



TCA3-CT-2003-506427

InMare

**Technologies and Methodologies for Safe, Environmentally-friendly
and Efficient Shipping Operations of the Future**

Instrument: Coordination Action

Thematic Priority 1.6: Sustainable Development, Global Change and Ecosystems

Key Action 1.6.2: Sustainable Surface Transport

Objective 4: Increasing road, rail and waterborne safety and avoiding traffic congestion

Research domains 4.11 - 4.16: Technologies for safe, efficient and environmentally friendly waterborne transport.

Final Reports: Publishable final activity report

Period covered: from 01/04/2004 to 31/03/2006

Date of preparation: August 2006

Start date of project: 01/04/04 Duration: 24 Months

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Cons.a.r. S.r.l. Revision [Final Version]

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1. PROJECT SUMMARY

In April 2004 the Coordination Action (CA) called “InMare” was launched with support of the European Commission by E.U. (D.G. R&D) and financed under the 6th R&D Framework Programme. The project partners included several European shipowners association, ship-operators, universities, system makers and maritime research centres. The INMARE project focused on technologies and methodologies for safe, environmentally-friendly and efficient shipping operations of the future. The main objective of the InMare CA was to use the maritime operators real needs as input for feasible and effective future studies and/or research projects by identifying the most promising scientific and technical developments for preparing the European shipping to face the challenges and competitiveness of the future.

In particular, the project aimed at coordinating activities within five identified topics:

1. Enhanced Efficiency Onboard and Ashore;
2. Human Resources;
3. Communications and Decision Support System;
4. Regulatory Matters;
5. Environmental Sustainable Ship Operations.

The basic idea of the InMare Co-ordination Action was, , to integrate expertise and experiences with a substantial contribution and steering by European ship owners’ representatives. It can be recognized as an important tool to maintain the European shipping industry on the front edge of competitiveness.

2.SCIENTIFIC AND TECHNOLOGICAL OBJECTIVES OF THE PROJECT

A greater effort in research and development is the most appropriate way to promote progress of the scientific and technological level of waterborne transport and to encourage a wider application of the so defined “best practices” among ship-operators. To this purpose, InMare C.A. proposed a bottom-up approach to the maritime problem, by collecting directly from ship operators their problems and improvement suggestions, and translating such indications in research needs through the contribution of specialized technological partners, universities and research centres. The areas and needs on which the InMare C.A. worked were the outcome of a wide and deep investigation over the European ship-operators. Such areas are listed and described in the following subparagraphs.

(It has to be noted that in the following list , there are some overlaps between items of different headings)

OBJECTIVE 1 - ENHANCED EFFICIENCIES ON BOARD AND ASHORE

The consideration of many needs and priorities, inherent to different sectors, is considered of importance. They are aimed to the general enhancement of the efficiency of the maritime operations through the attention to different aspects relevant to the on-board and ashore technologies and procedures, the commercial operations, the shore interface phases, the integration etc.. The following items are considered of high priorities:

- Testing the impact of Security regulations: Security procedures and techniques aimed at enhancing efficiency and reducing operational impact (for different ship types).
- Communication & information technologies - Integration for logistic chain.
- Reduction of cargo handling time in port (loading/unloading, lashing) – Standardized automated and computer assisted procedures
- Ship and ship/shore interface cargo handling equipments – Automation of ship/shore cargo handling and supervision of cargoes on-board during voyage.
- Ship manoeuvring in restricted areas and mooring/unmooring
- Comfort and cargo integrity (ship design, sea keeping, noisy vibrations, stability, etc.)
- Cargo safety planning/monitoring system

OBJECTIVE 2 – HUMAN RESOURCES

A well educated and trained crew can reduce significantly the risks of accidents and pollution. To this purpose there is a need to adopt and diffuse on board the vessels advanced information, education and training sources (“Computer-based” and “long distance” training systems, Internet, broadcast). Actually one of most important problems is the lack of availability of European seafarers, especially for cargo ships. Technological, Communicational and Organizational solutions must be evaluated and promoted in order to increase the attractiveness of maritime careers.

The following items are considered of high priorities:

- Reallocation of duties and workload redistribution onboard and between crew onboard and staff ashore
- Rise education level of crew in order to meet evolving practical requirements
- “Computer-based” and “long distance” training systems
- Definition of scenarios for standardized regular training for different ship types
- Diffused and free use of information, internet, entertainment, etc.
- New tools/software to support onboard duties by the crew

OBJECTIVE 3 – COMMUNICATION AND DECISION SUPPORT SYSTEM (DSS)

With increasing complexity of the system “ship” and its handling, a parallel increasing number of sophisticated DSS on board is expected. To keep handling of the bridge instrumentation as concise

and efficient as possible, inclusion of the sole DSS to one major system is regarded worthwhile. In order to improve such a general DSS to become once “master’s best friend”, a basic and profound concept and design of information presentation and the human machine interface (HMI) is required. The following priorities have to be developed:

- Low cost and efficient satellite communication solutions for ship-shore data/information interchange, in routine as well as in emergency situations
- Low cost and efficient communication solutions for short and medium range data/information interchange (SSS, VTMIS, Landing phases, etc.)
- Distance (E)-learning
- Remote maintenance (distance controls and maintenance support /supervision)
- Remote piloting
- Fully integrated DSSs
- Systems interchange and standards
- Concept of integrated bridge system: integrated console (ergonomics and standard operating based solutions), intuitive man/machine interface (MMI)

OBJECTIVE 4 – REGULATORY MATTERS

Introduction of new rules often produces an economical impact on shipping companies but not always produces the benefit desired, neither have the expected efficiency. It would be of great benefit for all parties if the Administrations and other non-Governmental Organizations, whenever elaborating new rules, or revising existing rules, analyze all facts and feed-backs from the ships and their crew. To this purpose, it seems necessary to develop methods and tools for a European and/or International system for registration and analysis of near-misses and accidents.

- Review and revision ("streamlining") of existing Rules and regulations based on input from the ship owners and crew onboard the ships
- Standard methodology for cost-benefit analysis before new regulatory measures are decided on and implemented
- European (and international) system for registration and analysis of near-misses and accidents

OBJECTIVE 5 – ENVIRONMENTAL SUSTAINABLE SHIP OPERATIONS

While in the past more attention was paid to prevent large environmental incidents and, when they happened, to reduce their consequences, now the public opinion requires also the control and the reduction of the operational impacts in the whole process. The control of such impacts requires the general reduction of the pollution sources (the machineries condition, the ship efficiency, the waters, the waste, etc.), together with the adoption of efficient criteria and methodologies for their monitoring, control and management.

The topics considered of high priority are worthwhile for research and development activity and funding:

- Alternative fuels (hydrogen, LNGs, etc.) & enhanced Power systems.
- Fleet performance indexing (fleet utilization / efficiency / cargo load factor)
- Grey/black water treatment
- Technologies for ballast water treatment

3.CONTRACTORS INVOLVED

InMare Consortium was composed of 20 partners, ship owners, operators or their representative organizations (15), leading electronic equipment manufacturers (2) and sea transport research institutions (3). This consortium is regarded as highly complementary in terms of end-user interests, with the technical, scientific and administrative expertise necessary to perform the tasks described in the project proposal. In fact all areas of interest were covered by this wide ranging group of participants. The partnership established a research co-operation between numerous European countries (U.K., Germany, Italy, Greece, Portugal, Poland and Norway)

In detail, the members of the consortium are showed in the following table :

Partner No.	Country	Name (abbreviated)	Business activity/ main mission/ area of activity	Role in the project
1	IT	CON SAR	Ship-owners research consortium	Co-ordinator
2	NO	NSA	Norwegian ship-owners Association	Partner
3	UK	BMT	Research-technology dev. – test facility	id
4	NO	MATEK	Research-technology dev. – test facility	id
5	D	TUB	Technical university	id
6	UK	CARNIVAL	Shipping Company	id
7	NO	TEEKAY	Shipping Company	id
8	D	SAM	Navigation systems' maker	id
9	D	SOS	Satellite observations-Data provider	id
11	GR	DANAOS	Research and Services in the shipping	id
12	IT	DEMAR	Shipping Company	id
13	IT	SEMA2	Services for ship management	id
14	UK	SSRC	University	id
15	IT	CONFIITARMA	Italian Ship-owners Association	id
16	IT	ISSIA	Research on Maritime Transport	id
17	NO	DNV	Classification society	id
18	IT	FINC	Shipbuilder	partner
19	PO	AAMC	Portugal Ship-owners Association	Expert/Adviser
20	EU	ECSA	European Community of Ship-Owners Association	Partner
21	PL	PSA	Polish Shipowners' Association	Expert/Adviser

4. THE WORK PERFORMED (STRUCTURE AND METHODOLOGY)

The C.A. was divided into Work Packages with one partner appointed as work package leader for each W.P.

- WP 1 “Specification of end-user needs”
- WP 2 “Establishment of Working Groups”
- WP 3 “Working Group activities”
- WP 4 “Arrangement and execution of Assessment Workshops”
- WP 5 “Harmonise and summarise results of all Working Groups”
- WP 6 “Dissemination actions”
- WP 7 “Project management and administration”

According to the five topics of InMare, five WGs were established, mainly composed by ship owners, system makers and ship operators.

The allocation of the members to the WGs was defined according to their competencies and preferences.

The obtained results in the W.G.s (and of the C.A.) are illustrated in deliverables which reports, for each of five topic, the following :

1. State-of-the-Art
2. Identification of R&D needs
3. Overview of existing systems/solutions as well as proposal for new ones (where applicable)
4. Support EU policies towards upcoming IMO regulations through specific R&D actions

Each working group worked in order to produce a contribution for these deliverables, as expected in the project. In parallel to the research works, during the project meetings and various events were organized with direct participation of all Project partners, external invited experts and the Commission's representative.

5. THE END RESULTS

The main results achieved by the Coordination Action are identified as recommendations for research/studies activity, some consideration on the regulatory aspects of the studied priorities and some dedicated picture of the state of the art, seen from the point of view of the ship operator (end user).

The outcome of the InMare C.A. is grouped under the five main topics. A short description is reported here below:

1. Enhanced Efficiency Onboard and Ashore

Specific R&D actions recommended by the InMare C.A. consist of a combination of information gathering and provision:

- In general it is recommended to use upcoming satellite and surveillance technology for improved fleet planning and raised flexibility in logistic chains. As state of the art it is suggested to explore feasibility of higher future potentialities of the Galileo system in combination with AIS. High potentials are also seen in an extended vessel traffic monitoring and information system (VTMIS) to have a positive impact on logistic chains and on efficiency of port operations.
- Additional sampling, preparation and presentation of ship specific information to assist operators and to increase safety and reliability of sea transport are regarded worthwhile. Development of specific monitoring systems to assist in ship handling as well as to supervise and document cargo integrity are recommended.

- For new builds a reconsideration of ship designs in terms of safety (stability, sea keeping, freak wave survival) and of extended operational windows for small and medium sized ships are recommended. Impact of water on deck and service in cold climate conditions (Arctic) are regarded to become a topic for small and medium sized ships

Looking at the wide list of incoming or planned rules that the InMare consortium examined, under its own specific viewpoint the following items are considered of major interest:

- Standardized, automated and computer assisted procedures in port operations – to reduce time associated with loading/unloading, lashing
- Cargo safety planning and monitoring systems

2. Human Resources

Specific R&D actions suggested consist of:

- Reducing administrative burden from master and crew: Develop instruments enabling a shift of tasks to the shore
- Long distance training and education for continuous upgrading of crew members qualifications.
- Rise availability of European seafarers
- Low cost solution which overcomes today's restrictions of satellite time and bandwidth; for easy access to and sharing of information
- New tools and integrated systems for handling paperwork and organizational tasks along logistic chain, Computer Assisted Maintenance and Decision Support Systems for navigating in adverse weather conditions and emergency situations

Regarding upcoming and reviewed regulations it is recommended that studies and evaluations are promoted to support currently on-going rules:

- Reallocation of duties and workload redistribution onboard and between crew onboard and staff ashore
- "Computer-based" and "long distance" training systems to be fully recognised by the certification bodies.
- Definition of possible scenarios for standardized regular training for different ship types

3. Communication and decision Support System

As specific R&D studies /actions are suggested:

- Investigate the need and possibilities for data format standards
- Explore feasibility of higher future potentialities of AIS and VTMIS , cf. topic A
- Higher diffusion of e-learning tools , cf. Topic B
- Increase level of shore side involvement at maintenance and repair with specific tools to remote controls, commands and settings
- Remote piloting
- Fully integrated DSSs
- Systems interchange (integrated bridge) and standards (functionality / operating)
- Concept of integrated bridge system: integrated console (ergonomics and standard operating based solutions), intuitive man/machine interface (MMI).

It is very evident that all of the aspects (efficiency, safety, security, ect.) of the shipping industry and of the maritime transport are increasingly linked to the application and the diffusion of

advanced high-performance and low-cost Information and Communication Technologies (ICT). The spread and the changeable long-range displacement of the ‘productive units’ (the ships) constitute the reasons for which the maritime transport sector is penalized, and, compared to other shore based industrial sectors, does not fully benefit neither take advantage in real time of the I.C.T developments and of the wide quantity of the services offered on it. The internet is a typical case. Furthermore, in addition to the data/information exchanges for the advanced remote ship’s navigation and management (maintenance, control, monitoring, etc.), new procedures, architectures and services could be developed or optimized.

Not only the routine but also the emergency and crisis management will have beneficial effects from the evolution and diffusion of I.C.T. Also the selection of data, their priorities and ranking in emergency situations will depend on the on-board availability of monitoring and communication technologies (on-scene monitoring, remote-medicine, equipment control, etc.). All priorities of this topic are also recommended for consideration when it comes to amendment or revision of IMO regulations.

4.Regulatory Matters

As R&D actions or studies the consortium suggests to:

- Develop extended functions of vessel data recorders (VDR) to record: e.g. radar image, near misses, bridge conversation & orders as a basis for *European (and international) system for registration and analysis of near-misses and accidents.*

Upcoming IMO regulations and procedures under review were commented on by the consortium in order to provide support to the European maritime authorities and legislators. Concerning regulatory matters themselves, it was highlighted the need to investigate in what ways regulation can be better evaluated, and it was suggested that a “*Standard methodology for cost-benefit analysis before new regulatory measures are decided on and implemented*” is considered and introduced soon.

5.Environmental Sustainable Ship Operations

The consortium regards worthwhile for research and development activity and funding:

- Fuel cell powered systems adapted for onboard applications .
- Alternative propulsion systems .
- Study on feasible and available technology for (grey / black) water treatment, including analysis of the standards and definition of requirements .
- Develop cost efficient and suitable for retrofit ballast water treatment system .
- Fleet performance indexing on the one side on fleet utilization, efficiency and on the other on environmental friendliness for the service, under specific criteria .

When it comes to the time for amendment or revision of regulations related to environmental impact, the consortium recommends, for different reasons item by item, to focus on:

- Fleet performance indexing (fleet utilization / efficiency / cargo load factor).
- Grey/black water treatment.
- Technologies for ballast water treatment

6. POTENTIAL IMPACT

The World Sea borne trade is growing continuously, this involves the need of always major efficiency, safety and improvement of environmental performance. In addition, there is even more increased focus on intra European maritime transport (in particular on the Short Sea Shipping), because it offers potential benefits in terms of environmental pressure and road congestion. To this purposes the C.A had put its attention on new approaches to improve reliability and safety of European maritime activities, and on intelligent systems to support on-board decisions, in particular under emergency situation. Emphasis and suggestions were also put by InMare C.A. on the adoption and diffusion of telematic and communication tools to better integrate ship and shore resources.. Through a tool like a dedicated C.A., involving trans-national co-operation of directly or indirectly qualified parties, it was reached the optimal level of knowledge, to set the priorities for technology and methodology developments required to realise the aims of industry. The results of the InMare C.A. may also give foothold for the expansion of technology-based industry, specializing in ship instrumentation, telecommunications, design and construction of marine systems, tools related to quality assurance etc. in the marine and other sectors. Such improved systems and tools enhance the quality of the ship operation and may in turn be adopted by the industry to design and construct safer and more cost-effective ships and marine structures in the future.

7. DISSEMINATION OF KNOWLEDGE

Introduction

The InMare C.A has used a variety of means to disseminate the results to a wide audience. The spirit of the InMare C.A. was to be open to the contribution of external parties. Priorities and polices derived from the work have been disseminated through regular workshops with top industry participation. This has ensured dissemination of results, and high end-user influence in the processes. Proceedings from the workshops had been distributed to the participants, to the widest possible category of maritime transport operators. Intermediate results were delivered to the D.G. R.D. as a contribution for the 3rd Call of the 6th F.P.. Since September 2004, five months after the project started date, InMare CA has maintained updated the website with deliverables and other documents (minutes, meeting agendas, partners contributions) produced by the project.

Overview table

This section covers the Dissemination activities carried out in the whole period.

Planned /actual Dates	Type	Type of audience	Countries addressed	Size of audience	Partner responsible /involved
Jun –July 2004	InMare 1 st investigation	Maritime ship-owners/operators	All EU Countries	N.A.	Cons.a.r./Project Partners
September 2004	Project web-site	Maritime field	All EU Countries	N.A	Cons.a.r.
13-15 September 2004	Workshop open session	Maritime ship-owners/operators	All EU Countries	30-40 people	Cons.a.r./Project Partners
September – October 2004	InMare 2 nd investigation	Maritime ship-owners/operators	All EU Countries	N.A.	Cons.a.r./Project Partners
3 May 2005	Mid Term Convention open	Maritime ship-owners/operators	All EU Countries	30-40 people	Cons.a.r./Project Partners

Planned /actual Dates	Type	Type of audience	Countries addressed	Size of audience	Partner responsible /involved
	session				Partners
16 March 2006	Final General meeting	Maritime ship-owners/operators	All EU Countries	N.A.	Cons.a.r./Project Partners
July 2006	Public document	All	All E.U Countries	N.A.	Coordinator

The InMare C.A. activities were regularly recalled in the Information network of the Confitarma (Italian National ship-owners Association) and other National associations involved in the C.A., included mentioning in the main periodical publications of the European Ship-owners Association.

7.1 THE PROJECT WEBSITE

The InMare Web site (<http://www.inmare-fp6.com>) was conceived in order to be an open tool (open area) for information and dissemination purposes as well as a working tool (private area) for the partners of the C.A., used as support to the information exchange and to the management activities

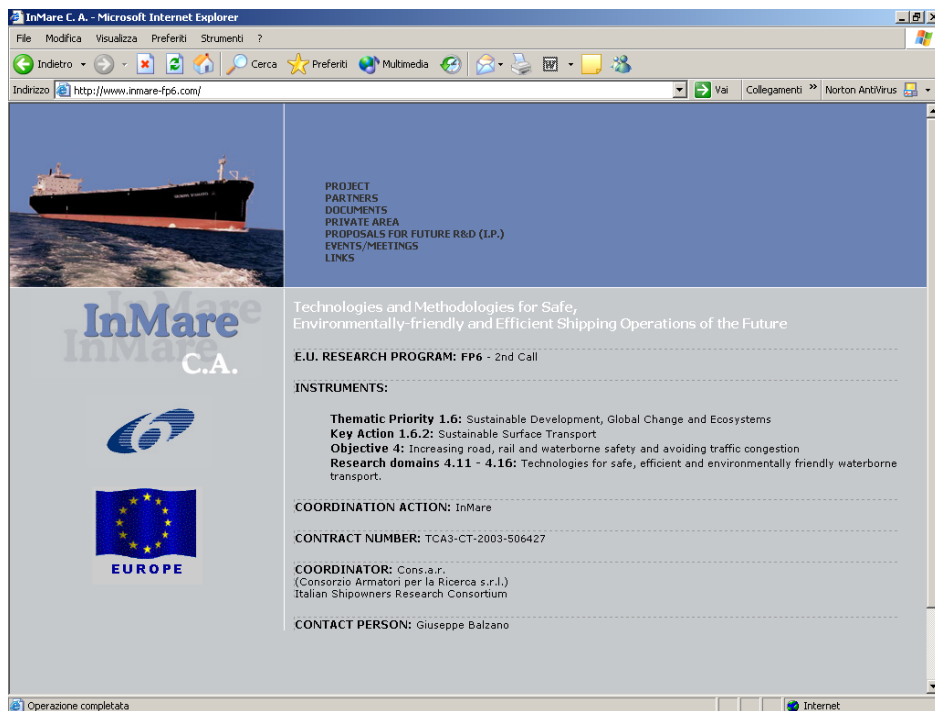


Figure. InMare Home page

In fact, a private area was established, where the partners could find all the documents produced by the project. Partners have access to the project areas they are involved in, and they have access to the documents uploaded to these sections. Deliverables and other documents (minutes, meeting agendas, partners contributions) have regularly been uploaded to the website during the whole period.

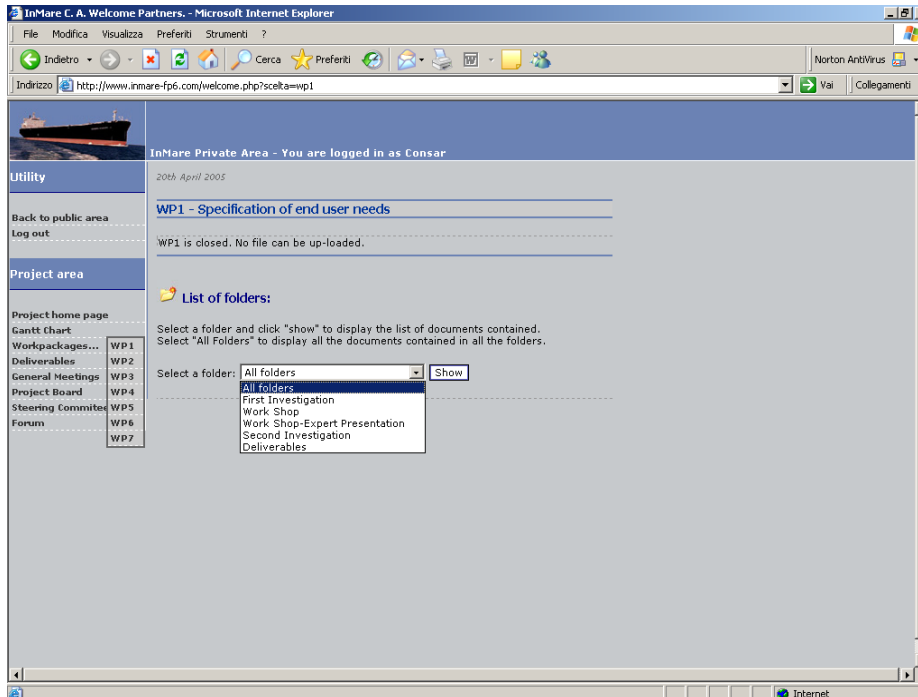


Figura InMare Private Area

The InMare web site was also provided with a forum where the partners had discussed the main issues of the project.

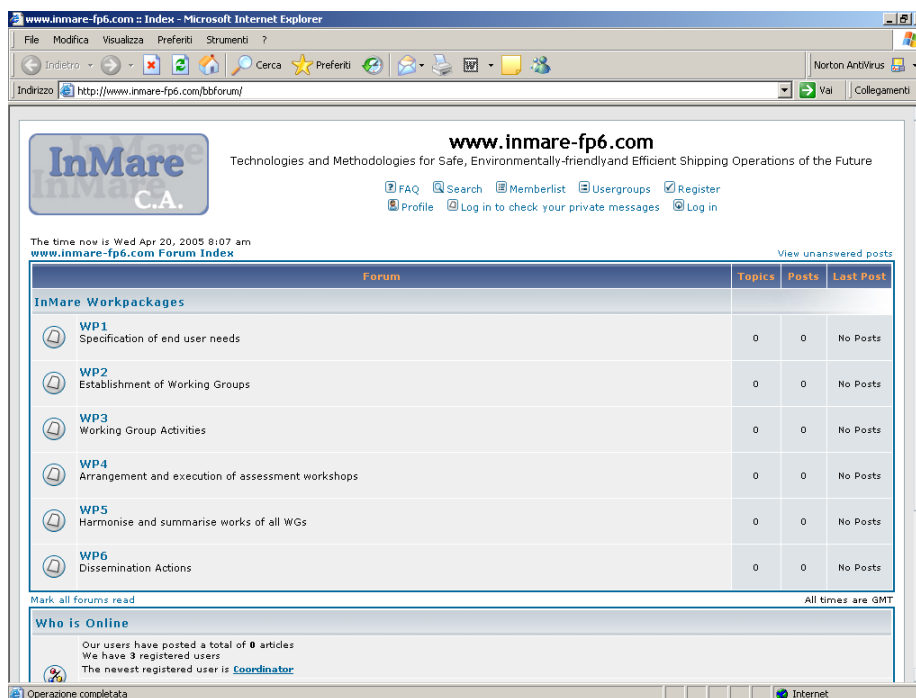


Figure . InMare Forum

Co-ordinator had updated the Web site during the entire duration of the project.

7.2 MILESTONES, MEETINGS AND VARIOUS MAIN EVENTS

The *1st InMare investigation* was carried out by means of a questionnaire, circulated among European ship-owners/ship-operators. The Investigation was successful thanks to the efforts of all the InMare partners. The results achieved were elaborated, analyzed and presented at the Workshop of 13-14-15 September 2004

A September 2004 *Workshop* was organized with the contribution of the European Commission and held at the DG R&D offices in Brussels. It was attended by most of the InMare partners and other external participants (ship-operators). It was based on the results of the first investigation. During the workshop contributions from InMare partners and from other external ship-operators gave the basis for a wide, effective and productive discussion. The event produced a critical analysis of the preliminary results achieved up to then (investigation, contribution from partners, etc.) and, through different sessions (plenary, brainstorming, separate Working Groups meetings and plenary discussions) produced a list of needs to be assumed as the first measurable result of InMare.

During the event working group sessions analysed the preliminary needs identified. It was decided to expand the list of needs through a further investigation on a wide sample of European ship-operators, before being considered as final. It was further stated that the findings and contributions from the InMare C.A. were to be delivered timely for use in the preparation of the 3rd Call of the 6 F.P..

The internal management procedure of InMare C.A. provided that, before being formalized, the final list of Topics and priorities that emerged from the investigations and the work-shop, had to be submitted to the approval of the Project Board.

A *second investigation* was carried out to validate the conclusions arrived at. A new questionnaire was produced by coordinator. (taking into account all the contributions) and adopted by the partners. The questionnaire was circulated among European ship-owners for judgment and comments thanks to the contribution of their national ship-owners associations.

The coordinator and the partners involved made a special effort to contact ship-operators of countries not represented in the consortium through their national associations (Cyprus, France, Spain, Germany, Swedish, Finland and Denmark). The results of this investigation enabled a preliminary list of R&D needs to be submitted for analysis to the Project Board (P.B.).

The *InMare Mid Term Convention* (MTC) was held in Brussels, at the EC premises, on 3 May 2005. This event involved all the InMare partners, the EC representatives and external operators as guests. The purpose of this meeting was to arrange a round table where to talk about and assess the work carried out by the Consortium over the first year of activities, and evaluate possible future actions/activities and strategic decisions to be taken. Some month later InMare produced a contribution to the D.G. R&D for the preparation of the 3rd Call of 6th F.P.

The *InMare Final General Meeting* was held in Brussels, at the EC premises, on 16 March 2006. This event involved all the InMare partners, the EC representative and external experts, that were invited as speakers to present specialized contribution.

The Final Meeting focused on three topics and five priorities of the InMare list of priorities and topics, and it was considered as an additional opportunity to collect inputs from main actors contributing to and/or influencing the ship-operations world.

The meeting was conceived as a mix of internal project event and a open opportunity for gathering input from qualified actors (external to the project consortium).