1. Final publishable summary report

1.1. Executive summary

The MARitime POlicy Support (MARPOS) project is an FP7 coordination and support action that aims at assisting the European Commission in the implementation of the EU Maritime Transport Policy objectives by utilizing the results of past research work in the field of Maritime Transport and related expertise from the Transport sector.

The project addresses the above issue by consolidating and synthesizing the results of Maritime Transport research in the past two Framework Programmes (FP5 and FP6) and the most recent FP7 in order to come up with a set of conclusions as they apply to five (5) Maritime Transport Research Themes, namely:

- Competitiveness
- Environment
- Energy
- Safety & security
- Human factors

The project also looks in detail on the future needs and priorities for EU funded maritime transport research so as to better serve the realization of the objectives of the general Maritime Transport Policy.

An important part of MARPOS work is also devoted to dissemination and networking actions. These activities include the organization of two (2) major events and other internet based dissemination activities. The aim is to present to various experts, administrators and policy makers across EU, the Maritime Transport research evolution, including objectives and outcomes and recommendations regarding future Transport research themes and priorities.

The key outputs of MARPOS consist of a publication containing the results of the research work, and an easy-to-use searchable internet database (e-tool) through which all interested parties have the opportunity to be informed on the results of the European research over the past decade. This Maritime Transport Research Database (MTRD) is an updateable e-tool providing an overview of a series of past and current maritime transport research projects funded under DG RTD in the various Framework Programmes (starting from the 5th FP). For each project included in the database, MTRD presents key information on projects' scope and objectives, consortium members and budget size, project duration, results and the implementation of the research outcomes during the project period and beyond.

1.2. Project context and objectives

The MARPOS project aims at assisting the European Commission (EC) in the implementation of the European Maritime Transport Policy priorities by utilising the results of past and current research work in the Maritime Transport field and building upon related expertise from the Transport sector. For the scope of the analysis, MARPOS uses a set of research "themes" covering key aspects of maritime transport. The selection of the so-called maritime themes was based on the priorities and key objectives set by the EC concerning maritime policy and maritime transport policy mentioned in its related legislative documents as described below.

Following a set of recently published documents the key identified priorities of the European Maritime Transport Strategy[3] concern to:

- The strengthening of the European shipping competitiveness through the development of an attractive framework for quality shipping and quality operators in Europe including financial measures;
- Investing in human factor by making maritime professions more attractive to young people and thus improve employment of seafarers;
- Promoting greener maritime transport;
- Supporting the enforcement of existing Community and international rules leading to a safe and secure system;
- Promoting short sea connections between all the maritime regions of the European continent;
- Improving Europe's commercial sea ports;
- Supporting research and innovation development to strengthen the competitiveness of the European maritime industries and their capacity to meet the environmental, energy, safety and human challenges.

In addition, the existing framework for European Maritime Policy, as expressed through the Commission's Blue Book (published in 2007) concerns to[4]:

- Maximizing the sustainable use of the oceans and seas;
- Building a knowledge and innovation base;
- Delivering the highest quality of life in coastal regions;
- Promoting Europe's leadership in international maritime affairs;
- Raising the visibility of Maritime Europe and its heritage.

Following the above described priorities and strategies, MARPOS identified five (5) key maritime areas, so-called Maritime transport themes, based on which the project analysis will take place.

[3] Maritime transport strategy 2009-2018, DG TREN, 21 January 2009
[4] "An integrated Maritime Policy for the European Union", {COM(2007) 574 final}, {SEC(2007) 1278}, {SEC(2007) 1279}, {SEC(2007) 1280}, {SEC(2007) 1283}

Key objective of this work is to come up with a set of conclusions about the research results, which will be available to the wide public through the use of different dissemination means such as publications (inventory publication, brochures etc), dissemination events (Workshop/Conference) and internet based tools (on-line searchable database) . MARPOS goes one step further coming up with several suggestions addressing the future priority lines for the European research in maritime transport, in light of recent developments and future anticipated conditions. The following figure provides an overview of the MARPOS concept:

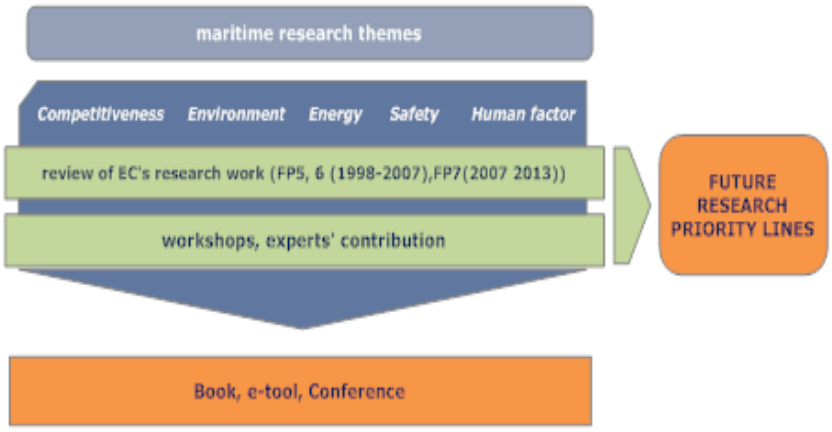

Figure 1: MARPOS concept

MARPOS, as presented above, is conceived to proceed with its analyses and recommendations aiming to support research and innovation in European maritime area to strengthen the competitiveness of the EU maritime industries and their capacity to meet the environmental, energy, safety & security and human challenges. Therefore MARPOS analysis will be based on the following five (5) Maritime Transport Research Themes, namely:

- Competitiveness
- Environment
- Energy
- Safety & security
- Human factors

All five (5) maritime transport themes are closely related to each other, as shown in the next figure, while, each one of them might be further analyzed in subthemes which will be defined at a later stage of MARPOS, depending on the nature of the RTD projects[5] to be collected and analyzed.

[5] MARPOS analysis focused on DG Research projects

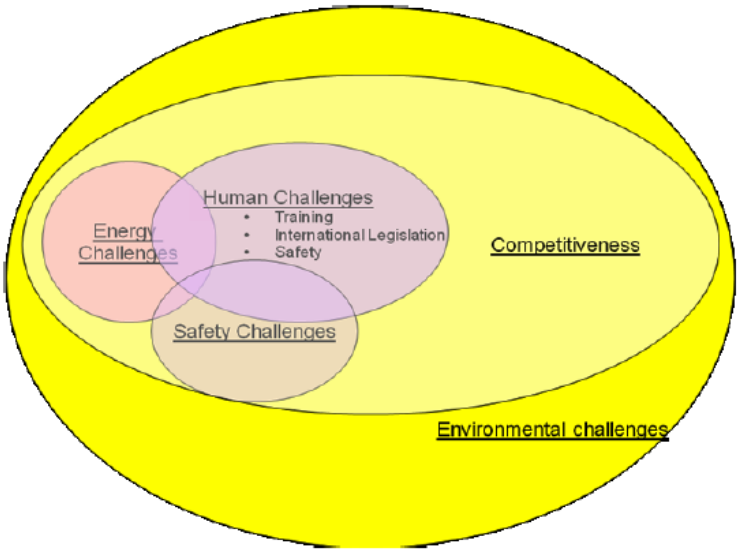

Figure 2: MARPOS Themes

This approach, as already mentioned, takes into consideration the targets of the research and innovation priorities in both European Maritime Policy and Maritime Transport Policy and provides the opportunity to obtain an overall picture of what has been done in terms of research in significant areas of maritime transport over the past decade[6].

The five (5) maritime transport themes that are taken into consideration at the framework of the project analysis can be considered as diachronic covering the priorities and addressed topics of most of the European maritime transport projects, even though the research priorities were modified, according to the needs at the time of each project, over the past decade.

The specific objectives of MARPOS include therefore the following:

- Identification and analysis of past maritime transport research results / outputs from FP5, and FP6 projects, and information – interaction with the on-going work of FP7 projects.
- Organisation and execution of a consultation Workshop with the relevant maritime stakeholders aiming to capture the experts' point of view and to provide useful input to the analysis of the maritime transport research results implemented at the framework of previous and on-going projects of the European Framework Programmes.
- Provide the opportunity to all interested parties to be informed on the results of the so far implemented research work in the maritime transport area. For this reason, key dissemination means and channels (such as a searchable, internet database for maritime transport related research work, publications, brochures, etc.) will be exploited.
- Based on the experience gained through the maritime transport research that have so far taken place, identify future maritime transport research needs to support the Commission's objectives and targets for maritime policy.
- Dissemination of the project results and outputs (publication with the results of the EC funded maritime research work, searchable internet database for maritime transport related research work etc) through the organisation of a major Conference in Brussels at the end of the project. This

[6] The 5th Framework Programme covered the period 1998-2002while the 7th FP was launched at 2007

event aims to provide wide visibility of the project as well as of the overall research work in European maritime transport already implemented or ongoing. It aims at bringing together maritime transport stakeholders, providing the opportunity for discussions on the future of maritime transport, networking and promoting new co-operations in the area of maritime transport research.

1.3. Main S&T results/foregrounds

The main final results of MARPOS can be summarized to the following:

1. **A report in the form of a publication entitled "The Current and Future Agendas of Maritime Transport Research 1998-2010"**

The MARPOS publication provides an overview of the technology products that have been developed over the last decade by maritime transport research projects co-funded by the DG Research and Innovation under the 5th, 6th Framework Programmes and the first three calls of the 7th Framework Programme.

To better analyse and present the projects' results in a systematic way, five (5) maritime transport themes have been considered, as described in the previous section. The research priorities set in the last three Framework Programmes (FPs) have been investigated and the evolution of maritime transport research is presented. Furthermore, the successful implementation and the industrial uptake of the projects' final outputs have been identified through personal interviews.

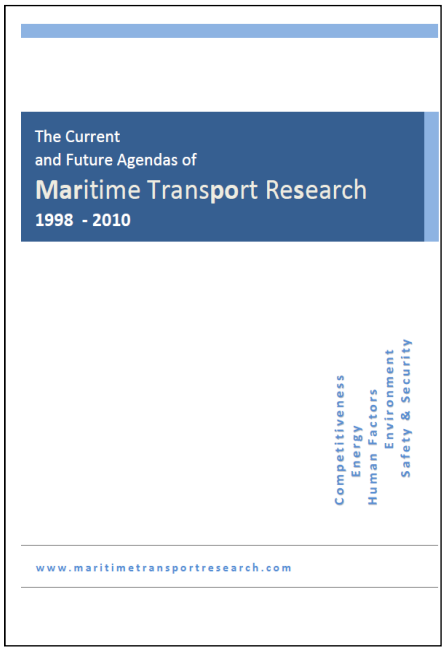

Figure 3: MARPOS Publication

The analysis of maritime transport research through the three (3) FPs provided the basis for performing a technology gap analysis by comparing challenges, research targets and visionary goals with the research work that has been conducted over the last decade and considering the WATER*BORNE*TP Strategic Research Agenda. The gap analysis, which was based on the needs of the maritime transport industry, identified future technology and knowledge development, future research needs and the potential impacts of future research. Through this analysis a comprehensive and holistic view on future maritime transport research and priority lines is provided. The analysis comes as a timely contribution to the preparation of the next EU Research and Innovation Framework Programme. In more detail, the four stage approach that was followed for the development of a comprehensive and holistic view on future maritime transport research consisted of:

(i) <u>An initial analysis of the drivers of maritime research</u>

Global challenges and societal needs prove to be the primary drivers for strategic research. However, a number of secondary drivers such as accidents and safety at sea, local policy priorities as well as market developments also play a significant role in setting the research agenda.

Primary drivers

The primary drivers for maritime transport research in Europe consist mainly of global challenges and societal needs, where the aspects of competitiveness, the environment and safety are integrated and taken, to a large extent, into consideration.

The most important global challenges that drive maritime transport research can be summarized to the following:

- Global warming and climate change;
- Sustainable eco-systems and biodiversity;
- Shortage and increasing demand of global resources (including energy) and
- Globalization of the economy.

Three types of research can be identified, responding to these challenges:

- Research to understand the nature of global challenges and to identify the mechanisms to properly react on them, without creating new problems and challenges
- Research to develop and implement the proper mechanisms (legislation, tax, etc.), to stimulate reaction on global challenges
- Research on technologies to counter-act global threats and challenges

The societal needs represent the demand of the society for goods and services, which will ensure protection and improvement of the quality of life. The most important societal needs regarding maritime transport research are:

- Sustainable and competitive transport infrastructure and operations to secure external trade as well as the mobility of people and goods within Europe;
- Safety and security of European citizens to ensure health and well being;
- Competitiveness of the European industry to ensure economic growth;
- Quality of life of European citizens including satisfying jobs, human working environments, leisure opportunities for all citizens while also considering the ever increasing aging population.

Secondary drivers

Along with the strategic objectives presented above, there are several secondary drivers with a direct impact on European maritime transport research.

Safety and the prevention of accidents at sea are such secondary drivers. While a comprehensive strategic research agenda should be able to foresee and pro-actively react to potential threats, it should also be able to quickly react to new threats and challenges, such as the ERIKA and PRESTIGE incidents, being typical examples triggering further research on oil spill removal and structural integrity. Although maritime operations have become much safer, the maritime industry still faces pressures to improve its performance, with “zero tolerance” being its future challenge to achieve.

Legislation also proves to be an important secondary research driver. The rules and regulations governing the maritime transport sector are issued mainly from the following authorities:

- IMO (International Maritime Organization) Regulations and Resolutions
- ILO (International Labor Organization) Legislation
- Classification Society Rules

Furthermore, the European Union has introduced a series of policy initiatives with a direct impact on maritime research, the most important ones being the White Paper on Transport (2011), the

Commission's European Strategy for Marine and Maritime Research (2008), the Integrated Maritime Policy for the EU (2007), the Energy from Renewable Sources Directive (2009), etc. However, national and regional policy priorities may vary due to different economic and industrial conditions as well as societal needs, leading to a certain fragmentation of maritime research and sometimes duplication of research efforts. To address this issue and optimize the use of public funding, the EU is supporting the coordination and cooperation of the national and regional programmes through the ERA-NET scheme.

(ii) Assessment of the current maritime transport research priorities and needs – identification of future research objectives

The analysis of the maritime transport research drivers, as described above, in accordance with the WATER*BORNE*^{TP} Strategic Research Agenda and the research priorities of two (2) other noteworthy European initiatives defining the maritime research agenda i.e. MARTEC II and SURSHIP, enabled an initial identification of research priorities and needs in the maritime transport sector, as noted in Table 1.

Table 1: Future research objectives based on WATER*BORNE*^{TP}, MARTEC II and SURSHIP

Competitiveness: Meeting Europe's Transport Demand of the Future Objective to create the technical foundations to: ▪ Secure the transport of European imports and exports in a global market; ▪ Ensure mobility of people and goods to satisfy increasing transport demand; ▪ Support modal shift to waterborne transport as an economic and environmentally friendly transport mode by increasing the volume of short sea and inland waterway shipping by at least 20%; ▪ Increase the productivity and reduce construction cost of the European shipbuilding sector in complex ships by 50%; ▪ Ensure competitiveness of maritime transport and offshore services at global scale; ▪ Reduce time to market innovative products and process technologies by at least 30%.
Energy: Securing Europe's demand for Energy and Resources in the Future Objective to create the technical conditions to: ▪ Facilitate the exploitation of new energy sources and resources from the oceans; ▪ Support the efficient and sustainable use of energy and resources; ▪ Increase the overall energy efficiency of ships by at least 40%; ▪ Increase the share of marine renewable energy by 50%;
Environment: Reducing maritime emissions and the environmental footprint of maritime operations to counter act climate change Objective to create the technical foundations to: ▪ Increase the share of environmentally friendly (gas) and renewable energies in ships by at least 20%. ▪ Reduce the amount of GHG emissions by ships by at least 40%; ▪ Reduce the maritime pollutions by accidents and operation by 50%.
Safety and Security: Ensuring maritime Safety and Security Objective to create the technical foundations to: ▪ Reduce the risk of fatal accidents in maritime operations by at least 20% aiming to achieve in the longer term a "0" accident target.
Human Factors: Sustainable Human resources and Quality of Life for European Citizens Objective to create the technical conditions to: ▪ Improve working conditions; ▪ Ensure knowledge building, spreading and application in the maritime sector; ▪ Improve passenger comfort as well as leisure opportunities for European citizens; ▪ Cope with the demand of elderly passengers.

(iii) Detailed analysis and clustering of the technological results of maritime transport research projects co-funded by DG Research and Innovation over the last decade

The extent to which maritime transport research has addressed, over the last decade, the above research needs was assessed through an analysis of 120 maritime transport research projects co-financed by the EC DG Research and Innovation, under the past 5th and 6th as well as the on-going 7th (up to the 4th Call) EU Framework Programme. For each project, the analysis focused on the research priorities they addressed and the outcomes they produced, emphasizing particularly on technological developments.

Maritime Transport Research Priorities

The research priorities that were set on the 5th, 6th and 7th Framework Programme regarding the maritime transport sector are summarized in the following table (Table 2).

The table indicates a certain continuity of the objectives and drivers for maritime transport research, throughout the last three FPs, even if the specific topics and targets changed over time, focusing on the transport technology means in the early FP5 to the establishment of the European Research Area (ERA) in the latest FP7. This continuity mainly concerns: (i) strengthening the competitiveness of the EU maritime transport industry by improving ship production and operation, (ii) minimizing energy consumption, (iii) reducing the environmental impact of maritime transport, (iv) examining human and behavioral aspects and (v) increasing waterborne transport safety.

Table 2: Maritime Transport Research Priorities set on the 5th, 6th and 7th FP

FP5	FP6	FP7
Reduction of CO_2 emissions by 15% between 1998-2002 compared to the level of 1995	20% substitution of fossil fuel and development of technological solutions to reach the GHG emissions defined in the Kyoto agreement and Euro V	Reduce GHG emissions by 25-40% until 2020 and by 80% until 2050 compared to the level of 1990
		Increase of the share of renewable energy fuels in transport by 10% until 2020
		Reduce noise emissions from transport
Reduction of time to market of innovative maritime products by 15-20% through improved design and production processes	Reduction of production lead time by 25% while improving the environmental friendliness of production and product quality	
Increased efficiency and reduction of operating costs by 30-40%	Reduction of production cost by 30-40%	Maintain the European share of ultra large cruise ship production
	Increase the safety of transport, reduce the number of fatalities by 50% until 2010, increase transport capacity by 15%	Improve safety levels for transport system combined with at least a neutral impact on the environment
Reduction of time-to-market and costs by 50% for the development of vehicle /vessel concepts and main infrastructure components	Remove transport from road to more environmentally means of transport, including short sea shipping (no specific targets given for maritime)	Develop innovative transport systems with higher attractiveness, efficiency and environmental friendliness
Improvements in vehicle / vessel quality and reliability by 50%		Optimize logistics chains and in particular door-to-door transport

Maritime Transport Research Priorities

To form the basis for performing a technology gap analysis, with the objective to identify the fields within maritime transport where further research is needed, a detailed assessment of the technological developments of previous and ongoing EU maritime transport research projects was undertaken.

With regard to the main five (5) maritime transport research themes and their technological developments, the 120 maritime transport research projects were analyzed and classified into technological clusters representing certain areas of technology, grouping together projects with outcomes of similar technical content as indicated in the table below (Table 3).

Table 3: Technical clusters and sub-clusters of maritime transport research outcomes regarding the five (5) maritime transport research themes

Technical clusters and sub-clusters		Research Outcomes
COMPETITIVENESS	Competitive SHIPPING	
	Innovative ship concepts	Novel cargo carrying concept for river-sea transport / ship consisting of a ship platform and cargo-containing module / innovative cargo vessels in terms of equipment, propulsion, structure, maintenance and operation / new logistical and vessel concept with optimized performance on hydrodynamics and fuel economy
	Shipping operations and e-Maritime	Improvement of the issues a ship operator confronts (ship itself, operations, equipment, emergencies etc.)
	Ship shore interfaces and port efficiency	Modifications, adaptations of the existing ship/terminal technologies / automatic (un)loading techniques for High Speed Crafts / improvement of the interface of LNG ships and terminal infrastructures / safe and quick maneuvering of ships inside the ports / after-treatment technologies to reduce emissions and time / innovative offshore floating storage terminal for importing LNG / split terminal concept
	Competitive SHIP DESIGN	
	Design tools for structural reliability	Improved refined shape optimization / definition of probabilistic / design of new crashworthy structures / novel structural concepts to carry cruise ship longitudinal strength / advanced design synthesis and analysis techniques at the earliest design stage / design tools and guidelines for analyzing all hydro-structure interaction problems relevant to Ultra Large Container Ships
	Design tool integration	New model--based methodology and procedure of the initial and basic design containing all the information needed in the design flow of a ship / Computational tools for the optimized design of functional free--form surfaces (ship hulls and propellers) based on the exact representation of geometry
	Competitive SHIP PRODUCTION	
	Structural materials and material combinations	New crashworthy side structures / high tensile steel / lightweight sandwich panels – modules
	Maritime coatings and coatings processes	Auxiliary climbing robot and an Automatic Underwater Vehicle (AUV) unit both for underwater ship hull cleaning / innovative anti--fouling and drag reducing ship hull protective film where unfortunately research led only to a prototype process line / technology which suppressed the initial stages of bacteria formation that eventually lead to the formation of fouling / comparison of existing materials was also carried out and guidelines for the application of best practices / technology which proposed the replacement of the biocides with enzymes in antifouling paints so as to be less harmless to nature / optimization of marine coating activities during the entire ship's life cycle considering economy, technical performance, environmental impact and health issues
	Production equipment and processes	Innovative systems for welding operations / joining guidelines / metal composite lightweight sandwich panels/ integrated lightweight modules / tools for hull

	Production organization and chain integration	production, improved yard logistics, e--trade and e--procurement systems Laser welding systems / tools for hull production, improved yard logistics, e--trade and e--procurement systems
	Competitive LIFE CYCLE SERVICES	
	Inspection and maintenance	Development of automatic robots or systems for hull inspection and maintenance
	Repair, retrofit and dismantling	Optimization of the operations of a ship repair yard / composite pact repair and re-enforcement / guidelines for a prototype dismantling site / decision support systems and risk and economic frameworks for the optimization of existing dismantling processes
	Life cycle approaches	Holistic life cycle performance assessment methods and tools comprising life cycle cost, environmental impact, safety and societal needs
ENVIRONMENT	Reducing GAS EMISSIONS	
	Alternative fuels	Conceptual design of Fuel Cell ships and recommendations of the application of fuel cell technology on commercial ships / marine power plants / Onboard realization of a wind-powered generator, capable to harvest the altitude wind and to efficiently convert wind power into electrical power
	After treatment of exhaust gases	Developments in thermodynamics and mechanics of extreme parameter engines, advanced combustion engines, multistage intelligent turbo charging, engines with energy recovery and compounding
	Low emission engines	Prototype control systems able to optimize engine performance based on usually measured operating and external parameters / controlled pulse turbo-charging and air injection systems / optimized leisure boats and ship engines capable of running with high biofuel content blends / marine low speed two-stroke gas diesel engine research platform with a reduced emission footprint compared to present diesel engine technology
	Green ship operation	Study of the potential use of marine hybrid propulsion systems on small vessels / Design of a medium and long--term impact ship capable of providing a fleet that meets the 2020 and 2050 CO2 targets respectively
	OTHER EMISSIONS from waterborne transport	
	Reducing airborne and underwater noise	New technologies and tools for low noise ferries / green label proposal introducing target levels for noise and vibration / new method for measuring the noise produced by a powered recreational craft
	Reduced emissions by paints	New technologies preventing the formation of fouling / new products in terms of control and paint systems / specification and mock-up of a coating management system
	Impact from WASH and BALLAST WATER	New software examining wave and wash characteristics of High Speed Crafts/ballast water treatment plant with minimal environmental effects, adhering to the IMO guidelines
	Emergency INTERVENTION	Innovative robots or ship concepts capable of recovering oil thus eliminating the pollution threat / systems monitoring the marine traffic and pollution events / systems preventing oil spillages by stabilizing vessels immediately after an accident / methodological risk assessment regarding the design, operation and regulation of oil tankers
ENERGY	Optimizing RESISTANCE and PROPULSION	
	Resistance and drag	Introduction of air cushion/lubrication techniques / geometry processing tools and enhanced CAD systems able to perform shape variations / new control and paint systems in order to introduce air-lubricated ships
	Propulsion	Improvement of existing propellers by addressing the problems of vibration, cavitation, vortices, propeller-hull interaction, erosion, etc. / mathematical models for the optimization of propeller design / introduction of innovative propeller designs / combination of existing propulsion technologies such as CLT, CRT and podded propulsion
	Engines and ONBOARD ENERGY EFFICIENCY	
	Engines	New technologies optimizing specific engine's procedures and failure predicting systems / novel system exploiting the waste heat from the engine to provide

		refrigeration and cooling
	Alternative energy sources and energy management	Design and development of power plants based on molten carbonate fuel cells technology / electric power component design (on-board realization of a wind-power generator) / design, tools and guidelines for an energy efficient operation of cargo ships / Global energy consumption simulation system
SAFETY & SECURITY	DESIGN for SAFETY	Improvement of refined optimization / framework containing all the required information for the design flow of a ship / definition of probabilistic damage stability ensuring flexibility in design, integrating survivability in the design process as a regular design parameter / optimization of compartments and internal arrangements of passenger Ro-Ro ships / tools for safety performance pre diction and innovative safety critical technologies for the analysis of design proposals and concepts / computational tools for the optimized design of functional free-form surfaces / design tools and guidelines for analyzing all hydro-structure interaction problems relevant to Ultra Large Container Ships / new technologies for improving the design of ship structures in extreme seas / new formulations for the calculation of the survival probability of ROPAX and mega cruise vessels
	Safe SHIPPING OPERATIONS	Navigational and maneuvering aid / support tool assisting in the selection of the optimum sea route minimizing adverse and maximizing beneficial effects as sea performance, safety, quality of life at sea, etc. / sail planning system to optimize sailing time, reduce fuel consumption, emissions and minimize costs / systems for handling onboard crisis situations with regard to problems on propulsion systems, hull damage and intentional grounding / systems predicting the ship's motion and calculating the risk of operating the ship in a given situation / systems controlling and handling vessels in case they become disabled / systems determining optimal settings for minimizing risks to both ship and seafarer / navigation system estimating the risk of travelling into channels etc. / monitoring systems assessing the detection of possible deficiencies in ship's operations / ship evacuation simulator / design codes and regulations for icebound ships / evacuation system with improved rescue process of passenger – crew survivability / fire risk assessment techniques
	SECURITY	Innovative technical solutions for the most important ship systems and their combination in an optimal way on ship level
HUMAN	DECISION SUPPORT SYSTEMS	Simulator for salvage tugs, towing aid for salvage tugs / fatigue management toolkit for use by ship managers, set of recommendations that maritime regulators and ship managers can use to improve the safety and reliability of vessels
	Improving PASSENGER COMFORT	New motion sickness prediction model along with realistic standards for motion sickness and passenger comfort

The table above provides an overview of the technology fields, within maritime transport, in which several research efforts have been undertaken over the last decade leading to the development of a series of innovative products. It should be noted that many of the research projects, especially the integrated ones, had a wider focus and thus contributed to several technological clusters and sub-clusters.

(iv) Technology gap analysis

The technology gap analysis was based on the detailed assessment of the maritime transport research outcomes, as presented above, and aimed to identify technology gaps which require further research efforts to be undertaken in the next 5 to 10 years (Table 4).

Table 4: Technical cluster and sub-clusters regarding the five (5) maritime transport research themes

Technical clusters and sub-clusters		Technology gaps and knowledge development needs
COMPETITIVENESS	Competitive SHIPPING	
	Innovative ship concepts	Radically new ship concepts/optimum integration of system solutions and technologies/ ship concepts reflecting market and customer needs/ new methods for the assessment of transport efficiency/ ships without ballast water/ information tools and their integration/ IT solutions for distributed design.
	Shipping operations and e-Maritime	DSS to cross the boundary between alarm prioritization and alarm presentation during emergencies / Vessel Traffic Service (VTS) / technologies and procedures for integrity of information, reliability of equipment, better alert systems, equipment with a minimal need for ship-specific information / Integrated Navigation Systems (INS) / e-Maritime infrastructure and e-navigation initiative.
	Ship shore interfaces and port efficiency	New vehicle-vessel concepts capable of operation on different inland waterways / improved cargo handling concepts / information management systems for the entire logistics chain / tank containment system design / better understanding of wave conditions for FLNG vessels / innovative transport concepts and cargo handling solutions for Short Sea Shipping and inland waterways transportation.
	Competitive SHIP DESIGN	
	Design tools for structural reliability	Structural reliability / integrated design studies / simulation techniques for all aspects of ship design / use of super computers and computer GRID / quantification of loads and risks in ice infested areas / methods, tools and models for distributed design / worldwide calibration exercise / standardization of tools and methodologies.
	Design tool integration	New tools and functionalities to cope with new regulations and technology options / life product data management / distributed design platforms.
	Competitive SHIP PRODUCTION	
	Structural materials and material combinations	Development and application of new steels / joining, assembling, outfitting and repair techniques / materials with improved properties and a reduced environmental footprint / adoptable and intelligent materials and structures / life cycle performance assessment / dismantling, recycling and re-use of materials / specific material for the offshore renewable energy sector.
	Maritime coatings and coatings processes	Development, testing and quantification of new paints and alternatives to paints / coating processes in shipyards / study of the physical phenomena of corrosion protection / accelerated test procedures for coatings.
	Production equipment and processes	Low heat input, efficient and low cost welding techniques, adhesive bonding and mechanical joining techniques / automation of assembly and outfitting processes / flexible and easily adaptable equipment for various tasks and geometries / modular design for production / new process chains and business concepts for improved specialization and pre-outfitting / 3D management equipment
	Production organization and processes	Advanced planning methods for shipyards, logistics and process chains / methods, processes and tools to explore productivity potential / tools for space management and outfitting processes / integration of software tools for facility and resource planning / extension of steel production and outfitting tools towards the entire supply chain and to repair and retrofit / flow oriented approaches to ship production organization / Virtual reality methods for ship design and production
	Competitive LIFE CYCLE SERVICES	
	Inspection and maintenance	Monitoring and diagnosis system for ship equipment / autonomous robots and remotely operated vehicles for inspection and maintenance / concepts and solutions for holistic and predictive maintenance for all systems / DSS for ship operators, feedback to ship design / new techniques for inspection, monitoring and maintenance / monitoring and maintenance solutions to meet new legislator requirements.
	Repair, retrofit and dismantling	Planning processes and tools for repair, retrofitting and dismantling processes / reverse engineering, pre-outfitting and modularization of new building yards / modern measurement technologies and product data models (PDM) / design for retrofitting, easy maintenance, recycling and re-use / over lamination of joints and repair of aged structures / new business models and measures for IPR protection / scientific sound goal based worldwide legislation for ship repair and recycling / technology and knowledge transfer towards smaller shipyards

	Life cycle approaches	Product life cycle (PLC) management / new business models and joint life cycle services to integrate the actors in different life cycle phases / modeling of life cycle processes, collection of life cycle data and life cycle assessment tools
ENVIRONMENT	Reducing GAS EMISSIONS	
	Alternative fuels	Technologies dealing with LNG-related challenges, full scale demonstrations of entire LNG logistics chain / fuel cell technology, production and installation of the fuel cell system / technologies for facilitating the use of renewable energies / efficient storage systems
	After treatment of exhaust gases	Heat recovery and exhaust gas cleaning/ modeling of the spray, mixing and combustion process in the engine/ Selective Catalyst Reduction (SCR)/ study of the high maintenance requirements of exhaust after-treatment technologies/ seawater scrubbing/ understanding of the particular emissions behavior of heavy fuel engines/ design criteria regarding engine performance and impact on emissions
	Low emission engines	Technology for distribution, storage and power production of new alternative fuels / comprehensive overview of new fuel options / development of new multi-fuel engines and systems / methods and tools for evaluating, testing and demonstrating the overall system performance of new designs / improved design of piston engines and increased research within diesel/gas engine concepts
	Green ship operation	Weather routing / slow steaming solutions combined with port-planning solutions / operational guidelines for energy efficient ship operation / energy and emission management systems / simulation tools and prediction methods for evaluating the effect of technologies in real conditions / modeling and optimizing maritime transport systems / methods and tools for ship LCA
	OTHER EMISSIONS from waterborne transport	
	Reducing airborne and underwater noise	Noise and human health damages to passenger, harbor residents and crew members / effect of vibration on the health of crew members / real time measurement in order to establish a better overview of N&V from vessels / new technologies for limiting the vibration for passengers
	Reduced emissions by paints	Creation of propeller and hull founding / development, testing and qualification of new paints and alternatives / methods for measuring the effect of different coatings and other fuel reducing technologies
	Impact from WASH and BALLAST WATER	Development of ballast-less ships / reduction of wake
	Emergency INTERVENTION	Reaction of the maritime environment on oil spills / prediction of oil spill movements / oil collection in high sea areas and arctic waters / removal of wrecks / spill recovery preparedness and ship towing capacity
ENERGY	Optimizing RESISTANCE and PROPULSION	
	Resistance and drag	Validation data for full scale CFD predictions / methods to realistically predict operational ship resistance and deliver reliable statistical data / hydrodynamic properties of coating systems / concepts for large ocean-going vessels / determination of appropriate air flow rates / advanced modeling of air lubrication
	Propulsion	Systemic analysis of podded propulsors / systemic study of geometry modifications in close link with operating propellers / advanced propulsion improvement devices (PID) / reliable tools to predict the long-term effects of cavitation
	Engines and ONBOARD ENERGY EFFICIENCY	
	Engines	Study of new advanced combustion technologies / study of part load operation / prediction models for the main propulsion system including effects of aging, fouling, off-design and transient conditions / effects of waves and changes in propeller behavior / effects of maneuvering and ice navigation on propulsion system behavior / measurement, verification of the frictional loss in the piston ring package models and of the wear models / technology and understanding of high-pressure gas operated two-stroke engines / development of energy transformers capable to process a variety of fuels
	Alternative energy sources and energy management	Fuel technology to achieve improvements in: (i) weight/power ration, (ii) stack reliability of fuel cells, (iii) cost related to energetic output / adoption of reformer technologies to the maritime market / global analysis of energy demands / improvement of marine energy storage technologies / development of reliable concepts for the use and integration of additional energy sources

SAFETY & SECURITY	DESIGN for SAFETY	Improve methods to estimate probabilistic data for safety assessment / tools to model the entire safety chain based on first principle and statistics / new concepts of work sharing and knowledge transfer / safety as part of life-cycle design / optimization strategies and techniques to facilitate the requisite balance between cost, safety and environmental impact / enhanced degree of rationalization both in design and production / risk-based innovation management / consistent risk based design and risk management / legislation embracing holistically the concept design-up to end-of-life strategies
	Safe SHIPPING OPERATIONS	Integrated products, decision support systems and state-of-the-art communication and satellite technologies / cost effective approaches to manage the human factor in shipping operations / unmanned shipping operations in parallel with e-maritime practices / sustainability in operations as a Key Performance Indicators (KPI)
	SECURITY	Concepts and measures for the security of the passenger and cargo onboard and in terminals / anti-piracy measures
HUMAN	DECISION SUPPORT SYSTEMS	Systemic analysis, ranking and quantification of critical human factors in ship operation / design of ships with regard to comfort and safety of elderly people / tools to allow more ergonomic and failure tolerant ship systems / decision support systems to mitigate the consequences of an error fully integrated with bridge systems and e-maritime services / validation of decision support tools
	Improving PASSENGER COMFORT	Predictive methodologies to provide an instantaneous measure of the severity or incidence of motion sickness and fatigue / better understanding of the mechanisms which govern comfort perception / design criteria regarding the needs and abilities of aged passengers / marine data on acoustics

The above analysis resulted in the identification of more than one hundred (100) research and development needs and set the basis for the identification of future research priority lines as well as the recommendation of specific actions for implementation, complementary to the strategic research agenda of the WATER*BORNE*^{TP}.

Details information on the research projects supported by EU funding is to be found on the MARPOS e-tool (www.maritimetransportresearch.com), which is described in detail below.

2. Development of a searchable database with the form of an e- tool

The results of the work described in the above mentioned outcome are available to the wide audience via the project website (www.marpos-project.net) and the searchable, internet-based database (MARPOS e-tool) which was developed with the aim to provide the opportunity to all interested parties to be informed about the results of EC maritime transport related research work over the last decade. In more detail, the MARPOS e-tool provides:

- Information on the results of past and current research projects and their implementation status
- Wide visibility of maritime transport research results
- Links to past and current European research projects in maritime transport
- Links to European and/or regional research initiatives

The first step towards the implementation of the e-tool was to identify existing work concerning the development and operation of related databases on European research projects, and coordinate MARPOS work with other similar efforts that are currently underway. To this end, a dedicated research took place in order to:

- Identify gaps and missing links as well as problems in the existing mechanisms of the EU that are used for the projects dissemination;
- Examine best practice cases;

- Avoid duplication of work and make liaison with other related initiatives aiming to further increase visibility of maritime research results.

MARPOS has identified existing initiatives and databases and established contacts with them in order to examine the specifics of each initiative both in terms of content as well as functionalities, identify areas of cooperation and liaison that will result in win-win situations towards the visibility of each initiative and learn from their experience.

The MARPOS e-tool proves to be different from the existing efforts since:

- it focuses on maritime transport research, limited to DG Research supported projects it provides a thematic analysis based on the 5 maritime transport themes identified by the project (namely *Competitiveness*, *Environment*, *Energy*, *Safety & Security* and *Human factors)*
- it provides information of the type of project outputs (technology development such as software applications, communication platforms, DSS etc, methodology or policy recommendations, specific guidelines such as for maintenance/repair/inspection etc, infrastructures, future recommendations and others)

The targeted audience that is expected to benefit from the MARPOS e-tool comprises of:

- researchers and members of the EU academic society (universities and institutions);
- industry (shipbuilding, equipment suppliers, ship-repair industry, etc.);
- shipping and port companies;
- authorities (port authorities, customs authorities etc);
- transport companies;
- EU and national governments, and
- other stakeholders interested in maritime transport research

The Maritime Transport Research Database (MTRD), as the MARPOS e-tool was named, is one the most important outcomes of the MARPOS project and was developed as a powerful tool for maritime transport professionals seeking information on EU funded research projects, their outcomes and the outcomes' implementation; and for maritime transport researchers to publicize their work and increase the visibility of their research products. MTRD is accessible through both the MARPOS website (www.marpos-project.net) and its URL (www.maritimetransportresearch.com).

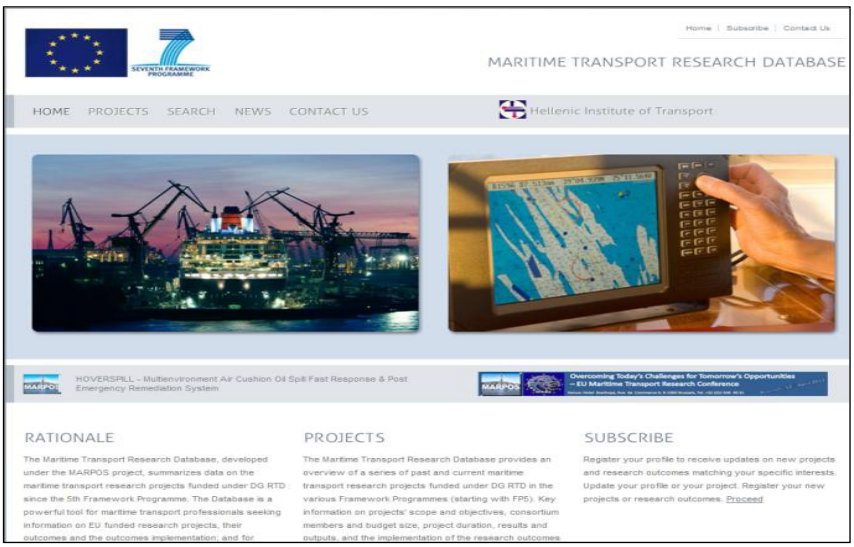

Figure 4: The Maritime Transport Research Database

MTRD provides an overview of a series of past and current maritime transport research projects funded under DG RTD in the various Framework Programmes (starting from the 5th FP). In detail, MTRD presents key information on projects' scope and objectives, consortium members and budget size, project duration, results and the implementation of the research outcomes during the project period and beyond.

It is structured around the following five (5) main sections:

- *HOME*: This section gives an overview of the e-tool rational and on the projects that are included and presented through the e-tool. It also includes a dedicated space for subscribing to the database for receiving information alerts on the latest news and updates of the tool as well as a shortcut to the newly reported projects outcomes implementation.
- *PROJECTS*: This section provides a quick access to the projects that are included in the database per (i) Framework Programmes, (ii) Theme (competitiveness, environment, energy, human factors, safety & security), (iii) Type of Instrument, (iv) Partner, (v) Acronym, (vi) Start date and (vii) Key words.
- *SEARCH*: This section includes the main functionality of the e-tool and is divided into simple and advanced search. The advanced search provides the opportunity of combining one or more of the following search criteria: (i) Theme, (ii) Project details (full title, keyword, scope & objectives, results, outcomes implementation, partner, coordinator), (iii) Framework Programme, (iv) Instrument, (v) Start date and (vi) Country (of coordinators and partners).
- *NEWS:* This section includes news and updates related to: (i) the projects already included in the database, (ii) new entries of research projects and (iii) conferences, workshops and other announcements.
- *CONTACT US:* The users of the database can provide their useful remarks and questions regarding the database, simply by completing some basic information.

3. Public "consultation and information" events

Consultation and information events (in the form of a workshop and conference) were organised during the project implementation period with a view to disseminating information related to the above issues, providing a forum for interaction between experts and authorities in the fields of Maritime Transport, and drawing into the project's recommendations for the orientations that the future research in maritime transport should have.

In more detail:

- A dedicated public consultation and Workshop on "*Research priorities for Sustainable Surface Transport"* took place in Brussels on the 24/06/2010 with main objective to present the results of the MARPOS survey of research outcomes and their implementation, related to maritime transport activities funded under the 5th, 6th and 7th Framework Programme. The event also opened a discussion among experts in the European maritime transport industry aiming to identify the future priorities of maritime transport research, building on the results of the above analysis and also taking into account the WATERBORNE TP Strategic Research Agenda, and the changes that have taken place in recent years, including the global economic crisis.
- A final Conference of the project took place in Brussels on the 12th of April 2011. The scope of the event, was to report on the results of the MARPOS survey on research outcomes and their implementation by the maritime industry. To this end, a series of successful examples of DG RTD maritime research projects funded under FP6 and FP7 were presented. Moreover, the conference

focused on the importance of cooperation & coordination in research and presented, based on the MARPOS results & the WATERBORNE TP Strategic Research Agenda, the research needs of the maritime transport sector that should be addressed in future research agendas in order to meet the future challenges, bearing in mind the changes that have taken place in recent years.

The main results, outcomes, discussion and recommendations that came out of the two events along with all presentations that took place were recorded to a series of project deliverables (namely D5.1 and D5.2) that are available to the wide public via the project website.

4. Recommendations about the needs and priorities for future Maritime Transport research

The key priorities for future research, development, and innovation for maritime transport, were derived from the technology gap analysis, taking into account the results of the DG RTD funded research projects, which both were briefly described in a previous section. The key research priorities for each of the five MARPOS research themes are indicated below:

COMPETITIVENESS

COM-1 Competitive SHIPPING

1) Technologies and system solutions have to work together in an optimal way in complex products like ships. The integration of knowledge and research results in radically new ship concepts shall be an increased focus of maritime research. The research challenges include:
   - Optimization strategies to support a holistic view on all ship systems and life cycle phases;
   - The integration of all suitable technologies and system solutions with focus on their optimized interaction;
   - Methods, data and benchmarking criteria for an holistic assessment of transport efficiency across modes and within waterborne transport;
   - IT solutions for a distributed design and knowledge management to facilitate a better cooperation of different disciplines and life cycle actors in ship design.
2) For competitive Ship Operation and e-Maritime
   - Decision Support Systems for Emergency Response in shipping,
   - Unified data structures and communication protocols for ship-shore and ship-to-ship communications in the frame of e-maritime.
3) For Port Operations and Ship-Shore Interfaces
   - Intelligent holistic solutions for the efficient management of ships in ports,
   - Optimized infrastructure of ports and terminals including hinterland connections allowing for efficient, safe, secure and environmental operation,
   - New concepts and solutions for efficient cargo handling considering the entire maritime / inland waterway chain,
   - Safe solutions for the loading / unloading of gas and other alternative fuels.

COM-2 Competitive SHIP DESIGN

4) For Design for Structural Reliability
   - Worldwide calibration of performance standards and safety margins based on risk assessment;

- First principle design tools and simulation techniques for all aspects of ship operation and all life cycle phases using super computers and grid computing,
- Quantification of extreme operational loads such as ice and extreme waves,

5) For Design Tool Integration
   - Better integration of design tools to cope with new rules and regulations, new technical knowledge and life cycle aspects,
   - Adaptation of design methods and tools for new maritime products,
   - Through life product data management and tool integration,
   - Platforms for distributed design and knowledge management in a work sharing environment are needed, in particular for smaller actors. Modern computing techniques like GRID computing need to be facilitated.

COM-3 Competitive SHIP PRODUCTION

6) For Structural Materials and Material Combinations
   - New steel materials for improved structural performance under maritime conditions as well as design, testing, joining and coating techniques for those materials,
   - Joining, outfitting and repair techniques for new materials and multi-material structures,
   - Innovative (none-metallic) materials with improved operational properties and reduced environmental footprint,
   - Adaptable and intelligent materials as well as materials with self-diagnostic and self-healing effects,
   - New and alternative materials suitable for long operation under harsh environments in the offshore renewable sector.

7) For Coatings and Coating Processes
   - Development, testing and qualification of new paints and alternative coating systems,
   - Efficient and environmentally friendly coating processes in shipyards, in particular smaller yards and outdoor operations (including repair),
   - Better understanding and modelling of physical phenomena and mechanisms for corrosion and fouling processes (propeller and hull),
   - Improved methods to predict and measure the effects of hull coatings on resistance and fuel consumption,
   - Accelerated test procedures for coatings and forecasting methods for real-life behaviour.

8) For Production Techniques and Equipment
   - Further development of low heat input, efficient and low cost welding techniques to bridge the gap between laser assisted and conventional welding,
   - Adhesive bonding and mechanical joining techniques in particular for outfitting and new materials,
   - Assembly and outfitting processes in later assembly stages with complex and difficult to assess 3D structures,
   - Flexible, intelligent and easily adaptable equipment without programming,
   - Modular design for production,
   - 3D measurement techniques and their integration.

9) For Production Organization and Chain Integration
   - Advanced and integrated planning methods and tools for shipyard and the supply chains,
   - Advanced planning and simulation techniques and tools for repair, retrofit and dismantling. Solutions for a wider use of simulation techniques in smaller yards,
   - Systematic approaches to explore productivity potentials in the entire process chain,

- Business process re-engineering and business models for increased work sharing and specialization in production,
- Tools for advanced space management in shipyards (including repair) and management of outfitting processes,
- Advanced statistical methods and strategies for data generation for quality assurance under the conditions of small series and one-of-a-kind production.

COM-4 Competitive LIFE CYCLE SERVICES

10) For Inspection and Maintenance
- New sensors, monitoring and diagnosis systems for all aspects of life cycle behaviour of ship equipment and hull structures,
- Modular platforms for autonomous underwater vehicles (AUV) and remotely operated vehicles (ROV) for ship inspection, maintenance and repair, offshore and marine observations,
- Harmonized and goal based regulations for inspection and maintenance,
- Concepts and solutions for predictive and risk based maintenance,
- Specific solutions for inspection and maintenance of new materials and for new maritime products,
- Integrated life cycle product data management (PDM) and feedback from inspection to design.

11) For Repair, Retrofitting and Dismantling
- Planning processes and tools for ship repair, retrofit and dismantling,
- Reverse engineering and measurement systems to acquire data for ship repair as well as solutions for a better use of new building data in repair,
- Innovative process chains for ship dismantling using experiences from new building,
- Design for retrofit, easy maintenance, recycling and re-use, in particular in relation to new materials,
- Over lamination of conventional structures and joints as a means for repair and improvement of strength properties,
- Technology and knowledge transfer from new building to smaller repair, retrofit and dismantling yards.

12) Life cycle Approaches and Services
- Product Life Cycle Management techniques and consistent through-life product data management,
- New business models and joint life cycle services for a better integration of actors, in particular for emerging maritime markets,
- Key performance indicators and holistic assessment methods for all life cycle aspects, including cost, safety and environmental impact,
- Modelling of life cycle processes including provision of reliable data,
- Concepts and solutions for increased recycling and re-use of materials and components,
- Research for regulations and standards supporting the life cycle approach.

ENVIRONMENT

ENV-1 Reducing GAS EMISSIONS

13) For Alternative Fuels and Energy Sources

- Efficient and safe solutions for onboard integration (storage, overall efficiency, bunkering) of gas and other alternative fuels as well as for the entire gas logistics chain,
- Advanced fuel cell designs with reduced weight, volume, cost and increased energy efficiency as well as sophisticated solutions for their integration in ships,
- Solutions for a more efficient use of alternative energy sources (such as wind and solar energy) under maritime environmental conditions also considering their efficient integration in the entire energy chain in ships,
- Development, testing and validation of technical solutions for the extended application of new fuels, such as propane, LPG, methanol, ethanol etc., special focus shall be given to system solutions which allow for a combined use of different low emission fuels in dependence from their local availability during worldwide operation,
- Onboard energy management systems for the most efficient use of different energy sources, converters and consumers under specific operational conditions as well as comprehensive tools to assess the energy efficiency in design,
- More energy and cost efficient systems for onboard energy storage and energy distribution in harsh marine environments,
- More emphasis should be given to research supporting the development of international rules and standards in relation to alternative fuels to make their practical application safe and efficient.

14) For After Treatment of Exhaust Gases

- Further improvement of the cost efficiency in production, maintenance and operation of after treatment solutions, such as selective catalytic reduction (SCR), particulate traps, oxidation catalysts, exhaust gas recirculation and seawater scrubbing,
- Better understanding and modelling of the emission behaviour of large diesel engines. Models need to be validated and tested in real scale.

15) For Low Emission (Diesel) Engines

- Techniques for a cost efficient conversion of conventional combustion engines with gas fuels,
- Energy transformers for the combined use of alternative fossil fuels (multi-fuel engines in difference to single fuel) need to be developed and tested for maritime applications,
- Despite of previous work a better understanding of spray, mixing and combustion processes in large marine diesel engines is still needed to allow further improvement of energy efficiency,
- Improved monitoring, diagnosis and maintenance procedures,
- Improved procedures and technical solutions part load operation of engines and related systems,
- Materials and maintenance procedures for components of ship engines to reduce cost and ensure longer life time.

16) For Green Shipping Operations

- Further development of weather forecasting techniques and weather routing in the frame of e-navigation,
- Advanced management systems for slow steaming solutions integrated with port planning,
- Operational guidelines for efficient, safe and environmentally friendly ship operations,
- Overall energy and emission management systems supported by onboard measurement systems and data communication,
- Advanced simulation tools and prediction methods to predict the effect of green technologies in operation,
- Advanced modelling and simulation of transport systems on ship and fleet level.

ENV-2 OTHER EMISSIONS from waterborne transport

17) For Reducing Noise
- The impact of noise and vibrations on passengers, harbour residents, crew and marine life needs to be better understood and used for the development of international rules and design criteria,
- Improved methods for real-time measurements of noise and vibrations,
- New technologies to limit the emission of noise and vibrations by active and passive damping to be developed and tested in real scale.

18) For Emissions from Paints
- Research needs are summarized under COM-3-2

ENV-3 Impact from WASH and BALLAST WATER

- Establishment of a comprehensive overview of all possible ballast water treatment systems and technologies,
- The feasibility of hybrid ballast water treatment systems need to be tested on board.

ENV-4 Emergency INTERVENTION

- Further investigations and modelling of the reaction of marine environments on oil spill and other pollutions from maritime accidents, under particular consideration of arctic conditions,
- Better prediction methods of spill movements and mechanisms of natural destruction of spills,
- Spill collection at high seas and in arctic waters is still not solved satisfactorily,
- More cost and time efficient technologies for wreck removal,
- Platform solutions for autonomous underwater vehicles to better facilitate common exploited in offshore, marine sciences and ship inspection (see also COM-4-1).

ENERGY

ENE-1 Optimizing RESISTANCE and PROPULSION

19) For Resistance and Drag
- Assessment of validation data for full scale CFD predictions to overcome uncertainties,
- Improved prediction methods for resistance and their statistical verification,
- Research to predict the hydrodynamic properties of paints and air lubrication,
- Air lubrication systems for large ocean going vessels, the determination of appropriate air flow rates and advanced modelling of air lubrication.

20) For Propulsion
- Systematic analysis for higher speed applications of podded propulsors, including a study on geometry modifications of pod casings in interaction with propellers,
- Systematic investigations of advanced propulsion improvement devices (PID) including an overview of available solutions,
- More sophisticated tools to predict the long term effects of cavitation considering the interaction with materials.

ENE-2 Engines and ONBOARD ENERGY EFFICIENCY

21) For (Combustion) Engines
- Research needs are summarized under ENV-1-3.

22) For Alternative Energy Sources and Energy Management

- Research needs for alternative energy sources and related engines have been summarized under ENV-1-1.
- Total energy management and monitoring systems for onboard use are needed as well as appropriate measurement technologies and guidelines for efficient operation,
- Operational data related to energy consumption need to be collected and made available to ship designers, holistic tools to model the energy system in ships are needed.

HUMAN FACTORS

HUM-1 DECISION SUPPORT SYSTEMS

- Data collection and establishment of design criteria related to the reasons and consequences of human errors in ship operation as well as the elaboration of related standards and regulations, the provision of realistic operational data is important to validate Decision Support and simulation tools,
- Methods and tools for the design of ship systems to reduce the occurrence and consequences of human errors

HUM-2 Improving PASSENGER COMFORT

- Methodologies to predict and assess the impact of motion sickness and fatigue on the health and the behaviour of passengers and crew,
- Better understanding of the mechanisms which govern comfort perceptions as well as corresponding rules and standards,
- Marine data on acoustics are needed to establish the impacts on marine environment,
- Specific data on needs and abilities of elderly and disabled passengers need to be provided and translated in design criteria and tools.

SAFETY & SECURITY

SAF-1 DESIGN for SAFETY

- Risk based design frameworks including all safety aspects need to be further developed, implemented in standards and rules.
- Guidelines for easy use of risk based methods as well as “simplified methodologies” and corresponding first principle assessment tools to allow wider application,
- Risk assessment needs to be integrated in all life cycle phases,
- Interdisciplinary and multi stake holder knowledge and innovation management is needed, not only, but including safety and security aspects.

SAF-2 Safe SHIPPING OPERATIONS

- Research needs related to system integration and e-maritime have been summarized under COM-4-3 and COM-1-2 respectively,
- Human factors in relation to safe ship operation are covered in HUM-1,
- Unmanned ship operation is a research topic for the future.

SAF-3 SECURITY

- Integrated concepts and solutions for passenger and cargo security onboard and in terminals and their integration,
- Anti piracy measures including field observations as well as active and passive measures on board.

In terms of instruments, the following actions are recommended to define and implement research priorities:

- **Periodic Calls:** As the detailed specification of each topic in the Periodic Calls in FP7 significantly increases the complexity of the work programmes and the efforts needed for their preparation, only large topics (IPs etc.) should be specified, as in FP6, while only defining the main targets for smaller topics (COM).
- **WATERBORNE Technology Platform:** The preparation of Strategic Research Agendas and call topics by European Associations is considered inefficient, due to absence of procedures for prioritisation, and the lack of direct participation of technical experts from maritime research. Industry and research actors need to be more involved in the process.

  A direct feedback from industry and research actors to the European Commission (preferably) or the WATERBORNE Technology Platform is therefore recommended, in the form of "Expressions of Interest", while strategic priorities need to be defined top-down, based on comprehensive research strategies.

  A think tank consisting of proven maritime experts is considered an important instrument for the WATERBORNE Technology Platform. The Sustainable Surface Transport Advisory Group should also include maritime experts with leading experience in research; the transparency and interaction of this group with the maritime community should also be improved.

  The WATERBORNE Technology Platform should take on the role of monitoring and exploiting the research results achieved in the maritime transport research projects.
- **Coordination and Support Actions:** Coordination and Support Actions are increasingly generic and fragmented, and they finance inefficient mechanisms. They do however have a limited value in structuring research results, identifying specific technical research gaps, and making them available to a wider European end-user community.

  The Coordination and Support Actions (CSAs) should be better coordinated between different priorities in FP7, and within the Transport priority. CSAs should have a specific technical focus to structure and define research in specific key areas of maritime technology. Furthermore, CSAs should be conducted by proven technical experts, rather than by associations. They must also provide a specific added value for the European Research Area.
- **External experts for the Sustainable Surface Transport Advisory Group:** The selection of external experts for the Sustainable Surface Transport Advisory Group, for defining the Periodic Calls and evaluating projects, should primarily be driven by technical expertise and research project experience. This makes it inevitable to invite experts who might be involved in proposals for the relevant call. Experience in FP5 and FP6, as well as in national research programmes, has shown that transparency and neutrality of the evaluation can be achieved, even if evaluators are involved in research projects or proposals, providing that the terms of reference are clearly defined and monitored by the Commission services.
- **Thematic Networks:** Networks of EU projects dealing with the specific priority areas for research and development, e.g. energy efficiency of ships, design for safety, or competitive ship production etc, would help strengthen the competitiveness of the European maritime industry and help to avoid duplication and fragmentation of research. These Thematic Networks could be similar to ERA-NET SURSHIP project.

- **A Technology Gap Analysis** for of EU projects should be updated continuously, to provide a comprehensive basis for elaborating future research needs for the maritime sector. More comprehensively information on the outcomes of EU research projects from the project consortia, and from the European Commission, would assist this analysis.

  The European Commission should ask project coordinators to provide a document indicating the difference between the results achieved and what was expected at the beginning of the project, how the results were exploited, and how the results could be relevant to other topics.

1.4. Potential impact and main dissemination actions of MARPOS

1.4.1. Socio-economic impact and wider societal implications of the project so far

The potential impact and use of the project results may be summarized to the following:

- MARPOS provides a building block for the European Commission's strategy to create a thorough understanding of the contribution of past and current (maritime transport) research results from the various Framework Programmes, and is disseminating the results with the relevant networks in Europe.
- Based on the analysis of past, current and future transport research, and upon consultation with the maritime/transport community in the European Union, MARPOS makes recommendations for future research to be undertaken and priorities to be set in the following RTD Framework Programme. The project should provide valuable background information regarding the impact of the research funded by the EC and contribute to setting future research priorities.
- The MARPOS events, namely the workshop and the final conference, will be raising awareness on the research that has taken place since 1998 in the various fields of maritime transport and the main outcomes of this research.
- The MARPOS outcomes, such as the EU maritime transport research inventory and the internet based e-tool will be available to a wide audience providing access to the maritime transport research related results that have taken place under the framework of the 5 identified maritime themes. Such comprehensive resource, focusing on maritime transport related research is not currently available.
- The project dissemination material will reach a large number of actors and stakeholders in the area of maritime transport through their distribution in the project events and their publication over the project's website. Furthermore, the project partners will exploit their networks of people and organisations in the area of maritime transport trying to spread the results and findings of MARPOS.
- MARPOS will help in maintaining and furthering the momentum and the positive energy that has been built through the discussions that followed the publication of the Green Paper, the consultation process and all subsequent documents, by providing an up to date overview of relevant research and implementation results, developing a comprehensive, holistic view on the future research agenda, proposing research themes and priority lines. It is therefore an efficient instrument to focus the energy of all the stakeholders in this complex process.

1.4.2. Main dissemination activities

Three (3) types of dissemination - promotion activities were implemented at the framework of the MARPOS project:

- The organisation of dissemination - consultation events;
- The production and distribution of dissemination material;
- The exploitation of dissemination channels for the wide dissemination of MARPOS work.

In more detail:

A. MARPOS dissemination- consultation events

During MARPOS implementation period, a consultation - dissemination Workshop and one major final conference were organized.

(i) MARPOS public consultation and dissemination Workshop

Based on its scope and objectives, the MARPOS Workshop on "*Research priorities for Sustainable Surface Transport"* can be considered both as information / dissemination event as well as a consultation Workshop. The Workshop took place in Brussels on the 24/06/2010 and its main objective was to report on the results of the MARPOS survey of research outcomes and their implementation, related to maritime transport activities funded under the 5th, 6th and 7th Framework Programme. The analysis, which was presented at the Workshop, identified useful research results that could be implemented within the maritime transport sector, and tasks that required further research and development.

Additional target of the event was to open a discussion among experts in the European maritime transport industry aiming to identify the future priorities of maritime transport research, building on the results of the above analysis and also taking into account the WATERBORNE TP Strategic Research Agenda, and the changes that have taken place in recent years, including the global economic crisis.

A number (43 participants) of key maritime transport experts participated in the event. The speakers, chairmen and participants came from several different organisations and institutions of the EU maritime transport industry representing key sectors and groups such as:

• WATERBORNETP Support and Mirror Groups
• European Member State and Regional Authorities
• European Maritime Industry and Associations
• European Research Organisations
• European Universities
• European Maritime Clusters
• Coordinators of relevant EU Projects and Support Actions

Figure 5: Photos from MARPOS Workshop

The workshop programme was structured around three main sessions:

- The first session aimed to present the results of MARPOS work and research priorities. The session also included a presentation of the WATERBORNE TP priorities as well as a presentation of the TKRC initiative, which aimed to open a dialogue on issues related to the availability of information and existing data sources within the research community.
- The second session included the presentation of three main maritime transport projects and emphasised on the way that research results are implemented and exploited. A fourth presentation addressed issues of fragmentation and duplication of maritime transport research.
- Finally, three parallel working group sessions took place aiming to capture the experts' opinions on the priorities that future maritime transport research should follow in each of the five themes addressed within MARPOS.

(ii) MARPOS Final Conference: "Overcoming Today's Challenges for Tomorrow's Opportunities – EU Maritime Transport Research Conference"

The final Conference of the project took place in Brussels on the 12th of April 2011. The scope of the event was to report on the results of the MARPOS survey on research outcomes and their implementation by the maritime industry. To this end, a series of successful examples of DG RTD maritime research projects funded under FP6 and FP7 were presented. Moreover, the conference focused on the importance of cooperation & coordination in research and presented, based on the MARPOS results & the WATERBORNE TP Strategic Research Agenda, the research needs of the maritime transport sector that should be addressed in future research agendas in order to meet the future challenges, bearing in mind the changes that have taken place in recent years.

Figure 6: Photos from MARPOS Final Conference

A number (41 participants) of key maritime transport experts participated in a joint event which was organized by the MARPOS and CASMARE consortia and took place in Brussels on the 12th of April 2011. The speakers, chairmen and participants came from several different organizations and institutions of the EU maritime transport industry representing key sectors and groups such as:

- WATERBORNE TP support and Mirror Groups
- European Member State and Regional Authorities
- European Maritime Industry and Associations
- European Research Organizations
- European Universities
- European Maritime Clusters
- Coordinators of relevant EU projects and Support Actions

The conference was structured around four (4) main sessions. In the first two sessions, a state of the art review of Maritime Transport Research was presented followed by a series of successful examples of DG RTD maritime research projects focusing mainly on the achieved or targeted implementation of their outcomes. The first two sessions were closed by presenting the research needs that have been identified through the MARPOS analysis along with the future challenges that must be addressed in view of the preparation of the next Research and Innovation programme.

The third session highlighted the importance of cooperation & coordination in research activities illustrating successful initiatives such as the Dutch Maritime Cluster and the Joint Programme Initiative. The last session focused on the significance of innovation and the challenges (environmental and societal) that future maritime research needs to address.

The key messages and main conclusions drawn from the Workshop and the Conference along with all respective material (agenda, list of participants, presentations as well as the photos of the event) are included in the Deliverables of Work Package 5.

B. Production and distribution of dissemination material

At the framework of the dissemination activities of the project, the following material was designed and produced during the second project period:

- The MARPOS project Logo (Figure 7)
- The MARPOS poster (Figure 8)
- An electronic leaflet for the dissemination of the MARPOS workshop (Figure 9)
- The Conference Agenda (Figure 10)
- The MARPOS Brochure (Figure 11)

Figure 7: MARPOS project Logo

Figure 8: MARPOS poster

MARPOS

MARitime POLicy Support

Workshop on: "Research Priorities for Sustainable Maritime Transport"

Venue: Stanhope Hotel
Rue du Commerce 9, B-1000, Brussels

24 June 2010, Brussels

About MARPOS

The MARPOS project aims at assisting the Commission in the implementation of the EU Maritime Transport Policy objectives, by utilising the results of past research work in the field of Maritime Transport and related expertise from the Transport sector. It consolidates and synthesises the results of Maritime Transport research funded by DG Research in the Framework Programmes: FP5, FP6 and FP7. Conclusions and future research priority recommendations are made for five Maritime Research Themes: competitiveness, environmental challenges, energy challenges, safety challenges, and human challenges. Key outputs include the publication of a book with the results of the research work, and a searchable database (e-tool) for the results of the European maritime transport research over the past decade.

About the Workshop

This workshop will report on the results of its survey of research project outcomes and implementation, related to maritime transport activities funded under Framework Programmes 5, 6 and 7. The analysis has identified useful research results that could be implemented within the maritime transport sector, and tasks that require further research and development. Building on the above analysis the workshop will help identify future priorities for maritime transport research, taking into account the WATERBORNE^{TP} Strategic Research Agenda, and the changes that have taken place in recent years, including the global economic crisis. The research priorities will be focussed on the MARPOS project's five Maritime Research Themes: Competitiveness, Environmental challenges, Energy challenges, Safety challenges, and Human challenges.

Who should attend?

- WATERBORNE^{TP} Support and Mirror Groups
- European, Member State and Regional Authorities
- European Maritime Industry and Associations
- European Research Organisations
- European Universities
- European Maritime Clusters
- Coordinators of relevant EU Projects and Support Actions

Please register no later than Thursday 10 June 2010: t.morrall@ecmar.eu indicating your choice for the parallel sessions: 1: Competitiveness, 2: Energy/Environment, or 3: Safety Security and Human Factors.

www.marpos-project.net

This workshop is organised by the European Support Action MARPOS, funded by DG RTD of the European Commission under the 7th Framework Programme. The organisers and participants are solely responsible for the opinions expressed in the workshop, and they will not represent those of the European Commission.

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AGENDA

09:00-09:30	**Registration – Coffee**	
Welcome: (Chair: Dr Maria Boile, CERTH-HIT, project coordinator)		
09:30-09:45	Welcome to MARPOS Workshop	▪ Mr Frédéric Sgarbi, Deputy Head of Unit, "Surface Transport" (DG RTD/H2)
Session 1: The MARPOS Project (Chair: Maria Boile, CERTH-HIT, project coordinator)		
09:45 - 10:00	The MARPOS Support Action	▪ Ms Dominique Ramaekers - Jørgensen, DG RTD, MARPOS project officer
10:00 - 10:20	Overview of past research project results (FP5, FP6 &FP7), and key findings	▪ Dr Holger Kramer, ISL
10:20 - 10:40	WATERBORNE^{TP} Research Priorities	▪ Lanfranco Benedetti, CESA
10:40 - 11:00	Transport Research Knowledge Centre (TRKC) project	▪ Mrs Gabriele Jauering, TRKC
11.00 -11.30	***Coffee Break***	
Session 2: Results and Implementation of Projects (Chair: Henk Janssens, DMN)		
11:30 - 11:50	The INTERSHIP project	▪ Matti Nallikari, STX Europe
11:50 - 12:10	The SAFEDOR project	▪ Pierre C. Sames, Germanischer Lloyd AG,
12:10 - 12:30	The POSE^{2}IDON project	▪ Chris Trout, BMT Defence Services Ltd
12:30 - 12:50	Fragmentation and Duplication of Maritime Transport Research	▪ Ralf Fiedler (MARTEC- ERA net)
12:50 - 13:00	Discussion	
13:00 -14:00	***Lunch***	
Session 3: Parallel Working Groups for selecting Research Priorities (Tony Morrall, ECMAR)		
14:00 - 15:15	Competitiveness	▪ Dr Karsten Seidel, MIF Executive Secretariat ▪ David Calduch, FVP, (rapporteur)
14:00 - 15:15	Energy/Environment	▪ Nico Wijnolst, Chairman of ENMC. ▪ Eliza Gagatsi, CERTH-HIT, (rapporteur)
14:00 - 15:15	Safety and Security & Human factors	▪ Prof. George Giannopoulos, Chairman of Transport Advisory Group ▪ Vytautas Paulauskas, KSRC, (rapporteur)
Coffee Break 15:15 -15:30		
15:30 - 16:30	Plenary Session	▪ Working Group Research Priorities
16:30	***Close***	

Figure 9: Electronic leaflet for the dissemination of the MARPOS Workshop

Figure 10: The agenda of the MARPOS Final Conference

Figure 11: The MARPOS Brochure

The above dissemination material was used to the project events and also was distributed by all MARPOS partners, to an important number of contacts and key stakeholders of the maritime transport area (technology platforms, maritime industry, academia, R&D community, shipping lines, port authorities, local authorities etc)

C. The exploitation of dissemination channels for the wide dissemination of MARPOS work.

Further to the above, during the project implementation period, MARPOS consortium exploited its dissemination networks for the promotion of the project results and activities. At the framework of the above, a series of actions have taken place namely:

1. Liaison with existing efforts, initiatives and projects in the area of maritime transport. Indicative examples are the liaison with the WATERBORNE TP, the projects CASMARE, MARTEC-ERANET, as well as projects/ initiatives and databases dedicated to the dissemination of EU research results such as the Transport Research Knowledge Centre (TRKC) and the Maritime Transport Research Database (MTRD) – developed though the MARPOS project
2. Presentation of MARPOS work and outputs to various Conferences, Workshops and meetings such as:
   a. Presentation of the MARPOS project approach (Maritime Transport Research: Setting the Priorities to Improve system efficiencies) on the Round Table on the "MEDITERRANEAN PORTS: PRESENT AND FUTURE CHALLENGES. HOW TO IMPROVE THE COMPETITIVENESS OF MEDITERRANEAN PORTS? - THE CONTRIBUTION OF DEVELOP MED" organised by the project DEVELOP-MED in cooperation with the Ministry for Economy, Competitiveness and Maritime Affairs of Greece (10/12/2009, Athens, Greece)
   b. Presentation of MARPOS work in the various meetings of the WATERBORNE TP Support and Mirror Groups (SG 27-17/9/2009, SG 28 1/07/2009, SG29 17/9/2009, SG 32 9/3/2010)
   c. Presentation of MARPOS project at ECMAR's General Assembly on 4 March 2009
   d. Presentation of MARPOS activities on EU Transport Advisory Group meeting in Brussels 11.03.2010
   e. The MARPOS approach was presented to the INTERREG NSR Secretariat on 4th Nov. 2009 in Bremerhaven and to the EU project Promotional Platform for Short Sea Shipping an Intermodality - PROPS on the 22nd June 2010 in Dortmund
   f. The MARPOS approach was presented at the FP7 Maritime Transport Brokerage Event in London, UK (02/09/2010)

g. The MARPOS work was presented on the Baltic opportunity Workshop on FP7 Transport Call. The Workshop took place on the 13th of September 2011 in Riga Technical University and was sponsored by the EC Officer Mr. Tiit Jurimae (Head of Unit – Aeronautics of the Transport Directorate, DG Research & Innovation)
h. The MARPOS work provided the basis for a scientific paper, currently under review, to be presented in the IAME (Institute for Maritime Economists) Conference October 2011, San Diego, Chile entitled "European Maritime Transport Policy and Research Priorities".
i. The MARPOS work provided the basis for a scientific paper, currently under review, to be presented in the TRA (Transport Research Arena) Conference April 2012, Athens, Greece entitled "Technology gaps and Research Priorities to support the EU Maritime Transport Policy".

3. Establishment of MARPOS Website (www.marpos-project.net)
4. Announcements of MARPOS project and events at the partners organisations' websites (HIT-CERTH, FVP, MTRD, ECTRI)
5. Presentation of MARPOS to the CASMARE project meeting in Brussels (04/02/2010) and participation of CASMARE to MARPOS meeting (Athens, 4/3/2010). In both meetings the two projects examined ways of cooperation and liaison.

1.4.3. Exploitation of results

The main results of the MARPOS project i.e. the MARPOS publication, which also includes the recommendations about the needs and priorities of future Maritime Transport research, and the MARPOS e-tool (Maritime Transport Research Database – MTRD) are both available to the wide audience through the public project website. For their wider dissemination, the two (2) MARPOS outcomes are also forwarded to all the participants of the MARPOS dissemination events i.e. the Workshop and Final Conference, who actually represent key actors of the European Maritime Transport Research and Industry. Both MARPOS outcomes are expected to serve as a valuable tool not only for the European Commission in better utilizing its financial research contribution through providing funding to research project addressing maritime transport research fields/topics that were not covered over the last decade but also for maritime transport research stakeholders in identifying the areas where they should focus the research efforts meeting the objectives of the European Commission. Furthermore, through the investigation of the current implementation status of the projects' outcomes, the EC should consider any problems and solutions proposed regarding the successful uptake of the projects' research products by the European Maritime Industry.

1.5. The project public website

The official website of the project was established from the very beginning (December 2008) of the project implementation period and remained active and updated throughout its whole duration. Through the MARPOS website, useful information was provided to any interested user regarding the project's work and progress, links to the project events and deliverables as well as its various outcomes (e.g. The Maritime Transport Research Database – MTRD (Figure 4). The project website will be maintained for at least two years after the end of the project (August 2011) enabling further utilization of the project's final results.

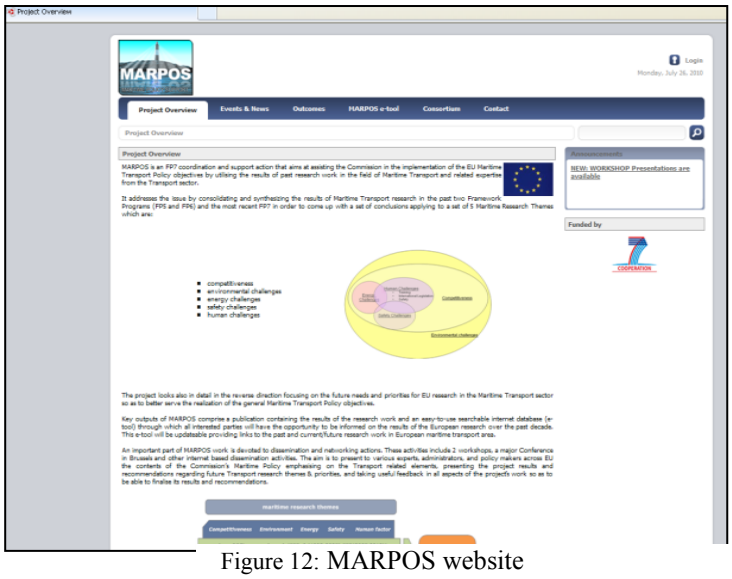

Figure 12: MARPOS website

The public project deliverables along with relevant supporting project material (brochures, flyers, etc) are available in the URL: www.marpos-project.net.

1.6. List of Beneficiaries and contact details

In the table below the list of the partners involved in the MARPOS Project is provided, along with the country they come from, the main responsible, the address and e-mail.

Table 5: List of beneficiaries

No	Partner	Country	Responsible person	Address	Email
1	Centre for Research and Technology Hellas – Hellenic Institute of Transport, CERTH-HIT ***(Coordinator)***	Greece	Dr. Maria Boile	357 Mesogeion Avenue, 15231, Chalandri, Athens, Greece	boile@certh.gr
2	Dutch Maritime Network DMN	The Netherlands	Drs. Ir. Henk Janssens	BEURSPLEIN 37, Rotterdam, 3011 AA The Netherlandas	h.janssens@dutch-maritime-network.nl
3	Fundacion de la Comunidad Valenciana para la investigacion, promocion y estudios comerciales de Valenciaport	Spain	David Calduch Verduch	Avenida Muelle del Turia Valencia 46024 Spain	DCalduch@fundacion.valenciaport.com

	FVP				
4	Institute for Shipping Economics and Logistics ISL	Germany	Dr. Holger Kramer	Universitaetsallee 11-13 Bremen, 28359, Germany	Kramer@isl.org
5	Klaipeda Shipping Research Centre Data KSRC	Lithuania	Prof. Vytautas Paulaskas	Igulas, 18A 5 Klapeida, Lithouania	donatasp@takas.lt
6	European Council for Maritime Applied R&D Association ECMAR	Belgium	Tony Morrall	Rue Belliard 159, Brussels, 1040 Belgium	tmorrall@bmtmail.com