Title: OUTLOOK FOR THE USE OF SINGLE HULL BOATS

Creation Date: 2013 - 04
Revision Date: 2014 - 02
Project: MoveIT!
WP: 6.7

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ABSTRACT

This document covers following contents:

The main aspect of the WP6.7 regards the existing single hull ships that cannot be modernized to meet ADN regulations, which from there can either be scrapped or used in new cargo segments. In this task it is investigated which segments are suitable, which modifications to the ship these segments require and if a viable business case can be developed.

As from 2018, single hull tankers will no longer allowed be to transport dangerous goods within Europe. This means that from 2018 onwards single hull tankers have to be taken out of the market, or – and that is the topic of this task within Move-IT – a new function for these tankers needs to be found out.

5 options are available regarding single hull units.

- Option 1 : processing unit to carry bulk commodities
- Option 2 : convert a single hull tanker to a double hull tanker
- Option 3 : convert to a container carrier
- Option 4 : waiting for 2018 and scrapping

For each option, we considered the following aspects :

- description,
- detailed costs,
- economic evaluation.

Each option is evaluated by comparing to the different types of units costs for a new boat on one hand, for a suitable used boat on the other. They are two type of costs: fix costs and variable costs.

Fix costs (FC)	Variables costs (VC)
- Amortization - Crew Labour Cost (including payroll) - Insurance - Taxes - Maintenance	- Fuel - Tax for navigation

Turnover T must be at least equal to the sum of the costs

Turnover = Fixed costs + variables costs

This type of analysis for each option gives the following results:

Option	Conclusion
Option 1 : Convert a single hull tanker to a bulk cargo vessel	Economically attractive compared to an existing unit. However, it is probably difficult to propose this unit to a customer as it was being transported dangerous goods.
Option 2 : transformation of the unit to continue the transport of dangerous liquid goods (within the meaning of DNA classification)	It is more profitable to build a new barge than to adapt an existing ship
Option 3 : adaptation for transport of Containers	It is more interesting to adapt an existing ship than build a new ship (for barge and ship) Only profitable for RHK and Rhine convoy
Option 4 : waiting for 2018 and destruction	

Document Properties

Document Name:	OUTLOOK FOR THE USE OF SINGLE HULL BOATS
Document Author(s)	Joffrey GUYOT
Document Editor(s)	Eloi FLIPO
Date of delivery	2014-04
Nature of Deliverable	☒ Report ☐ Prototype ☐ Demonstrator ☐ Other
Circulation	
Security Status	
Document Status	☐ Draft ☒ Final ☐ Approved by SG Steering (or SP meeting type-D) ☐ Approved by reviewer ☐ Acknowledged by MOVEIT! Steering ☐ Issued to EC
Keywords	--- --- --- --- ---
Related MoVeIT! Reports	

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Document history

Version	Date of delivery	Changes	Author(s) Editor(s)	Reviewed by

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1 Executive Summary

1.1 Problem Definition

In the WP 6, two alternative ways of making existing ships more efficient will be investigated:

1) regarding ships that are too small to reach the economies of scale required to be economically competitive, it is researched **in task 6.1 to 6.4** to which extent they can be lengthened and if this will result in a ship that is competitive. The outcome of this research is an overview of the boundaries to which small vessels (under 86 m in length) can be lengthened and the economic benefits this brings

2) Adaptation of existing vessels to new market situations. Here, 3 options are elaborated **in task 6.5 to 6.7**:

- It is rinvestigated how existing vessels can better cope with the low water levels in the rivers due to the changing climate
- It is researched if it is possible to adapt ships for the emerging market of CO2 transport
- It is researched how single hull tankers that cannot be modernized to meet ADN requirements in a cost-effective way can be used for other cargoes.

This research will result in a set of business cases from which it is clear if &how ships can deployed in an economically sound way in new situations.

The main aspect of the WP6.7 regards the existing single hull ships that cannot be modernized to meet ADN regulations, which from there can either be scrapped or used in new cargo segments. In this task it is investigated which segments are suitable, which modifications to the ship these segments require and if a viable business case can be developed.

In general, four different types of inland shipping tanker vessels can be distinguished :

- oil tanker
- chemicals tanker
- gas tanker
- powder products tanker.

As from 2018, single hull tankers will no longer allowed be to transport dangerous goods within Europe. This means that from 2018 onwards single hull tankers have to be taken out of the market, or – and that is the topic of this task within Move-IT – a new function for these tankers needs to be found out. It must be noted that generally the only group affected are the oil tankers, because in practice all chemical tankers sailing on EU inland waters are already double hull tankers and gas tankers are even triple hull tankers. Powder tankers transport semi- liquid commodities, like flour, cement and fly ash. Powder tankers are built differently to enable them to carry these semi-liquid commodities. Because these tankers are not used to carry oil or other dangerous goods, they do not fall within the scope of the EU regulation and therefore may keep their single hull.

1.2 Technical approach

- technical approach

5 options are available regarding single hull units.
- Option 1 : processing unit to carry bulk commodities
- Option 2 : convert a single hull tanker to a double hull tanker
- Option 3 : convert to a container carrier
- Option 4 : waiting for 2018 and scrapping

- main steps presented in this deliverable / report

For each option, we considered the following aspects :
- description,
- detailed costs,
- economic evaluation.

As agreed over the MoveIt ! consortium meeting in Paris in November 2012, estimations of costs were obtained by interviewing different shipyards in France.

- PM / Resources spent (not in detail, but budget spent in Person-months only in one figure without explanation) : 2

1.3 Results and Achievements

This type of analysis for each option gives the following results:

Option	Conclusion
Option 1 : Convert a single hull tanker to a bulk cargo vessel	Economically attractive compared to an existing unit. However, it is probably difficult to propose this unit to a customer as it was being transported dangerous goods.
Option 2 : transformation of the unit to continue the transport of dangerous liquid goods (within the meaning of DNA classification)	It is more profitable to build a new barge than to adapt an existing ship
Option 3 : adaptation for transport of Containers	It is more interesting to adapt an existing ship than build a new ship (for barge and ship) Only profitable for RHK and Rhine convoy
Option 4 : waiting for 2018 and destruction	

1.4 Exploitation and Implementation

- how can the results be used by other shipyards outside of MoVeIT!?

the results of this study will be available on the website MOve It. VNF planned to present the results in a E-letter and at a conference or a hundred carriers are present.

- intended implementation by the partners participating

yet, no known project.

- potential use for other ship types and EU-Community

It is estimated that in Europe has more than a hundred simple hull ships.
The results of the study show that there are potential profitability for RHK units. Some operators will therefore be interested.

Expert Report chapter 1

Transport of dangerous goods on inland waterways is monitored by the Dangerous Substances Committee of the CCNR/ZKR.

The missions of this committee are:

- Adaptation and development of the ADN Agreement;
- Cooperation regarding the coming into force and updating of the ADN Agreement – (Group WP.15 / AC.2 - UN-ECE) and adaptation in relation to other regulations;
- Monitoring of regulations and training concerning those in charge of dangerous substances;
- Analysing accidents in connection with the transport of dangerous substances and acting on the conclusions;
- Prevention of accidental water pollution;
- Specific barge safety problems: gas venting, double-hull vessels;
- Improvement of the vessel/land interface used to loadi and unload dangerous substances

Since the 19th century (1838) the Central Commission has drawn up specific rules for the transport of dangerous goods on the Rhine (cannon powder, explosives, poisonous and corrosive substances, etc.).

The ADNR regulation was written out & adopted in 1971. A new version came into force on 1 January 1995. This new version underwent in-depth restructuring to ensure improved harmonization with the ADR (road) regulations and RID (railway) regulations. (For example, in each of the three regulations Chapter 1.3 deals with the harmonized rules for training of personnel.) Restructuring was completed in 2002, and the new restructured version came into force in 2003.

Following a resolution in May 2008 (2008-I-25), the CCNR/ZKR updated the ADNR regulation, making two major additions:

- the introduction of new criteria for rating the hazard posed by substances in terms of water pollution and health;
- gradual transition from single hulls to double hulls (May 2008 press release).

Further to a contact in 1995 with the UN-ECE, the CCNR/ZKR was heavily involved in drawing up the European Agreement concerning the International Carriage of Dangerous Goods on Inland Waterways. These negotiations led to the signature of an agreement on 26 May 2000 in Geneva. The new agreement, known as ADN, came into force on 29 February 2008. The regulation annexed to this agreement was chiefly based on the terms of the ADNR. The updated ADN regulation came into force on 28 February 2009. The CCNR/ZKR for its part decided that following a period of transition the ADN

regulation would supersede the ADNR. This took effect on 1 January 2011. The resolution adopted by the CCNR to this end, based on the exercise of its powers under the Mannheim Convention, provides a range of adoption mechanisms (resolution 2009-II-20).

Simultaneously to these developments, the European Community adopted a Directive on the inland transport of dangerous goods (Directive 2008/68/EC of the European Parliament and of the Council of 24 September 2008)The new directive applies the ADN regulation to transport of dangerous goods by inland waterway within or between Member States by 30 June 2011 at the latest.

From empirical experience, the maximum volume of cargo tanks is limited to 380 m^3 for Rhine standard tanker vessels. New Rhine tanker vessels, just like container-carriers, can reach 135 m x 22.50 m sizes, whereas the traditional standard is 110 m x 11.40 m. An increase in the size of the vessels with the same maximum unit volume mentioned above for the cargo tanks would result in an increase in the number of tanks and thus the amount of ancillary equipment (connectors, valves, measurement apparatus, etc.). A method developed by the Dutch institute TNO makes it possible to deal with volumes in excess of 380 m^3 at no increased risk. This method entails the evaluation of construction processes for tanker vessels with energy absorption capacities in the event of a collision in excess of those of a standard vessel. This method has been incorporated into the ADNR regulation. In addition to allowing for larger tanks, the new provision also allows intervals between double-hulls other than the standard 80 cm inter-hull gap, and the use of new materials.

Environmental disasters caused by accidents to seagoing vessels carrying hydrocarbons or other chemical products have raised awareness amongst the general public and politicians. Until now, there was no consideration in inland navigation regulations governing the transport of hazardous substances for hazard criteria relating to water pollutants and substances that can endanger health. It has taken some time to finalise these criteria, but they have now been defined in the "Globally Harmonised System of Classification and Labelling of Chemicals (GHS)". In the case of transport by tanker vessels on rivers, these criteria go beyond the requirements for road transport (ADR) and rail transport (RID).

In fact, substances falling into toxicity categories Acute 1 or Chronic 1 (Group N1) must be carried in type C double-hull tanker vessels. Those falling into toxicity categories Chronic 2 or Chronic 3 (Group N2) must be carried in type N double-hull tanker vessels (the new type N double-hull tanker vessel was added to ADNR in 2007). Moreover, substances posing a health risk such as carcinogenic, mutagenic and reprotoxic substances (CMR substances) must also be carried in type N double-hull tanker vessels, as must "floating" or "sinking" substances (Floaters and Sinkers). Thus a large number of hazardous liquids such as petrol and diesel, currently transported in type N single-hull tanker vessels must now be carried in double-hull tanker vessels.

It is obvious that turning a single-hull fleet into a double-hull fleet requires an appropriate amount of time to balance the objective to protect the environment with technical and economic realities. These transitory measures have been drawn up in close coordination with the industry. A timeline has now been drawn up in three phases.

Special transitory measures have been laid down for single-hull vessels with a transport capacity under 1,000 t, and also for fuellers and oil trap vessels.

On the Central Commission of the Rhine's request (CCNR/ZKR), river organizations EBU (European Barge Union - Association of Inland Navigation-owners) and ESO (European Skippers Organization - Die Europaïsche Schiffer Organisation) submitted a joint proposal for a gradual transition from hull tankers to double hull units boats.

Under this proposal the Hazardous Products with tankers will no longer be carried on board of double-hulled vessels as from 31.12.2012 to the majority of
hazardous for water from 31.12.2015 for gas and similar products and from 31.12.2018 for diesel and equivalent products.

2 Expert Report chapter 2 : possibles options

1. The different options

A. Option 1: processing unit to carry bulk commodities

a. Description

You can consider removing the partitions and come up with a bulk ship provided this one is in good condition (lined, walls, girders, bottom floors, housing etc..) and may keep its European navigation certificate. Expertise is necessary to inspect each boat and decide case by case whether the ship can be retrofitted according to the regulation.

b. Adaptation Costs

Further to interviews with various French shipyards, we made the assumption that the cost of adaptation remains the same for a barge and a self-propelled ship.

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Cost of adaptation (€)	20 000 €	30 000 €	40 000 €	50 000 €	60 000 €

c. building cost of a new unit

		Type of vessel

		< 400 t	400 << 650 t	650 << 1000 t	1000 t << 1500 t	1500 t << 3000 t
Cost of construction (€)	**barge**	220 000 €	450 000 €	700 000 €	1 100 000 €	2 000 000 €
	ship	500 000 €	1 000 000 €	1 500 000 €	2 400 000 €	4 000 000 €

Those estimates were collected from several projects & studies in which VNF is involved, together with Entreprendre pour le Fluvial, a French organization in charge of promoting private initiative within the IWT industry (takeover of companies, training, private funding, …).

Costs of new shipbuilding prices correspond to a European market that can not be achieved, for example, with hulls built in Eastern countries, a Dutch architect and / or existing plans, and some Germans imported components or sometimes, even if the order and delivery are in France.

B. Option 2: convert a single hull tanker to a double hull tanker

a. Description

Possible adaptation requires a hardening resin to limit the loss of volume. This solution however seems to be very difficult to implement because it is necessary to check the impact resistance of the new wall.

b. Adaptation Costs

The following table sums up the cost of the work after each type of boat :
Unlike previous options, we made the assumption that the cost of adaptation remains the same for a barge and a self-propelled ship.

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Cost of adaptation (€)	200 000 €	300 000 €	400 000 €	500 000 €	1 000 000 €

c. building cost of a new unit

		Type of vessel

		< 400 t	400 << 650 t	650 << 1000 t	1000 t << 1500 t	1500 t << 3000 t
Cost of construction	**barge**	500 000 €	750 000 €	1 000 000 €	1 500 000 €	2 800 000 €
	ship	1 000 000 €	1 500 000 €	3 000 000 €	4 000 000 €	5 500 000 €

C. Option 3: adaptation to carry containers

d. Description

This option consists into fitting a ship building with a double hull in order to adapt it to transport of containers.

e. Adaptation Costs

We made the assumption that the cost of adaptation remains the same for a barge and a self-propelled ship.

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Cost of adaptation (€)	No sense	150 000 €	200 000 €	250 000 €	300 000 €

f. Construction cost of a new unit

		Type of vessel				
		< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Cost of construction	**barge**	300 000 €	500 000 €	750 000 €	1 250 000 €	1 750 000 €
	ship	600 000 €	1 000 000 €	1 500 000 €	2 500 000 €	3 500 000 €

D. Option 4: waiting for 2018 and scrapping

Ships are sailing until 2018, the date from which the authorizations navigation units for single hulls will end up.
After 2018, ship owners would sell those units to recyclers (WDM-type) vessels for the weight of steel value.

In France, this only applies to small Freycinet units. The boats are already paid, so there is no damping integrated in the cost and therefore the price of transport available to guests. However, this option is only available until 2018.

2. Assessment methodology and assumptions

A. Assessment methodology

Each option is evaluated by comparing to the different types of units costs for a new boat on one hand, for a suitable used boat on the other.

The freight rate will be given after a given number of annual trips.

They are two type of costs: fix costs and variable costs.

Fix costs (FC)	Variables costs (VC)
- Amortization - Crew Labour Cost (including payroll) - Insurance - Taxes - Maintenance	- Fuel - Tax for navigation **VC** = **CTN** + **CF** **CTN = Costs of navigation's taxes** CTN = A * TKS A = ratio of navigation duties. This ratio is 0,0012 €/ ton-kilometer in France. CTN = 0,0012 * TKS CTN = 0,0012 * N1 * TK1 TK1 = tk / trip TK1 = Cp * D (average distance = 250 km) TK1 = CP * 250 km **CF = costs of fuel** CF = B * TKS B = ratio of consumption of fuel (L/Tk)

	CF = A * N1 * TK1 **VC = N*CP*D (A + B)**

The cost of labor, even if it is French, however, corresponds to a level of European powers for which a transport company in Europe might have to pay a similar price even outside France.

Costs such as maintenance and insurance are probably not very different from one country to another, at least in order of percentage of total.

Turnover T must be at least equal to the sum of the costs

Turnover = Fixed costs + variables costs

B. General Assumptions

- The amortization period is, complying to private business accountancy rules applying within the EU, of 5 years for work and 15 years for the building of new boat.
- The ratio of consumption of fuel is better for a new ship (- 10 %)
- maintenance costs are twice as high for a suitable boat
- Each crew member costs in average 50 000 € per year (salaries + social charges).

The fixed costs are therefore as follows :

Adapted barge

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Crew cost	50 000 €	100 000 €	100 000 €	100 000 €	150 000 €
Insurance	2 500 €	5 000 €	7 500 €	12 000 €	22 500 €
TAx	9 000 €	9 000 €	9 000 €	9 000 €	9 000 €
Maintenance	5 000 €	5 000 €	7 500 €	7 500 €	10 000 €

Adapted ship

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Crew cost	50 000 €	100 000 €	100 000 €	100 000 €	150 000 €
Insurance	5 000 €	10 000 €	15 000 €	24 000 €	45 000 €

TAx	9 000 €	9 000 €	9 000 €	9 000 €	9 000 €
Maintenance	10 000 €	10 000 €	15 000 €	15 000 €	20 000 €

New barge

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Crew cost	50 000 €	100 000 €	100 000 €	100 000 €	150 000 €
Insurance	3 125 €	6 250 €	9 375 €	15 000 €	28 125 €
TAx	9 000 €	9 000 €	9 000 €	9 000 €	9 000 €
Maintenance	2 500 €	2 500 €	3 750 €	3 750 €	5 000 €

New ship

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Crew cost	50 000 €	100 000 €	100 000 €	100 000 €	150 000 €
Insurance	6 250 €	12 500 €	18 750 €	30 000 €	56 250 €
TAx	9 000 €	9 000 €	9 000 €	9 000 €	9 000 €
Maintenance	5 000 €	5 000 €	7 500 €	7 500 €	10 000 €

Moreover, a ship works 270 days over a year. The Daily navigation is 14 hours per day, which is a working capacity of 3,780 annual hours. For a journey of 250 km to 500 km at an average 10km/h speed the trip lasts about 50 hours. **The ship can therefore achieve 76 annual trips.**

Variables costs

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
ratio of consumption of fuel (L/Tk)	0,0120	0,0110	0,0097	0,0053	0,0048
ratio of tax of navigation (€/Tk)	0,0012	0,0012	0,0012	0,0012	0,0012

3 Expert Report chapter 3 : Economic assessment

A. Option 1: Convert a single hull tanker into a bulk cargo vessel

For this assessment, these specifics assumptions are been taken:

- Loan for the purchase of the ship refunded
- Number of tripsover a year = 40 for a Freycinet ; 60 for a 110 m (based upon VNF statistics on the French IWT net – each trip is registered through a cargo report from the skipper, either on paper forms, or since Oct. 17th, 2013 through an online cargo reporting system called VELI

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Carrying of barge or ship	250 t	500 t	800 t	1 250 t	2 300 t

First Part of the evaluation is to identify what the most profitable investment will be, between adaptation and construction. For this, we can consider a freight rate with assumptions on N : Number of trips per year = 40 for a Freycinet type ; 60 for a 110 m (based upon VNF statistics on the French IWT net).

Collection of previous data can lead to the results presented in attachment n°1.

The results are as follows:

Barge

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Adapted barge	10,67 €/t	8,34 €/t	5,73 €/t	3,61 €/t	3,10 €/t
adaptation cost	0,42 €/t	0,25 €/t	0,18 €/t	0,14 €/t	0,09 €/t
Building a new barge	11,27 €/t	8,99 €/t	6,27 €/t	4,34 €/t	3,89 €/t
Difference	5,5%	8%	9%	20%	25%

➔ Therefore, it is more profitable to invest into adaptation of an existing ship.

Ship :

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Adapted ship	11,42 €/t	8,74 €/t	5,99 €/t	3,87 €/t	3,33 €/t
adaptation cost	0,42 €/t	0,25 €/t	0,18 €/t	0,14 €/t	0,09 €/t
New ship	13,80 €/t	10,88 €/t	7,71 €/t	5,81 €/t	5,15 €/t
Difference	21%	24%	28%	50%	55%

➔ therefore, it is a more profitable investment to adapt an existing ship even if the difference is smaller for the small ship

➔ This option can be economically interesting compared to an existing unit. However, it is probably difficult to propose this unit to a customer as it was being transported dangerous goods.

B. Option 2 : Convert a single hull tanker into a double hull tanker

For this assessment, these specifics assumptions are considered :

- Evaluation of the loss of available transport capacity due to the Double hull transformation (double hull overall thickness = 0,8 m)
- Loan for the purchase of the ship refunded
- Transport of Fuel (density = 0,85 t / m3)
- Number of trips per year = 40 for the Freycinet type ship ; 60 for the 110 m type ship (based upon VN statistics on the French IWT net)

Calculations take into account fix and variable costs

Turnover T = **T1** * **C1**
T1 = quantity of fuel transported per year = **T1** = **N** * **CP with**
N = annual number of trips
CP = transport capacity for one trip

C1 = price of the transport per TEU

➔ **T = N * CP * C1**

To be profitable, the condition is that T > FC + VC

So , on the basis of the collected information, N * CP * C1 > FC + N*CP*D (A + B)

N * CP [C1 – (A+B)] > FC

At those conditions, the skipper should achieve the following number of trips :

$$N > \frac{FC}{CP\,[C1 - D * (A + B)]} \quad \rightarrow \quad N > \frac{\alpha}{C1 - \beta}$$

Under the same conditions, the transport price should be is :

$$C1 > \frac{FC}{N * CP} + D * (A + B) \quad \rightarrow \quad C1 > \frac{\alpha}{N} + \beta$$

in which :

$$\alpha = \frac{FC}{CP} \quad \text{and} \quad \beta = D * (A + B)$$

The 1st purpose of the evaluation is to find out what the most profitable investment between adaptation and construction will be. For this purpose, price of transport should be based upon the following assumptions on N : Number of trip / year = 40 for the Freycinet ; 60 for the 110 m (based on the stats on the French IWT net).

So the results are as follows :

Barge

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Adapted barge	40,00 €/t	18,77 €/t	11,33 €/t	7,19 €/t	6,23 €/t
New barge	36,69 €/t	17,47 €/t	10,42 €/t	7,03 €/t	5,94 €/t

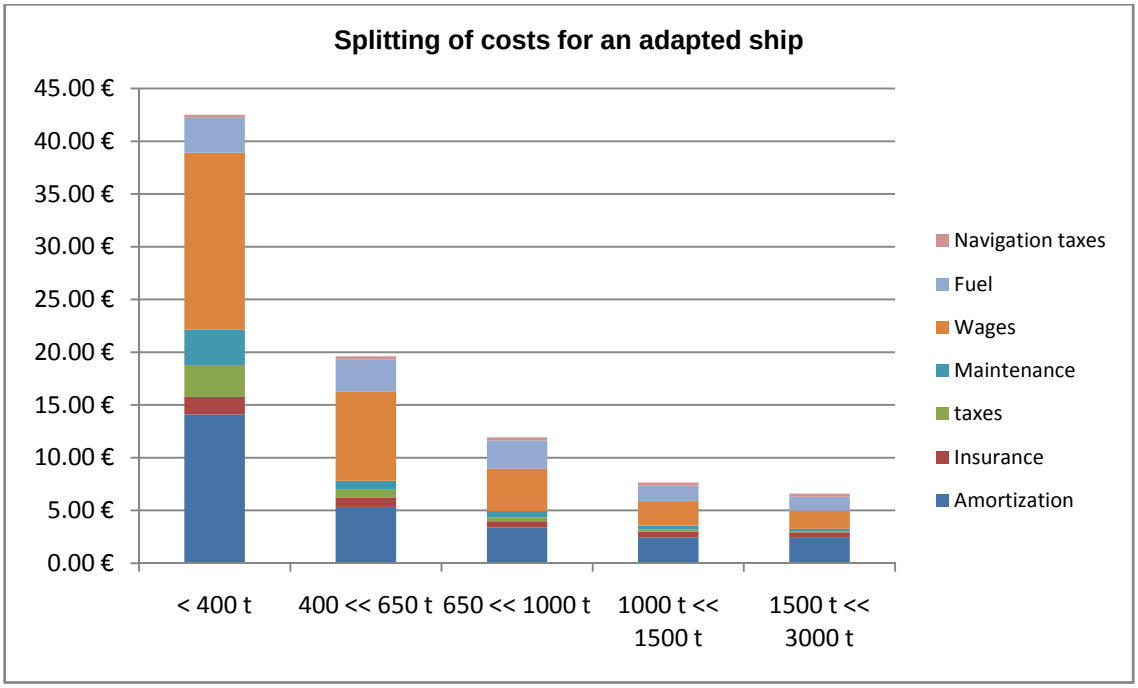
➔ So, it is more interesting to build a new barge.

Self-propelled hip

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Adapted ship	42,52 €/t	19,62 €/t	11,93 €/t	7,65 €/t	6,60 €/t
New ship	50,32 €/t	22,67 €/t	16,58 €/t	11,54 €/t	8,50 €/t

➔ as a result, it is more profitable to adapt an existing ship.

Regarding an adapted ship, the decomposition of costs is as follows:



We notice that labour cost would account for approximately 30% of transport costs for any type of unit.

The second part of the evaluation is to find out for each type of boat the price range transport compatible with the reality of exploitation. Indeed, we saw a boat could not travel more than 76 trips of 250 km.

➔ Price analysis of carriage of liquid bulk market requires limiting the range of price per ton to **20 € / ton**. This gives the following tables:

For an existing ship

Price of the ton transported	< 400 t	400 << 650 t	650 << 1000 t	1000 t << 1500 t	1500 t << 3000 t
5 €/t	915	417	236	104	85
10 €/t	232	117	73	42	35
15 €/t	133	68	43	26	22
20 €/t	93	48	3	19	16

For a new barge

Price of the ton	<	400 <<	650 <<	1000 t <<	1500 t <<

transported	400 t	650 t	1000 t	1500 t	3000 t
5 €/t	786	371	204	96	76
10 €/t	200	104	64	39	31
15 €/t	114	60	38	24	20
20 €/t	80	43	27	18	14

This chart shows that this retrofitting is profitable **provided the payload is higher than 400 tons**. The transport costs (€/ton transported) must at least reach 10 € for vessel over 650 tons, 15€ otherwise.

Under these conditions, a skipper must travel 64, 39 and 31 respectively. the ship use rate for these three cases is quite high:

- ➔ 84% pour the [650 1000 tons] units
- ➔ 51 % for the [1000 1500 tons] units
- ➔ 41% for the [1500 3000 tons] units

C. Option 3: adaptation for transport of Containers

For this assessment, these Assumptions are been taken:

- Evaluation of the number of TEUs which can be transported every year

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Capacity of transport of TEU par trip	No sense	24	48	90	192
Number of trip (based on the stats on the French IWT net)		50	60	60	60
Annual Capacity of transport of TEU		1 200	2 880	5 400	11 520

- Loan for the purchase of the ship refunded
- Amortization over 5 years
- Number of trips per year = 40 for a Freycinet type ship ; 60 for a 110 m (based upon VNF's statistics on the French IWT net)

Calculations take into account the fix and variable costs.

This survey results in the price level that the barge ownver must sell to carry a TEU.

The unit operating costs consist of fix and variable costs. The unit is obviously profitable provide the turnover is higher than the cost of operations.

With :

Turnover T	Fixed costs FC	Variables costs VC
T = **N1** * **C1** **N1** = number of TEU transported per year **C1** = price of the transport per TEU With **N1** = **N** * **CP** **N** = annual number of trips **CP** = transport capacity in TEUs per trip of the ship ➔ **<u>T = N * CP * C1</u>**	**FC** = **CIns** + **CA** + **CT** + **Cimp** + **CM + CW** **Cins** = cost of insurance **CA** = amortization of investments **CT** = taxes **CM** = maintenance **CW** = wages of crew (including payroll)	**VC** = **CNT** + **CF** **CTN** = Costs of navigation's taxes CTN = A * TKS A = ratio of tax of navigation CTN = 0,0012 * TKS CTN = 0,0012 * N1 * TK1 TK1 = tk / EVP TK1 = 11 ton * 250 km **CF** = costs of fuel CF = B * TKS B = ratio od consumption of fuel (L/Tk) CF = A * N1 * TK1 **<u>VC = N*CP (A + B)</u>**

To be profitable, the condition is that T > FC + VC

consequently , based upon the hereabove elements, N * CP * C1 > FC + N*CP (A + B)

N * CP [C1 – (A+B)] > FC

the condition is therefore that :

$$N > \frac{FC}{CP\,[C1 - (A + B) * TKEVP]}$$

First Part of the evaluation is to find out what the most profitable investment between adaptation and construction. For this, we can give a price of transport with assumptions on N : Number of trip / year = 40 for the Freycinet ; 60 for the 110 m (based upon VNF statistics on the French IWT net).

Under those conditions, the results are :

Barge

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Adapted barge	No sense	162 €/TEU	90 €/TEU	53 €/TEU	40 €/TEU
New barge		163 €/TEU	91 €/TEU	58 €/TEU	44 €/TEU

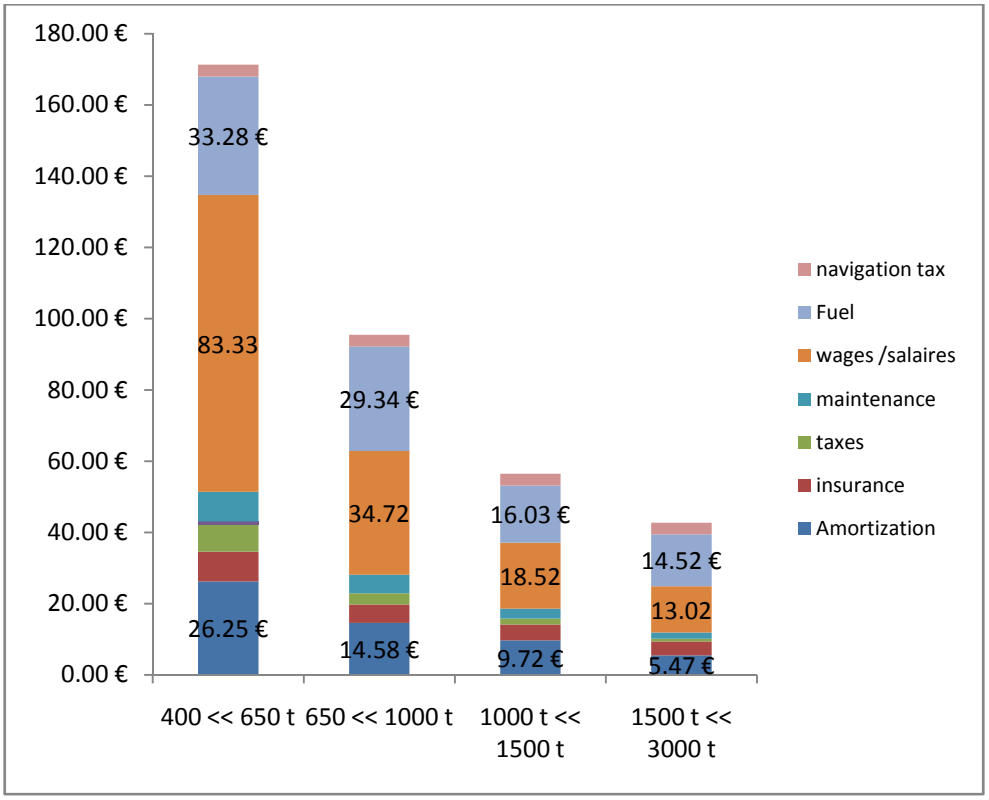
➔ So, it is more interesting to adapt an existing barge

Self propelled ship

	Type of vessel				
	< 400 t	**400 << 650 t**	**650 << 1000 t**	**1000 t << 1500 t**	**1500 t << 3000 t**
Adapted ship	No sense	170 €/TEU	95 €/TEU	56 €/TEU	43 €/TEU
New ship		199 €/TEU	114 €/TEU	78 €/TEU	57 €/TEU

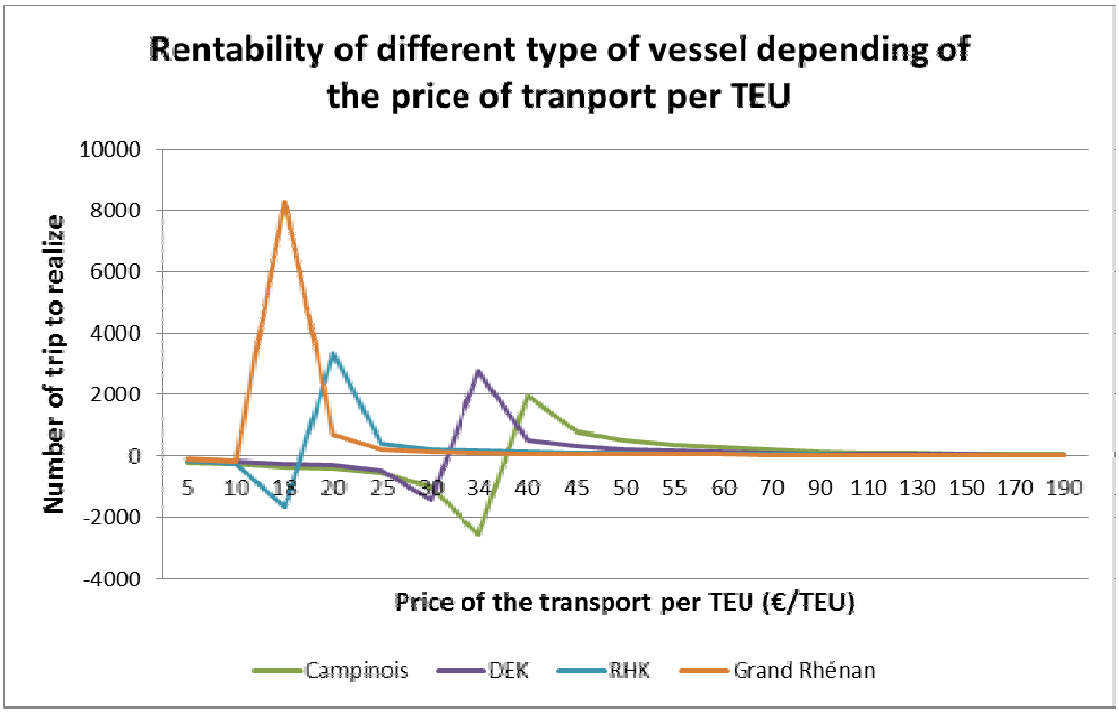
➔ consequently, it is more profitable to adapt an existing ship.

For an adapted ship, the costs can be split as follows:



The weight of the investments in the transport rates vary from 15% for a Campinois type to 14 % for the Grand Rhénan. This weight is small and relatively constant for each type of vessel.
By cons, if the unit is new, this cost will be added to fixed costs. Under those conditions, this option is not profitable.

Taking into account the value of parameters of the different ships, the condition about the number of trips can be illustrated with the following graph :



The conclusion is for the small ship, the price of the TEU transported should be very high. Considering a 50 € freight rate / TEU, **the ship would have to achieve 500 trips.**

This however is only a mathematical curve. **To refine the analysis, it should be based upon freight rates recorded on the French market.** The transport rates shall not exceed 60 € / TEU.

The following table shows the price for transport between 5 and 60 euros, the number of trips to achieve in order to reach financial equilibrium.

Price accepted by the market

Price of the transport per TEU	Campinois	DEK	RHK	Grand rhénan
5				
10				
15				
20			3337	686
25			393	208
30			209	123
35		1600	142	87
40	1953	513	108	**67**
45	794	305	87	**55**
50	498	217	**73**	**46**
55	363	169	**62**	**40**
60	285	138	**55**	**35**

Legend

	Number of trips greater than 76
	Number of trips fewer than 76

This table shows that this type of retrofitting is profitable **only for RHK and Rhine convoys**. The transport costs per TEU must at least reach 50 € for RHK, 40 € for a grand Rhine convy. Under those conditions, a barge owner should travel 73 and 67 respectively. The barge would be used, for these two cases, significantly: 96% for RHK, 87% for large Rhine.

4 Conclusion / outlook to next steps

Option	Conclusion
Option 1 : Convert a single hull tanker to a bulk cargo vessel	Economically attractive compared to an existing unit. However, it is probably difficult to propose this unit to a customer as it was being transported dangerous goods.
Option 2 : transformation of the unit to continue the transport of dangerous liquid goods (within the meaning of DNA classification)	It is more profitable to build a new barge than to adapt an existing ship
Option 3 : adaptation for transport of Containers	- It is more interesting to adapt an existing ship than build a new ship (for barge and ship) - Only profitable for RHK and Rhine convoy
Option 4 : waiting for 2018 and destruction	

5 Bibliography and References

Document reference: Author's or Editor's name, first name, title, subtitle, publisher, year of publication.

6 Indexes

6.1 Index of Figures

Geen gegevens voor lijst met afbeeldingen gevonden.

6.2 List of Abbreviations

7 Annexes

7.1 Public summary (mandatory - for each deliverable)

Input: results and their benefits, technical contact and contact for external dissemination
Briefly (max. 2 pages per deliverable) describes the contents of the deliverable respectively of the work done. Does not go into technical results or details, just intended to inform the public, what has been done and to enable them to get in touch with the MOVEIT! consortium if the want to get more detailed information or want to co-operate. External contacts in the consequence of this public summary shall always been handled through SA.3.

7.2 User Manual

(no applicable)

7.3 Training Material

(no applicable)

7.4 Other Annexes

(no applicable)