos Ventikos/MOSES
10:45	The CLUSTERS 2.0 project: Presentation of the New Modular Loading Units	Ton Bertens/VanEck
11:00	Panel discussion	Moderated by Ørnulf J. Rødseth
11:45	Summing up and way ahead	Ørnulf J. Rødseth

The entire video of the workshop can be found at this YouTube link:

https://www.youtube.com/watch?v=ZyoTOaJi5us

Key comments in the ensuing discussion included the following (list below is not prioritized):

- Moving trucks in the RoRos is inefficient.
- Cooperation is key to overcome these issues.
- Autonomy attracts cargo through lowering operational costs.
- Smaller boxes make sense also for direct compatibility with last miles delivery.

- The question here is how to integrate these flows better (modular pallets and boxes) into the IWT and the SSS.
- Mixing maximum loading on mass (bricks) and maximum loading on volume (insulation material) optimizes loading rates.
- Current players may not be willing to change due to their current thinking and investments. Someone who is really committed to the idea and is willing to "suffer" until the idea takes root and shows is needed. This is how the container actually was injected, and it is how Christensen hypothesized a disruptive technology starts its life.
- We need to also remember that the container is only a part of a system. To get the system to handle a new packaging paradigm is something that requires lots of effort.
- All ideas presented in this workshop cannot be introduced with a big bang. It must be used from day one and increase over time.
- The key is road E-tolling for the whole of Europe. How can this be introduced is another question.
- We need to keep in mind that it took a long time for the container to be accepted. The final nail in the coffin that forced the issue was moving all of the military cargo to Vietnam for the US military that was containerized.
- Regardless of emissions (which are important), there are also important trade-offs of getting trucks off the road. One hour of traffic jam with 1000 people in it are a huge societal cost.
- What we need from politicians in the EU is to place a hefty road toll on trucks - to cover CO_2 and local emissions, and road infrastructure cost.
- Interoperability is a key determinant for enhancing intermodal efficiency.
- Getting users and innovation owners in the projects is very important as they will move them to the market.

5 Summary and conclusions

The outcome of AEGIS Task 2.2 can be summarized in the following bullet points:

- The types of loading units which are candidates/most attractive for the solutions envisaged in AEGIS are both trailers and containers. LoLo's and RoRo's seem a suitable solution depending on the use case. For UC-A, LoLo's, for UC-B, RoRo's, and for UC-C both.
- The 45' container is found to be relevant for the AEGIS solutions since they can fit trucks and can be the perfect alternative to road freight. In addition, 20' and 40' containers, which are easier to handle and automatize, are also relevant. All these three container sizes would be allowed to be used in road transport too.
- Cost and standardization are the key determinants for a more efficient cargo handling operational system. In fact, cargo unit standardization allows automatization. Thus, both are key parameters that should be studied to make the new AEGIS cargo handling a better solution. It is also expected that small terminals would benefit the most from this.
- In addition, automated palletized cargo is found to be an interesting alternative for what is being studied here. Moreover, lightweight containers are key to reduce costs and stuffing and sharing of containers could be key to utilize the containers in a more efficient way.
- From a container vessel perspective, the width of the container is more or less standardized. Nonetheless, the length of the container is more troublesome.
- The lack of standard container dimensions risks that a container cannot be transported on road, and thus limits the transport options for shippers to only use this size for specific lane trades (for example only oceangoing voyages with no intermodal option). With regards to the AEGIS case studies, the proposed case studies will ensure that the sizes allow fast and easy loading and unloading of the cargo at each port, and that the size of the container permits its transportation with all available modes in the European network.
- Finally, given the fact that there is an ambitious goal to improve emissions intensity of maritime shipping, it is of utmost importance that the ships are loaded to their maximum capacity on their voyages. Therefore, it is crucial that most (if not all) of the available cargo space on the AEGIS vessels is occupied by the loading units. Using containers of the same width is important to maximize the utilization of the cargo space (so that these can placed one after another), and that the width of the cargo space on the ship allows placing containers next to each other with minimal lost space in-between.

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