<u>For publication</u>

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CREATING

CONCEPTS TO REDUCE ENVIRONMENTAL IMPACT AND ATTAIN OPTIMAL TRANSPORT PERFORMANCE BY INLAND NAVIGATION

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EXECUTIVE SUMMARY

Introduction

The CREATING project aims at stimulating the transport via inland waterways by identifying land-based cargo flows that can be maritimised as well as shippers interested in shifting their cargo to inland waterways and providing the optimal logistic and technical conditions to make this modal shift a success.
In this paper, the author aims to present the work, the output and dissemination of the Creating-project as a whole.
Maritime cargo is already to a large extent transported onward from seaports via water, but continental cargo is still for almost 100% transported via road. Still there is a strong and increasing demand to accommodate transport via water as much as possible because the increasing transport flows via roads lead to a strong decrease of mobility and severely contribute to the exhaust of harmful gasses and materials. The aim of CREATING is to reach the goal: "stimulating the transport via water" by strengthening the position in the transport market of the entrepreneur of inland navigation.
To achieve this goal a strong team was required, and that was indeed the case. The project team comprises 27 partners from 9 countries and includes research institutes, governmental organizations, universities, shipyards and branch organizations of shippers, ship owners and shipbuilders.

Areas of research

The approach of CREATING is as follows. As stated, the transport of continental cargo flows takes place almost completely by road. Some of these flows can (and should) be maritimized. Finding feasible cargo flows in that respect is the prime mission of work package (WP) 2. Of course, for the considerations of WP 2 besides the logistics, the economics are of the utmost importance. To be able to detect these flows, out of a database encompassing the major continental cargo flows of Europe, criteria are developed to support and speed up the identification process. Logistics also includes the handling of cargo: The costs of cargo handling are often prohibitive for transport by ships and in order to optimize the processes involved, detailed studies with respect to loading and unloading equipment are carried out.
The processes in WP 2 lead to the formulation of 4 feasible cases. In the selection of cases for elaboration, CREATING required that commercial parties expressed their interest and (if necessary) cooperate in these cases. This was also carried out this way. All cases were directly supported by business partners. Subsequently the cases were handed over to the team of WP 3: Design of innovative vessel concepts. In order to be able to produce first global designs intermediate input was required from the other more technical oriented work packages: WP 5, 6, 8 and 9, see Figure below.

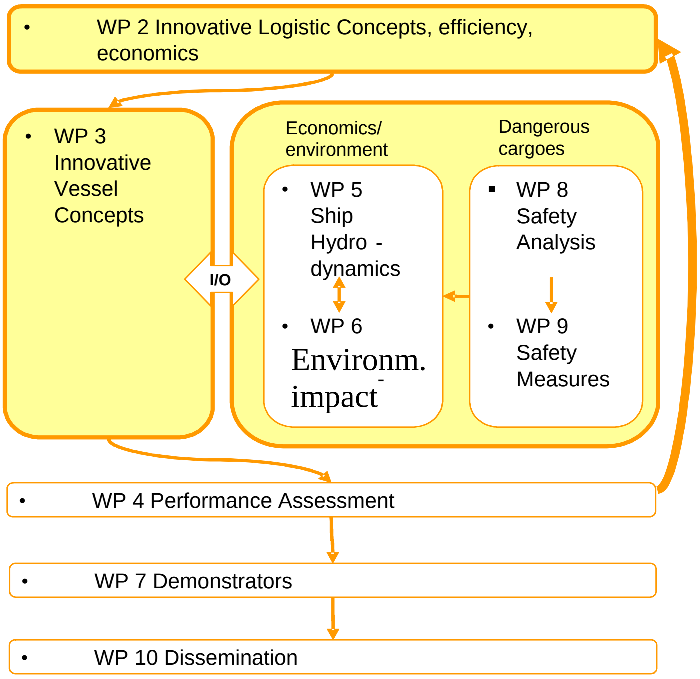


Figure 1 Relation between the Work packages and structure of CREATING

First input was required from the ship hydrodynamics, WP 5. WP 5 aims at reducing the resistance of the ship and improving the efficiency of the propulsors. They ended up with the generation of a propulsion tool box on basis of which first designs of hull and propulsion systems were carried out. However, when required in the course of CREATING, specific assistance to the prevailing cases which are designed in WP 3, was given.

Reduction of exhaust gasses and particles, which can strengthen the position of inland navigation can not only be achieved by optimizing hull and propulsor to minimise fuel consumption but can also be achieved by the application of modern engines and various techniques to reduce the exhaust of gasses and particles. First of all benefits can be obtained by introducing speed control equipment (economizers) and also by the application of after treatment techniques. These are the subjects of study in WP 6. These aspects are of special interest for the “green” transport by inland navigation and may significantly contribute to a cleaner world.

Another very important issue is safety. Transport (especially in case of dangerous goods) must take place on basis of a (as high as possible) safety level for people on board, the environment (both part of the internals system) as well as for citizens living near by the transport corridors (the external system). This can be done by reducing the probability of an accident as well as the effects of an accident.. In WP 8 (defining risk calculation methods) and WP 9 (the safety measures that can be taken, including a quantification of their positive effects) both were subject to this research. Apart from actually increasing the safety of inland ships, CREATING also aimed at defining and proposing standards for the calculation of external risk and the methods to monitor and evaluate accidents that occur. Also within the framework of CREATING a proposal was set forth to introduce Nautical Risk as a better instrument than External Risk.

Logistic requirements as well as the desire to reduce the emissions and improve safety of inland navigation lead to the global design of new vessel concepts. These are worked out in WP 3. In this WP the economics also play an important role. Of course, transport should be

as favorable as possible for the environment, but the economic benefits should outweigh the costs, otherwise the transport is not considered to be feasible.
The performances of the new designs were assessed in WP 4. Also in this WP a comparison with the other modalities will be determined on basis of logistics, economics, environmental impact and safety. The performance should at least meet the economic and logistic requirements set forth by the chain approach as worked out in WP 2.

There are already a lot of existing possibilities to reduce the energy consumption and the exhaust of harmful particles. A number of these is demonstrated (WP 7) in course of CREATING, showing the positive effect as well as the cost benefits. Type and number of the Demonstrators were determined during the second year of CREATING. The results were:

- A logistical demonstrator, given at three exhibitions
- A ship design demonstrator, organized and given at the CCR,
- The Cleanest Ship demonstrator, given at Rotterdam and Brussels.

The last two demonstrators could not be organized within the formal time schedule of CREATING. Therefore it was asked that the project could extend up to February 29th 2008. This request was sustained.

Finally in WP 10, the dissemination of results was taken care of. The results include recommendations on existing rules and regulations and recommendations to adopt proposed standards. However, also during the process of CREATING, the intermediate results were released.

STATE OF THE ART OF CREATING

Final Status

During the last period of CREATING (June 1st 2006 up to February 29th 2008) the emphasis was on management of finishing all deliverables in time.

The closing conference of CREATING was successfully held on June 14th , 2007, at the STC in Rotterdam.

Summarizing, all WP's of CREATING were finished according to original time plan except for two. During the extension of CREATING also these 2 WP's were realized:

- The Cleanest ship demonstrators and the
- The ship design demonstrator.

At that moment CREATING could be completed. The deliverables (WP 7 for the demonstrators and WP 10 for the dissemination of results) became available direct after the extended planning, i,e, in May 2008. WP 10 includes the management summary of CREATING.

During CREATING many papers were composed. A complete survey is given in ***Annex 1.***
The innovations and impact on rules and regulations is given in ***Annex 2.***
The program of the closing conference is given in ***Annex 3.***
In ***Annex 4*** *the abbreviations are listed, while in* ***Annex 5*** *the programs of the Cleanest ship demo's and the ship design demo are given.*

It can be concluded that CREATING was successfully completed taken into account that 9 months more were required than scheduled, due to the presentation of the demonstrators to a European wide audience.

WP 2: Logistics and economics

(***EVO***—*TNO INRO—Uni Buda—SPB—EFIP—Portolan—DPC—CBRB—Vopak)*

Overall status

The WP on Logistics was successfully completed slightly after the start of the third year, i.e. at October 2006. One important remark should be made in this respect. It turned out to be complicated to get industrial partners interested to assist in this fourth case but we succeeded at the end. A small company[1] proved to be interested in the design of a small tanker (for the transport of tar) with a small double skin. All 4 initiatives could subsequently be elaborated in WP 2 and handed over to WP 3. The total delay amounted about two months. After the completion of the feasibilities the final deliverable could be composed. The final deliverable was very well received.

Many cases were studied and discussed with shippers involved. One of the most important conclusions of the research carried out is that it proves to be difficult to attract the attention of shippers in such a way that they actively cooperated and started thinking of new processes for their logistics. Obviously in this respect the saying: "What the farmer does not know he doesn't eat" is true. CREATING succeeded in elaborating 4 cases. It is expected that 3 out of 4 cases will become reality. The combination of logistics and techniques as applied in CREATING proved to be successful.

Detailed overview of activities

The EVO carried out the final feasibility study, i.e. the one of the small chemical tanker. Subsequent the final report was made. The first concept proved to be far too thick. The MT composed a set of rules concerning the lay out of the deliverables. On basis of these rules a second version of the report was made and handed over to the MT. This report was received very well. The EVO also prepared the lecture to be given at the closing conference of CREATING.

TNO focused during the first period of the third year on the logistical evaluation of all 4 concepts. This resulted in improvements of the final deliverable with respects to the elaboration of the 4 concepts.

According to schedule, the University of Budapest, CBRB and Vopak did not carry out any activities for WP 2. The same holds for Portolan. After the management shift at Portolan the profile of the company changed in such a way that CREATING no longer fitted in. It seems the best solution to skip Portolan from the list of cooperating partners.

The EFIP contributed by delivering a report on the economical developments in the Rhine Area. This report was included into the final deliverable.

Finally the SPB carried out the check on the content as well as the quality check. The report was send to Brussels in November 2006 and was received well.

Lessons learned: it should be further elaborated how shippers can be approached such that more positive attitude towards the development of new ways of dealing with the logistical processes involved.

[1] *The names of the companies are left out on request die to reasons of commercial confidentiality.*

WP 3: SHIP DESIGN

*(**DST,** SPB, EVO, DPC, TNO-INRO, CBRB (relation with WP 2), DUT, VNSI and Hoebee (relation with WP 4), Marin and CTO (relation with WP 5), ECN (relation with WP 6), LR (relation with WP9)*

Overall status

At the end of the third year all four cases are ready, i.e:

- Banana carrier
- Wood chip ship
- RoRo for the Danube
- Small chemical tanker

At the beginning of the third year the attention was focused on the first three cases. The design of the small chemical tanker was starting up at that time. This was –as stated- later than planned due to the fact that it was hard to find commercial market parties who wanted to cooperate. Finally this was the case, but this case has to be treated in a confidential way. During the third year all designs were finished as well as the first concept of the final deliverable.

Detailed overview of activities

DST being the most important partner for WP 3, conducted the following activities:

RoRo carrier
With respect to the RoRo carrier for the Danube the final technical report was compiled, edited and fine-tuned. The design was ready at the beginning of year 3. Extensive Resistance and propulsion tests captive model tests were carried out at Marin. Next, the attention was focused on the remaining three cases. DST performed as leading party for this case.

Woodchip carrier
The design of the woodchip carrier was performed with special emphasis on the ice breaking concept. Mr Wilckens made some remarks on this issue during the Consortium day and on basis thereof the ice breaking design was based. Also the consequences for the ship of the pneumatic loading and unloading system were taken into account. Also the exploitation calculations made in WP 2 were checked and slightly improved also covering the operational costs. Finally, all design results of the wood chip ship were complied, edited and tuned. Delft took the lead for this case.

Banana carrier
For the banana carrier the main particulars of five different designs were set up. This was done for the **Banana Carrier** on the route Antwerp-Strasbourg. Also the hydrodynamics were optimized as well as the operational costs involved. Captive resistance model tests were performed at CTO. All these activities resulted in a draft Technical Report , which was improved and fine tuned up to standards. Hoebee was leading this concept.

Small chemical tanker
The design for the small chemical tanker was realized. Most of the activities in this respect were carried out and headed by Delft University.
Finally, DST and Delft composed a paper stipulating all innovative aspects of the 4 designs involved.

The **SPB** followed the processes closely with special emphasis on the translation of the results of WP 2 to the designs of WP 3. This was done in close cooperation with the **EVO, DPC (RoRo case for the Danube), TNO-INRO and CBRB**. The discussions ended in solid boundary conditions for the 4 cases. In fact these discussions are the linking pin between logistics and techniques.

DUT and Hoebee put a lot of effort into the designs. Hoebee into the banana carrier and DUT into the Wood chip ship and the small chemical tanker. VNSI assisted Hoebee in this respect. Major points for the banana carrier were the design of the many alternative solutions which proved to be necessary due to changing conditions within the shipper Dole and for the wood chip the specific conditions in ice for the resistance of the ship.
Marin and CTO were involved in the hydrodynamic aspects of the 4 cases. CTO performed captive towing tank tests for the banana carrier. Only the resistance was measured during the tests. The required propulsion power was calculated. The captive tests were not in the original plan but in the course of the project it was decided to do preferably three tests: one at Marin and two at CTO, but the budget available allowed only two. Marin carried out resistance and propulsion tests for the Danube RoRo carrier with a very large captive model (scale being 1:20). Moreover Marin carried out calculations to optimize the form of the ships resulting in higher block coefficients and less resistance. These calculations were carried out with Rapid, a model focusing on optimizing the wave making and form resistance. The resistance and propulsion of the remaining two models were calculated: the wood chip ship by Delft looking at ice conditions and the small chemical tanker also by Delft as well as Marin.
The design solutions developed within CREATING cover a wide range in dimensions. This is very positive, because at WP 5 (see later on) the propulsion tool box has to be generated and this tool box depends to a large extent on the design results as obtained with the present research.

ECN functioned as the linking pin to WP 6, environmental impact. For the alternative designs the consequences for the environment and alternative solutions were discussed. These discussions also contributed to the demonstrator of the Cleanest ship.
Lloyds was the connection with WP 9, improvements of safety. The link with the design consisted mainly of looking at the maneuverability. At CTO tests were performed with a captive model especially focusing on the effectiveness of all different types of rudders. The results of these tests were intensively discussed, because the results seemed at first sight to be surprising: the flat plate rudder proved to be the most effective. This is true, however, the resistance scores maximal and this is of course a negative aspect. The construction of the ship (see WP 9) is still too much in research phase for practical application and the effect of instruments does not link directly with the design.

Finally the SPB carried out the check on the content as well as the quality check. The report was send to Brussels in July 2007 and was received well.

Lessons learned: It is remarked that a lot of efficiency can be gained by looking at the form of the hull and the propulsors in detail. It is almost surprising that this is not been carried out much more as is yet the case, because the optimization does not cost much money whereas the benefits can be great.

WP 4: PERFORMANCE ASSESSMENT

(**Ulg**, DUT, SPB, EFIP, Uni Buda, **ECN,** CBRB)

Overall status

The University of Liege and University of Delft continued to team up very well in the management of the WP. Two major developments took place: one is the setting up and definition of STPI's (Sustainable Transport Performance Indicators) , Milestone 2 for inland navigation and Milestone 3 for other modes of transport and the other that of the quantification of the costs related to the exploitation of the ship, environmental impact and the safety. At the end both ends came together in Milestone 4. Delft was mainly involved in the last part, the quantification of costs, impact on environment and safety, while Uni Liege was mainly involved in the elaboration of the STPI's. This cooperation went well and resulted in very useful results. At the end of the third year the results were demonstrated and discussed, also with the International Steering Committee, the ISC.
After discussion the results were tuned and the final reporting of the deliverable was started. The concept report was ready in time. The team did a good job, because they had to perform very well at the end of CREATING because they needed the final material of all other WP's and elaborate these results into the STPI's.

Detailed overview of activities

ANAST (University of Liège) focused the attention especially on the STPI's. The idea behind the STPI's is that a thorough insight into the consequences of alternative possibilities of door to door transport are calculated. This insight comprises the effect on costs (the exploitation of the ship), on environmental impact (in terms of CO_2, NO_x and PM) and (external) safety. This insight is very interesting for shippers, inland shipping companies but also for the politicians. ANAST developed the philosophy behind the STPI's and made a mathematical model encompassing all theory.
This was done for inland ships but also for other transport modes.
Delft focused, as stated earlier, especially on the quantification of the consequences of the logistics selected for:

- The exploitation of the ship,
- The impact on the environment, and
- The external safety.

These basis calculations are essential input in order to be able to design the STPI's. All experience obtained in The Netherlands so far was integrated into this approach. Delft cooperated for these aspects intensively with SPB. SPB worked especially on the development of a prototype of the exploitation model of an inland ship. For this development also a student of the University of Delft graduated on this subject.

EFIP kept a keen eye on the relation with Brussels and linked developments over there with activities of WP 4. Subsequently CREATING played a role at the Smart River Conference (November 7th at Brussels) and participated (via EFIP) in the NAIADES action programme.

The university of Budapest participated actively in the STPI discussion, being supportive for ANAST in this respect. Also a paper on the work done on the EIWN conference was made and presented.

ECN was supportive for Delft with respect to the parameters to determine the environmental impact, while CBRB supported the development of the exploitation model as carried out by SPB.

Finally the SPB carried out the check on the content as well as the quality check. The report was send to Brussels in September 2007 and was received well.

WP 5: SHIP HYDRODYNAMICS

(**MARIN**, SPB, VNSI, DST, DUT, CTO, DPC)

Overall status

Generally spoken, WP 5 developed slightly behind schedule. There was a delay due to the fact that the design of the small chemical tanker was later than planned, but also because the E-commerce program at Marin did not function as required at the start.
At the start of the third year the surveys of the present state of the art of resistance and propulsors were available. The attention was focused on the two tool boxes, one for the hull design (resistance) and one for the propulsion (power). For this purpose boxes Marin made use of an existing own internet tool (E- commerce of Marin), called Qnowledge, based on the Questor system.
As stated, due to software problems with respect to Questor the process was delayed. The reports became available at June 2007. The advantage of the application of Qnowledge is that the results of CREATING can be used in the future in order to optimize the design of inland ships with respect to wave resistance. This is free for CREATING partners, while other have to pay. Marin will develop the toolboxes further and use the own data base to guarantee as good as possible results and, which is most important, keep the tool boxes developed alive.

The final deliverable was just in time for the Closing Conference, so the results could be part of the overall CREATING Management Summary.

Detailed overview of activities

During the last year of CREATING's formal playing time Marin carried out CFD calculations for the banana carrier and the small tanker. The CFD calculations for the banana carried were supportive to CTO who carried out captive model tests on resistance. Also Marin assisted with CFD calculations Delft with the power prediction of the small chemical tanker.

Captive model tests with the RoRo vessel were performed in order to have an as good as possible power prediction for this ship. Combining model testing (banana carrier, RoRo vessel) with CFD calculations (banana carrier, small chemical tanker) outstanding power prediction results were obtained. With respect to the wood chip ship the ice conditions complicated the calculations considerably. Among the partners there is hardly experience with navigating through ice conditions. Only Delft has some experience and succeeded (with some external assistance from DST) to make the required calculations. If the wood chip ship becomes reality these ice conditions have to be studied again with specialists in this respect.
Both toolboxes were developed. First ideas were worked out to include shallow water effects on the propulsion. Much more study (after CREATING) is required in this respect. The data base was filled with the findings of CREATING and both of the tool boxes became operational. Both tools were tested and several demonstrations were given to test the two systems involved.

SPB followed the processes involved closely and stimulated that the required interactions between all researchers became reality.

VNSI also followed the processes involved with a keen eye for the improvements which proved to be possible for the designs on basis of affordable calculations only. Here the major problem is that the inland ships are ordered (many at the time) by brokers and that the form is not an issue. Ship yards and inland shipping branches together have to stimulate that the new designs of inland ships will be optimized as done within CREATING. Also the financing institutes of inland ships (bancs) should be more aware of the fact that a little more investment will lead to a better exploitation.

DST was supportive for most of the aspects mentioned earlier. DST delivered input for the power prediction of the banana carrier. This was not only restricted to the power prediction but also DST did detailed calculations with respect to the performance of the ship on its trips including the resulting costs of fuel consumption. Therefore DST was particularly interested in the power production protocol and did a lot of testing to validate it.

Delft was actively involved in the assessment of the hydrodynamic improvements. These are required as input for the quantitative calculations of the performances of the ships in terms of exploitation and environmental impact.

CTO carried out captive propulsion tests on the banana carrier and elaborated and analyzed the results. During the tests the hull form was optimized.

DPC focused with literature on shallow water effects. The aim was to obtain propulsion coefficients for river vessels sailing in restricted water. Also DST did a lot of work in analyzing the tool boxes delivered and improving them on basis of own input. This holds both for the manual for hydrodynamic and propulsion tool box as for the power evaluation tool box.

Finally the SPB carried out the check on the content as well as the quality check. The report was send to Brussels in June 2007 and was received well.

WP 6: ENVIRONMENTAL IMPACT

(**via donau,** SPB, CBRB, VNSI, IPA, ECN)

Overall status

The final report was delivered in time by the end of 2006. One of the most striking recommendations of the report is that the introduction of low sulphur fuel (diesel with less than 10 PPM sulphur content) for inland navigation is imperative for improved environmental performance. The conclusions and recommendations elaborated in WP6 contributed to the round table decision of the CCNR demanding the introduction of low-sulphur fuels for inland navigation as soon as possible in one step. Similarly, the results of WP6 contributed also to a change of the proposal of the European Parliament, demanding the introduction of low sulphur fuel (10 ppm) for inland navigation in one step already in 2009. The former proposal foresaw a two-stage approach with introduction of fuels with 300 ppm in 2009 and 10 ppm in 2011. In combination with a Tempomaat (reduction of fuel consumption) and a SCR in combination with a PM filter a very clean (conventionally driven) ship is obtained. It was decided that it is of the utmost importance to demonstrate such a ship to the EU. A cooperation with BP was established and the mv Victoria of BP is being used for the demonstration. The practical demonstration was started in Rotterdam in the end of 2007. CREATING was extended for this reason. The planned demonstrator with the fuel cell was started up but could not be realized within the life time of CREATING.

Detailed overview of activities

via donau, being the WP Leader of WP 6, put most of the effort into the composition of the final deliverable including the management summary. The final results were discussed during the closing meeting at Vienna on October 24th, 2006. The team had accomplished a good job, with great external impact. Moreover, via donau contributed to the WP6 newsletter, e-news of via donau and composed and presented papers at the following conferences:

- NAV 2006, International Conference on Ship and Shipping Research, Genova, Italy, 2006,
- European Inland Navigation (EIWN) conference,Visegrad, 2007,
- CREATING Final Conference, Rotterdam, 2007.

SPB was actively involved in the whole process, reviewed the final deliverable and stimulated the external impact as far as possible.

CBRB also followed the process and focused on the possible impacts of using clean fuel (EN 590, gas oil with less than 10 PPM sulphur) and the translation to the Demonstrator of WP 7. Especially the PR aspects were taken care of.

The VNSI monitored the processes involved step by step and did a lot of work in checking texts. Also, the VNSI was intensively involved in the development and realization of the CREATING Newsletter of WP 6. This first Newsletter was realized in three languages, English, German and Dutch. On basis of the experiences with the first Newsletter, it was decided to do the same for all developed innovations in CREATING.

IPA revised the final deliverable and joined the International Transport Systems conference at Budapest with an own contribution, based on the measurements carried out with respect to the exhausts of engines.

Finally the SPB carried out the check on the content as well as the quality check. The report was send to Brussels in January 2007 and was received well.

WP 7: DEMONSTRATORS

The demonstrators encompassed:

Demo 1, Logistics: **SPB**, EVO, van Tongeren Kennemer BV
Demo 2, Cleanest ship: **SPB**, CBRB, VNSI, via donau, LR
extended with BP, Hug engineering, Breko, MTU, VT, Hanwel, Yara, Bitfactory
Demo 3, Ship design: **SPB,** CBRB, Marin, VNSI, LRS

Overall status

Three demonstrators were executed within the framework of CREATING, i.e.:

- Logistical demonstrator during the original CREATING contracting period of 3 years
- Cleanest ship demonstrator, at Rotterdam November 20th and Brussels February 28th 2008 , and the
- Ship design demonstrator at Strasburg, October 11th 2007,

First of all the plan was made by the WP Leader and agreed upon in the MT describing the scope of activities. The execution of the demonstrators is elaborated in the report on WP 7 while the dissemination of results is described in WP 10, the management summary.

Detailed overview of activities

Demo 1: the logistical demo
The logistical Demo was finalized in close cooperation with Van Tongeren Kennemer.
A combined brochure of Van Tongeren Kennemer and CREATING was composed and three exhibitions were visited to demonstrate the system. Also the group payed a visit to Finland to discuss the pneumatic loading and unloading system with the managing directors of the Power Plant at Jyvaskyla and the local water authorities.
The demonstrations encompass the inland navigation innovation day (April 2007) and the maritime event at Gorinchem, May 2007. In Finland the concept is still active for the wood chip ship. Decisions in this respect are expected in the second half of 2008.
EVO and SPB –in close cooperation with van Tongeren Kennemer- organized the three demonstrators. So far, industrial parties expressed interest, but so far no system has been sold. In Finland the decision making is still pending.

Demo 2: the Cleanest ship demonstrator
CBRB/SPB organizes the Cleanest Ship demo in close cooperation with BP (see Annex 5).
The ms Victoria of the BP (operated by VT bv, Rotterdam) was equipped with:

- Tempomaat
- Use clean fuel
- SCR, and
- PM filter

The first demo was given at Rotterdam, November 20th, the second at Brussels February 28th 2008. An official site was made and launched (see: www.cleanestship.nl) on which the weekly results of the demo are presented.

The operational execution of the demo was in the hands of BP, while CREATING assisted during the organization. Also the CREATING staff members participating acted as linking pin with WP 10, dissemination. CREATING stayed in full charge of these aspects, including the Cleanest ship demo.

The following organization were involved in the operational execution:
BP: as owner of the ship and project manager of the operational execution
Hug engineering: as manufacturer of the SCR and PM filter
Breko: for all constructional aspects
MTU: all aspects related to the engine of the Victoria
VT: being the manager of the ship on day to day basis
Hanwel: being the representative of Hug engineering yin The Netherlands
Yara: delivery of the Ureum
Bitfactory: composition of the site: www.cleanestship.eu

SPB was in charge of all technical aspects as well as of the acquisition and elaboration of the data on the site.
CBRB and VNSI acted as the linking pin between WP 7 and WP 10. VNSI did most of the coordinative work in WP 10. via donau assisted in making the measurements program and wrote relevant texts and publications for WP 7 on basis of their work in WP 6. The publications refer to:

- The journal, The Naval Architect, Royal Institution of Naval Architects, November, 2007
- Marine Fuels and Emissions Conference, Rotterdam, 2007,
- Contribution to the Green Ship Technology Award, 2008.

Lloyds was involved with respect to the retrofitting installation: this had to be classified. The Classification went according to schedule not in the least because of the good cooperation of Lloyds with all other technical partners.

Demo 3: the ship design demo
The ship design demo was tested internally twice, i.e. the first time during a planned meeting of the ISC at Marin August 16th and a second time at Rotterdam at Lloyds August 31st. There proved to be insufficient time to organize the demonstrator before holidays, so it was organized at October 11th 2007 at Strasburg. It was agreed with the CCR that after a meeting of the Untersuchsausschuss CREATING could demonstrate the three main aspects of the ship design demo, i.e.:

- The developed tool boxes for hull design and determination of required power
- Effects on safety by instruments on the bridge, manoeuvrability and crashworthiness.

CBRB/SPB were involved in the overall management of the ship design demo and assisted during the set up. Also SPB took care of a presentation on CREATING for the members of the Untersuchsausschuss. CBRB assisted as a linking pin to WP 10 as well as the VNSI. Marin did most of the technical work for the demo, assisted by LRS for the WP 9 aspects: improvements of safety.

Finally the SPB carried out the check on the content as well as the quality check. The report was send to Brussels in May 2008 and was received well.

WP 8: Safety Calculations

(WP 8: **BV,** LR, IVR, AVIV, CBRB, SPB)

Overall status

During the third and last year of CREATING the team got really under steam and started to perform as required. The report on the survey of existing calculation methods of external risk was in concept ready and also the selection of the most promising one: this is the model owned by the ministry of water management, public works and traffic and managed by AVIV. Next the survey of monitoring methods was completed. It came out that good examples of monitoring accidents on fairways are found in The Netherlands. Also in this case one system was selected. The calculation method for the external risk as well as the way of monitoring risks was advised to the EU as standards. The proposal for standardization of monitoring was very well received by the CCNR. It was decided to continue the cooperation with CREATING in this respect. During the execution of the tasks involved it was decided to put effort into the development of a method to develop a method to quantify the effect of measures aiming at improving the safety. The ideas developed should get more attention in future projects. Also (extra) an addendum to the deliverable was made to illustrate the possibility to come to standardized ways of working with respect to safety monitoring and calculations.

Detailed overview of activities

BV was in charge of the execution of the safety calculation work package. BV focused on general management and the generation of a prototype model to assess the risk level and also quantify the effect of measures aiming at improving safety.

Lloyds looked especially after the monitoring and contributed to a discussion paper for the standardization of the monitoring of risks. This discussion paper was mainly composed by IVR and was meant to start a discussion on standardization of an accident monitoring system at the CCR.

AVIV focused on the calculation method for external risk. The existing model was made operational and can be used in any country in the EU. All texts are in English and a good manual was prepared. The required data base was also made available and can be used directly. The data base is filled with a number of fairway stretches in The Netherlands with respect to accidents with ships.

CBRB and IVR together worked on the addendum, to give an example how a standard for monitoring can be obtained. The intention of this addendum is to pave the path to introduce standardization for inland shipping.

SPB assisted throughout the project on basis of experience with respect to the subjects experienced in The Netherlands, especially in the Scheldt area.

Finally the SPB carried out the check on the content as well as the quality check. The report was send to Brussels in April 2007 and was received well.

WP 9: SAFETY IMPROVEMENTS

(WP 9: **LR,** BV, AVIV, Imtech, Marin, DST, IVR, CBRB, CTO, SPB, TNO CMC)

Overall status

Towards the end of CREATING also the deliverable concerning the possibilities with respect to safety improvements was produced. An outstanding report dealing with the effect of instruments, manoeuvrability and crashworthiness was composed. Most important conclusion is that AIS on the bridge is an extremely effective instrument to reduce the probability of an accident. The price is low and the effects of the AIS are strong. In fact it pleads for the equipment all ships with AIS in the coming years to enhance safety.

Detailed overview of activities

Lloyds did a lot of work at the end especially in the field of determination of the improvements. This is not so easy as it may be looks. These improvements focused on the effect of manoeuvrability as well as those of the instruments on the bridge. The effects of crashworthiness were not finished: the research to new ways of construction did not proceed as planned and the results (although promising) resulted in recommendations for further research. These developments can be expected since CREATING is dealing with research. This also implies that a lot of effort has been invested in research and that this research should be finished first before attention can be paid to the consequences. However, the results of the effects of better manoeuvrability and instruments on the bridge are very interesting. The instruments on the bridge encompass first of all the AIS. Operational AIS on the bridge (being part of the implementation of the envisaged RIS) proves to be very effective in improving safety. This is mainly due to the fact that ships which are equipped with AIS have all relevant information log before an accident may happen. Subsequently there is sufficient time to contact each other and agree mutually upon measures required to avoid a collision. Of course, better manoeuvring properties than standard do help because when the threat of a collision looks to be immanent, there is only little time left to avoid. Keeping in mind that the AIS is a relatively cheap investment with a great positive effect on safety, the improved manoeuvrability is expensive while the effectiveness is far less. So, WP 9 concludes that investing in AIS is without any doubt worthwhile doing.

BV and AVIV looked at the aspects mentioned above in improving the safety level on board and analyzing the differences in the prevailing possibilities. BV spent a lot of research (see also WP 8) to quantify the improvement of risk by means of a probabilistic model. No doubt such a model would be of great interest for fairway and port authorities to determine the right safety level at the one hand while looking at the required investments at the other. Also for ship owners and insurance companies this could of interest in the future: obviously there is a link between the properties and equipment of the ship and the probability that accidents will occur. It proved to be difficult to determine the effect of safety improvements with the external risk model. This idea had to be abandoned.

Imtech worked on the AIS on board covering all relevant aspects. These studies resulted in contributions to the final deliverable.

Marin, of course, focused on the manoeuvring properties of the ship. In this respect Marin analyzed the effects of alternative steering devices taking into account the DST and CTO results.

DST researched the CTO results and reported these. They formed input for the Marin analysis. The results of the analysis of CTO/DST/Marin were very interesting and stimulated a lot of internal discussions. The plate rudder proved to be the most effective, however the technological and strength factors as well as better interaction with the propeller (thus increasing overall propulsive efficiency) resulted in selection of NACA rudder profile as a standard. The optimum between steering capacity at the one hand and overall performance at the other was determined. The main results are presented above.

IVR, CBRB and SPB mainly followed the processes closely from point of view of shipping. Their enthusiasm for the application of AIS improved because of the work carried out. This is already a big plus!

CTO carried out the model tests with a DST model on the effect of different rudders. The results formed valuable input for the studies and analysis as reported.

Last but not least TNO carried out extensive research on ship material and construction. The aim was to detect a way of construction that made it possible to avoid the double skin as far as possible. Solutions were sought in the direction of multilayer plates existing of steel and polypropylene layers. The basis idea of the research is to create the possibility to absorb as much as possible energy before the construction collapses. This goes hand in hand with a large deformation of the material. Although the results proved to be promising at the end, the research had to stop and will have to be continued in another project.

Finally the SPB carried out the check on the content as well as the quality check. The report was send to Brussels in June 2007 and was received well.

WP 10: DISSEMINATION OF RESULTS

(WP 10: **SPB,** CBRB, VNSI, IVR, DPC, via donau)

Overall Status

Dissemination of results was considered to be one of the most important aspects of the work done by the CREATING team. The dissemination is dealing with the following aspects:

- Newsletters (see Annex 1 for survey) highlighting all important topics of CREATING
- The Demonstrators, also see WP 7
- Impact on rules and regulations and innovations of CREATING (see Annex 2)
- Closing conference (see Annex 3), and
- Final survey of results of CREATING, WP 10, the management summary

The plan for WP 10 was approved by the MT at the end of 2006.

Newsletters

It was decided to deliver 7 newsletters on all results of CREATING. These newsletters encompass:

- Environmental impact (WP 6)
- Logistics (WP 2)
- Ship design innovations (WP 3)
- Hydrodynamic toolboxes (WP 5)
- Safety and safety improvements (WP 8 and 9)
- Assessment (WP 4)
- Cleanest ship demo (WP 7)

The newsletters were published in English, German and Dutch. The VNSI had a stimulating role with respect to the composition of the newsletters.

The demonstrators

In order to organize the demonstrators properly the ISC was asked to assist in the preparations. This group became operational just after period 8. Main aim of the group was to look after correct set up of the PR of the demos and a proper interfacing of the demonstrators and the ongoing political discussion. This was especially of importance for the second demo, the cleanest ship. The assistance of the ISC was very stimulating in this respect.

The ship design demo was organized at October 11th at Strasburg, for the CCR. The Cleanest ship demonstrators were organized at Rotterdam (November 20th 2007 and Brussels (February 28th 2008). The programs of the ship design demo as well as those of the two Cleanest Ship demonstrators are included in Annex 5.

Innovations and impact on rules and regulations

The innovations of CREATING and the impact on rules and regulations are included in Annex 2.

Closing conference
The team of WP 10 spent a lot of time on the organization of the final conference. The conference was given at the STC, Rotterdam and became a success. The program of the Conference is given in Annex 3.

WP 10: final survey of results, management summary
The final survey of results is elaborated in the final document of CREATING, the management summary. This management summary was composed by the technical coordinator and was ready early May 2008.

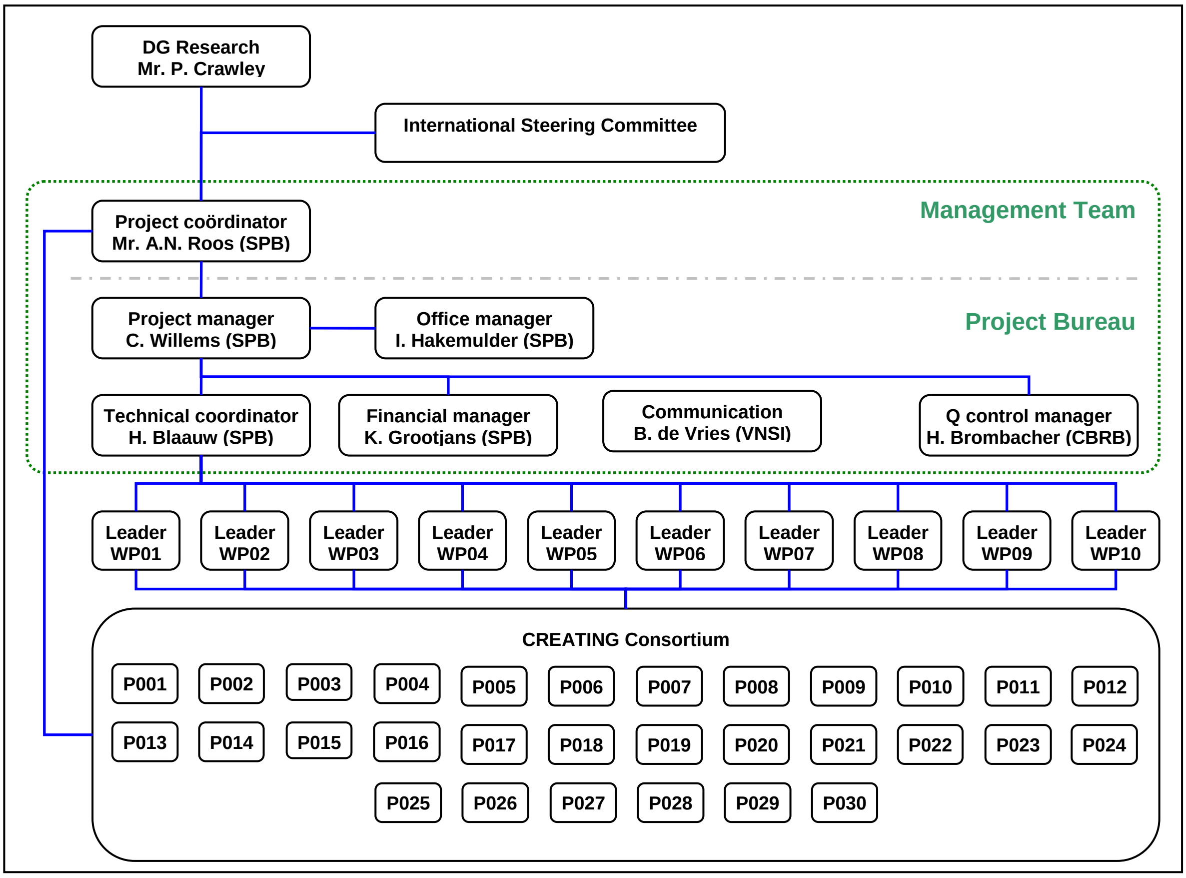
Detailed overview of activities

SPB was very much involved setting up the work package as a whole. In close cooperation with the partners CBRB, VNSI, IVR and DPC all activities were set up and executed.
CBRB/SPB headed the meeting while the IVR carried out all secretarial activities.
VNSI was (as stated) in charge of the newsletters with respect to organization and generation: stimulating that the required texts are written in time, reviewing the texts and lay outing, having the translations done, organizing the distributions and so on.
CBRB was the linking pin between WP 7 and WP 10.
The VNSI and the CBRB were in charge of the PR of the cleanest ship together with the EU, BP and the Port of Rotterdam as well as the port of Brussels. Also DG research was of great help in this respect. The Port of Rotterdam supported the first demo by facilitating the happening and offering food and drinks, the Port of Brussels did so for the second. DPC was especially involved throughout the process to see that the interests of the Danube countries were taken into account properly. At the end of May 2007 DPC also organized a symposium on the results of CREATING.
via donau made all text required for the newsletters on the Cleanest ship as well as the site based on the work done in WP 6. It proved to be a great help.

Finally the SPB carried out the check on the content as well as the quality check. The report was send to Brussels in May 2008 and was received well.

Project Organization and Participants

The following diagram gives an overview of the project management



Participants in CREATING:

P001	SPB - NL
P002	CBRB - NL
P004	EVO - NL
P006	Vopak Barging Europe b.v. - NL
P007	EFIP - EU
P009	Left the Consortium
P010	Shipyard Hoebee - NL
P011	VNSI - NL
P014	Imtech Marine and Offshore – NL
P015	IPA CIFATT – Ro
P016	Bureau Veritas – F
P017	Lloyds' Register – NL
P018	IVR - NL
P019	University of Liege - B
P020	MARIN - NL
P021	DST - D
P022	Delft University of Technology - NL
P023	Budapest University Technology & Economics - Hu
P024	ECN - NL
P025	CTO - PL
P027	TNO - NL
P028	AVIV - NL
P029	Danube Project Centre - Sb
P030	Portolan – Hu; left the consortium
P031	Left the Consortium
P032	via donau - A

Website

More information on this project is available via the internet. The project has its own website with both a public part and a restricted area for project participants. It is accessible via www.CREATING.nu. Link to or direct to cleanest ship (www.cleanestship.eu)!

Coordinator Contact information

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E-mail: info@CREATING.nu

ANNEX 1: PUBLICATIONS OF CREATING

Publications of CREATING (status May 2008):

1. EIWN, Hungary, Gyor, First ideas on CREATING, June 2003.
2. Bureau Innovation inland shipping, Rotterdam, Introduction on CREATING, December 2003.
3. EIWN, Hungary, Szeged, State of the art of CREATING, June 2005
4. Journal: EVO Logistiek, CREATING: intermediair tussen verlader en binnenschipper, February 3, 2005, nr 1.
5. 26th Colloquium Universität Duisburg, Danube Intermodal Ships,
   Container vs RoRo, June 2005
6. 26th Colloquium Universität Duisburg, Das RoRo Schiff im intermodalen Verkehr auf der Donau, June 2005
7. 26th Colloquium Universität Duisburg, The Inland reefer, June 2005
8. CCNR, Strassburg, Preliminary results and conclusions of CREATING Work Package 6: Environmental impact, December 2005
9. Lectures on CREATING, NHTV, Breda, November 2003, 2004 and December 2005
10. RINA, London, The four cases of CREATING, 15, 16 March 2006
11. Bureau Innovation Inland Navigation day, Integration of inland ships in logistical chains, Rotterdam, March 17th 2005
12. Bureau Innovation Inland Navigation, Emission reduction on inland ships, Rotterdam, March 17th 2005
13. PIANC conference, 2006, at Estoril, Environmental impact in relation to economics of inland Navigation, May 15th…May 18th 2006.
    PIANC conference, 2006, at Estoril, , May 15th, . “Unified Performance Indicators for Inland Waterway Transport”
    May 18th 2006
14. RoRo Conference at Gent, New opportunities on the Danube Corridor, May 2006
15. ICT Conference at Craiova, Romania, Emission factors in inland navigation,, June 2006, Romania.
16. INE magazine, Transport of bio mass in Finland, May 2006.
17. EVO logistiek, CREATING, het vervolg, February 200-6, No 1.
18. Journal Schip, Werf en de Zee, “CREATING”, stand van zaken na 2 jaar onderzoek. July 2006
19. CREATING presentation at CCNR meeting on diesel engine emissions 12 Oct. ’06
20. Attending Smart Rivers Conference 7 Nov. ‘06 (Brussels)
21. Article in WCN, November 2006, “Going Greener on the Blue Danube”
22. Lecture 10th Odra meeting in Potsdam on November 24th
23. 2nd Seminar on EU waterborne projects in Hamburg, December 6th, 2006
24. 3rd Danube Summit in Budapest, The need for environmental friendly and energy efficient ships”, March 6th 2007
25. Lecture 4th Danube meeting in Bucharest, March 16th, on innovations in ship building.
26. CREATING presentation NOVE (= association of fuel suppliers) 13 Dec. ‘06
27. January 2007, Yangtze Shipping Forum: “Optimizing the use of waterways by optimizing intermodal chains”
28. January 2007, EAMARNET conference on Ship design production & operation: “Concept exploration modelling in inland waterway transport”
29. February 2007, GreenPort 2007 conference: “Development of Energy Efficient and environmental inland shipping concepts”
30. CREATING presentation at University of New Orleans 15 Feb. ’07 (New Orleans)

31.CREATING WP4 presentation at the BIVEC GIBET Transport Research day, Rotterdam, 3 April 2007, “Performance Assessment for Intermodal Chains”
32. CREATING Seminar in Belgrade, May 25th, 2007
33. CREATING WP4 presentation at EIWN conference, Budapest, 27-28-29 June 2007, “Integrated indicator for the sustainable assessment of transport chains”
34. June 2007, EIWN 2007,” Development of Next Generation Chemical Tankers”
35. June 2007, EIWN 2007, “Integrated Indicator for the sustainable assessment of intermodal chains; Apllication to the transport of cargos from Frankfurt am Main (Germany) to Sofia (Bulgaria)”
36. June 2007, EIWN 2007, CREATING session
37. European Journal of Transport and Infrastructure Research “Performance assessment for intermodal chains”, Juha Schweighofer,
38. CREATING Efficiency, Motorship, C. Thill, MARIN, October 2007.
39. CREATING, Cleanest ship Demonstrator, Motorship, H. G. Blaauw, J. Schweighofer, M. Smyth, October 2007
40. RINA; The Naval Architect, Inland Environmental Performance, November 2007.

Survey of CREATING newsletters

Newsletter regarding environmental impact of inland navigation	WP 6
Newsletter on innovations in Logistics	WP 2
Newsletter on ship design innovations in CREATING	WP 3
Newsletter on hydrodynamic toolboxes	WP 5
Newsletter on safety and improvements	WP 8 and 9
Newsletter on Assessment	WP 4
Newsletter on the Cleanest ship	WP 7

ALL NEWSLETTERS ARE AVAILABLE HERE UNDER.

CREATING Inland navigation

CREATING NEWS OCTOBER 2006

INTRODUCTION

CREATING NEWS is the periodical newsletter of CREATING, a European project which aims at stimulating waterborne transport within logistic chains, paying attention to both economical, environmental and safety aspects. This edition fully focuses on emission reduction of marine diesel engines.

ENVIRONMENTAL IMPACT OF INLAND NAVIGATION

Inland navigation is an environmentally friendly mode of transport: highly energy efficient and thus emitting relatively small amounts of harmful substances. Over the past decade, however, trucks have drastically reduced their NO_x, SO_x and Particulate Matter (soot) emissions. No reason for sorrow about NO_x, SO_x and PM, however: a variety of measures can be taken to restore or even increase the environmental advantage of inland navigation. What's needed are more stringent regulations and application of technical measures to the ship itself.

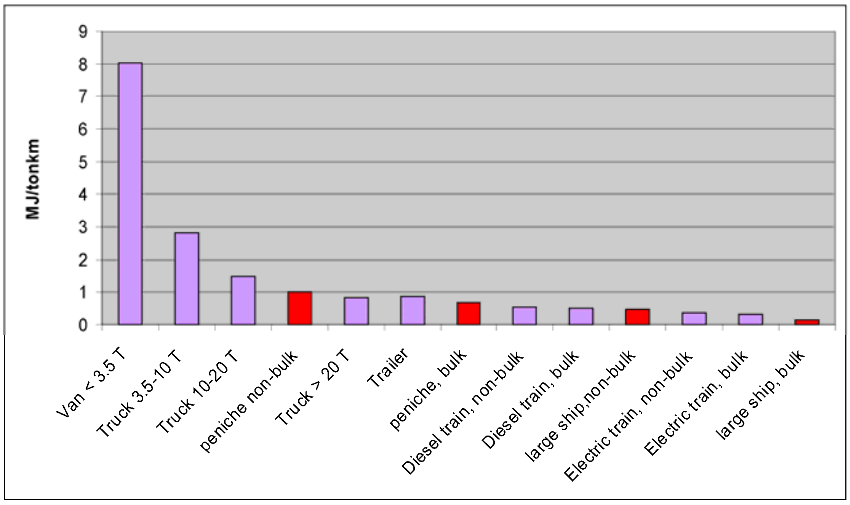


Figure 1: Energy consumption per tonkm, data from report "To shift or not to shift", CE Delft, 2003

The first blow is half the battle: low sulphur diesel oil

The very first step leading to further emission reductions should be a fast introduction of low sulphur fuel. Low sulphur fuel will in itself reduce emissions considerably, but is also a prerequisite for application of various other emission reduction techniques.

New engines can run on low sulphur fuel without technical problems; for older engines potential problems can be coped with by fuel additives or fuel type adapted lubricants.

Within CREATING, extensive research has been done into this topic. A demonstration project is envisaged in 2007 to prove the effectiveness of various measures. **This will effectively lead to the world's cleanest inland navigation ship ever.**

CREATING also shows that improving the environmental performance of a ship is not necessarily harmful to the ship owners' wallets: a reduction of fuel consumption facilitates the return on emission reduction investments.

Emissions regulations per kWh

As indicated before, inland navigation has long been considered the cleanest way of transporting goods. Fuel consumption per tonkm of waterborne transport is roughly 1/3 of that of road transport.
As a result, CO_2 emissions in inland navigation account for 1/3 compared with the ones associated with road transport. Additionally, other emissions like NOx and PM are partly lower – depending on the specific transport case, the age of the ship engine and the truck EURO level used for comparison.

Road transport and inland navigation (CCNR) emission regulations have developed fully different, however, as shown in figures 2 and 3.

The EU has set its own emission limits for inland ships, but those are based on marine engines and therefore are less stringent, at least for EU stage IIIA limits to be implemented in 2007. These rules allow up to 0.5 g/kWh of PM and 11.0 g/kWh of HC and NOx combined. At the end of 2007, the European parliament will consider further tightening of their demands. This is also reflected in the CCNR rules regarding NOx emissions: as engines get bigger ((power over 560 kW and rpm under 2800 (phase 1) or 3150 (phase 2)) more NOx may be emitted. For phase 2, this value becomes as high as 11 g/kWh at revolution rates under 343 per minute. Proposed EU stage IV envisions similar rules as CCNR stage III.

Both EURO (truck) and CCNR (inland ship) standards define maximum emissions per kWh of energy consumed, resulting in the following comparative graphs for NOx and PM emissions:

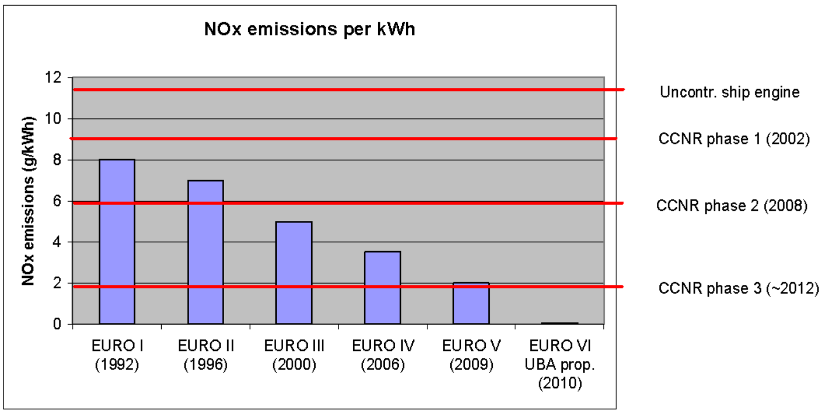


Figure 2: Maximum NOx emissions according to EURO (truck) and CCNR (ship) standards

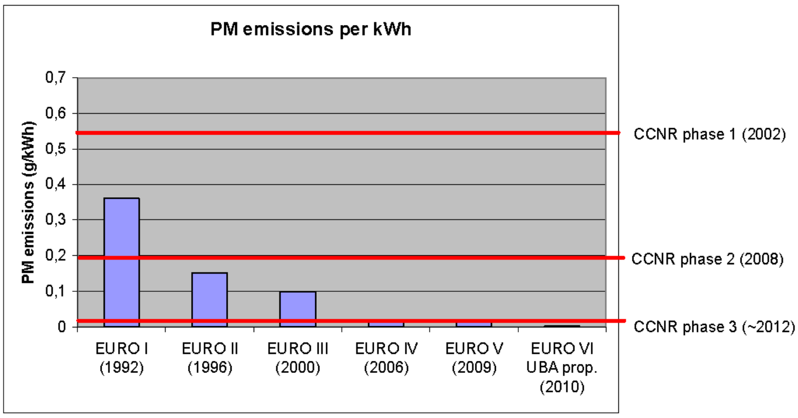


Figure 3: Maximum PM emissions according to EURO (truck) and CCNR (ship) standards

Emission regulations and performance per tonkilometre

When combining the data from the previous tables, the performance per tonkm can be determined as shown in figure 4.
For this comparison an average fuel consumption of a heavy duty truck and an inland ship is used which corresponds to the **energy use of a *truck > 20 ton* and a l*arge ship, non bulk*** *shown in Figure 1.* The emissions are taken from Figures 2 and 3.

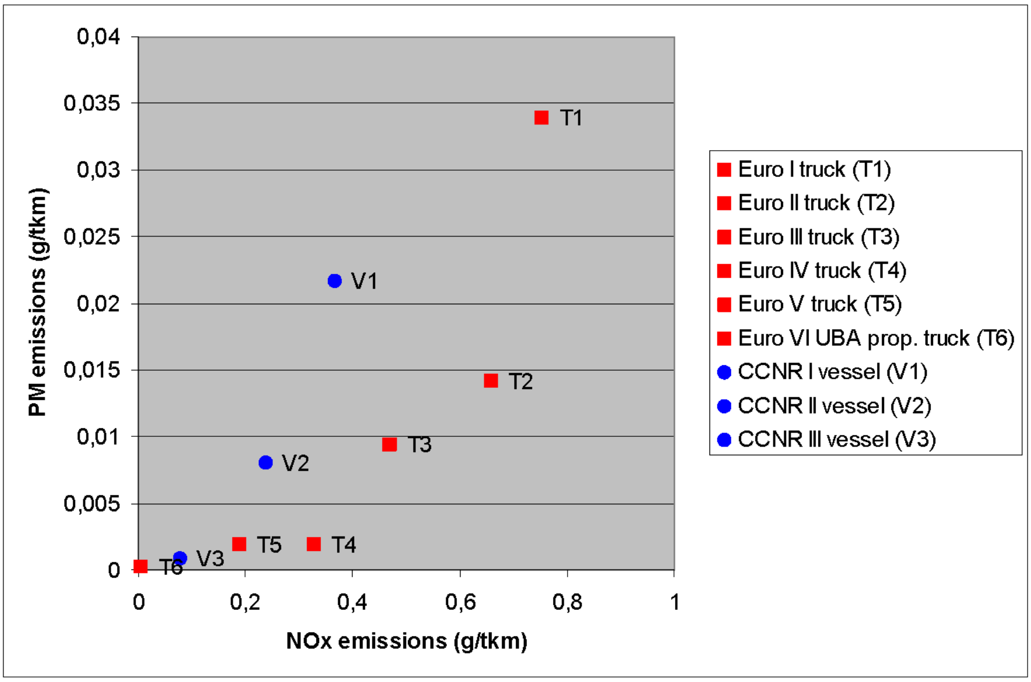


Figure 4: performance comparison on the basis of tonkm

CONCLUSIONS AND RECOMMENDATIONS REGARDING EMISSION REGULATIONS

- The various graphs show a serious time lag in implementation: requirements for inland navigation will not be up to the current standard for road transport until 2012. Even then, since the lifespan of marine engines may be up to 20 years, it will take a very long time for CCNR phase 3 standards to be common practice in the inland navigation sector.
- The most crucial and first step, at the shortest notice possible should be: reduce the allowed sulphur content for diesel oil used for marine diesel engines to 10 ppm.
- Lower emission limits are required in order to keep the future emissions caused by inland navigation (related to the transported mass) below road transport emissions.
- In order to be effective, such policy measures should affect not only new engines but also the retrofitting of older engines with after-treatment devices.
- Only a combination of lower emission limits, low sulphur diesel oil and financial incentives for implementation of emission reduction techniques will pave the way for a major improvement in emission reductions from inland navigation.

MEASURES TO IMPROVE THE PERFORMANCE OF INLAND NAVIGATION

Basically there are four options for emission reductions (the first one is not described in this news letter):

- reduction of power needed to propel the ship (improved hull form, air lubrication, other propulsors like Z-drive or whale tail wheel)
- clean fuel (low sulphur or sulphur free)
- exhaust gas cleaning
- new engine technology
- better sailing information to the captain

Evaluation of various technique and fuel options

- **Selective Catalytic Reduction (SCR):** An SCR system removes NO_x in the exhaust system. This allows the NO_x concentration produced by the diesel engine to be higher than for an exhaust system without SCR. Advantages in combination with optimisation of the motor management are a better combustion and a higher efficiency, resulting in less fuel consumption and thus leading to reduced PM and CO_2 emissions.

- **Advising Tempomaat (ATM)**: An electronic control system for optimising the energy efficiency of a vessel by advising the crew of the optimal speed for the prevailing water conditions. Reduces fuel consumption and consequently PM and NO_x emissions.

- **Biodiesel (BD)**: An alternative fuel mainly used for the reduction of CO_2 emissions due to its regenerative attributes.

- **Biodiesel Blend (BDB)**: A mixture of 80% fossil diesel and 20% biodiesel.

- **Low Sulphur Fuel (LSF)**: A fuel of higher quality compared to normal gas oil for inland navigation, having a maximum allowed sulphur content of 2000 ppm. Low sulphur fuel will bring this down to 10 ppm, equal to diesel oil for road transport.

- **Particulate Mass Filter (PMF)**: A filter to reduce the PM emissions of the engine. Requires low sulphur diesel oil.

- **Natural Gas Engine (NGE)**: An engine which shows outstanding emission characteristics in both NO_x and PM emissions compared to diesel engines. Although the fuel consumption of a gas engine is slightly higher, CO_2 emissions are reduced due to the better C/H (Carbon to Hydrogen) ratio of gas compared to diesel.

The effects of application of these techniques to emission characteristics are shown below:

	NO_x	PM	FC	CO_2
SCR	-81%	-35%	-7.5%	-7.5%
ATM	-10%	-10%	-10%	-10%
BD	+10%	-5%	+15%	-65%
BDB	+2%	-1%	+3%	-13%
LSF	none	-17%	none	none
PMF	none	-85%	+2%	+2%
NGE	-98.5%	-97.5%	+4.5%	-10%

Figure 5. Changes in mass emissions for different emission-reduction techniques compared with a basic case without emission reduction techniques. FC means changes in fuel consumption.

OTHER (EMERGING) TECHNIQUES

Exhaust gases

Wet scrubber

Wet scrubbers are widely used in the electrical power industry and use water to clean exhaust gases.
A specific maritime application of this technique removes roughly 90% of SO_x, 7% of NO_x and 80% of PM emissions. However, this system requires large space on board of a vessel and might prove as not practicable for a large scale implementation in inland navigation.

Humidification of inlet air

By adding water to the air entering the combustion chamber of a diesel engine, the flash vaporisation of that water during combustion results in a lower peak temperature, being the main factor responsible for NOx formation in an engine. As a result NOx formation is reduced by up to 50%.

Gas engines

Basically, gas engines offer the potential to reduce emissions drastically. Today, gas engines are only applied to a limited extent in the marine industry, mainly in high capital lightweight ships that require a lot of power (navy frigates, cruise ships, fast ferries).

Better sailing information to the Skipper

The energy consumption of an inland ship is dependent on the speed of the ship, its dimensions and the dimensions of the waterway. Especially in restricted water, the ship's resistance rises rapidly as the speed approached critical speed of Froude depth number 1.

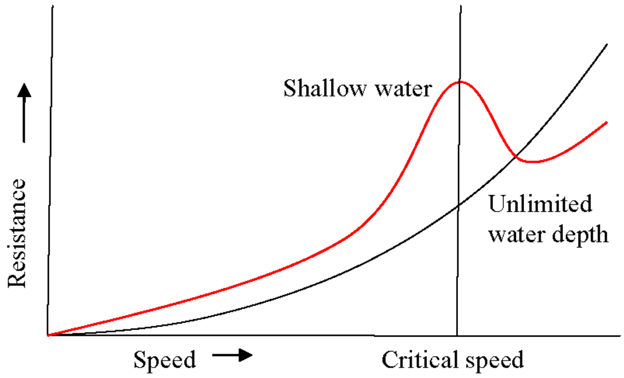


Figure 6: ship resistance in shallow water

As a result, a lot of energy can be wasted without any significant gain in speed. If the skipper can be made aware of this fact and is informed about the optimal speed to navigate through various waterways on his trip, this waste of energy can be prevented while the vessel still sticks to the original sailing schedule.

A first development with this respect is the Advising Tempomaat (ATM) system, a device which advises the skipper on the optimal speed of the ship on the basis of fuel consumption measurements. Long term trials confirmed the 10% average fuel savings in figure 5.

There is a considerable potential for further savings when the system is connected to routing software as well as electronic navigation charts with GPS controls.

RECOMMENDATIONS TO TECHNIQUE PROVIDERS

- Adapt mass produced after treatment technology from the trucking industry like SCR and particulate filter systems for being used in combination with inland vessel engines.
- Search, in co-operation with engine manufacturers, for solutions to optimize after treatment systems for marine diesel engines to a good compromise of low pollutant emissions and a low fuel consumption
- Develop other smart and affordable techniques that help inland navigation to further reduce emissions
- Inform and advise the inland navigation sector about the fuel saving and emission reduction possibilities

RECOMMENDATIONS TO OIL COMPANIES

- Make available low sulphur diesel to inland navigation as soon as possible
- Advise your clients regarding eventually necessary fuel additives and/or change of lubrication oil

RECOMMENDATIONS TO SHIP OWNERS

- Stop thinking that inland navigation will remain the cleanest transport mode without efforts from your side
- Use low sulphur diesel oil as soon as this will be available, after having consulted your engine manufacturer on possible consequences (fuel additives or fuel type adapted lubricants)
- Investigate the potential possibilities for reduction of fuel consumption and emissions from the propulsion and auxiliary engines on board

  Such an investigation may comprise, but is not limited to:
    - after treatment techniques to reduce exhaust emissions
    - installation of speed advising equipment
- Consult your engine manufacturer on the results
- Invest in the available technology

THE PROOF OF THE PUDDING

Salesmen may have the best product to sell, the potential buyer will always ask himself: true or not true?

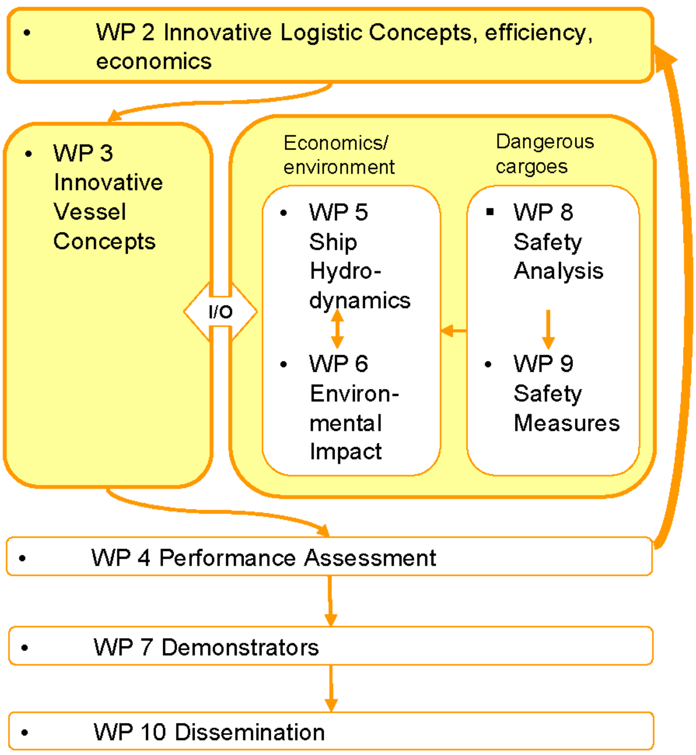
One way to prove that claimed advantages are met is to demonstrate the possibilities available.

The CREATING team is preparing a practical demonstration in the first half year of 2007, to show what is claimed to be world's cleanest diesel powered inland navigation vessel, being a vessel provided with

- Low sulphur diesel
- State-of-the-art propulsion engine
- Selective Catalytic Reduction (SCR)
- Particulate mass filter
- Advising Tempomaat

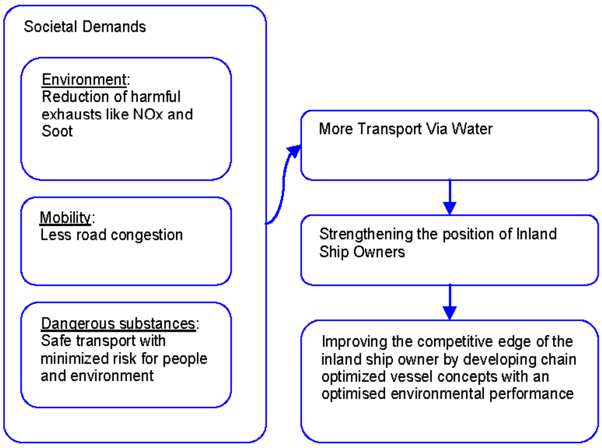
During the entire demonstration period measurements will be made to assess fuel savings and emissions. The results will be published.

MAIN TOPICS IN THE VARIOUS CREATING WORK PACKAGES



PROJECT BACKGROUND

A major part of maritime cargo, for instance maritime containers, is nowadays transported to the hinterland via inland waterways. Continental cargo, however, is mainly transported by trucks. The ever increasing transport flows, road congestions and air pollution require the exploration of other transport solutions.
Waterborne transport is safe, reliable and has by far the lowest fuel consumption per ton/kilometre. Even more important: the main European waterways could easily absorb a multiple of the present waterborne transport volume.



Project partners

NL	SPB Management, coordinator
NL	CBRB - Netherlands Rhine and Inland Shipowners Association*
NL	VNSI - Netherlands' Shipbuilding Industry Association*
A	Via Donau
B	University of Liege, Faculty of Applied Sciences
D	DST - Development centre for Ship technology and Transport systems
EU	EFIP - European Federation of Inland Ports
EU	IVR - Internationale Vereniging Rijnschepenregister
F	Bureau Veritas
HU	Budapest University of Technology and Economics, Dept. of Transport Economy
HU	Portolan
NL	AVIV
NL	Delft University of Technology, Dept. of Mechanical Engineering and Maritime Technology
NL	ECN - Energy Research Centre of the Netherlands
NL	EVO - Dutch Shippers' Council
NL	Shipyard Hoebée
NL	Imtech Marine & Offshore
NL	Lloyd's Register of Shipping
NL	MARIN - Maritime Research Institute of the Netherlands
NL	TNO INRO - Netherlands Organisation for Applied Research
NL	Vopak Barging Europe
PL	CTO Ship Design and Research Centre
RO	IPA CIFATT
SB	DPC - Danube Project Centre

** Project initiators*

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CREATING Inland navigation

CREATING NEWS

JANUARY 2007

INTRODUCTION

CREATING NEWS is the periodical newsletter of CREATING, a European project which aims at stimulating waterborne transport within logistic chains, paying attention to both economical, environmental and safety aspects. This edition fully focuses on logistics.

Logistics within CREATING

One of the main goals of CREATING is to identify and acquire continental cargo flows which are now transported by truck but are assumed feasible to be transported by ship. For this purpose criteria have been developed to obtain a quick insight into their potential feasibility for modal shift towards inland waterways.

The CREATING process started with paying thorough attention to the key role of shippers, representing the demand side. This important Work Package was lead by the Dutch Shippers Council. Emphasis has been put on detection of cargo flows which can be maritimized and on active participation of identified shippers who are dealing with such cargo flows and have an open mind with respect to modal shift. As a matter of fact, door to door transport costs are the most important criteria for considering the feasibility of modal shift.

Technically oriented teams have designed optimal ships for the identified cargo flows. They especially aimed at improving hydrodynamics, environmental impact and safety. All results have been assessed and compared to the base case of road haulage.

The combination of the efforts by the shippers involved in the CREATING processes on the one hand and improving the competitive edge of inland navigation by designing new ships on the other, is an important innovative approach of transport research.

CREATING and NAIADES: a good team

In January 2006 the European Commission launched the multi-annual Action Programme NAIADES to foster transport by inland waterways, focusing on five strategic areas:
1. Creating favourable conditions for services and attracting new markets,
2. Stimulating fleet modernisation and innovation,
3. Attracting new workforce and increasing investment in human capital,
4. Promoting Inland Waterway Transport as a successful business partner through a promotional network
5. Providing an adequate inland waterway infrastructure.

The CREATING team highly welcomed this initiative, as their project goals are well in line with NAIADES. The project results will definitely contribute to implementation of this ambitious and important EC programme.

The CREATING approach

Logistics is an essential part of CREATING: to stimulate waterborne transport more cargo must be acquired.

The CREATING team not only collected and analysed data on cargo flows, but also looked for stakeholders in logistics chains with an open mind for new ways in the logistic operation, as well as for stakeholders who are confronted with logistical bottle necks for whom waterborne transport might be a solution.

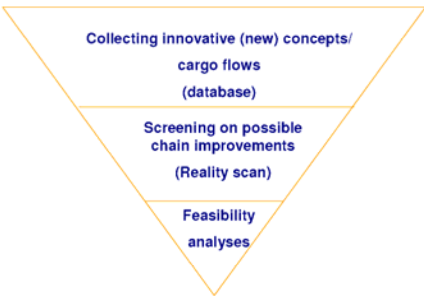


Figure 1. From cargo data base to feasibility analysis

METHODOLOGY TO IDENTIFY AND ANALYSE INNOVATIVE CASES

A logistics concept is tested in several stages, shown in figure 2.

First of all, innovative cases need to be identified. Then supply criteria can be used to select cases for analysis through a so-called reality scan. Main questions in this *first phase* are what cases are available and which of them seem to offer the best opportunities.

In the *second phase*, the reality scan analyses the selected cases at macro level and specifies the innovative character, the scope of the distribution network, the logistic organisation in general terms and the market exploited (type of goods, volume, frequency, etc.). If the reality scan shows that a case has market potential, demand criteria can be used to detail the scan and to look for supply chain partners.

Main questions in the *third phase* are whether a case is feasible from both economic, logistic and technical point of view. This phase is the **core** of the logistic research of CREATING.
The aim of the research is that the results will effectively lead to successful market implementation.

To realise market implementation, it may be necessary to set up a pilot when supply chain parties, i.e. shipper(s) and logistics service providers (LSP), are confident of the market potential and are willing to commit themselves to a pilot (*phase 4*).

After a successful pilot, parties can detail it to full implementation (*phase 5*).

From a thorough market exploration, the CREATING team identified more than 20 potential cases. Out of these – based on Supply Criteria – 10 cases were considered interesting for further study in a Reality Scan. The scans finally led to 6 feasibility studies, of which 4 turned out positively.

The four feasible cases are shortly described on the next pages.

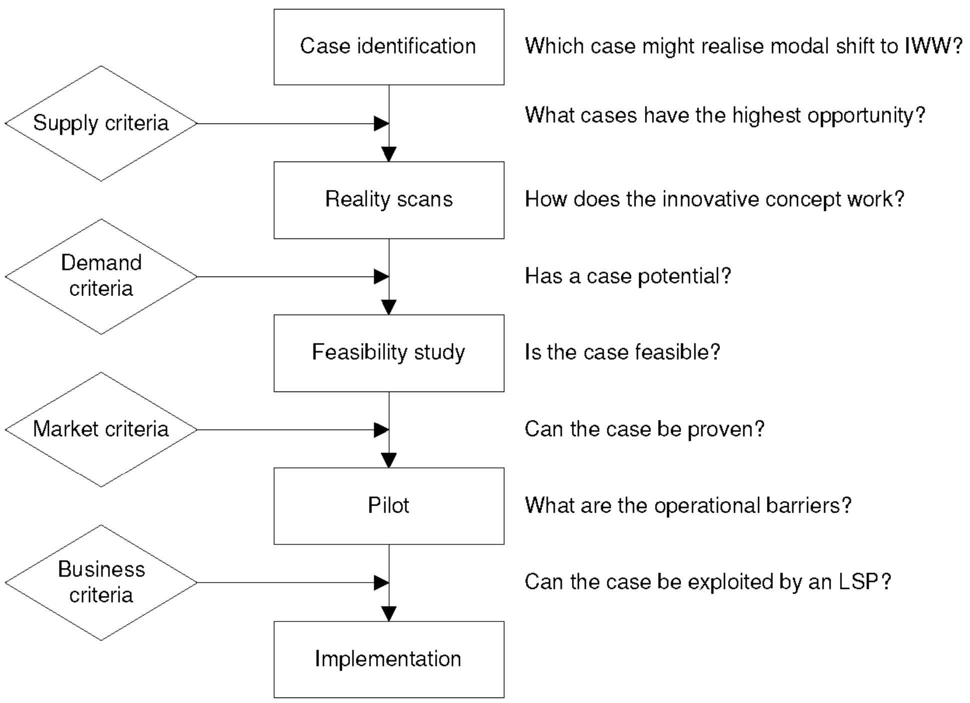


Figure 2. Methodology to identify and analyse innovative cases

CASE 1: BIOMASS HANDLING AND TRANSPORT

In Finland, the Jyväskylä Power Plant is preparing to build a new installation which will mainly be fuelled by wood chips and peat. Both biomass products are excellent fuel for power plants, though peat has a less favourable CO_2 balance.

The wooded area of Jyväskylä is characterized by long and relatively closely connected lakes over 400 km long stretches. The woods are of utmost importance for various industries. Wood products and peat generate an annual transport volume of about 5,5 million m^3.

Wood chips and peat can be transported by trucks to the power plant. Truck transport only, however, would cause logistic bottlenecks. The project study aimed to determine whether it is feasible and beneficial to transport about 3 million m^3 per barge.

A CREATING team elaborated a special inland vessel with an advanced pneumatic loading and unloading installation. In view of the high energy demand in winter, the vessel has a special propulsion installation, enabling it also to navigate in ice conditions.

The feasibility study turned out that using such inland barges will save at least € 400,000 a year. As cost calculations were based on conservative estimates for nearly all factors that would benefit inland navigation, the actual benefit is expected to be significantly higher, possibly up to over € 1,000,000.

Dual use, twin profit

A very interesting option – not further elaborated in this study – would be to use the vessel for transporting wood chips to paper mills in summertime. This would reduce transport costs considerably and prevent the vessels from lying idle during prolonged periods when energy demand from the power plant is low.

Figure 3. Loading stations and power plant location

Figure 4. Wood chip fuel (Source: www.i-sustain.com)

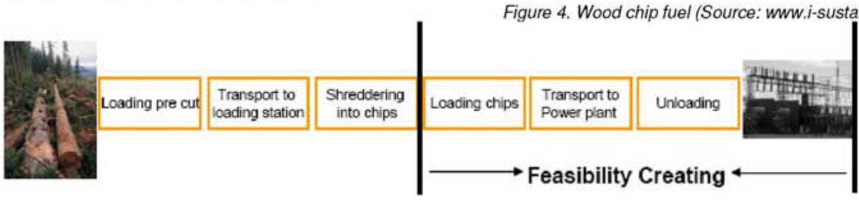


Figure 5. Core element in CREATING logistics: the feasibility study

CONCLUSIONS CASE 1: BIOMASS HANDLING AND TRANSPORT

- Biomass transport by inland barges to the Jyväskylä power plant will save at least € 400,000 a year
- As conservative estimates were used for inland navigation aspects, the actual benefit is expected to be significantly higher
- Using the vessels for wood chips transport to paper mills during summer will probably lead to considerable further savings

CASE 2: BANANA TRANSPORT

The main stakeholder in this concept is Dole Food Company, the world's largest producer and marketer of bananas and other exotic fruit. Dole will utilize a large ripening house in Hamburg and a smaller one in Strasbourg for the sale of yellow bananas.

Ripening house Hamburg

The large ripening house in Hamburg (not located at the waterside) will have room for 1800 pallets of bananas. Initially, these will be supplied on a weekly basis. In future up to 2700 pallets per week may be brought to the ripening house.

Ripening house Strasbourg

At present approximately 300 pallets per week are delivered to the small ripening house in Strasbourg (not located at the waterside either). In the next 5 years this number is expected to grow to the maximum capacity of the warehouse, being around 900-1350 pallets per week.

A real challenge was to offer a concept that meets market demands. It is not only necessary to meet the transport conditions) in relation to the product characteristics, but also to generate the right scale for an efficient transport concept.

The CREATING concept is focused on the demand in the Strasbourg area.

The concept can already be feasible with bananas only (transport cost reduction of 1 to 2%), but a combination with other products and therefore enlarging the scale would lead to an interesting transport cost reduction.

Port	Fruit Imports (Ton)
Antwerp	1.532.073 *(2004 figures)*
Rotterdam	862.770 *(2003 figures)*
Amsterdam	unknown
Bremen/Bremerhaven	383.000 *(2003 figures)*
Hamburg	572.000 *(2004 figures)*

Figure 6. Fruit imports are substantial in European Ports.
The CREATING concept would be even more interesting when linked to other products than bananas only

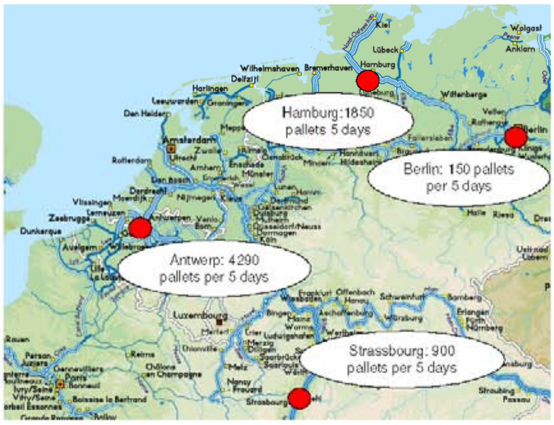


Figure 7. Waterborne transport concepts from seaport to hinterland

CONCLUSIONS CASE 2: BANANA TRANSPORT

- At the moment the business case offers a limited volume of goods
- The potential would be much larger when the transport volume of Bananas in Southern Germany increases or when a combination with similar kind of goods (e.g. perishables) is found
- On this corridor, inland navigation experiences severe competition from road transport
- Transport cost reduction in this case will be 1-2%. Increase of capacity/good flows will lead to a much higher cost reduction

CASE 3: RO/RO TRANSPORT ON THE DANUBE

State of the art

Roll on/Roll off vessels are operated on the Danube for more than 20 years already by transport company Willi Betz. These are single deck vessels with a capacity of fifty 28 tons semi-trailers each. In the eighties, these vessels made around 50 roundtrips a year on the Passau-Vidin-Passau route.

Since this service was very successful, expansion of the fleet was planned. The current transport growth requires contemporary multimodal transport to relief traffic jams in the Austrian Alps.

CREATING Objective

The objective was to investigate the feasibility of a new generation Ro-Ro vessels for transporting 14 m trailers, 6.6 m vans and 5 m cars. For this purpose several transport routes and multiple loading cases have been analysed.

Logistic and Design Requirements

The following criteria had to be met:

- Unaccompanied point-to-point transport for trailers on the main flush-deck and vans and cars on the twin deck
- 25 roundtrips of 12 to 14 days each on the Passau-Vidin-Passau route per year
- Yearly transport capacity of 5000-6000 semi-trailers or 25000-30000 cars per direction
- Danube limitations (a shallow unregulated waterway with low bridges and a number of locks)

Four vessel types, all of monohull design were analysed:

LRRV : Large Ro-Ro Vessel (L=120.0 m, B=22.8 m)
SRRV : Small Ro-Ro Vessel (L=109.7 m, B=11.45 m)
PRRB : Pushed Ro-Ro Barge (L=90.0 m, B=11.45 m) (push train consisting of 2 barges + push boat)
VLRRV: Very Large Ro-Ro Vessel (L=133.8 m, B=22.8 m)

Figure 8. The Danube Corridor (TEN Corridor nr. VII)

New Ro-Ro nominal loading unit: ESTR

Feasibility calculations were inhibited by the lack of a uniform "loading unit", as three different sorts of loads were utilised. The CREATING team developed a new nominal loading unit - Equivalent Semi Trailer or **ESTR** - to enable calculations for different Ro-Ro cargo mixtures. A standard **ESTR** unit is equivalent to a single semi-trailer, or 6 cars, or 2 vans, or 2 vans plus 1 car, all of specified dimensions.

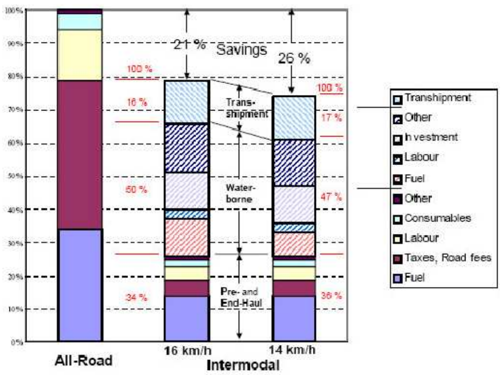


Figure 9. Example of cost structure per ESTR (load unit)

CONCLUSIONS CASE 3: RO/RO TRANSPORT ON THE DANUBE

- For car and van transport only, a **PRRB** vessel (optimised for small vehicle transport) is more convenient than self-propelled vessels
- For mixed cargo including semi-trailers a **VLRRV** is the most efficient solution
- On the route Frankfurt/M-Sofia-Frankfurt/M, savings of at least 20% to 25% are expected with intermodal transport compared to all-road transport. This is valid for a specific **LRRV** loading case of 63 **ESTR** (45 semi-trailers + 112 cars) and a ship speed of 16 km/h and 14 km/h, respectively.
- A **VLRRV** carrying 73 **ESTR** may attain a cost reduction of up to 30%
- The breakdown of total intermodal costs shows 50% for waterborne transport, 15 to 20% for transhipment, whereas the rest covers pre- and end hauling
- Labour costs (drivers and crew) are only around 10% of total intermodal cost
- Within the waterborne transport costs, approximately 20-30% are fuel costs (depending on ship speed), up to 30% investment costs, while other waterborne costs take up 35-40% - *continued page 6*

CONCLUSIONS CASE 3: RO/RO TRANSPORT ON THE DANUBE (CONTINUED)

- All considered cases were cost effective for both ship speeds considered. The ratio of intermodal to all-road costs of around 0.7-0.8 was achieved, with better results for larger vessels. The ratio of fuel consumption of intermodal to all road transport of around 0.85 and 1.0-1.1 was achieved for both **LRRV** and **VLRRV** for 14 km/h and 16 km/h, respectively.
- Existing 20 years old vessels are 30% less cost effective; their fuel consumption is 40% higher
- Other benefits of Ro-Ro service, such as elimination of the insufficient number of truck quotas for passing through Austria for non-EU trucks, lower environmental impact, higher safety and security, availability to transport non-standardised cargo etc, have not been quantified in monetary terms.

CASE 4: SMALL CHEMICAL TANKER

The feasibility study for this case had two main objectives:

a. To show that even with new (ADNR) regulations for transport of dangerous goods, requiring a double hull for chemical tankers, inland waterway transport by smaller vessels can compete with road transport on short distances.

b. To show that by clever design of inland tankers, a competitive edge can be gained over existing ships. The main dimensions (length and beam) can be reduced without losing cargo carrying capacity, or vice versa the carrying capacity can be increased without compromising its ability to sail in narrow canals.

Figure 10. Conventional chemical tanker (source: www.damenshipyards.com)

Case 4a: Tar transport in the Amsterdam area: inland navigation versus road transport

In the Amsterdam area, there is a substantial transport of ADNR goods in the form of liquid bulk to a chemical plant. This is currently done by water, road and rail, depending on the origin and destination of the cargo.

One very substantial cargo flow is tar, which can only be transported through the city of Amsterdam. This limits the ship both in length, breadth, height and draught. As a result, the transport volume per voyage is limited to roughly 800 tons.

Double hull consequences

Nearly all inland tankers in service today have the same basic layout: accommodation and wheelhouse located at the stern, behind the relatively low cargo hold.

Due to the new double hull requirement (and thus loss of loading tank volume), a higher tank deck is required for transporting the same volume as before. This is believed to be technically feasible, but in many cases the wheelhouse will have to be height adjustable in order to be able to see over the deck (high position) but also to pass low bridges (low position).

The CREATING study has led to a new conceptual design of inland tankers:

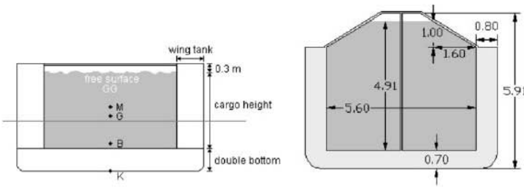


Figure11. Conventional and optimized tank cross section

Case 4b: increasing the carrying capacity of inland tankers

The above case study reveales that waterborne tar transport in the Amsterdam region is cheaper than all road transport, especially when modifications are made to the cargo tanks. Tar, however, is a "heavy" liquid and losing tank volume due to double hull requirements does not strongly influence the loading capacity in weight.

For lighter liquids, however, the situation is more complex: a substance like methanol having a density of only 2/3 of that of tar, requires far more volume per weight unit. As a result the loading tank volume becomes more important and the centre of gravity of the cargo will be higher, causing potential stability problems for the ship.

Cost and benefit

Fuel consumption of the new tanker design will be higher due to the increased displacement of the ship. Furthermore the building costs will be slightly higher as a result of the larger cargo tanks.
In the exploitation, however, this should result in substantially cost reduction per ton of cargo, provided that the ship does indeed sail in deep water often enough.

Compared to all road transport, inland navigation shows a transport cost reduction of more than 50%, provided that cargo volume is large enough to fully utilize the ship, the road transport distance is short (thus expensive per km) and no pre- or end haulage is required.

Applicability to other ship sizes

The matter discussed before is basically valid for all ship sizes, although there are limits. When applying a conventional double hull instead of a single hull, a tank width of 1.6 to 2 metres is lost. It has been demonstrated for a 7.2 m wide vessel that this is not an insurmountable problem. The difficulties become smaller as the beam of the ship involved increases.

For ships with a smaller beam, however, the effect of the reduced tank is larger and will certainly pose problems for Peniche-size vessels that are only 5 m wide. In this case options should definitely be explored to reduce the width of the double hull structure in order to keep the amount of cargo that can be carried at the same level as for single hull ships.

CONCLUSIONS CASE 4: SMALL CHEMICAL TANKER

- Case 4a: compared to all road transport, inland navigation can reduce transport cost over 50%, provided that cargo volume is large enough to fully utilize the ship, the road transport distance is short (thus expensive per km) and no pre- or end haulage is required
- Case 4b: more work is needed to accurately calculate the ship's empty weight, hull form, power requirements, centre of gravity of the lightship etc.
- Probably it is more advantageous to design the ship for less diverse cargoes than was done for the parameter study in CREATING

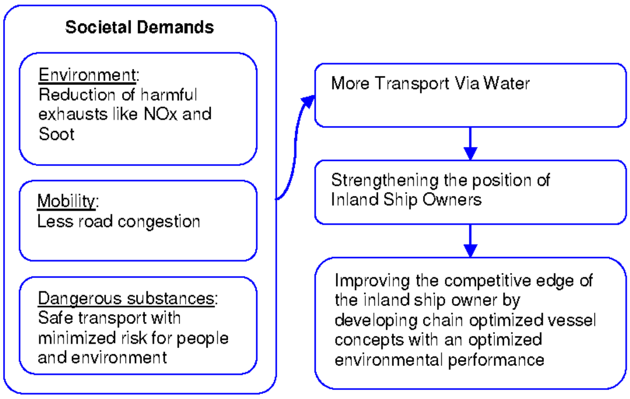
OVERALL CONCLUSIONS AND RECOMMENDATIONS REGARDING LOGISTICS

- Best examples of developing new concepts are those coming from the demand side (an incentive is a good starting point)
- To develop new concepts for inland navigation it is necessary to understand logistical and transport concepts, as no standard recipe is available
- Commitment of stakeholders is crucial for the development of new concepts, but is hard to get (continuous changing circumstances, policies)
- A lot of time has to be invested to contact the market to find the right parties that stand open for thinking in new concepts
- Changing circumstances ask for a long lead time of projects
- To develop new concepts for inland navigations it is favourable to combine expertise/knowledge of logistics, inland navigation, technique and stakeholders as CREATING does
- The working method and selection method can also be used for other projects
- Innovative projects within logistic chain have a long lead time, but can lead to substantial cost reductions

PROJECT BACKGROUND

A major part of maritime cargo, for instance maritime containers, is nowadays transported to the hinterland via inland waterways. Continental cargo, however, is mainly transported by trucks. The ever increasing transport flows, road congestions and air pollution require the exploration of other transport solutions.

Waterborne transport is safe, reliable and has by far the lowest fuel consumption per ton/kilometre. Even more important: the main European waterways could easily absorb a multiple of the present waterborne transport volume.



Project partners

NL	SPB Management, coordinator
NL	CBRB - Netherlands Rhine and Inland Shipowners Association *
NL	VNSI - Netherlands' Shipbuilding Industry Association *
A	Via Donau
B	University of Liege, Faculty of Applied Sciences
D	DST - Development centre for Ship technology and Transport systems
EU	EFIP - European Federation of Inland Ports
EU	IVR - Internationale Vereniging Rijnschepenregister
F	Bureau Veritas
HU	Budapest University of Technology and Economics, Dept. of Transport Economy
HU	Portolan
NL	AVIV
NL	Delft University of Technology, Dept. of Mechanical Engineering and Maritime Technology
NL	ECN - Energy Research Centre of the Netherlands
NL	EVO - Dutch Shippers' Council
NL	Shipyard Hoebée
NL	Imtech Marine & Offshore
NL	Lloyd's Register of Shipping
NL	MARIN - Maritime Research Institute of the Netherlands
NL	TNO INRO - Netherlands Organisation for Applied Research
NL	Vopak Barging Europe
PL	CTO Ship Design and Research Centre
RO	IPA CIFATT
SB	DPC - Danube Project Centre

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CREATING Inland navigation

CREATING NEWS

MARCH 2007

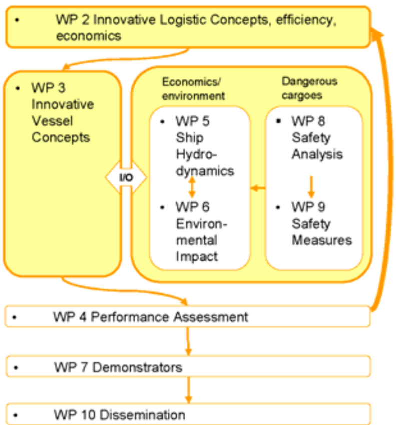
INTRODUCTION

CREATING NEWS is the periodical newsletter of CREATING, a European project which aims at stimulating waterborne transport within logistic chains, paying attention to both economical, environmental and safety aspects. This edition fully focuses on the elaboration of innovative vessel concepts, based on the preceding logistic requirements.

SHIP DESIGN WITHIN CREATING

One of the main goals of CREATING is to prove the feasibility, and to demonstrate economic and environmental potentials for the integration of inland ship into transport chains. To achieve this stronger position, waterborne transport should be competitive with road transport and as clean and safe as possible. Within the project concrete example cases have been worked out, including economic feasibility calculations and optimal technical solutions in the form of innovative ship designs.

According to the EU system for research programs the project is divided into Work Packages (WP). Mutual relations between the work packages and the CREATING structure are displayed in the scheme.



LOGISTIC REQUIREMENTS

CREATING identified 4 transport cases where the integration of inland vessels into transport chains might provide lucrative results for the stakeholders. Basic information for each of them is listed below. Please note that the logistic data were collected in 2005/2006. Later developments may influence these data, for instance for the Danube project due to the EU access of Bulgaria and Romania.

Case	1	2	3	4
Type of ship	**Biomass Supplier**	**Banana Carrier**	**Ro-Ro Vessel**	**Chemical Tanker**
Operation area	Finnish Lakes	River Rhine	River Danube	Dutch canals
Commodity	Wood chips and peat in bulk	Bananas on pallets	Semi-trailers, cars, vans	Special products
Capacity per ship (annual or per leg)	700.000 m^3 peat 150.000 m^3 wood chips	65700 pallets per year	~ 1500 ESTR per year	~ 900 tons per leg
Average speed	14 km/h in ice free water 10 km/h through the ice	16 km/h, depending on direction and depth	16 km/h, depending on direction and depth	14 km/h

Capacity requirements per ship were set-up on the base of the total annual volumes and the vessel size limits resulting from waterway restrictions. For the Biomass Supplier the annual transport volume requires two ships, whereas the Danube Ro-Ro potential volumes require more units. The Ro-Ro case also allowed the development of several conceptual ship designs of various types and sizes. Hence the number of ships to satisfy the annual volume depends on their unit size and attainable speed, related to a reasonable power demand. Only in the case of the Chemical Carrier the annual capacity was not set up as a strict demand – instead of this the capacity of the ship was determined by nautical restrictions.

CASE N°1: BIOMASS SUPPLIER FOR FINNISH LAKES

The main particulars were set up following restrictions imposed by the waterway. The minimal water depth within the area of operation, the existing bridge clearance and lock chamber dimensions determined the main ship dimensions as follows:

Length	105,0 m
Breadth	14,0 m
Draught	2.4 m
Air draught	5.5 m
Volume cargo capacity	5500 m^3

A very unfavourable fact is the uneven seasonal distribution of supply demand from the power plant. The peak demand is during winter months when ship operation is additionally affected by ice. Therefore the highest ship power demand is when navigating under ice conditions.

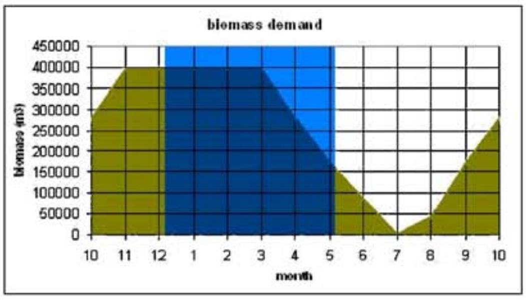


Fig. 1: Monthly distribution of supply demand vs. estimated ice period (blue)

The big difference between the power needs for open water and for ice breaking navigation confirms the choice of diesel-electric concept and DAS principle. With electric pod propulsion arrangement thrust can be generated almost equally in each direction. Another decisive reason for diesel-electric concept is the high power demands of the reloading system.

(DAS = Double Action Ship, meaning that the ship can efficiently operate sailing ahead in free water and astern in ice-breaking mode)

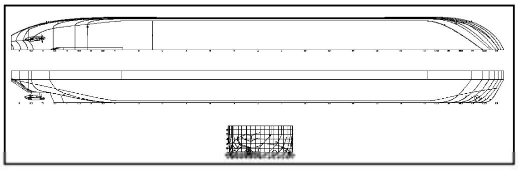


Fig. 2: DAS body lines as a compromise for good performances both in free water and ice operation

The total installed power of four main diesel generator sets and one auxiliary set is 2070 kW. The propulsion output is 2 x 900 kW. This power is needed to propel the ship when operating in ice. The second largest power demand is for the pneumatic cargo handling installation. Other important equipment are spud-poles for keeping position during reloading, a vibrating device to facilitate sliding of peat and woodchips to the central conveyor belt and a 50 m long pneumatic arm.

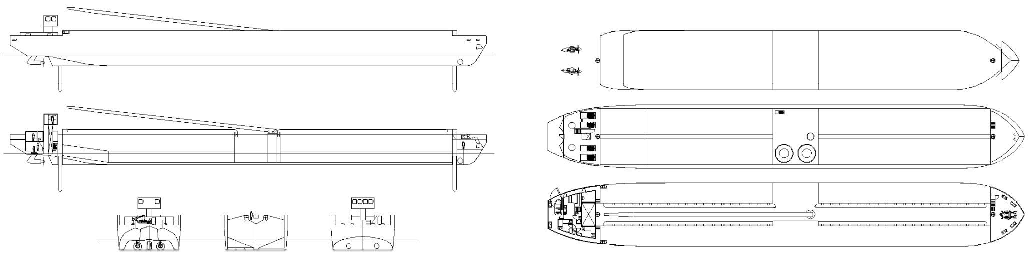


Fig. 3: General arrangement concept of the woodchip supplier

CONCLUSIONS AND RECOMMENDATIONS ON BIOMASS SUPPLIER CONCEPT

- The derived concept design of the wood chip supplier supports the modal shift feasibility. The cargo volume can be increased if the present draught and air draught limitations can be relieved.
- Full utilization of the available power on board would enable the ship to reach a considerably higher speed than presently required.
- In case of further design developments, special attention should be paid to the ship operation in ice, the filling rate of the cargo hold and the ability of cargo gear to handle all sorts of woodchips under most severe weather conditions.

CASE N°2: BANANA CARRIER FOR THE RHINE

At the very beginning of the task elaboration for banana transport three vessel concepts have been considered:

- a dedicated inland reefer, suitable for pallet transport
- a pushing unit with two barges, suitable for pallet transport
- a container vessel suitable for transport of 45 foot refrigerated containers

Eventually a dedicated inland reefer was chosen as the best viable concept for the concrete case.

This concept was further elaborated in different ship sizes and combinations:

- A "small" basic ship (SBS) having a capacity of about 1200 pallets
- A "long" ship (LS) of 2250 pallets capacity
- A so called coupling train (CT), consisting of a "small" ship and a pushed barge, having a total capacity of 3040 pallets
- A modified "small" ship (MS) with about 1000 pallets capacity, whereby "fast" (FMS) and "slow" (SMS) versions were additionally analyzed in the voyage scenarios

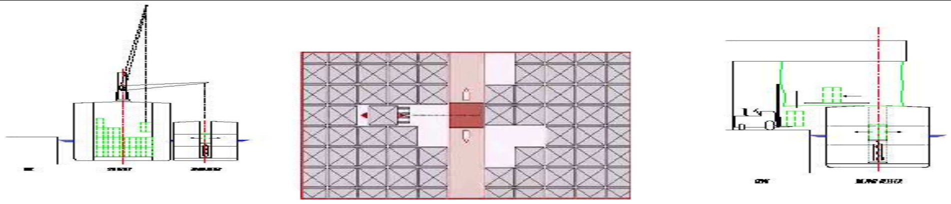


Fig. 4: Cargo handling principles:
Left: banana ship-to-ship transshipment in the Port of Antwerp
Middle: horizontal distribution of pallets aboard inland reefer
Right: ship-to-shore transshipment principle in the Port of Strasbourg

The waterway distance between Antwerp and Strasbourg is about 775 km. Applying a voyage scenario with average conditions for sectional water depth, stream flow rate and a reasonable ship speed, the turnover cannot be realized within 120 hours, being the client's ultimate request for delivery frequency. Hence two ships are needed, causing two serious negative effects: capital costs are doubled and the annual transport capacity of two ships is many times larger than the requested volume.

In an attempt to increase the speed up to the upper reasonable limit and to enable operation with one ship only, the small ship concept was modified.

The carrying capacity was lowered to a minimum of 1000 pallets, still matching the annual volume with a five days call frequency.

This resulted into a vessel with the following main particulars:

Length overall	85.94 m
Breadth moulded	11.40 m
Draught loaded	2.65 m
Installed propulsion power	2 x 750 kW
Displacement loaded	2220 tons
Carrying capacity volume	1000 pallets
Carrying capacity	900 tons

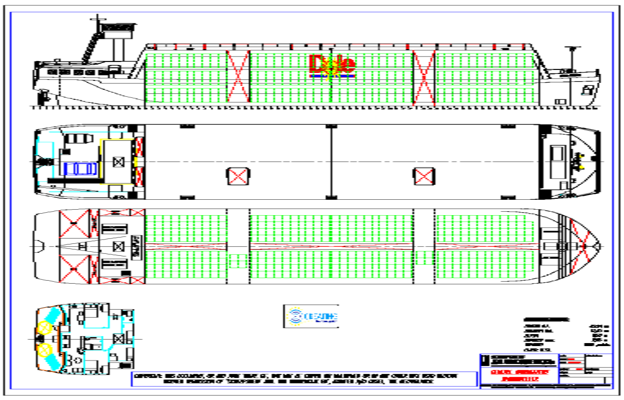


Fig. 5: General arrangement plan and side elevation of the modified small inland banana carrier

Eventually, the operation costs of feasible transport scenarios with all ship alternatives, including ship-to-shore (to-truck) transshipment in the port of destination as well as the costs of the final leg by truck, were compared to the costs of direct transport by truck along the entire route.

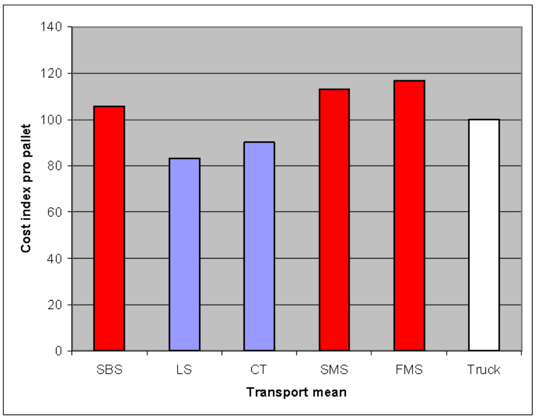


Fig. 6: Cost indices by different ship designs compared to full road transport

CONCLUSIONS AND RECOMMENDATIONS ON THE INLAND BANANA REEFER CONCEPT

- On the selected route only larger ships (shipments) could be cost competitive to road haulage. Unfortunately this situation cannot be matched, as currently the client does not envisage larger market development in the considered local distribution area (Strasbourg).
- The waterway distance between Antwerp and Strasbourg is almost twice as long as the road distance (about 775 km vs. about 460 km), bringing the main leg by inland ship on this route from the very beginning into a handicapped position.
- The unlucky combination of schedule of calls each 120 hours and the limited volume and waterway conditions imposes the need to operate with two relatively small ships.
- One larger ship with a proportionally lower service frequency, for instance once in 240 hours, could probably be much cheaper than any other alternative.
- A potential system advantage of inland ship in this chain might be direct ship-to-ship reloading in the sea-terminal.
- Increasing the volume demand, modifying the logistic concept to utilize the ship advantages and employing the capacity of ships for the journey back would dramatically change the above economic indices in favour of the ship.
- The best potentials would be a “long” ship and a coupling train.

CASE N°3: RO-RO VESSELS FOR THE DANUBE

Three alternative vessel concepts were drafted at the beginning of the design procedure: a large Ro-Ro vessel (LRRV) and a pushed Ro-Ro barge (PRRB), both based on the consideration and proposals by SoMAT and a small Ro-Ro vessel (SRRV) based on a conventional river ship type and size.

After determination of the principal particulars, a feasibility check of hydrostatic and hydrodynamic properties and structural strength, as well as operational cost analyses, it turned out that the large Ro-Ro vessel is the most favourable of the three solutions.

This vessel was even lengthened by 14 metres, resulting in a so-called “Very large Ro-Ro vessel” – VLRRV with the following main particulars:

Length overall	134.00 m
Breadth max.	22.80 m
Breadth moulded	20.60 m
Depth moulded	4.20 m
Draught without ballast	1.65 m
Fixed point height above 1.65 m draught	6.90 m
Deadweight	1900 tons
Empty weight	2030 tons
Maximum draught with ballast	2.70 m
Maximum loading capacity (payload)	1770 tons
Maximum speed in calm water (h_w = 5.0 m) in fully loaded condition	16 km/h

The purpose of the ship and the non-uniform nautical conditions along the route resulted in extraordinary high B/T and extremely high L/D ratios, setting up a challenge for both the hydrodynamic and structural part of design.

A chosen triple screw monohull with optimized form seems to be the best solution regarding operational costs and environmental impacts.

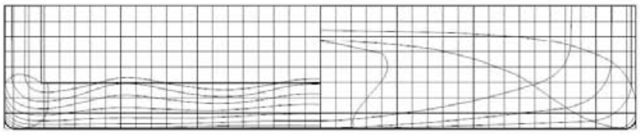


Fig. 7: Body plan of the LRRV/VLRRV after hydrodynamic optimization

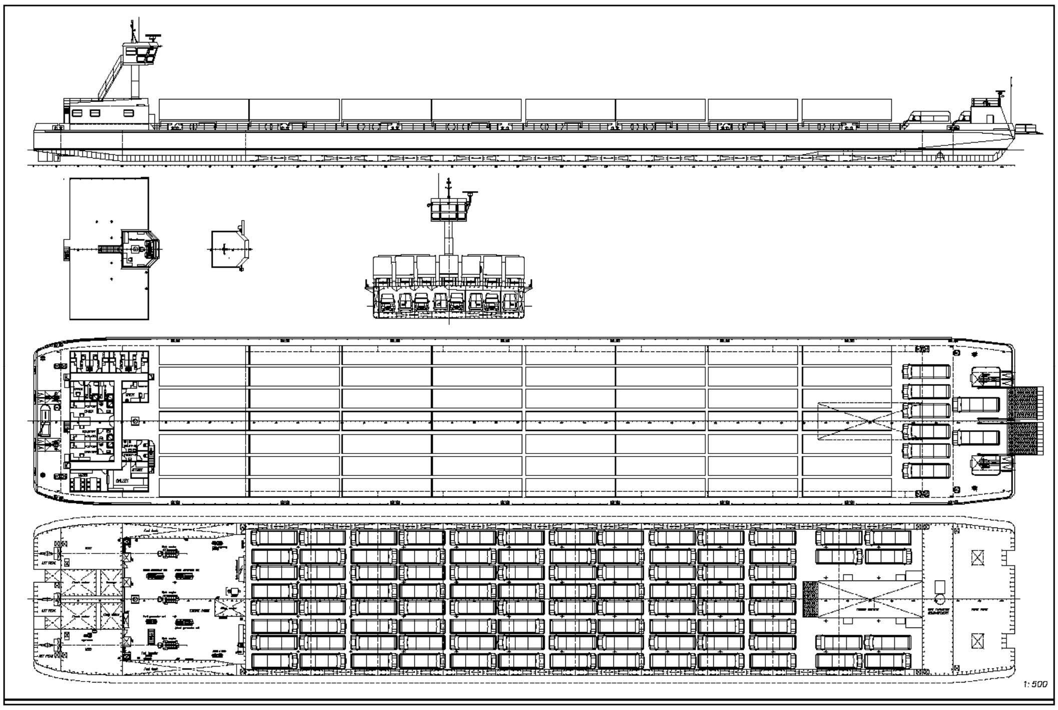


Fig. 8: General arrangement of the VLRRV having a total capacity of 73 ***ESTR***

New Ro-Ro nominal loading unit: ESTR

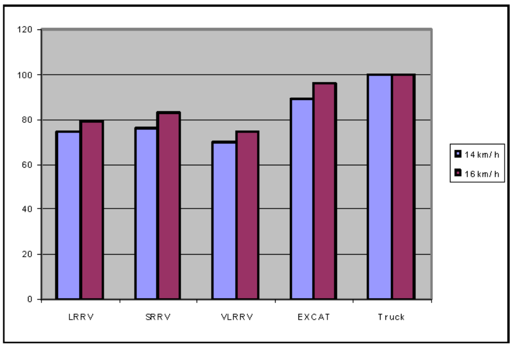
Feasibility calculations for the Danube Ro/Ro vessels were seriously inhibited by the lack of a uniform “loading unit”, as three different sorts of loads were envisaged.

The CREATING team developed a new nominal loading unit - Equivalent Semi Trailer or **ESTR** - to enable calculations for different Ro-Ro cargo mixtures.

A standard **ESTR** unit is equivalent to a single semi-trailer, or 6 cars, or 2 vans, or 2 vans plus 1 car, all of specified dimensions.

An operational cost comparison of various design options, existing Danube Ro-Ro ships and truck, (taking into account pre- and end-haulage by truck for waterborne transport) showed 20 to 30 % savings, the VLRRV being by far the best option. Due to a propulsion concept based on modern truck engine technology the emission could be directly compared to full road transport, showing about 20% less emissions for the intermodal transport scenario with integrated VLRRV. The calculations were made for the Frankfurt/Main (D) – Sofia (BG) route.

In case of end destinations closer to the Danube terminals Passau and Vidin, the advantages of Ro-Ro service would be even more emphasized.



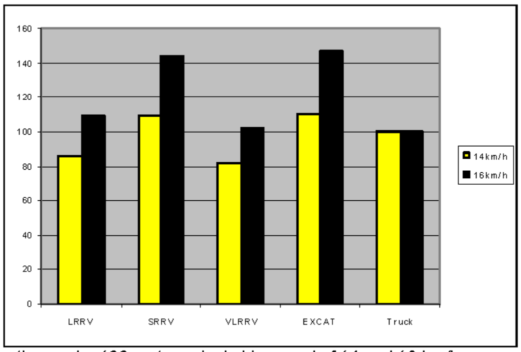


Fig. 9: Cost index (left) and fuel consumption index (right) – truck on the road = 100 – at nominal ship speed of 14 and 16 km/h

CONCLUSIONS AND RECOMMENDATIONS ON RIVER RO-RO VESSEL CONCEPT

- Regarding overall transport costs it is evident that all compared versions of the Danube Ro-Ro vessels are economically competitive, especially in a slower scenario at only 14 km/h nominal speed.
- The fuel consumption is very sensitive to the speed. Sailing at 16 km/h in a water depth of 5 metres might be too fast. Reducing the speed to 14 km/h also reduces the fuel consumption significantly.
- At least the modern large vessels – LRRV and VLRRV - could bring considerable fuel savings.
- This speed reduction does not affect the logistic requirement of 25 annual turnovers per ship.
- The fuel consumption of the SRRV could be considerably improved when using an optimized hull form and propulsion arrangement. In the CREATING study the SRRV was intentionally assumed as low-investment ship, simplified in all aspects in order to reduce the capital costs. A design optimization would inevitably lead to an increased value of the new ship and consequently to slightly higher operational costs, but energy savings vs. full road haulage could be easily achieved.
- Despite the obvious fact that a larger vessel has lower costs per transport unit, for Ro-Ro services the departure frequency might be the crucial factor to gain the market.
- Considering the annual capacity of the Danube Ro-Ro service between Passau and Vidin, a fleet of 5 LRRV has almost an identical annual capacity as 11 SRRV. Consequently, the equivalent capacity fleet of SRRV can offer at least a twice higher departure frequency than LRRV. For truck operators running along the Danube corridor, especially in West-East direction, this aspect might be decisive.
- The final conclusion is that both cost and fuel indices show that the advantages of using the Danube Ro-Ro vessels are very impressive for all three new intermodal concepts and point out the huge potential progress in comparison with the old EXCAT ships. The PRRB version with 3 decks is dedicated to passenger car and van transportation and as such assumed to be the optimal option for this particular segment of Ro-Ro transports on the Danube.

CASE N°4: SMALL CHEMICAL TANKER

The goal was to design a small chemical tanker to transport special products over a short distance.

The waterway restrictions determined the maximal dimensions of a ship as follows:

Length	63.0 m
Breadth	7.2 m
Draught	2.3 m
Depth	3.8 m
Air draught	4.5 m

This resulted in a form with very high block coefficient of 0.91 and the following main particulars:

Displacement	1156 m^3
Lightweight	230 ton
Deadweight	926 ton
Liquids (effects)	25 ton
Cargo weight	900 ton
Cargo volume	772 m^3

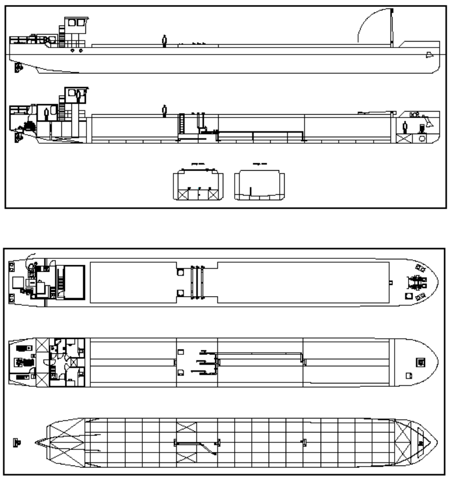


Fig. 10: General arrangement plan of a small chemical tanker

The single Z-drive diesel driven propulsion arrangement was chosen as the most reasonable for the purpose of the ship, her size and sailing area.

Based on a preliminary power prediction, a 300 kW main diesel engine would ensure a speed of at least 14 km/h in the given fairway conditions.

This allows wide possibilities to implement the last generation of advanced technology truck based engines as prime mover, however with a cooling system adjusted for marine use.

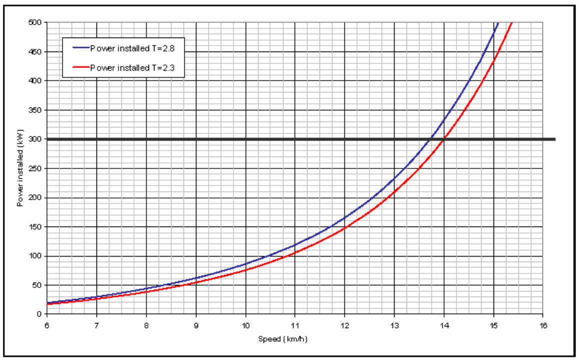


Fig. 11: Preliminary power estimate for the small chemical carrier

The double skin structure complies with the CCNR (Rhine) regulations and the ADNR (transport of hazardous materials on the river Rhine) rules for so-called N-type inland waterway tankers.

The proposed concept completely satisfies the prescribed rules and indicates the highest standards with regard to active and passive safety aspects – ability to avoid accidents by efficient manoeuvrability as well as ability to withstand a possible collision without fatal consequences.

Note:

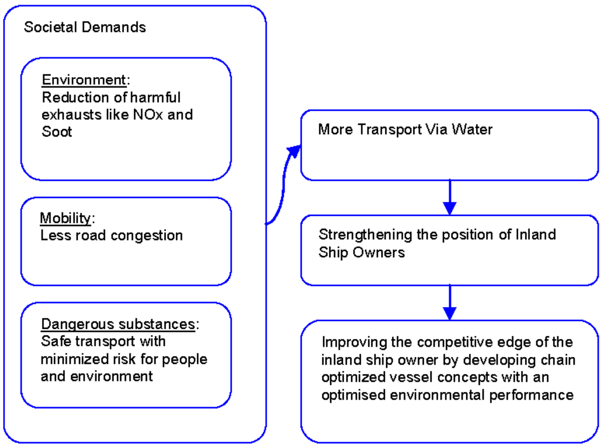
At the time of editing this newsletter the design work for the small chemical tanker was not yet fully completed and operational cost indicators therefore could not yet be derived.

As a consequence, it was neither possible to bring firm conclusions regarding the ship's efficiency, nor to make recommendations for further technical or other developments.

PROJECT BACKGROUND

A major part of maritime cargo, for instance maritime containers, is nowadays transported to the hinterland via inland waterways. Continental cargo, however, is mainly transported by trucks. The ever increasing transport flows, road congestions and air pollution require the exploration of other transport solutions.

Waterborne transport is safe, reliable and has by far the lowest fuel consumption per ton/kilometre. Even more important: the main European waterways could easily absorb a multiple of the present waterborne transport volume.



Project partners

NL	SPB Management, coordinator
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NL	VNSI - Netherlands' Shipbuilding Industry Association*
A	Via Donau
B	University of Liege, Faculty of Applied Sciences
D	DST - Development centre for Ship technology and Transport systems
EU	EFIP - European Federation of Inland Ports
EU	IVR - Internationale Vereniging Rijnschepenregister
F	Bureau Veritas
HU	Budapest University of Technology and Economics, Dept. of Transport Economy
HU	Portolan
NL	AVIV
NL	Delft University of Technology, Dept. of Mechanical Engineering and Maritime Technology
NL	ECN - Energy Research Centre of the Netherlands
NL	EVO - Dutch Shippers' Council
NL	Shipyard Hoebée
NL	Imtech Marine & Offshore
NL	Lloyd's Register of Shipping
NL	MARIN - Maritime Research Institute of the Netherlands
NL	TNO INRO - Netherlands Organisation for Applied Research
NL	Vopak Barging Europe
PL	CTO Ship Design and Research Centre
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CREATING NEWS MAY 2007

INTRODUCTION

CREATING NEWS is the periodical newsletter of CREATING, a European project which aims at stimulating waterborne transport within logistic chains, paying attention to both economical, environmental and safety aspects. This edition of CREATING News fully focuses on safety aspects.

SAFETY WITHIN CREATING

The aim of CREATING is to strengthen the position in the transport market of the entrepreneur of inland navigation. Due consideration is also given to environmental and safety performance of subject logistic chains.

Measures are determined to enhance the safety level. These concern navigational aids on the bridge and manoeuvring aids with the objective to decrease the probability of collisions and measures related to the construction of the ship to decrease the effect of an accident: active and passive safety measures.

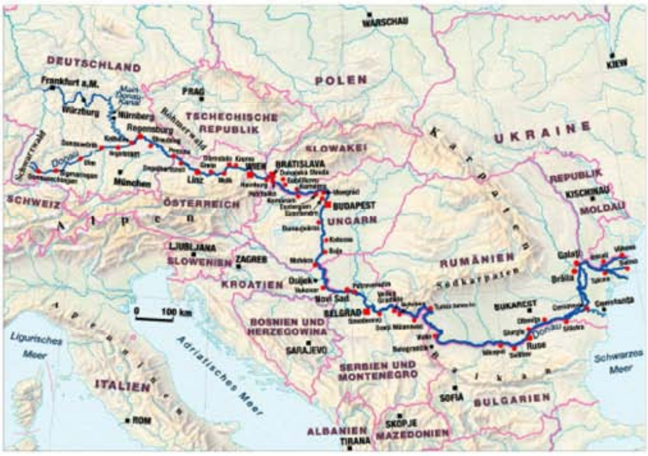
The typical character of inland navigation has been the starting point:

- Restricted fairway width
- Stream flow rate on the rivers, especially in river bends
- Dense and oblique traffic conditions in way of junctions
- Strongly fluctuating (cross-)wind conditions
- Structures like bridges and locks
- Shallow waters just metres aside the fairway
- Floating debris

These characteristics are also boundary conditions for the work reported here. Combinations of navigational aids, useful in
decreasing the probability of accidents, have been defined. The effectiveness of a number of manoeuvring devices was established, as well as their possible influence on safety. The passive safety embodied in the “crashworthiness” of the hull’s structure has been assessed.

The mutual influence of these measures is governed by the sequence of events during a manoeuvre to avoid an accident, a collision or a grounding.

Figures 1 and 2: European main rivers Danube and Rhine (the colours indicate the navigable Upper, Middle and Lower Rhine)



Active safety

The effects of the active safety measures, navigational and manoeuvring equipment are brought under a common denominator: the influence on the time available for "decision making". This time lapse is bounded by the moment the skipper becomes aware of a possible danger ("awareness") and the moment he ultimately should start a manoeuvre to avoid an accident ("start manoeuvre"). Nautical instruments advance the moment of awareness. Better manoeuvring effectively delays the latest start of an evasive manoeuvre. Both types of equipment lead to an increase in time and travelling distance available for decision making.

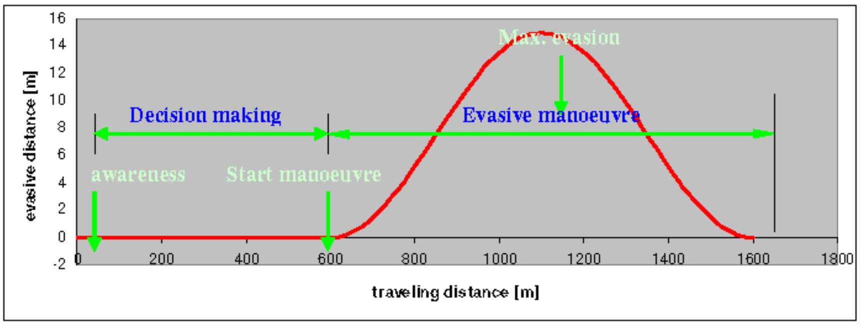


Figure 3: Characteristics of an evasive manoeuvre

In terms of cost-effectiveness latest developments in nautical equipment are better than manoeuvring devices *(fig. 5)*. ECDIS (Electronic Chart Display and Information System) combined with an overlay of GPS (Global Positioning System) and AIS (Automatic Identification System) information provides excellent performance. The results are expressed in terms of the improvement of the probability of occurrence of an accident (collision or grounding), relative to the current probability (ratio of new probability to current probability) *(fig. 4)*

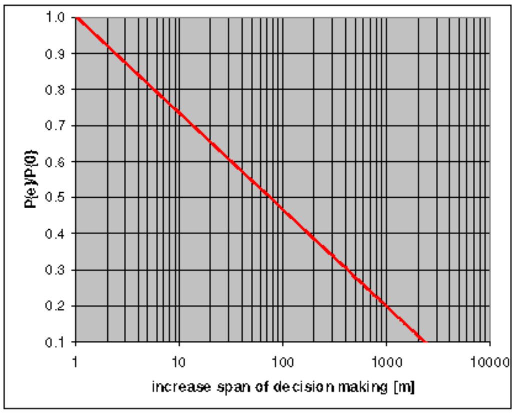


Figure 4: Probability of an accident as a function of span of decision making

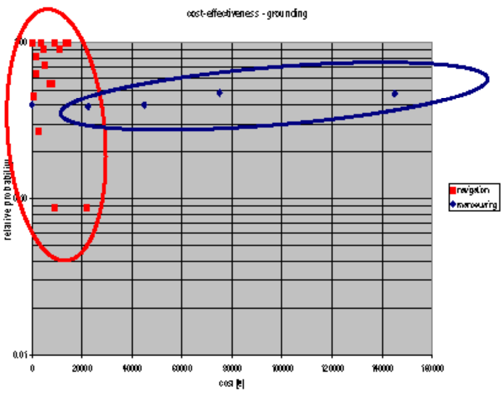


Figure 5: Cost effectiveness of nautical (red) and manoeuvring(blue) equipment

Passive safety

If an accident is unavoidable, the ship's ability to cope with the consequences is essential.
An estimate has been made of the influence of different structural solutions. A specific proposal to improve the crashworthiness of hull structures is under consideration: ply-steel.
Three layers of steel, bonded by plastic foils or layers. The anticipated effect is to maximise the (side shell) area affected by the collision forces. The mechanism ruling this effect is that the middle layer of steel, protected by the adjacent layers can slide and stretch over a much larger area than the directly hit spot. This structure is expected to show improved energy absorption during a collision.

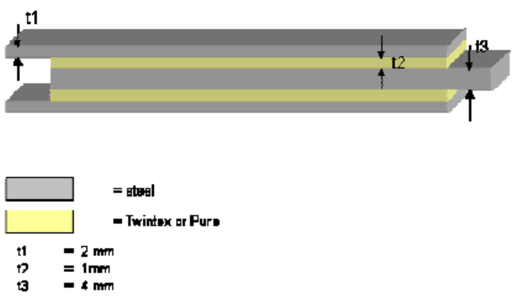


Figure 6: Typical ply-steel package

Contribution to concept design

Four different ship designs, dedicated to four different trades have been described in CREATING News of March 2007. These designs were evaluated on their potential to improve the level of safety.

The active safety level is assessed from the manoeuvring devices incorporated in the designs together with a proposed set of navigation equipment, best suited for the particular trade. A similar approach is chosen for the structural, passive safety. An estimate is made of the effectiveness of the proposed structure, relative to “normal” structural designs.

Alternative solutions have been proposed as far as they are feasible within the constraints of the design.

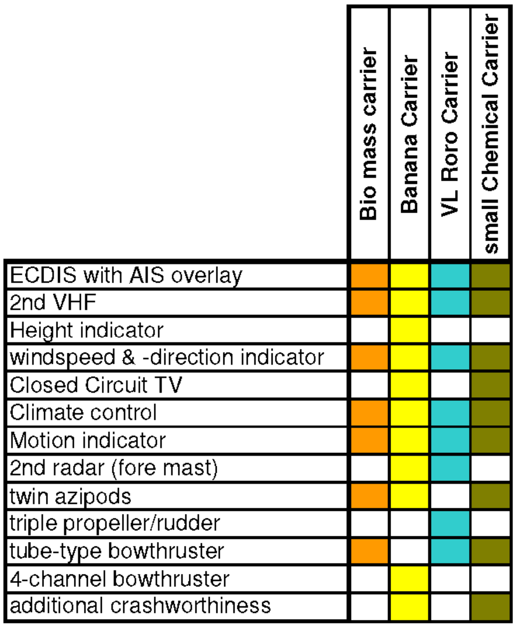


Figure 7: Measures advised for CREATING logistic concepts

CONCLUSIONS

The CREATING research gave rise to the following key conclusions:

- Human factor is the most decisive for accident risk assessment
- The effectiveness of type approved equipment is governed by the competence of the crew in using subject equipment
- Predictability of manoeuvring characteristics is more important than turning ability
- Cost-effectiveness with regard to the improvement of safety is better for navigational aids than for manoeuvring devices
- Rudder efficiency itself is not the measure for efficient and safe manoeuvring
- The second propeller provides redundancy; it does not improve manoeuvrability

RECOMMENDATIONS

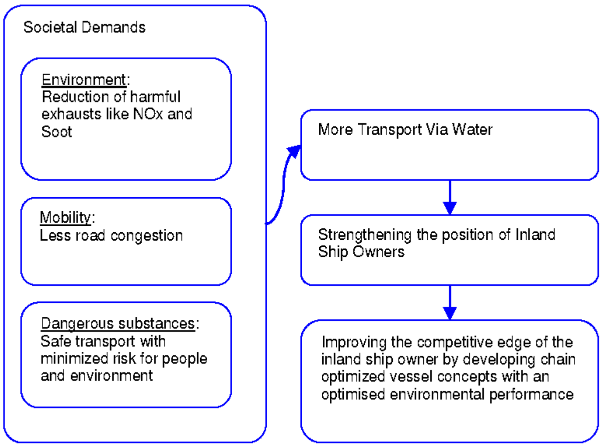
From the discussions on safety improvements a couple of recommendations have emanated. It is recommended to expand the current regulatory framework with regulations covering the following issues:

- All navigational aids on a vessel’s bridge should be of an approved type
- Skipper should be trained and authorised to use the navigational equipment installed, also when this equipment is beyond the minimum required
- AIS should be mandatory for all vessels with a length overall exceeding 20 m
- A standard navigation desk layout should be made mandatory by ROSR regulations
- In addition to the CCNR criteria on evasive performance, a set of criteria for least manoeuvring quality of inland ships should be developed for different widely used propulsion steering arrangements

PROJECT BACKGROUND

A major part of maritime cargo, for instance maritime containers, is nowadays transported to the hinterland via inland waterways. Continental cargo, however, is mainly transported by trucks. The ever increasing transport flows, road congestions and air pollution require the exploration of other transport solutions.

Waterborne transport is safe, reliable and has by far the lowest fuel consumption per ton/kilometre. Even more important: the main European waterways could easily absorb a multiple of the present waterborne transport volume.



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HU	Portolan
NL	AVIV
NL	Delft University of Technology, Dept. of Mechanical Engineering and Maritime Technology
NL	ECN - Energy Research Centre of the Netherlands
NL	EVO - Dutch Shippers' Council
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CREATING Inland navigation

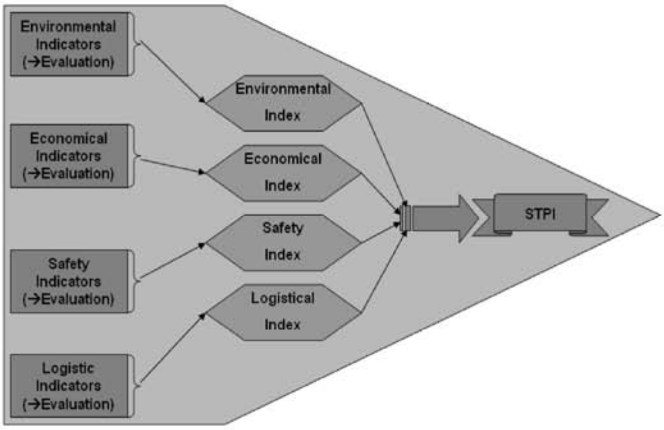
CREATING NEWS JUNE 2007

INTRODUCTION

CREATING NEWS is the periodical newsletter of CREATING, a European Project which aims at stimulating waterborne transport within logistic chains, paying attention to both economical, environmental and safety aspects. This edition focuses on the elaborated “Sustainable Transport Performance Indicator” (*STPI*) and its implementation for the aggregated assessment of the four transport cases developed within CREATING, integrating inland vessels into existing transport chains.

ASSESSMENT WITHIN CREATING

One of the main goals of CREATING is to prove the feasibility, and to demonstrate economic and environmental potentials for the integration of inland ship into transport chains. To achieve this stronger position, waterborne transport should be competitive with road transport and as clean and safe as possible. Then, the acceptation of the concepts developed within CREATING is important. Therefore, the pertinence and the viability of the elaborated cases should be clearly demonstrated according to economical, environmental, logistic and safety aspects.
The reasons for choosing or promoting a certain way of transporting goods are dependent on a multitude of factors. Shippers will be interested in reliable logistics and low cost, while authorities are in general more concerned with relieving congestion and minimizing the environmental impact of transport in general.
To this end, the CREATING partners involved in the work package on Assessment have joined forces to develop a model that determines transport cost and emissions related to intermodal transport chains, based on the technical and operational aspects of the transport means utilized. This has resulted in a multi-criteria decision aiding methodology that can translate values obtained into a single performance indicator and a method to measure logistic performance of transport chains.



SUSTAINABLE TRANSPORT PERFORMANCE INDICATOR (STPI)

The STPI is an indicator aggregating the environmental, economical, logistic and safety performances.
First, a list of indicators related to each evaluation field is established. So, the emissions of pollutants (CO2, CO, NOx, SOx, PM and fuel) are evaluated for each transport scenario, weighted by the related societal costs and aggregated in a global environmental index by using a MCDA[1] methodology. The costs of the transport leg, transhipment and storage are added for calculating the total cost of each scenario. The risks of deaths (VKM) and material damages are calculated and aggregated in the global safety index. Six qualitative logistic parameters are defined according to specific linguistic scales and aggregated in a logistic index. Then, the global indexes are integrated and the STPI can be calculated.
Finally, a sensitivity analysis is realized for each case study in order to test the robustness of the results.

[1] MCDA: Multi Criteria Decision Aiding.

CASE N°1: BIOMASS SUPPLIER FOR FINNISH LAKES

General Description

The Finnish biomass case relates to a power plant planned at the town of Jyväskylä.

This power plant will run on biomass (i.e. peat and woodchips). The power plant is located directly at the side of a lake system. The biomass, totalling roughly 5.5 million cubic meters per annum, will be produced from the woods around the lake. Roughly half of this biomass is planned to be transported by ship, while the other half will be transported by road.

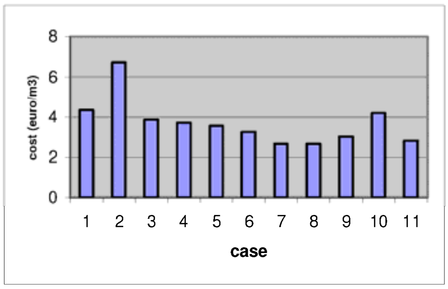
Eleven specific scenarios have been developed and assessed on the basis of the STPI framework.

The scenarios / intermodal variations

1. Truck transport at current prices, “Road”
2. Truck transport at more sustainable levels of 1.7 €/km instead of 1.1 €/km, “Road1.7”
3. Basic ship (1189 t of cargo) sailing 90 trips through ice, 45 without ice and being inactive for 3 months, “S45/90”
4. Basic ship (1189 t of cargo) sailing 68 trips through ice, 67 without ice and being inactive for 3 months, “S67/68”
5. Basic ship (1189 t of cargo) sailing 45 trips through ice, 90 without ice and being inactive for 3 months, “S90/45”
6. Basic ship (1189 t of cargo) sailing 90 trips through ice and 90 without ice, thereby being operational all year, “S90/90”
7. Large ship (1500 t of cargo) sailing 90 trips through ice and 90 without ice, thereby being operational all year, “L90/90”
8. Large ship without taking into account the emissions from loading/unloading, “L90/90LU”
9. Small ship with reduction of building price from 8M€ to 6M€, “S6”
10. Small ship with fuel price raised from 450 to 800 €/ton, “S800”
11. Small ship with crew cost halved (to 340000 €/year), “SCrew”.

Economic Results:

Transport by ship will always be cheaper than by road, but the amount of ice on the lake (cases 3 to 5) has a large impact on cost, due to the amount of fuel required to plough through it. Increased utilization and cargo capacity (cases 6 and 7) also have a beneficial effect on cost. Since a lot of fuel is required, an increase in fuel price, as shown in case 10, will have a strong direct effect on cost.

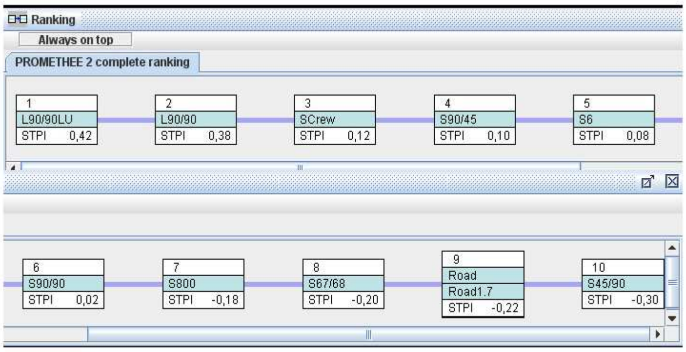


STPI and recommendations

Concerning the environmental impact, it appeared the road scenarios are the best ones, due to very specific geographical and meteorological conditions disadvantaging the intermodal scenarios.
The intermodal chains obtain the same best score for safety aspects and seem very competitive with the road from a logistic point of view.
Calculating the final STPI by aggregating these indexes results in the following ranking, highlighting the best compromises according to the four evaluation fields.

The final ranking

For biomass transport, only one intermodal scenario is at a worse place than road transport. This means, in case of favourable operational environment for the development of the analyzed scenarios, the intermodal chains could be a pertinent and interesting sustainable solution.



CASE N°2: BANANA CARRIER FOR THE RHINE

General Description

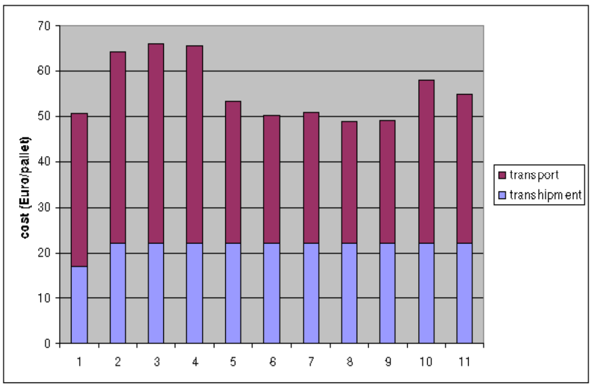
The banana transport case concerns conditioned transport of cargo: unripe bananas that need to be temperature controlled and kept under an atmosphere with reduced amounts of oxygen. The bananas arrive in Antwerp at 5-day intervals by seagoing reefer ships. They then need to be transported to the ripening houses in Strasbourg (900 pallets per trip).

The scenarios / intermodal variations

- S1 (“Road”): Road, base case
- S2,3 & 4: Small ship, 900 pallets, 10 days round trip;
  - S2: Base case , “Int”
  - S3: 5 days round trip, “Int_fast”
  - S4: SCR catalyst, Soot filter & Low sulphur fuel, “Int_SCR+DPF”
- S5,6,7,8,9: Long ship, 2250 pallets 10days round trip
  - S5: Base case, “Int_Long”
  - S6: Increase of speed, ”Int_Long_fast”
  - S7: Increase of speed, SCR catalyst, Soot filter & Low sulphur fuel, ”Int_SD_LF”
  - S8: Reduction of fuel price from 530 to 400 euro/ton, ”Int_2_LF”
  - S9: Depreciation of ship over 30 instead of 20 years, ”Int_3_LF”
- S10, 11: Coupled unit 2720 pallets, 10days round trip;
  - S10: Base case, “Int_C_S”
  - S11: Increase of speed, ”Int_C_F”

The economic results

Having established that the small ship is not economically competitive, an alternative was researched in the form of the long ship.
The upstream power levels for propulsion were raised to 1200 kW (case 6), allowing the ship to sail in mode A2: 18 hours per day makes it possible to reduce the personnel cost. This outweighs the increase in fuel cost, thereby reducing the operational cost of the ship and making it competitive with road transport. Application of an SCR and soot filter, together with low sulphur fuel (case 7) marginally increases the cost.
Cases 8 & 9 are economically competitive.



STPI and recommendations

From the environmental point of view, the three scenarios using a long ship and SCR catalyst, soot filter & low sulphur fuel minimize the pollutant emissions. The reduction of accidents and material damages is obviously maximized by the use of coupled units thanks to the reduction of the number of VKM.
The road scenario is logistically optimal but the use of a long ship is very competitive with a similar score. Calculating the final STPI by aggregating the indexes results in a ranking shown on the next page.

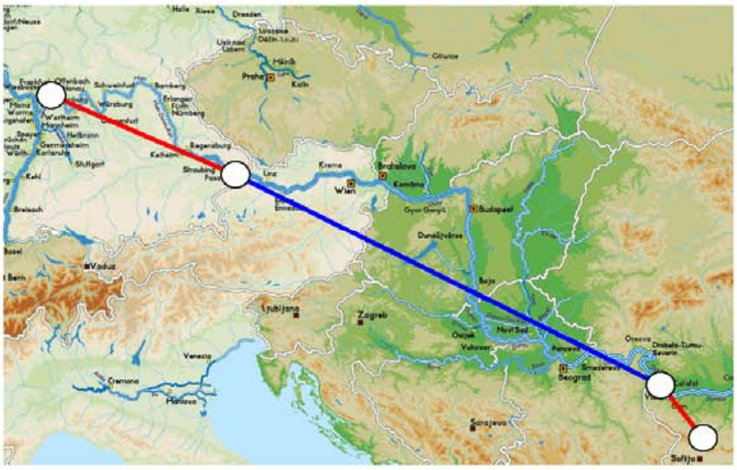
The final ranking

The best compromise between environmental, economical, logistic and safety impacts is case 8, being a long ship (2250 pallets) characterized by an upstream power level raised to 1200 kW and equipped with soot filter, SCR catalyst and uses low sulphur fuel, with an expected reduction of the fuel price to 400 €/ton. The second best scenario uses the same technologies but highlights depreciation of the ship over 30 years.
Even without these two economical assumptions, the basic related scenario obtains a very good third place.

CASE N°3: RO-RO VESSELS FOR THE DANUBE

General Description

The Danube Ro-Ro case deals with transport of trailers with goods, as well as of new cars and vans between Germany and South-Eastern Europe. The existing service is operated with 20-year old Ro-Ro ships. In the CREATING studies various new ship concepts have been discussed, ranging from small ships (SRRV) and pushed barges (PRRB) to large (LRRV) and very large (VLRRV) ships.
The route from Frankfurt am Main (D) to Sofia (B) with transhipment in Passau (D) and Vidin (B) is assessed in detail.



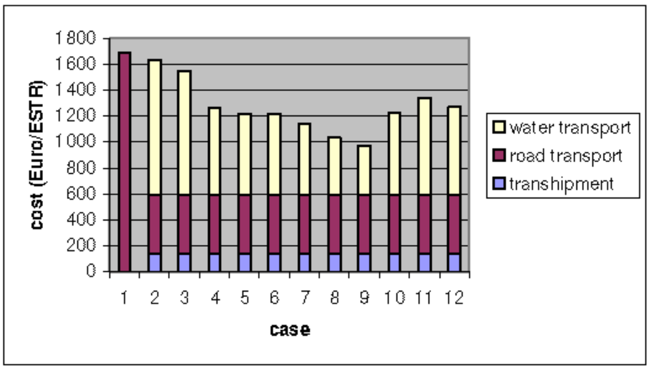
Scenarios / Intermodal variations

1. Road
2. Small Ro-Ro vessel, speed: 16km/h, capacity: 29 ESTR[2] ("SRRV_16")
3. Small Ro-Ro vessel, speed: 14km/h, capacity: 29 ESTR ("SRRV_14")
4. Large Ro-Ro vessel, speed: 16km/h, capacity: 63 ESTR ("LRRV_16_63")
5. Large Ro-Ro vessel, speed: 14km/h, capacity: 63 ESTR ("LRRV_14")
6. Large Ro-Ro vessel, speed: 14km/h, capacity: 63 ESTR, improving the hull form (5% resistance reduction) ("LRRV_14_5")
7. Very large Ro-Ro vessel, speed: 14km/h, capacity: 73 ESTR ("VLRRV_14")
8. Large Ro-Ro vessel, speed: 14km/h, capacity: 89 ESTR ("LRRV_14_89")
9. Very large Ro-Ro vessel, speed: 14km/h, capacity: 104 ESTR ("VLRRV_14_104")
10. Large Ro-Ro vessel, speed: 14km/h, capacity: 89 ESTR, SCR catalyst, PM filter and low sulphur fuel ("LRRV14SP")
11. Large Ro-Ro vessel, speed: 14km/h, capacity: 89 ESTR, increase in building price from 10 to 15 M€ ("LRRV1415")
12. Large Ro-Ro vessel, speed: 14km/h, capacity: 89 ESTR, increase of fuel price from 530 to €/ton

[2] ESTR: Equivalent Semi Trailer. See for further explanation CREATING News January 2007

The economic results

It becomes clear that intermodal transport outperforms all-road transport in all cases. What also becomes apparent is that in this case modifications to the vessel do not substantially influence this performance. But the carrying capacity influences performance in a strong way, although not as directly as one might think. This is due to the large portion of cost taken up by pre- and end haulage.

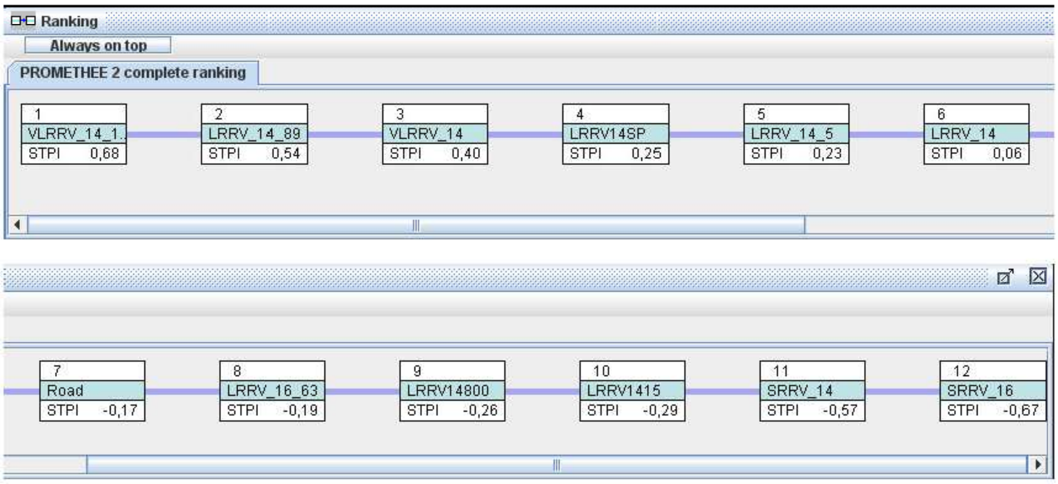


STPI and recommendations

According to the emission of pollutants, the use of a Large Ro-Ro vessel including a SCR catalyst, a PM filter and low sulphur fuel is optimal.

The very large Ro-Ro vessel with an increased capacity (104 ESTR) optimizes the safety aspects as the large Ro-Ro vessel with a capacity of 89 ESTR, which reduces the VKM.

The logistic impacts benefit the road transport but the intermodal scenarios obtain a very competitive score. When aggregating these indexes, the STPI and the final ranking are obtained as follows:



The final ranking

The highest STPI score, meaning the best compromise is case 9, using a VLRRV with a speed of 14 km/h and a capacity of 104 ESTR.

The second best scenario involves a LRRV with a speed of 14 km/h and a capacity of 89 ESTR.

Road haulage is at 7th place.

CASE N°4: SMALL CHEMICAL TANKER

In a certain Dutch region there is a substantial transport of dangerous goods in the form of liquid bulk to chemical plants. These transports are currently done by water, road and rail, depending on the origin and destination of the cargo.
For one of the transport routes the vessel size is limited in length, breadth, height and draught.
This route has been subject to the performance assessment mentioned below.

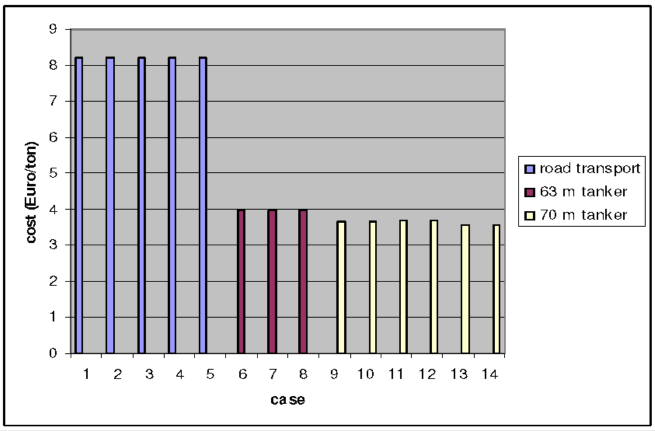
Scenarios / Intermodal variations

1. Road, "EURO I" truck
2. Road, "EURO II" truck
3. Road, "EURO III" truck
4. Road, "EURO IV" truck
5. Road, "EURO V" truck
6. 63 meters Tanker with CCNR class I engine, 13 km/h ("CCI")
7. 63 meters Tanker with CCNR class II engine, 13 km/h ("CCII")
8. 63 meters Tanker with CCNR class III engine, 13 km/h ("CCIII")
9. 70 meters Tanker with CCNR I engine, 13 km/h ("CCI70")
10. 70 meters Tanker with CCNR I engine, and diesel particles filter & clean fuel, 13 km/h ("CCI70D")
11. 70 meters Tanker with CCNR I engine, and an SCR catalyst, 13 km/h ("CCI70S)
12. 70 meters Tanker with CCNR I engine, and a diesel particle filter & clean fuel and an SCR catalyst, 13 km/h ("CCI70DS")
13. 70 meters Tanker with CCNR I engine, speed: 10 km/h ("CCI7010")
14. 70 meters Tanker with CCNR III engine, speed: 10 km/h ("CCIII7010")

Economic results

The economic superiority of waterborne transport is underlined. It also shows the benefits of a larger ship, since costs per ton for the 70 m tanker are lower than for the 63 m version.

Of course, variations can be made in ship price (taken at € 2.2 million for the 63 m ship and € 2.5 million for the 70 m ship), but this will not bring cost of IWT to the same level as that for road transport.



STPI and recommendations

Concerning the emission of pollutants, the use of EURO IV and EURO V trucks is satisfactory, but the use of a 70 m tanker with CCNR III engine and a speed reduced to 10 km/h is also very competive.

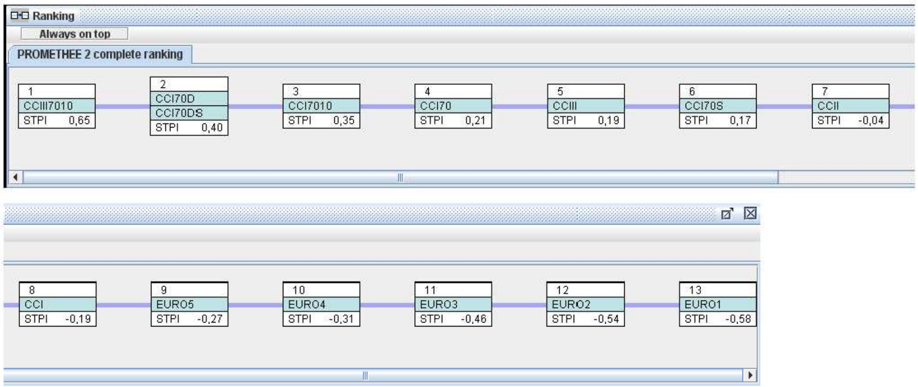
From safety point of view, the larger tanker reduces the VKM and so optimizes the probability of accidents and deaths per VKM.

The intermodal scenarios are optimal according to the logistic performances.

The STPI on the basis of these indexes and the final ranking are shown on the next page.

The final ranking

According to the evaluation and the used parameters, case 14 is the best compromise between environmental, economical, logistic and safety impacts: a 70 meters Tanker with a CCNR phase III engine, sailing at a speed of 10 km/h. It obtains a very high score, compared to the other scenarios:



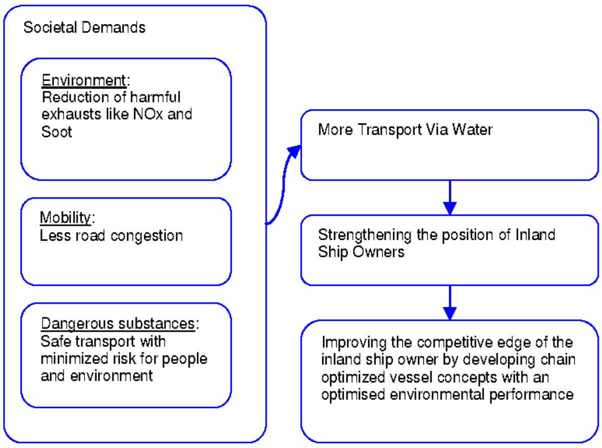
PERSPECTIVES AND CONCLUSIONS

- The analysis of the "CREATING scenarios" shows that intermodal transport involving inland waterway sections, represents a very pertinent and competitive solution to single road transport problems related to economic, environmental, logistic and safety aspects.
- Each case revealed that considering of inland waterway sections can improve the global performance of the entire logistic transport chain by reducing negative impacts and optimizing positive logistic effects
- The results underline the importance of actively striving for cleaner ship engines and low sulphur fuel in order to maintain environmental competitiveness with road transport.
- Key to the economic success of inland navigation is to have a possibility to limit cost of transhipment and of pre- and end haulage. Especially for the banana case, these factors are crucial for an inland shipping concept.
- The STPI methodology developed in CREATING can be a powerful decision support aid for shippers and shipowners, allowing them to gain better insight into the performance they may expect from their operations.

PROJECT BACKGROUND

A major part of maritime cargo, for instance maritime containers, is nowadays transported to the hinterland via inland waterways. Continental cargo, however, is mainly transported by trucks. The ever increasing transport flows, road congestions and air pollution require the exploration of other transport solutions.

Waterborne transport is safe, reliable and has by far the lowest fuel consumption per ton/kilometre. Even more important: the main European waterways could easily absorb a multiple of the present waterborne transport volume.



Project partners

NL	SPB Management, coordinator
NL	CBRB - Netherlands Rhine and Inland Shipowners Association*
NL	VNSI - Netherlands' Shipbuilding Industry Association*
A	Via Donau
B	University of Liege, Faculty of Applied Sciences
D	DST - Development centre for Ship technology and Transport systems
EU	EFIP - European Federation of Inland Ports
EU	IVR - Internationale Vereniging Rijnschepenregister
F	Bureau Veritas
HU	Budapest University of Technology and Economics, Dept. of Transport Economy
HU	Portolan
NL	AVIV
NL	Delft University of Technology, Dept. of Mechanical Engineering and Maritime Technology
NL	ECN - Energy Research Centre of the Netherlands
NL	EVO - Dutch Shippers' Council
NL	Shipyard Hoebée
NL	Imtech Marine & Offshore
NL	Lloyd's Register of Shipping
NL	MARIN - Maritime Research Institute of the Netherlands
NL	TNO INRO - Netherlands Organisation for Applied Research
NL	Vopak Barging Europe
PL	CTO Ship Design and Research Centre
RO	IPA CIFATT
SB	DPC - Danube Project Centre

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CREATING Inland navigation

CREATING NEWS JULY 2007

INTRODUCTION

CREATING NEWS is the periodical newsletter of CREATING, a European project which aims at stimulating waterborne transport within logistic chains, paying attention to both economical, environmental and safety aspects. This edition fully focuses on the hydrodynamic optimization of vessel concepts being designed within the CREATING project.

SHIP HYDRODYNAMICS WITHIN CREATING

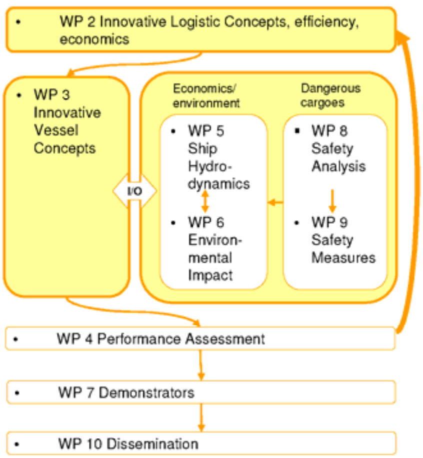
Hydrodynamics in the respect as mentioned above is of such importance that an own work package is devoted to that subject. This work package (WP5) is leaded by MARIN, the Maritime Research Institute Netherlands.

The design process started with initial lines developed within Work Package 3. These lines fulfil the global demands of the design case in terms of displacement, main dimensions, engineering and the propulsion concept. Within an iteration loop between the logistic-, basic design- and assessment teams within CREATING, these lines are optimized from a hydrodynamic point of view.

According to the EU system for research programs the project is divided into Work Packages (WP). Mutual relations between the work packages and the CREATING structure are displayed in the scheme.

Work package 5, dealing with hydrodynamics can be seen as a serving work package for the design on innovative vessel concepts (WP3).

The shape of the hull might be subject to hard design points imposed by the construction, the engineering and operation of the vessel. Only if a careful check results in a green light from all work packages in the process, these lines are used for the final concept.



The four cases developed in CREATING are introduced in *table 1*; the design work done is reported on the following pages.

Case	1	2	3	4
Type of ship	Biomass Supplier	Banana Carrier	Ro-Ro Vessel	Chemical Carrier
Operation area	Finnish Lakes	River Rhine	River Danube	Dutch canals
Commodity	wood chips and peat in bulk	bananas on pallets	semi-trailers, cars, vans	Special products
Capacity per ship (annual or per leg)	700.000 m^3 peat 150.000 m^3 wood chips	65700 pallets per year	~ 1500 ESTR per year	~ 900 tons per leg
Average speed	14 km/h in ice free water 10 km/h through the ice	16 km/h, depending on direction and depth	16 km/h, depending on direction and depth	14 km/h

Table 1: The "four cases of CREATING"

CASE N°1: BIOMASS SUPPLIER FOR FINNISH LAKES

The main particulars were set up following restrictions imposed by the waterway. The minimal water depth within the area of operation, the existing bridge clearance and lock chamber dimensions determined the main ship dimensions as in *table 2:*

Length	105.0 m
Breadth	14.0 m
Draught	2.4 m
Air draught	5.5 m
Volume cargo capacity	5500 m^3

Table 2: Specifications of the biomass supplier

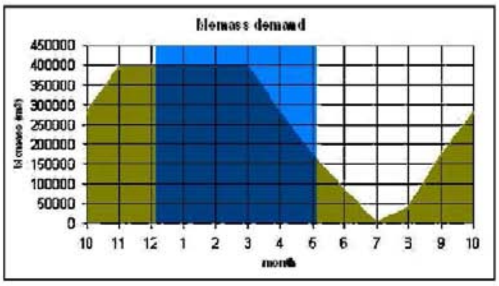


Figure 1: Monthly distribution of supply demand vs. estimated ice period (blue)

As described in CREATING News of March 2007, the uneven seasonal distribution of demand from the power plant implies that the ship is operation mainly when navigation is additionally affected by ice, see *figure 1.*

In other words, the biomass supplier has to operate in conditions ranging from 'normal' open water in summer to a situation where the ship need to plough through up to 60 cm of ice in winter. Needless to say, if the latter is to be done at any significant speed substantially more power is required than in free-running summer conditions.

The estimate for the power demand of ice-breaking is given by the empirical formula of the Central Marine Research & Design Institute in St. Petersburg. It turned out that the first estimate of the installed power should be around 1800 kW to break through 60 cm of ice, which is more than thrice the power required in open water. Therefore, the power in open water is not critical and further efforts to survey this concept were reduced to the bare minimum for the economic evaluation.

The calculated speed power curves of the biomass supplier in open water for two draughts are shown in *figure 2.*

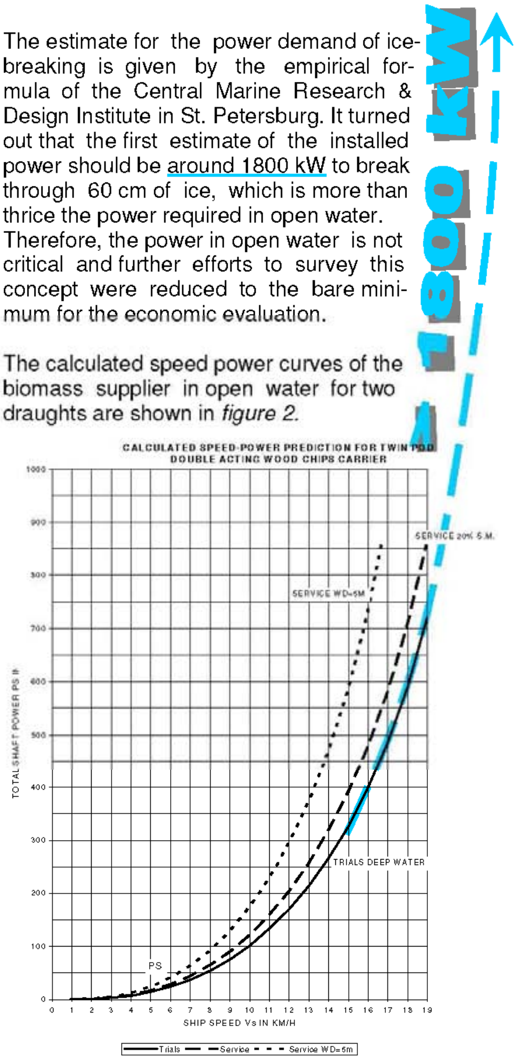


Figure 2: Speed power curves biomass supplier

CONCLUSIONS AND RECOMMENDATIONS ON BIOMASS SUPPLIER CONCEPT

- The most determining factor for the design of the biomass supplier is the performance in ice. Because the decision for the biomass supplier resulted from a study within CREATING, this could not have been foreseen in the project description phase of CREATING. Consequently, no expertise was reserved for ice going vessels.
- The concept was surveyed with the available resources and turned out to be very interesting. It is recommended to make it subject to dedicated tests in ice, as only based on such tests the concept can be fully developed and designed.
- If the lines resulting from the optimization in ice impose a too severe penalty on the open water performance of the vessel, a double acting concept is proposed, meaning that the stern of the vessel is designed as an icebreaker bow and that the propellers act as ice mills in this condition.

CASE N°2: BANANA CARRIER FOR THE RHINE

From hydrodynamic point of view, the second concept of CREATING, the banana carrier (see *table 3*, represents the class of current inland navigating vessels on the river Rhine.

Length overall	85.94 m
Breadth moulded	11.40 m
Draught loaded	2.65 m
Installed propulsion power	2 x 750 kW
Displacement loaded	2220 tons
Carrying capacity volume	1000 pallets
Carrying capacity	900 tons

Table 3: Specifications of the banana carrier

Within CREATING, time and resources were available to come to a dedicated design for the purpose of banana transport on the Rhine. Within daily design praxis, the advantage of a dedicated design is often passed for the sake of a universal design promising higher revenues when the vessel is resold.

To quantify the benefits of a dedicated design, the banana carrier was made subject to a sophisticated optimization process within CREATING. Though the results can not one by one be translated to another concept, similar improvements are likely to be found if another concept than the banana carrier for the Rhine is optimized dedicatedly for its purpose.

In figures 3 and 4 the results of these CFD calculations on the initial lines and after the optimisation process are shown. The applied design strategy was to shift volume from the forward shoulder of the vessel and concentrate it in the centre of the vessel in the bow region close to the basis.

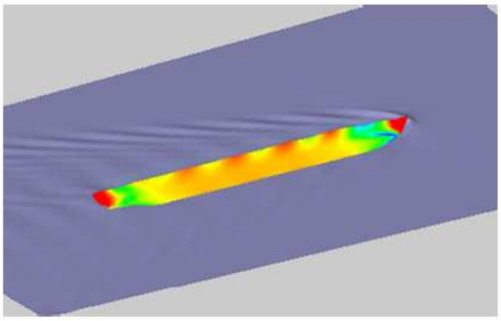


Figure 3: 1st CFD calculation on the banana carrier

Volume close to the waterline is generating waves by its displacement, which volume close to the baseline of a vessel does in much lesser extent. This way, total displacement of the vessel could be kept constant.

It is noted that the wave making resistance, i.e. the part of the ship's resistance which was addressed with these calculations, was reduced by 30%, which means that the total resistance of the ship was reduced by about 10%.

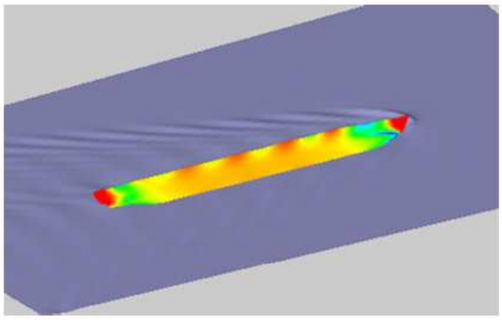


Figure 4: Improved design of the banana carrier

Finally, the banana carrier performance was validated by means of model tests, see *figure 6*. The purpose of the work was to elaborate the effective power requirement of the inland water Banana Carrier in different loading and water depth conditions. For this purpose the set of resistance tests in the shallow water towing tank of Ship Hydromechanics Division, CTO S.A. in Gdansk, Poland, was carried out. During the tests the resistance force of the bare hull was measured at the speed range corresponding to the operational speed of the vessel in full scale.

Experimental data obtained from the tests consisted of the resistance force, dynamic vertical displacement (sinkage) and trim angle each corresponding to the hull speed with respect to the water. These data were recalculated into full scale, based on the Froude law of similitude according to the ITTC procedures.

Propulsion tests could not be performed because of the applied scale of the model. The measured effective powers are shown in *figure 5* for the water depths of 3.5 and 5 m.

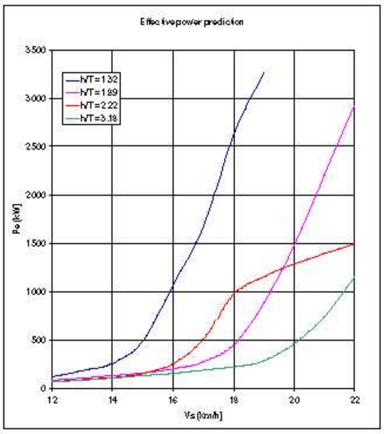


Figure 5: Model test results from CTO

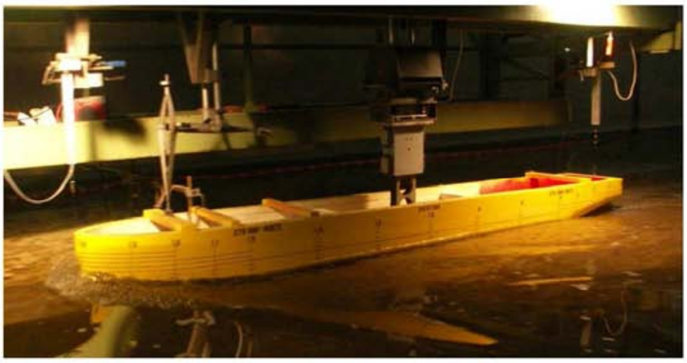


Figure 6: Model tests of the Banana carrier at CTO in Poland

CONCLUSIONS AND RECOMMENDATIONS ON THE INLAND BANANA REEFER CONCEPT

- From hydrodynamic point of view, the banana carrier could be improved by 30% for wave making resistance, yielding a total resistance improvement of 10%.
- The dedicated design for banana transport from seaport to hinterland implies return journeys in ballast condition. As this is in downstream condition, the optimisation was carried out in design draught condition, i.e. for the more severe case of sailing upstream.
- Model tests on two draught and two water depth conditions were carried out to validate the findings of the calculations.
- From a logistic point of view, the surveyed concept performs similar to the road transport (see CREATING news of March 2007). It was therefore recommended to exploit the economies of scale by designing a larger vessel (135m) or even a barge train. The hydrodynamic performance of the 135m vessel could be improved by some 7%, because longer vessels generate less wash and waves, respectively.
- As by the computations only the wave making resistance is addressed, smaller vessels sailing with the same speed (i.e. relative faster) benefit more from optimization than larger vessels. In both cases, however, noticeable improvement was achieved.

CASE N° 3: RO-RO VESSELS FOR THE DANUBE

The Danube is an extremely challenging river, having water depths varying from less than 2 meters till more than 80 m in extreme cases.
At the start of the design procedure three alternative vessel concepts were drafted: a large Ro-Ro vessel (LRRV), a pushed Ro-Ro barge (PRRB) and a small Ro-Ro vessel (SRRV). Later on, a very large Ro-Ro vessel (VLRRV) was added, which was also chosen for the optimization phase.

Length overall	134.00 m
Breadth max.	22.80 m
Breadth moulded	20.60 m
Depth moulded	4.20 m
Draught without ballast	1.65 m
Fixed point height above 1.65 m draught	6.90 m
Deadweight	1900 tons
Empty weight	2030 tons
Maximum draught with ballast	2.70 m
Maximum loading capacity (payload)	1770 tons
Maximum speed in calm water (h_w = 5.0 m) in fully loaded condition	16 km/h

Table 4: Specifications of the Very Large Ro-Ro Vessel (VLRRV)

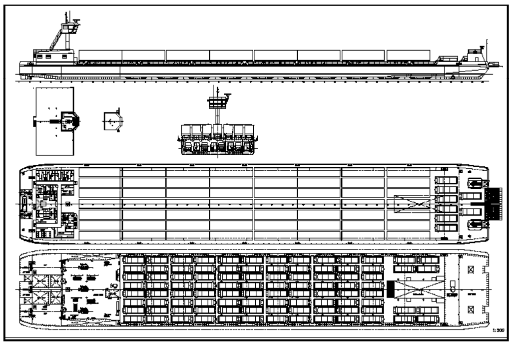


Figure 7: General arrangement Very Large Ro-Ro Vessel (VLRRV)

From hydrodynamic point of view, the optimization of this VLRRV was dictated by the minimum water depth, resulting in an extreme beam/draught ratio (*Figure 7*).

A vessel of these specs was firstly optimized by means of CFD calculations and finally model tested in self propulsion tests at MARIN.

The incoming lines of the Ro/Ro vessel concept were used for the first CFD computation. As the terminal for the vessel is not longer depending on a pram shaped bow, the same design strategy as applied for the banana carrier was applied, meaning to concentrate volume in the centre of the ship deeply submerged at the bow, see *figure 8*.

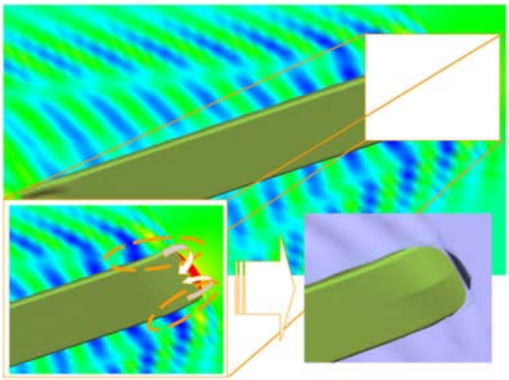


Figure 8: First iteration and design strategy

Despite of the good experience with the banana carrier, this strategy first degraded the performance as can be seen by the apparently deeper wave troughs in *figure 9*.

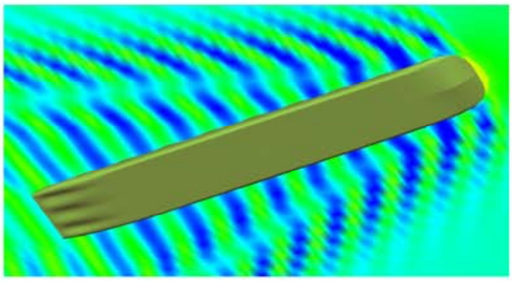


Figure 9: Second iteration

Finally, the same strategy yielded the drastic improvement shown in *figure 10*, underlining that usage of a CFD design tool requires plenty of user experience.

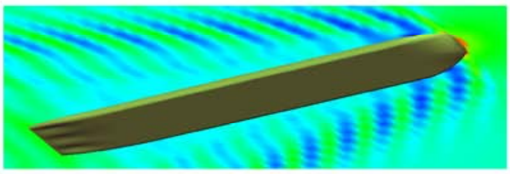


Figure 10: Final result

Much too easy the minimum as found in *figure 9* was overlooked when just seeing the result of the first iteration presented in *figure 8.*

When comparing *figures 9* and *10* it can also be seen that volume from the stern was shifted to the bow. The expected advantage for the water supply of the triple propulsors cannot be computed by the applied CFD code, however. The benefit of this strategy was successfully validated by model tests *(figure 11).*

Figure 11: Model tests of the Danube Ro-Ro ship at MARIN

These tests were conducted as self propulsion test on a 12m model, having sufficiently large model propellers in ducts to enable measurement of thrust and torque inside the propeller hubs and the nozzle forces between hull and duct. Furthermore, the pressures in the tunnels were measured to survey the propeller hull interaction in shallow water *(figure 12).*

Figure 12: Triple screw propulsion

The measured pressures *(figure 13)* yielded new insights into the complex flow phenomena of propeller hull interaction in shallow water.

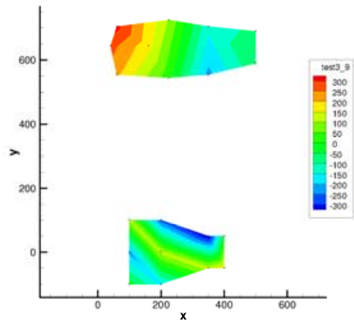


Figure 13: Measurement set-up

CONCLUSIONS AND RECOMMENDATIONS ON RIVER RO-RO VESSEL CONCEPT

- The basis design has been improved by about 30% regarding wave resistance
- This improvement means about 10% improvement in total resistance
- The new bow design requires well more water depth at the terminals, which was deemed feasible in mutual agreement with the other partners and potential end users.
- Model tests yielded new and fundamental insights in the phenomena of ship propulsion in shallow water

CASE N° 4: SMALL CHEMICAL TANKER

The 4th concept is a small tanker to transport liquid bulk to chemical plants over a short distance. Being a small vessel, see *table 5*, building costs should be small as well.

Length	63.0 m
Breadth	7.2 m
Draught	2.3 m
Depth	3.8 m
Air-draught	4.5 m

Table 5: Specifications of small chemical tanker

Therefore, the hydrodynamic optimisation became challenging again as hydrodynamic favourable forms, i.e. smoothly curved topologies, were mainly avoided, see *figure 14*.

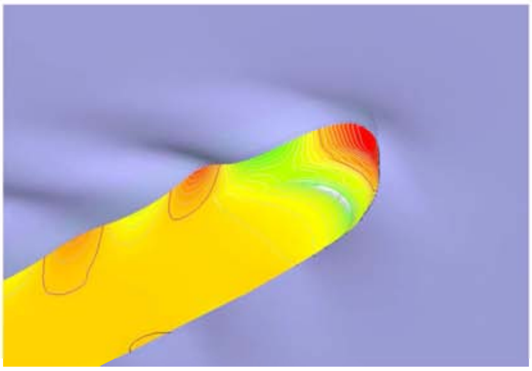


Figure 14: Small tanker CFD results

A consequence of this design strategy are knuckle lines. Undesired areas of steep pressure gradients at such knuckle lines could not be avoided, see bow foot in *figure 14*. The power demand was calculated as shown in *figure 15*.

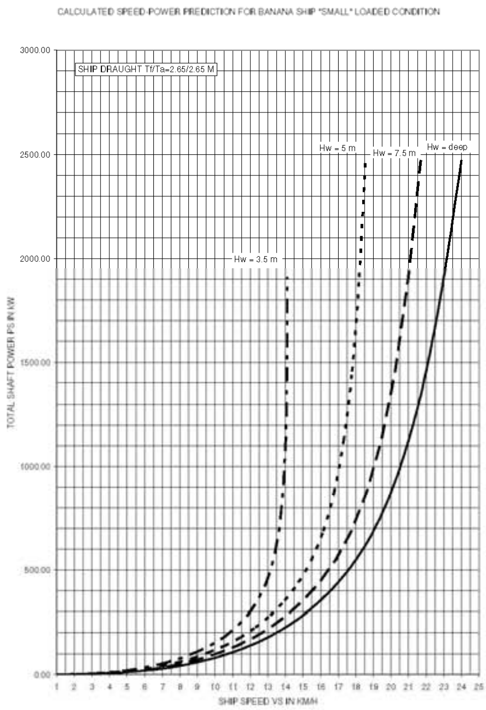


Figure 15: Small tanker performance prediction

CONCLUSIONS AND RECOMMENDATIONS ON SMALL TANKER CONCEPT

- Low building costs forced a design of mainly two dimensionally curved surfaces.
- Orientation of knuckle lines was improved by CFD calculations, but unfavourable pressures close to the knuckle lines could not be avoided.
- Being close enough to standard designs, no dedicated model tests were conducted.

TWO TOOLBOXES

One of the CREATING targets was to develop toolboxes usable in an early design stage to determine the lines concept and the propulsive performance of an inland navigation vessel.

For this purpose both a hydrodynamic and a propulsion toolbox were developed. The hydrodynamic toolbox is a database approach, making an arbitrary amount of CFD calculations accessible to a less experienced user. The computed wave pattern of a ship having the mail parameters as selected by the user is visualised, as well as the data of some important parameters such as trim, sinkage and wave patterns, see *figure 16*.

Being a database approach, the usage of this toolbox might in the beginning be impeded by a too small database. So far just the four cases of CREATING could be considered, meaning that results obtained by interpolation are less meaningful.

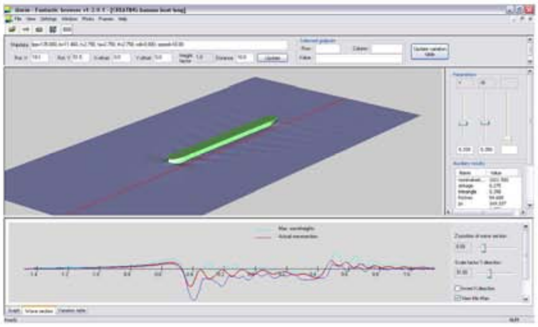


Figure 16: Hydrodynamic toolbox

The propulsion toolbox is an internet based expert system accessible for CREATING partners. The system is requesting basic information from the user as shown in *figure 17*. The data are checked and used for a power prediction, firstly in deep water.

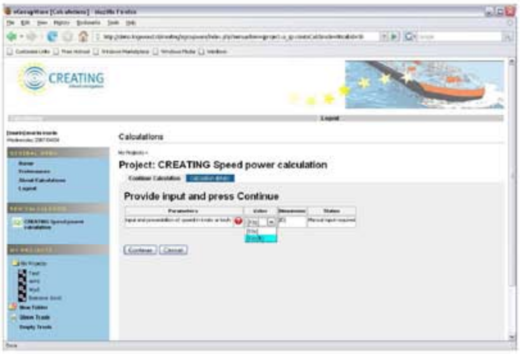


Figure 17: Propulsion toolbox

Two shallow water resistance correction methods are implemented such that the calculated results can be corrected for inland navigation vessels suffering from shallow water effects. The results are placed at the disposal of the user as shown in *figure 18*.

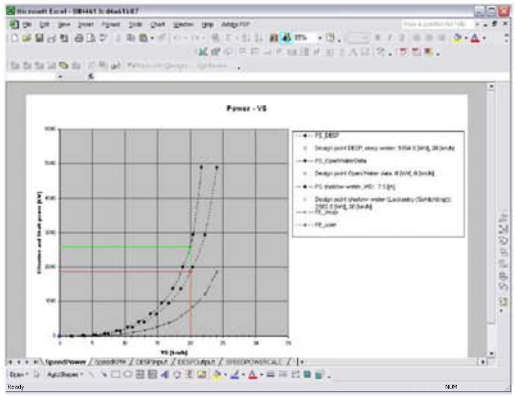


Figure 18: Propulsion toolbox results

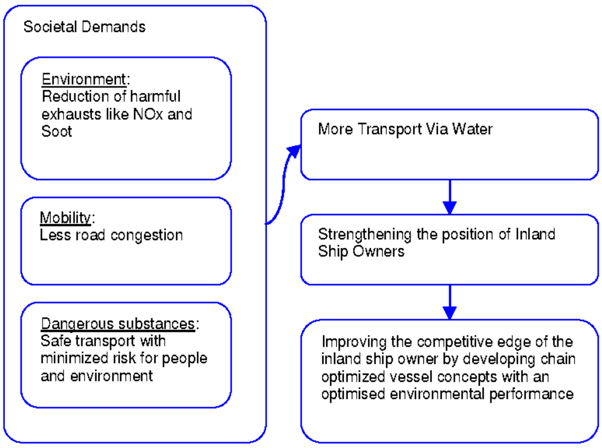
CONCLUSIONS AND RECOMMENDATIONS ON THE TOOLBOXES

- More computed cases will make the hydrodynamic toolbox a powerful means to get an appreciation of different inland navigating ship designs in an early design stage.
- With the internet based propulsion toolbox, the experience of a renowned maritime research institute is placed at the disposal of an end user.
- A standard and a recent (Jiang 2001) shallow water resistance correction method is implemented in the propulsion toolbox.
- It was found that a sound theoretical approach for shallow water propulsion coefficients is lacking. Such coefficients are required for a reliable prediction of a ship's performance in very shallow water, or sailing close to the critical speed. It is therefore recommended to continue the research on shallow water propulsion and to implement the findings in the propulsion toolbox.

PROJECT BACKGROUND

A major part of maritime cargo, for instance maritime containers, is nowadays transported to the hinterland via inland waterways. Continental cargo, however, is mainly transported by trucks. The ever increasing transport flows, road congestions and air pollution require the exploration of other transport solutions.

Waterborne transport is safe, reliable and has by far the lowest fuel consumption per ton/kilometre. Even more important: the main European waterways could easily absorb a multiple of the present waterborne transport volume.



Project partners

NL	SPB Management, coordinator
NL	CBRB - Netherlands Rhine and Inland Shipowners Association*
NL	VNSI - Netherlands' Shipbuilding Industry Association*
A	Via Donau
B	University of Liege, Faculty of Applied Sciences
D	DST - Development centre for Ship technology and Transport systems
EU	EFIP - European Federation of Inland Ports
EU	IVR - Internationale Vereniging Rijnschepenregister
F	Bureau Veritas
HU	Budapest University of Technology and Economics, Dept. of Transport Economy
HU	Portolan
NL	AVIV
NL	Delft University of Technology, Dept. of Mechanical Engineering and Maritime Technology
NL	ECN - Energy Research Centre of the Netherlands
NL	EVO - Dutch Shippers' Council
NL	Shipyard Hoebée
NL	Imtech Marine & Offshore
NL	Lloyd's Register of Shipping
NL	MARIN - Maritime Research Institute of the Netherlands
NL	TNO INRO - Netherlands Organisation for Applied Research
NL	Vopak Barging Europe
PL	CTO Ship Design and Research Centre
RO	IPA CIFATT
SB	DPC - Danube Project Centre

** Project initiators*

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CREATING Inland navigation

SPECIAL EDITION

CREATING NEWS NOVEMBER 2007

INTRODUCTION

CREATING NEWS is the periodical newsletter of CREATING, a European research project which aims at stimulating waterborne transport within logistic chains, paying attention to both economical, environmental and safety aspects.

The research on environmental impact of inland navigation resulted in recommendations to both regulatory bodies, technique providers, oil companies and ship owners. *(See CREATING NEWS of October 2006)*

Application of low sulphur fuel, advising speed control, selective catalytic reduction and particulate matter filter were found to be the most suitable solutions to improve the environmental performance of inland navigation.

All solutions mentioned are applied in the **Cleanest Ship project**, a joint project of CREATING and energy company BP. Lasting one year from November 2007, this demonstration project will show how inland waterway vessels can optimise their fuel efficiency and reduce harmful emissions.

CLEANEST SHIP

bp

THE CLEANEST SHIP PROJECT

The demonstration is carried out on the motor vessel 'Victoria', owned by BP Shipping. The vessel is managed by Verenigde Tankrederij (VT) and on long term charter to BP Marine Lubricants. She is operating in the Port of Rotterdam and Antwerp areas.

The emission reduction results, including a comparison with road transport, will be monitored and presented on a regular basis on *www.cleanestship.eu.*

Fuel consumption and NO_X emissions are directly measured; CO_2 and SO_X emissions are calculated from fuel consumption, whereas PM emissions are evaluated using the emission reduction potential estimated on the test stand. The latter is done because accurate measurement of PM emissions at service conditions is very difficult.

Low sulphur fuel

The m/v 'Victoria' uses low sulphur fuel equal to road standard diesel fuel (EN 590), supplied by energy company BP.
Combustion of low sulphur fuel is a precondition for application of particulate matter filters (soot filters) and for efficient reduction of SO_X emissions, which are directly related to the sulphur content of the fuel used.

PM filter and SCR Catalyst

The Nauticlean S system, developed and built by Hug Engineering, encompasses a PM (soot) filter and selective catalytic reduction (SCR) catalyst in the same reactor. The filter is equipped with a diesel full-flow regenerative burner.

Selective catalytic reduction is a technique for efficient removal of NO_X emissions by means of injecting a reducing agent into the exhaust gas. The Nauticlean S system uses ammonia to reduce nitrogen monoxide and nitrogen dioxide to nitrogen and water, which is injected as urea (33 % solution).

For PM removal catalytically coated silicon carbide (SiC) particulate matter filters are used, consisting of several honeycombs made of micro fibres.

During operation, soot particles are retained in the filter. As soon as the regeneration temperature is reached, the soot is burned off without residue. Due to the catalytic coating, the regenerating temperature is around 450 °C. The filter burns itself clean without requiring auxiliary energy. The full-flow regeneration burner system ensures independent and reliable regeneration of the filter even at low exhaust gas temperatures and in long low-load and idling phases.

Advising speed control

The Advising Tempomaat (ATM), developed and supplied by Techno Fysica (NL), is a system enabling an economically optimised operation of a vessel. The core of the system is a computer programme advising the skipper on the most economical combination of route and speed, enabling the vessel to arrive on time with a most efficient use of fuel, leading to reduction of fuel consumption and emissions.
The ATM, where the advised fuel settings are realised manually, is the successor of the Tempomaat which automatically adjusted the vessel speed, without giving advice.

Emission reduction expected

	NO_x	PM	FC	CO_2	SO_x
Advising Tempomaat	-7%	-7%	-7%	-7%	-7%
Low sulphur fuel (EN 590, max. 10 ppm S)	none	-17%	none	none	-99.5%
SCR (selective catalytic reduction)	-85%	none	none	none	none
PM filter (soot filter)	none	-95%	+2%	+2%	+2%
Total emission reduction	-86%	-96%	-5%	-5%	-99.5%

By using the Advising Tempomaat, fuel consumption (FC) may be reduced by up to 15 % for longer distances. For this demonstration project, however, a moderate reduction is assumed. This is due to the small operational area of the vessel and frequent manoeuvring in harbours.

The value for the PM filter also includes the SCR effect on PM reduction.

GENERAL INFORMATION ON CREATING

CREATING is a research project within the 6th Framework Programme (FP6) of the European Commission, comprising 23 partners from 9 European countries. Its objective is to stimulate waterborne transport in an economical way and improve its competitive position versus road transport.

LOGISTIC INNOVATION

Development of innovative logistic concepts is a key issue in the CREATING project. Analysis of a large number of cargo flows eventually has led to four new logistic concepts, described below.

Biomass Supplier

Sailing area: Finnish Lakes

A Finnish power plant is preparing to build a new installation which will be fuelled by biomass: wood chips and peat. CREATING designed an inland vessel with an advanced pneumatic loading and unloading installation. In view of the high energy demand in winter, the vessel has a special propulsion installation, enabling it also to navigate in ice conditions.
The feasibility study turned out that using such inland barges will save at least € 400,000 a year.

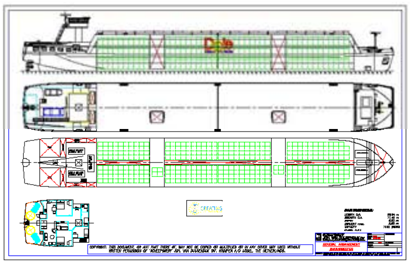
Banana Carrier

Sailing area: River Rhine

Bananas are transported from seaport to hinterland by truck, despite the availability of the 'water highway' Rhine. CREATING considered three waterborne transport concepts:

- a dedicated inland reefer, suitable for pallet transport
- a pushing unit with two barges for pallet transport
- a vessel for transport of refrigerated containers

Eventually a dedicated inland reefer was chosen as the best viable concept for the concrete case.



Roll on / Roll off Vessel

Sailing area: River Danube

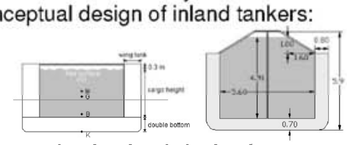
For the Danube a shallow draft very large Ro/Ro vessel has been developed, which can substantially improve the existing Ro/Ro services between various Danube terminals.
To enable feasibility calculations for different Ro-Ro cargo mixtures a uniform "loading unit" was developed: Equivalent Semi Trailer or *ESTR*.

Chemical Carrier

Sailing area: Dutch canals

The challenge was to design a small tanker to transport special products, with waterway restrictions determining the main dimensions. The proposed concept completely satisfies the prescribed rules and indicates the highest standards with regard to active and passive safety aspects.

The CREATING study has led to a new conceptual design of inland tankers:



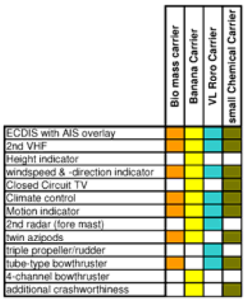
Conventional and optimized tank cross section

ENVIRONMENTAL IMPACT

The CREATING research on environmental impact of inland navigation has been focused on the present performance of inland vessels regarding pollutant emissions to air and on solutions to improve this.

The following main topics were subject to research:

- Impact of diesel engine emissions on human health and environment
- Current and future emission standards with relevance to inland navigation
- The state of the art of emission characteristics in inland navigation
- Short- and mid-term solutions for improving the emission characteristics in inland navigation
- Long-term solutions for improving the emission characteristics or eliminating emissions to air



SAFETY

All ship designs were evaluated on their potential to improve safety.

The active safety level is assessed from the manoeuvring devices incorporated in the designs together with a proposed set of navigation equipment, best suited for the particular trade.

A similar approach was chosen for the structural, passive safety. An estimate was made of the effectiveness of the proposed structure, relative to "normal" structural designs. Alternative solutions have been proposed as far as they are feasible within the design constraints.

PERFORMANCE ASSESSMENT

The reasons for choosing or promoting a certain way of transporting goods depend on a multitude of factors. Shippers will be interested in reliable logistics and low cost, while authorities are in general more concerned with relieving congestion and minimizing the environmental impact of transport in general.
CREATING developed a multi-criteria decision aiding methodology that can translate environmental, economical, logistic and safety data into a single performance indicator: the Sustainable Transport Performance Indicator or STPI.

For more information please contact:

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PROJECT PARTNERS CLEANEST SHIP

UK	BP (owner of m/v 'Victoria' and supplier of low sulphur fuel during one year)
A	Via Donau
CH	Hug Engineering
D	MTU Detroit Diesel
NL	Bitfactory
NL	Breko shipyard
NL	DLD - Dutch Logistic Development
NL	Lloyd's Register EMEA
NL	Soottech
NL	Techno Fysica
NL	Verenigde Tankrederij (VT)
NL	VNSI - Netherlands' Shipbuilding Industry Association
NL	Yara Industrial

Annex 2: Innovations of CREATING and impact on rules and regulations

Innovations

In the course of CREATING many innovative aspects were developed. The most striking ones are mentioned below.

I. Designing new inland ships requires strong input from the parties responsible for transport, i.e. the shippers. The best designs are based upon a strong cooperation between shippers and inland shipping companies. The CREATING research was based on real interference of shippers with the research processes involved. This innovative way of working did stimulate the research team to a large extent but also had a positive impact on the practical applicability of the results obtained.

II. Looking at the ship designs (WP 3) the following elements are innovative:

- RoRo ship: new generation of RoRo vessels on the Danube
- Transport of bio mass: innovative loading and unloading system, icebreaking capability and
- Diesel-electric propulsion with multi directional thrusters
- Transport of bananas: first design of inland reefer
- Chemical tanker: much smaller double skin than possible up to the present.

III. The hull design of inland ships can be improved considerably by the application of available and cost effective internet based tools. CREATING delivered two tool kits, one for hull design and one to predict the required propulsion of the ship. Both tools will stay available at MARIN via internet.

IV. CREATING stimulated and speeded up the discussion using clean fuel for ship engines. In this respect real progress was made. It was also demonstrated clearly that cleaning the exhaust gasses is without any doubt possible, but still costly. The demonstrator with the Cleanest ship made this point very clear and stimulated the discussion to a large extent.

V. CREATING made clear that it is very effective to invest in RIS. This is not only stimulating efficiency but certainly also safety. It proves to be the by far most effective way to enhance safety.

VI. Finally CREATING delivered an assessment method, on basis of which a comparison of various modes of door to door transport can be achieved on basis of cost and environmental impact.

Impact on rules and regulations

Emanating from the research carried out the following impacts on rules and regulations are foreseen.

From the results of WP 6: CREATING recommends strongly to introduce the application of low sulphur fuel much earlier that anticipated by the EU so far. The application of clean fuel paves the way for using PM filters which are of great importance because of the negative health impact of fine particles. The research stimulated the discussion in the EU and actually really speeded up the progress.

From the results of WP 8: CREATING proposed a method to standardize the monitoring of accidents as well as the density of shipping. This is further discussed now within CCNR. Furthermore a standardized method has been proposed to calculate external risk.

From the results of WP 9: CREATING proved that investing in RIS instruments on the bridge (AIS preferably in combination with ECDIS) strongly contributes to safety in a very cost effective way. It is a plea for mandatory application of AIS (preferably in combination with Inland ECDIS) as soon as possible.

ANNEX 3: PROGRAMME OF CLOSING CONFERENCE

The closing conference takes place at the STC at Rotterdam, June 14th 2007.
The program is as follows:

CONFERENCE PROGRAMME
8.45 hrs **Registration**
9.15 hrs **Welcome by the chairman**
Mr. Ton Roos, Project Coordinator CREATING, Rotterdam
9.30 hrs **Perspectives of Inland Shipping in Europe**
Mr. Felix Stenschke, Director Shipping,
Federal Ministry of Transport, Building and Urban Affairs, Berlin
9.45 hrs **Commissions perspective on the work of CREATING**
Mr. Dirk Van Vreckem, Conseiller to the Deputy General Director, European Commission, Energy and Transport DG, Brussels
10.00 hrs **LOGISTICS**
Keynote speaker:
Mr. Dick van den Broek Humphrey, EVO/ESC, Brussels
10.30 hrs **Discussion**
10.45 hrs Coffee Break
11.15 hrs **SHIP DESIGN**
Keynote speaker:
Ir. Arne Hubregtse, Marin BV, Wageningen
11.45 hrs **Discussion**
12.00 hrs **The ambitions of the European Parliament on Inland Shipping**
Mrs. Corien Wortmann – Kool, Rapporteur on 'NAIADES',
European Parliament, Brussels
12.30 – 14.00 hrs **Lunch and exhibition on the CREATING Research**
14.00 hrs **ENVIRONMENTAL IMPACT**
Keynote speaker:
Manfred Seitz, via donau, Vienna
14.30 hrs **Discussion**
15.00 hrs **ASSESSMENT**
Keynote speaker:
Mr. Alassane Ballé Ndiaye, University of Liège, Liège
15.30 hrs **Discussion**
15.45 hrs **A push on innovation**
Mr. Jan Lintsen, Deputy DG Transport and Aviation
Ministry of Transport, The Hague
16.00 hrs **Final observations**
Mr. Peter Crawley, European Commission DG Research, Brussels
16.15 hrs **Conclusions and closure**
Mr. Ton Roos, Project Coordinator CREATING, Rotterdam
16.30 hrs **Reception**

ANNEX 4. ABBREVIATIONS

abbreviations

VNSI	Verenigde Nederlandse Scheepsbouw Industrie	Netherlands' Shipbuilding Industry Association
CBRB	Centraal Bureau voor de Rijn- en Binnenvaart	Central Bureau for Inland Barging
DUT	Technische Universiteit Delft	Delft University of Technology
HBR	Havenbedrijf Rotterdam	Port of Rotterdam Authority
V&W	Ministerie van Verkeer en Waterstaat	Ministry of Traffic and water management
TKV	Thyssen Krupp Veerhaven	
SPB	Stichting Projecten Binnenvaart	Shipping Projects Bureau
IVW	Inspectie Verkeer en Waterstaat	Inspection of the Ministry of traffic and water management
ECN	Energie Centrum Nederland	Energy Research Centre of The Netherlands
VT	Verenigde Tankrederij	United Tankers shipping company
DLD	Dutch Logistic Development	
Lrs	Lloyds Register of Shipping	
BV	Bureau Veritas	
Hoebee	Hoebee Shipyard	
SCR	Selective Catalytic Reduction	
PM	Particulate Matter	
RIS	River Information System	

ANNEX 5: PROGRAM OF ROTTERDAM LAUNCH CLEANEST SHIP, BRUSSELS EVENT AND SHIP DESIGN DEMONSTRATOR

PROGRAMME ROTTERDAM – UNVEILING OF THE CLEANEST SHIP

We cordially invite you on Tuesday 20 November 2007 to attend the unveiling of the Cleanest Ship by Mr. Lubbers, Chairman of Rotterdam Climate Initiative.

Cleanest Ship is a demonstration project of the European research project CREATING in cooperation with energy company BP. It demonstrates how inland waterway vessels can optimise their fuel efficiency and reduce harmful emissions.

Come to the project launch and find out more!

The programme for the day will be as follows:

15.00 hrs	Welcome reception
15.30 hrs	Word of welcome by Mr. A. Toet, Director Infrastructure and Maritime Affairs Port of Rotterdam and introduction of speakers
	* Mr. H.J.M. van der Wyck, Chairman of the Central Bureau for Inland Barging
	* Mr. M.J. van der Wal, Chairman of The Netherlands Shipbuilding Industry Association
	* Mr. D. Baldry, Group Vice President & CEO – BP Shipping Ltd
	* Mr. R.F.M. Lubbers, Chairman of Rotterdam Climate Initiative
16.00 hrs	Guided tours of the Cleanest Ship followed by refreshments
17.30 hrs	End

The gathering will take place at Maritime Simulation Center Rotterdam (MSR), Wilhelminakade 701 Rotterdam. Sufficient parking spaces are available in the vicinity. Also, the metro station Wilhelminaplein is within walking distance of the MSR.

We kindly request you to inform us whether you will accept this invitation by filling in the enclosed registration form.

Clean Waterborne Transport event Brussel

EUROPEAN COMMISSION
European Research Area

CREATING
Inland navigation

Port de Bruxelles
Haven van Brussel

Clean Waterborne Transport Event

Thursday 28th February 2008
Location: Heembeek quay, Brussels (near Royal Yacht Club)

The European Commission, the Port of Brussels, energy company BP and the EU research projects CREATING, HERCULES and METHAPU cordially invite you for a one day event to present their project results. Visit the Cleanest Ship demonstration vessel, BP's motor tank vessel 'Victoria' and learn about clean ship developments on short, medium and long term!

PROGRAMME

09.30	Welcome reception + registration
10.00	**MORNING SESSION**
10.00-10.10	**Opening and introduction** **Chair:** Mr. Bert de Vries, Netherlands' Shipbuilding Industry Association (CREATING partner)
10.10–10.25	***European research: supporting cleaner, safer, more competitive shipping*** Mr. Janez Potočnik European Commissioner for Science and Research
10.25–10.35	***CREATING project: Towards sustainable, safe and efficient inland water transport*** Mrs. Theresia Hacksteiner, Secretary General European Barge Union (CREATING partner)
10.35-10.45	***BP's Commitment to clean waterborne transport*** Mr. Simon Lisiecki Vice President Government & Industry, BP Shipping (Cleanest Ship partner)
10.45-10.55	***Sustainability, key issue for Port of Brussels*** Mrs. Laurence Bovy Chair Port of Brussels **COFFEE BREAK + NETWORKING OPPORTUNITIES**
11.45	**SESSION II** **Chair:** Luisa Prista, Head of Unit, Surface Transport Research, European Commission
11.45-12.00	***European Parliament view on clean shipping*** Mrs. Dorette Corbey, MEP Member EP Committee on the Environment, Public Health and Food Safety
12.00-12.10	***METHAPU project: Fuel cell power on board ships*** Mr. Carl-Erik Sandström Wärtsila Corporation (METHAPU partner)
12.10-12.20	***HERCULES project: The next generation of large marine diesel engines*** Prof. Nikolaos Kyrtatos ULEME (HERCULES coordinator)

12.30	**LUNCH + NETWORKING OPPORTUNITIES + VISIT OF THE 'VICTORIA'**
14.00	**AFTERNOON SESSION: TECHNICAL BRIEFINGS** **Chair:** Mr. Bert de Vries
14.00-14.15	***Combustion with ultra low emissions for ships*** Prof. Nikolaos Kyrtatos ULEME (HERCULES coordinator)
14.15-14.30	***Methanol and SOFC fuel cells for auxiliary power on board of vessels*** Mr. Carl-Erik Sandström Wärtsila Corporation (METHAPU partner)
14.30-14.45	***Research goals and results of CREATING*** Mr. Henk Blaauw Technical coordinator CREATING
14.45-14.55	***Exhaust gas treatment on board the 'Victoria'*** Mr. Hans Thomas Hug CEO Hug Engineering (Cleanest Ship partner)
14.55-15.05	***Environmental solutions for NO_x treatment*** Mr. Thorleif Hals Managing Director Yarwil (Cleanest Ship partner)
15.05-15.15	***Optimizing fuel efficiency by speed advising device*** Mr. Piet Kloppenburg Managing Director Techno Fysica (Cleanest Ship partner)
15.15	**CONFERENCE CONCLUSIONS**
15.30	Reception

Come to the event and find out more!

Participation on invitation, free of charge; admission only after preregistration

For anyone wishing to take a guided tour of the barge, hard hats will be provided and appropriate dress and footwear (flat soles) are required.

bp

CLEANEST SHIP

IP-HERCULES

METHAPU

Ship design demonstrator

Presentation programme October 11th, 2007 at CCNR, Strasburg

1. ***Short introduction of the founding fathers of CREATING[2] (H. Brombacher, CBRB)***
2. ***Short introduction on CREATING (H. Blaauw, SPB)***
3. ***Tool kits on hull design and power prediction (C. Thill, MARIN)***
4. ***Opportunities to increase safety on ship by measures on board (T. van der Werff, LR)***

Followed by discussion

[2] VNSI and CBRB