LOGBASED MANAGEMENT DOCUMENT

PUBLISHABLE FINAL ACTIVITY REPORT

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WP/Task leader	:	GRIEG LOGISTICS
Key person	:	IVAN OESTVIK
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EXECUTIVE SUMMARY

This Publishable Final Activity Report is part of the end-of-project reporting as required by the Contract with the European Commission. The report contributes to summarising the work conducted over the 3-year period of the Project.

This Report provides the status of the technical research work conducted in the LOGBASED project within WP0, WP1, WP2 and WP3.

The report aims to inform the reader about the findings and results from the LOGBASED Project in an easy-to-read manner without being too detailed about the administrative aspects.

This report provides, for the main Work Packages, the reader with:

- **A short description of results;**
- **The innovative character of the results; and**
- **How these results link up with the objectives of the project: improved design & improved performance.**

This report also provides an overview of the LOGBASED method and a user-guide on how to apply the method, which by most of the partners is seen as the two main long-term results of the Project.

A chapter on "Lessons learned" is also provided in this report, which should be seen as a comment from the industrial partners on the benefits and drawbacks of utilising time and resources in such EU R&D projects.

The project formally ended in June 2007 and some of the partners are already utilising the project results in commercial projects with external customers, whereas other partners are continuing research on some other aspects of the project.

This document has been written by Grieg Logistics, Fresti, FSG and SSRC, which constituted the project management group.

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1 INTRODUCTION

1.1 GENERAL

This Report provides the status of the technical research work conducted in the LOGBASED project within WP0, WP1, WP2 and WP3.

The report aims to inform the reader about the findings and results from the LOGBASED Project in an easy-to-read manner without being too detailed about the administrative aspects.

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A chapter on "Lessons learned" is also provided in this report, which should be seen as a comment from the industrial partners on the benefits and drawbacks of utilising time and resources in such EU R&D projects.

A comprehensive project summary is provided in doc no "FP6-1708-WP0-D0.8-001 Project Presentation and Publishable Executive Summary".

1.2 PROJECT AIM AND OBJECTIVES

The final aim of the LOGBASED effort was to develop ro-ro vessels enabling motorways of the sea to become more competitive towards their road/rail equivalents. To accomplish this aim, the LOGBASED partners have been working towards the achievement of the following objectives:

- Identifying the principal requirements and variables influencing the development of a viable intermodal transport business;
- Capturing the principal ship design and shipbuilding variables, as well as their interrelationships;
- Mapping the commercial and technical aspects in a logistics-based design methodology and developing a supporting software tool to facilitate its application; and
- Applying the developed method and tools for selected business cases (intermodal transport systems) in order to verify the approach through the design of more efficient ro-ro vessels.

The aim and objectives have been met whereas the Final Method Report (doc no FP6-1708-WP2-D2.4-R01 Final LOGBASED methodology) and assessment of vessel designs (doc no FP6-1708-WP3-D3.4-R01 Measurement of vessel performance) provide documentation on this aspect.

The project summary report (doc no FP6-1708-WP0-D0.8-001 Project Presentation and Publishable Executive Summary) provides additional reading to this report as well as illustrating how the contributions of the LOGBASED approach advances upon the state of the art in ship designing.

A comprehensive project paper has also been prepared illustrating the main results from the Project, which is an attachment to this report. This paper will be submitted to:

- **The International Marine Design Conference (IMDC) in 2009 in Trondheim, Norway as a follow up to the two papers presented at the previous IMDC conference in 2006.**
- **A maritime journal having the audience of interest.**

2 OVERVIEW OF THE RESEARCH WORK

2.1 INTRODUCTION

This section provides a thorough understanding of the LOGBASED methodology and its logic, which forms a multi-attribute decision-making guide procedure for the development of transport systems and their integrated ship design solutions. The specific results from each of the WPs are subsequently provided and linked to this overview chapter.

Figure 2-1 shows schematically how the various main elements of the LOGBASED approach are linked and how they bring *expectations* of the stakeholders involved to the draft and final steps of a *realisable* design to fit the transport system in question. Figure 2-1 illustrates the various modules being developed in the project. The method report is the cornerstone of the approach, which is fully supported and made operational by the Excel (guidance) tool in form of 9 modules forming a step-by-step procedure. A number of additional supporting tools have been developed within and as attachments to the 9 modules. Utilising the procedure shall result in an outline specification of a ship design within the context of a transport system, and through linking this process with naval architecture work (using external tools), also drawings and other decision-making support document/reports are made. In sum, the LOGBASED approach will produce enough background documentation, within a short time span and utilising relatively few resources, to enable the decision-maker to decide if the business opportunity in question shall be further pursued through putting forth heavy investments in transport system and ship design building.

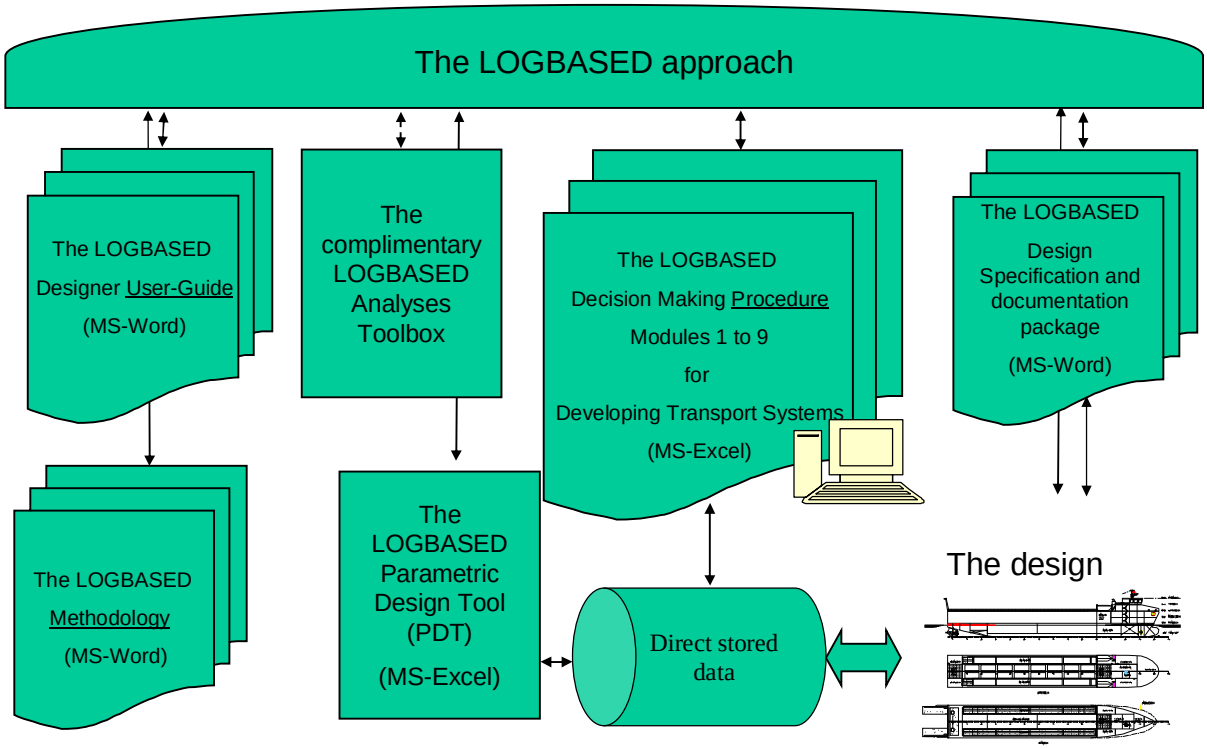

Figure 2-1: The LOGBASED Approach

2.2 DEVELOPING INPUT TO THE METHOD – LOGISTICS ANALYSIS (WP1)

Input to the method has in this project been developed in WP1 where logistics analysis of a number of routes was conducted as background research. The various logistics requirements were assessed and structured into the early parts/modules of the method. In this process improvement criteria for the routes were identified being targets for the ship designing work in WP3. The WP1 work formed the initial parts of the LOGBASED Method. The WP1 work is further described in Chapter 3.

2.3 THE LOGBASED METHOD AND USER-GUIDE (WP2)

The LOGBASED approach is a methodology that is developed in order to structure the process of turning a business concept, which includes a maritime transport system with one or more ships, into a comprehensive detailing of the transport system and ship specification. In other words; providing decision-support towards developing/identifying ships (new or second hand) that fits into the commercial and operational context in which they shall operate. The method is outlined in Chapter 4.

The LOGBASED approach is supported by a LOGBASED Guide, which currently is an Excel based tool consisting of 9 modules, with additional supporting tools, ensuring a comprehensive and structured approach of capturing the commercial and operational context into the ship design(s).

In order to ease the understanding of the LOGBASED Guide a Guideline document "FP6-1708-WP2-D2.3-R02 Guidelines for using Excel tool" has been produced as a guidance document to the users of the LOGBASED EXCEL Guide. The user can consult this document in order to put the correct emphasis on the various elements (modules and tools) of the Guide and make use of the results in the correct manner. It could be added that consulting one of the developers, or partners, may add clarity to the utilisation of the Guide. The Guideline document also presents and describes the flow of information through the LOGBASED Guide and shows how the modules are linked and how they relate to each other.

It should also be mentioned that it seems like the generic method and guide developed serve the purpose as a research result, whereas the partner companies following the project are fine-tuning and revising the guide and tools to become company-specific before being applied in in-house commercial work. An example on this is within the Grieg Group whereas the database utilised as a backbone in the Parametric Design Tool (in Module 5) is being structured to address only ships that are relevant for the business being conducted in the company. Another example is that Grieg Logistics is developing specific calculators for various port operations that are conducted as part of business. A common aspect in all such examples is that the method remains and seems to be of a generic and robust type.

2.4 SHIP DESIGNING (WP3)

The practical ship design work in WP3 is conducted as a parallel activity to utilising the method, which should be seen as a practical, innovative way to structure the input to the ship design process as well providing decision-support to the designer throughout the design work. The method covers all the phases of the design process, but the designer needs to populate the databases and Module 5 with case-relevant data/information in order for the method to function as intended. In other words, the method is not a black box producing a finalised design through feeding it with the required input data. The designer should see the method as assistance to his/her work, which over time and through building up reference cases will speed up the work as well as reduce errors and improve quality in the early phases of the design spiral. The WP3 work is further described in Chapter 5.

3 WP1 – LOGISTICS ANALYSIS

3.1 SHORT DESCRIPTION OF RESULTS

The work conducted in WP1 was organised under the three main tasks described in the following sub-sections. An overview of the results achieved in each task is included.

3.1.1 Compilation of statistical data

Upon the identification of the transport routes that were to constitute the core of each of the LOGBASED business cases, WP1 was responsible for the gathering and analysis of statistical information that could be relevant for these cases. Such information related mainly to the volumes of freight transported along the different routes under study.

The selection of routes itself were conducted by the two ship owners participating in the project based upon their in-house market analysis and requirements for conduct development work for certain geographical areas and towards selected customers. Initially 8 routes were assessed for the business attractiveness before a final 4 routes were chosen to be the focus for each of 4 design tasks, respectively.

Results included a fairly comprehensive database with figures on external trade and on freight transport volumes along the selected transport routes. For the Atlantic case, the raw statistical information was later complemented by a trade modelling tool developed by one of the partners, which enabled a finer modelling of freight volumes by origin and destination, by cargo category and by freight unit type. Because this tool was, to a considerable extent, derived from previous research on Irish trade conducted by one of the LOGBASED partners, it was not possible within the project to replicate it for the remaining business cases. For the Hydro and Rhine Line cases, the initial database was later augmented with specific information on the trade between Norway and various countries in continental Europe, enabling added refinement of the statistical base used for these cases.

This data on cargo volumes was thereafter used as input to develop ship functions that could accommodate the cargo in question, as well as being the dimensioning factor regarding ship size and speed on the respective routes.

3.1.2 Gathering of market prices of transport services

This task aimed at describing the conditions and prices of existing transport services competing with or complementing the transport services developed in the selected business cases.

Through direct contact with transport operators, some estimates of current market prices were compiled. In addition, details on a number of ports along the different transport routes were collected, as well as the prices for the utilisation of the respective services, all of this information having later been gathered in the project's port database.

Faced with the lack of results from the inquiries with transport operators and with the fact that inquiring transport operators was often inconclusive because the prices and conditions offered by such operators vary substantially, an own calculator for estimating road transport costs was developed. This tool, based upon a calculator for truck operation costs developed by the Spanish Ministerio de Fomento, enabled a detailed estimation and breakdown of the costs of the multiple legs of the transport systems that composed each of the LOGBASED business cases, besides enabling an estimate of the costs of competitive services.

The truck calculator was subsequently used in all the 4 cases to estimate the door-to-door prices for the solutions being developed, thus accommodating a direct comparison with existing services to warrant a shift from often road-based systems (such as the Ireland-Spain trade) to a more direct ship service.

3.1.3 Transport system scenario modelling and business case development

The main contribution of WP1 in regards to the development of the LOGBASED analysis methodology consisted in applying the Transport System Development module of that methodology to the development of the selected business cases. Besides being a critical step in the development of the cases, this task was central to the advancement of that module, thereby contributing to the work of WP2 (Module 5, see below chapter 4).

The key outcomes of this task were the development, analysis and description of the four main business case selected in LOGBASED – gathered in individual LOGBASED Methodology Excel spreadsheets - which were later used as the starting and reference point for the ship design work to be conducted in WP3. The results of WP1 were in general a direct input to Modules 1, 2, 3, 4 and 5, whereas further WP3 work added further details and refinement to the early WP1 input.

3.2 INNOVATIONS

Except for the contribution to the development, and later refinement, of the LOGBASED methodology and Excel tool, there was limited innovation in the remaining tasks conducted in WP1. This does not come as a surprise, given that the bulk of the work conducted in WP1 was meant to support the development of the methodology, which took place mainly in the remaining two WPs. Nonetheless, as was mentioned above, because WP1 members were extensively involved in the iteration process that led to the final set of modules in the LOGBASED methodology, it is fair to say that this contribution was instrumental to the overall level of innovation of the project.

In regards to the collection of statistical data, and of prices and conditions of transport services, the innovative aspects have been towards 1) the work on modelling of freight transport volumes between the Irish Sea and the Northern Spain regions, conducted by LOGBASED partner NECL, and 2) the development of the transport costs calculator, as alluded to above. The WP1 work on cargo volumes and statistics illustrated that this is a difficult topic to examine within a project like LOGBASED and with the current partners. However, the learning aspect of this issue for the involved partners, also including the ship owners, have been considerable and is a knowledge that is beneficial for the daily work.

3.3 MEETING THE OBJECTIVES

It is fair to say that the objectives of WP1 have been met. A significant amount of data on transport of freight along the proposed transport routes was gathered, which was critical for the well-funded development of the four LOGBASED business cases. This data was compiled in databases accessible to all of the project partners. Where difficulties were encountered in respect of the gathering of prices of competing or complementary transport services, WP1 was able to devise an alternative way of estimating costs of such services. This was shown to be instrumental in analysing the economic competitiveness of the proposed transport services.

Finally, in what concerns the development of the final four business cases, albeit through a longer and lengthier process than initially expected, WP1 was capable of fully developing the four business cases, in this process contributing to the amelioration of the overall LOGBASED methodology, and providing the fundamentals for the posterior ship design conducted in WP3.

4 WP2 – METHODOLOGY DEVELOPMENT

4.1 OUTLINE OF THE METHODOLOGY AND ITS MODULAR STRUCTURE

The LOGBASED-approach and its logic, forms a multi-attribute decision-making guide and communication tool for the development of transport systems and their integrated ship design solutions. The LOGBASED-approach has been developed as a modular structure where the various modules can be utilised to various extents pertaining to the case in question. The modular structure, as illustrated in Figure 4-1, guides the business developer/ship designer through a systemic process.

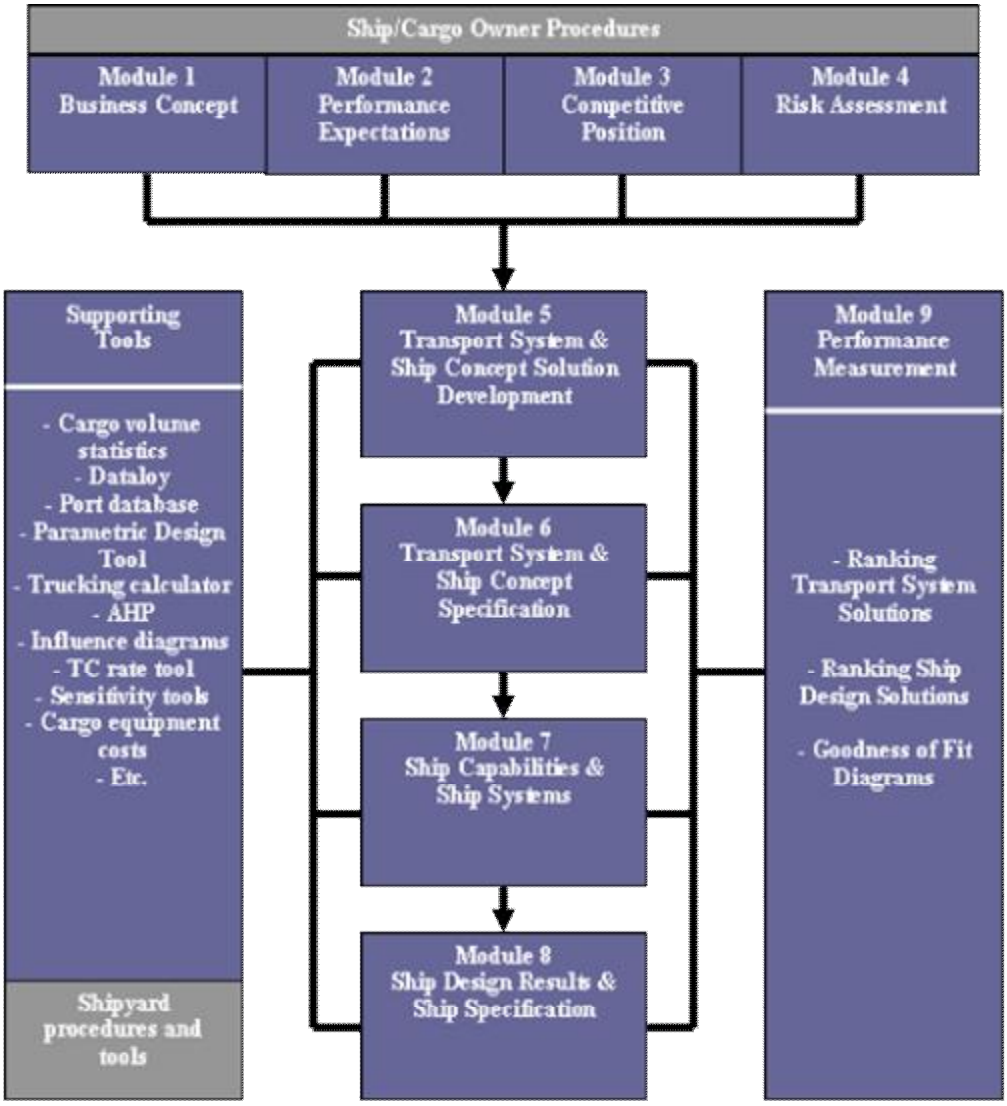

Figure 4-1: The LOGBASED Methodology

Most transport systems are complex and consist of many different commercial, operational, economical, technical and social facets with their related uncertainties. The LOGBASED approach developed guides decision-making processes by handling complexity and their corresponding

uncertainties in a more explicit way and ensuring that the uncertainty level is well known to the stakeholders in question, and reduced to the extent possible.

The LOGBASED-approach, the business concept development process consists of nine modules methodology sequence, which can be used in full, or as separate modules, where decision-making support is provided all along the process. The methodology is made explicit in applying a Microsoft *EXCEL* format to hold the information and the various integrated analyses routines. Each module consists of a set of tabular "archive," with interwoven systematic as to: i) what information is needed here to perform the necessary analysis and ii) where to proceed with the results, when the analyses are done. Each routine has guidance notes linked to it.

An information flow tree, as illustrated in Figure 4-2, assists the user to follow process input and output as the LOGBASED-approach progresses. As analyses in module 5 are carried out, this may have major impact on the assumptions and expectations set in the modules 1-4. Similarly, when technical work (naval architecture work outside the Excel tool/guide) is conducted with the assistance of Module 7-9, it may be necessary to re-visit Module 5 to adjust the conceptual development work. This may cause the user to track back to check and calibrate the information given in these modules. In general the process is an iterative one and this sort of back-tracking is common for all modules as new information is revealed and assumptions are checked out and realism of promising solutions are tested. The strength of the procedure is that the process is manageable as the information on which decisions are made, are stated and visible in the Guide causing a more transparent and auditable process.

The guide is not a black box automatically providing the user with an answer once input is given. Rather, it is a descriptive process, in the form of a guide, forcing the user to closely think and rethink all aspects of the business concept at hand that influence the ship design being developed for the transport system (business case) in question. The procedure secures the collection and proper collation of critical information of the business concept in the nine modules of the LOGBASED-approach and offers decision-support at various stages and levels.

The LOGBASED-approach focuses on identifying particular logistics and design problems to be solved and corresponding uncertainties to be managed. It specifies the premises and boundary conditions (assumptions, limitations, needed information, etc.) of the decision-making domain. It sets the scope of the possible design solutions in question and integrates the design in the preferred logistics setting. In this respect, the LOGBASED-approach and guide goes beyond just being a design procedure like the traditional *design spiral* approach. Rather, it expands the current design process *upstream* to encompass all relevant commercial, economical, and social aspects of the business and integrates these aspects into the design solutions both for the transport system and the integrated ship design. *Downstream*, it takes the broader business aspects far into the detailed design process of most design bureaus' and/or yards' project departments.

The novel LOGBASED-approach meets the existing and traditional ship design methods and analysis techniques as an interface in Modules 5, 7 and 8, via a Parametric Design Tool (PDT). This new PDT application being developed especially in the LOGBASED project as a part of the LOGBASED set of methodologies provides specific recognisable metric input to the well established and developed known ship design packages available in the market place. Thus, the LOGBASED-approach does not replace existing design tools, but complements them. It is more like a macro application better handling the complexity of information involved and the sometimes unclear decision making process following all business development. The existing design tools and applications then become necessary support means to finalise and complete the logistics-based designs.

The Approach is meant to represent a better and more explicit interface between the two major stages of a transport system and integrated ship design development process using the

traditional and existing ship design application packages. In sum this shall result in an effective ship concept development and detailed design/engineering process, which shall result in better performance of the transport system as well as the ship itself designed to accommodate the requirements of the transport system in question.

Provided the ship design shall be developed for a flexible utilisation where its functions and transport assignments may alter during the expected life time, this can readily be accommodated utilising the LOGBASED method/guide through specifying such a flexibility requirement in Module 1 and 2. Then this requirement will be taken into account during the development process.

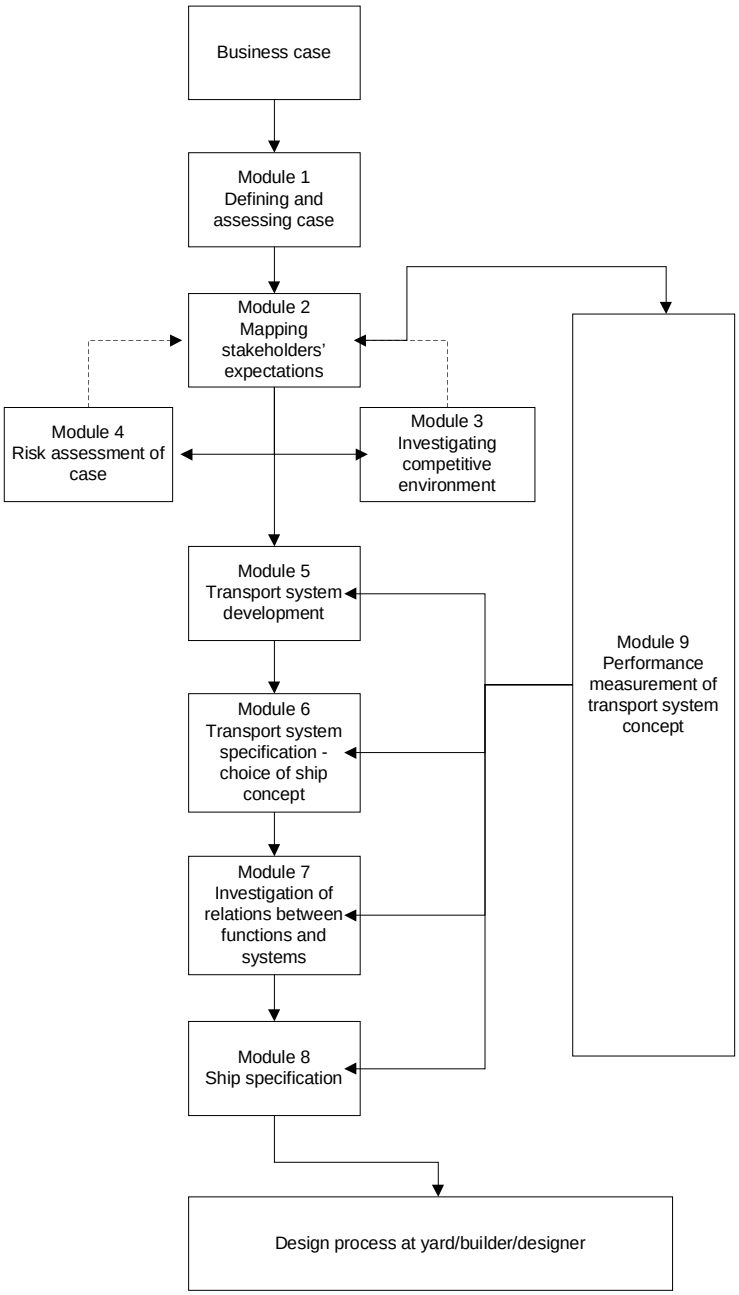

Figure 4-2: Information flow through the LOGBASED Guide

It is referred to the attached paper "A Methodology for Logistics-Based Ship Design" by Per Olaf Brett[1], Evangelos Boulougouris[2], Richard Horgen[1], Dimitris Konovessis[3], Ivan Oestvik[4], George Mermiris[3] and Apostolos Papanikolaou[2] for further reading on the method.

4.2 INNOVATIONS

The LOGBASED method is both a *communicational* and a *decision-making support instrument* to be used among all the actors in the total decision-making process of a transport system realisation. Its role is to record and guide the complex information gathering and decision-making process. Assumptions, presuppositions, limitations and restrictions are described and kept readily available for further and later interpretation of the results of the feasibility analyses being carried out. Various influences among system variables are identified and measured. The LOGBASED approach is the structure (*process guide*) within which the various methodological elements, analysis techniques, supporting default values, design tools and work procedures are found and elaborated upon.

The new suite of transport system and ship design development methodology and corresponding analysis techniques, offered by the LOGBASED approach, can successfully facilitate a better understanding of almost any interactions and relationships among critical factors influencing the goodness of fit of market, owner and ship performance expectations/requirements. The task of making the right decisions as to the maximisation of value creation for the business in question or service to be introduced is a matter of improving the effectiveness of the more promising solutions thus, the impact this issue has on internal and external performance expectations and how these expectations are met. It is argued that this decision-making issue should be integrated into the overall development process in line with traditional considerations towards overall project performance measures of merit.

The LOGBASED methodology augments previous transport system planner and ship design approaches by appropriate input and output/outcome oriented analyses techniques as well as give particular attention to correctly identified actual choice variables or expectations of all relevant and involved stakeholders. The LOGBASED approach accurately reflects the day to day practice of transport system planners' and ship designers' decision making processes, step by step, thus introducing a practical method for inclusion of the logistics-based requirements of a transport system within the ship design process in a structured and scientific manner.

The Excel tool being utilised in the daily work is a novel feature in itself capturing the needs of a transport system or ship design developer. The Excel tool is moreover equipped with additional, independent tools, such as the truck calculator and the Parametric Design Tool. The Excel tool is currently, and following the end of the LOGBASED Project, being extended in functionality within further research projects and internally at the LOGBASED partners.

The tool and method is being utilised to create innovations in the market place and is specifically utilised by Grieg Logistics to enable better management of the (invisible) interfaces between the separate companies in the value chain from manufacturer to end customer. Often this value chain is separated into several contracts with little or no interaction between them, such as the port-ship interface, resulting in daily operations in the industry of little rationale. The LOGBASED method enables a full modelling of the total value chain where all interfaces can be modelled and quantified in the planning process. The method could be developed into, or seen as a draft of, a standard in the development of effective transport systems.

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[1] Det Norske Veritas, Norway (now with Ulstein International, Norway)
[2] National Technical University of Athens, Greece
[3] Universities of Glasgow and Strathclyde, UK
[4] Grieg Logistics, Norway

4.3 MEETING THE OBJECTIVES

Work Package 2 objectives, as stated in the project's Technical Annex, were "*to develop a logistics-based design (LBD) methodology, which scientifically integrates logistics requirements for intermodal transport routes … a suite of software tools will be developed that will enable the LBD-methodology to become a real design tool in line with other applications for stability, resistance, etc. … WP2 will also investigate the potential for developing a standard for the LBD approach for intermodal transport chains.*"

The technical objectives of Work Package 2 have been fully met through the research carried out in the course of the LOGBASED project. The logistics-based ship design methodology is developed through three cycles of iterations: during the first year, the initial set of prepositions and documents were put together. During the second year, these developments were reviewed and accordingly revised through workshop meetings with all the project participants and on the basis of the feedback received from the initial stages of design development in Work Package 3. The final version of the methodology was elaborated upon during the third year of the project, following comprehensive feedback from Work Package 3 developments.

The software developed captures the flow of information (as shown in Figure 4-2) as required to realise the methodology. Substantial efforts were expended by members of the LOGBASED team to develop the suite of software tools, also ensuring that software adequately represents the methodology. The main software developer were: DNV and Grieg (for the Excel spreadsheet), NTUA (for the PDT) and SSRC (for the Java prototype).

Finally, with reference to setting a logistics-based design standard, two separate developments took place: an industrial and an academic standard, namely, two approaches that can be used to promote the LOGBASED approach to the industry and an approach which would render logistics-based ship design part of academic curricula, respectively.

5 WP3 – SHIP DESIGN AND BUSINESS CASE DEVELOPMENTS

5.1 INTRODUCTION

The LOGBASED methodology has been utilised in four case studies in order to test, verify and further develop the methodology through designing ships accommodating the requirements and expectations relating to the respective routes.

The two activities "Methodology development" and "Ship design" have been run partly in parallel and in an interactive way. This integration of methodology development and methodology application has led to a high degree of maturity of the methodology, and both to a novel approach to ship design as well as novel designs.

The public information released regarding the four cases is currently limited due to the highly sensitive nature of the cases, where the ship owners have restricted wider publication of the case information.

5.2 ATLANTIC CASE

Geographic Area
The Atlantic Case is a business case investigating ro-ro sea transport services between Spain and the British Isles. Countries directly involved are Spain, Ireland and Great Britain. Trade between Portugal and the British Isles will also be affected. France will benefit through less transit traffic.

Trade characteristics and ports of call
The trade is characterized by harsh competition by existing trucking. The ports of call will be Santander, Liverpool and Dublin.

Cargo properties
The targeted cargo is any unitized cargo and new cars. Vessels are able to carry trailers, max 12 trucks/departure, cars and containers.

Character of business
The character of the business is to implement a service improving significantly the present supply and offering significant cost savings to potential customers.

Dominant transport system expectations
The main expectation is to provide a regular liner service with fixed and non-rolling schedule with at least 4 departures per week. Second driving expectation is to provide a service offering a 30 % customer saving in port to port costs.

Dominant ship expectations
The dominant ship expectations are adequate capacity, speed, harbour times and frequency of departures. Special challenge to the ship design is coping with the weather conditions in a given schedule.

Innovation
Main innovation is a vessel optimised for three different operational modes, enabling efficient operation in all expected conditions. The developed configuration also improves significantly the redundancy and flexibility (e.g. the ability of the vessel to be shifted to a variety of different routes) of the design compared to existing designs.

Second innovation is the constant search for simplicity and focus oriented minimisation, which resulted in a design with 10 % more capacity in a ship with 10 % less volume than of comparable competition.
The third innovation is the LOGBASED approach, where all transport system and design related decisions are made in a systematic and documented way. This enables benchmarking towards existing designs straight forward and effective.

5.3 BALTIC CASE

Geographic Area
The Baltic Case is a business case that investigates in services in the north-eastern part of the Baltic Sea. Two countries are involved in the Baltic Case

Trade characteristics and ports of call
The trade is characterized by its roundtrip nature. Preferably, the resulting transport system will provide a fixed schedule. Two ports will be called.

Cargo properties
The cargo is ro-ro and Container cargo. The ro-ro cargo is diversified into everything that is expected to be transported utilizing rolling units. Container cargo is diversified into TEU and FEU of standard type and high-cube type.

Character of business
The character of the business is to look into the possibilities of new services in the area.

Dominant transport system expectations
These are mainly expectations reflecting the uncertainties of a completely new service. Further, expectations concerning the future development of the cargo volumes relate directly to the nature of the transport system that has been developed.
In addition, schedule related expectation drive the development of the transport system.
Beyond this, usual expectations on the profitability do exist.

Dominant ship expectations
The resulting ship design has been driven mainly by the expectations on the cargo volumes, and on frequency of the service.

Innovation
One innovation is, that due to the specific performance measurement one type of cargo has been deliberately removed from the transport system – initially there were requirements to transport this cargo, the result is that no service is offered for this cargo.
The second innovation is related to how the transport system has been assembled in order to provide a fixed schedule with the required number of roundtrips for the cargo volume that is available today. This initial set-up of the transport system inherently provides means for upgrading the system in the future.
A third innovation is the approach, how the transport system solves issues related to terminal capabilities that are available at present.

5.4 HYDRO CASE

Geographic Area
The Hydro case transport system operates amidst the three main cities in the west of Norway, Bergen, Haugesund and Stavanger, having a population of app. 1 mill. This region produces much

of the Norwegian export and there are many ship routes to/from the region as well as much cargo being exported with road transport using the ro-pax ferries to/from Denmark as exit points.

Trade characteristics and ports of call
The Hydro business case concerns Wilson EuroCarriers' aim to renew the existing transport system for aluminium/anode transport between the Hydro aluminium factories, located in Husnes and on the island of Karmøy in the west of Norway, and the Port of Rotterdam in the Netherlands. The aluminium cargo is transported to end-customer on the Continent, whilst anodes are return freight to the factories.

Cargo properties
The targeted cargo is aluminium cargo and general cargo in trucks. Vessels are able to carry trailers on weather deck and aluminium cargo in the holds.

Character of business
The character of the business is to replace the existing tonnage with an LNG-fuelled cargo ship enabling to the keep the freight prices at the same level. In addition the new transport system will aim to attract road-based cargo today being transported by trucks using the ro-pax ferries out of Norway.

Dominant transport system expectations
The main expectation is to provide a regular liner service with a fixed weekly schedule. Second driving expectation is to provide a service offering a 30 % improvement in emissions to the same costs as today's services.

Dominant ship expectations
The dominant ship expectations are adequate capacity, speed, harbour times and frequency of departures.

Innovation
Special challenge to this ship design is to develop a new aluminium cargo handling system keeping port time low and providing requirements for a lower speed at sea.
The use of LNG as fuel is the first demonstrator on a ro-ro cargo ship.
The third innovation is the LOGBASED approach, where all transport system and design related decisions are made in a systematic and documented way.

5.5 RHINE CASE

Geographic Area
The Rhine Case is a business case investigating sto-ro/ro-ro sea transport services between Norway and the Rhine River. Countries directly involved are Norway, Holland and Germany.

Trade characteristics and ports of call
The trade is characterized by low margins and long term contracts. There will be several ports of call in Norway and two in Central Europe. The 10 ships sailing the routes today are all bulk carriers with capacity to take containers on deck. The Rhine line case consists of a transport system serving two routes; one from Duisburg to the East of Norway ending in Drammen and one from Duisburg to the West of Norway ending in Trondheim with a prolonged route up to Mosjøen every fourth week. The new transport system is considering to reduce the number of ports being called in Norway.

Cargo properties
Ships are transporting mainly bulk cargo southbound, which is loaded in piles and steel products northbound which is loaded in layers. The current design of the ships makes these two types of

cargo hard to combine. Loading and discharging seldom takes place in the same ports in Norway and therefore it is not a problem to empty the ship before new cargo can be loaded.

Character of business
Today the cargo of interest is bulk and containers. In addition to operating in the spot market for transport of cargo, owner also has made contracts for shipment of industrial cargo. This is southbound cargo from Norway to Europe and consists mainly of bulk cargo. It is necessary to restructure the Rhine Line to be more profitable. The ship should be streamlined by looking at:

- **Choice of vessels to use in the transport system**
- **Improving the efficiency of the port and cargo operations**
- **Restructuring the fleet operations**
- **Inspect the possibility for renewing the mix of cargo types**

Dominant transport system expectations
The main expectation is to provide a regular low-cost liner service. It is also an ambition to increase the cargo range allowing more profitable cargoes than bulk to be transported. Current service is very cost competitive, so the challenge is to improve it.

Dominant ship expectations
The dominant ship expectations are adequate capacity, speed, harbour times and frequency of departures. A challenge is to have a flexible loading system accommodating the diversity of cargo this route transports.

Innovation
Main innovation is a vessel being capable of transporting a set of different cargoes onboard the same platform, as this will increase competitiveness of the design.
Second innovation is a design that is fitted for transport on the Rhine River with a higher effectiveness than comparable ship.
Third innovation is the LOGBASED approach, where all transport system and design related decisions are made in a systematic and documented way.

6 LESSONS LEARNED – PRACTICAL ISSUES

The main obstruction to the research work has been the ability of the project partners to conduct research work in a booming market. The shipping market has been on a historic high throughout the project. This market situation led to one ship yard and one designer dropping out of the project early on. The input, or effort, to the project for the industry players has mainly come through effective and short workshops being prepared by a few of the central partners. The latter has been forced to devote more time to the project than planned in order to accommodate for the all-time-high situation in the market place. The result has been many workshop meeting at the premises of the ship owners and designers, led by DNV and Grieg Logistics. In the end, this work situation has functioned very well and has been adopted in other similar projects.

LOGBASED suggests keeping the number of participants in similar type of projects as the STREP-type to between 6-8 partners. Time and effort in the project proposal phase should be spent to carefully select the partners and provide them with a clear scope of work. Motivations and reasons for participating in European R&D should be carefully examined. It is not suggested to add participants one is unfamiliar with. This aspect should be part of the EC QA process following a positive evaluation of the project proposal from the EC evaluators.

Collection of relevant statistical information and, later, of actual market prices for different transport services, are tasks that should be conducted as being purchased/retrieved from a central EU body. This data is necessary input to many EU projects, and probably many projects are in parallel trying to collect this information. This issue should be carefully considered in the project planning/applying phases and should be picked up by the EC as a topic to discuss closely in the project early phases, or before the project is granted funds. This topic could be improved by:

- clarifying, as early as possible, what are the sufficient and the necessary levels of detail in terms of background data in the project;
- involving partners with previous knowledge about the type, quantity and quality data on freight transport in the regions under study, as well as of the market prices of transport services;
- involving partners with the capability of modelling transport flows along the desired corridors, or, alternatively, allocating a portion of the budget for the acquisition of such services.

Methodology development is always a challenge in such projects, but aiming for an innovative method with supporting guidelines and tools, this process has been very effective in LOGBASED. The focus on this part in the project has been extensive, which has secured its success. As a lesson learned and a tip for other projects is to have frequent and well-planned workshops with the same participants over a long period. Have a method group with a mix of experience and expertise and a method lead developer with the drive to make decisions where necessary. The focus and workload required on the method led subsequently to a delay for its use in the ship design cases, which also delayed the knowledge transfer to the end-users of the method. Adequate time must be provided in the project planning for this knowledge-transfer and training of the end-users of such methods.

The development of a software tool, which can be used to utilise the LOGBASED method/approach effectively has been a challenge to get all partners to agree the best way forward. This issue will always be a hot discussion issue between the partners as the motivation to use/develop the various codes are wide ranging. The preferences are often based upon what is already being used amongst the partners. A special note on this issue should be made during the project proposal phase already.

The process of developing concept designs and identification of the key design drivers in the business case is an extension of the typical design approach. The main difference between the

typical design approach and the LOGBASED approach is that the LOGBASED approach starts further "upstream", and ends where traditional design starts – in a ship specification. By this more and other, potentially non-technical aspects are captured in ship design.

On the other hand it came clear, that the application of the LOGBASED methodology might require skills other than typical skills of naval architects and marine engineers. The LOGBASED methodology requires a structured process with clearly defined interfaces. In this approach it is essential not to get stuck with technical details at the beginning. In addition, the skills of a facilitator are required to guide the design team through the process. These facilitating skills should be supported by know-how on the issues of modules 1-3 of the LOGBASED process, which is non-technical issues. These skills might to be developed prior to application of the process in a commercial environment. On the other hand, the potential advantage of extending the scope of traditional ship design work and giving it a well developed structure has been proven by the four design cases.

7 LIST OF TECHNICAL DELIVERABLES

The table below lists all the relevant technical deliverables developed in the LOGBASED Project. In addition to these deliverables there are a number of administrative and management deliverables, which in general have been provided at the end of each year of the three year project. This report is one example of such a management report.

No	Deliverable title
D 0.5	LOGBASED paper
D 0.8	Project official presentation
D 1.1	Logistics analysis of potential sea motorway routes
D 1.2	Identification of logistics requirements for 4 selected routes
D 1.3	Improvement criteria for the 4 selected routes to achieve a modal shift
D 2.1	An initial LOGBASED methodology and user guide
D 2.2	Tool requirements
D 2.3	Software tool (Excel and Java)
D 2.4	Final and validated LOGBASED methodology
D 2.5	A LOGBASED standard
D 3.1	Report on approach for tool integration in existing ship design packages
D 3.2	Initial design specification for 4 sea motorway routes – 4 reports
D 3.3	Ro-ro vessel designs for 4 sea routes – 4 reports
D 3.4	Report on how to apply the performance assessment and profiling concept on the 4 ro-ro vessel designs and their respective sea-routes

8 LOGBASED PARTNERS

Partners	Roles
LMG Marin (www.lmgmarin.no)	Project leader, Baltic/Hydro case development
Flensburg Shipyard (www.fsg-ship.de)	WP3 leader, WP3 model development, WP3 Baltic design
Navantia (www.navantia.es)	WP3 Rhine design
DFDS Tor Line (www.dfds.dk)	Baltic/Atlantic case leader
Wilson EuroCarriers (www.wilsonship.no)	Hydro/Rhine case leader
Fresti (www.fresti.pt)	WP1 leader, WP1 model development, Atlantic case development
Fordesi (www.fordesi.pt)	Assistance to all case developments
NAME-SSRC (www.na-me.ac.uk)	WP2 leader, WP2 methodology development, WP2 software development
NTUA-SDL (www.naval.ntua.gr/sdl)	WP2 methodology development
NECL (www.necl.ie)	Assistance to Atlantic case development, WP2 software development
DNV (www.dnv.com)	WP1 model development, Rhine/Baltic case development, WP2 methodology development, WP3 model development
Foreship (www.foreship.com)	WP3 Atlantic design, WP3 Hydro design
Grieg Logistics (www.grieg.no)	Technical co-ordination, WP1 model development, Baltic / Hydro case development, WP2 methodology development, WP3 model development

9 CONCLUSIONS

This Report provides a summary of the main results of the technical research work conducted in the LOGBASED project.

The final aim of the LOGBASED effort was to develop ro-ro vessels enabling motorways of the sea to become more competitive towards their road/rail equivalents. The aim and objectives have been met whereas the Final Method Report (doc no FP6-1708-WP2-D2.4-R01 Final LOGBASED methodology) and assessment of vessel designs (doc no FP6-1708-WP3-D3.4-R01 Measurement of vessel performance) provide documentation on this aspect.