TELEMAS

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Tele-Maintenance and Support through Intelligent Resource Management for Ship Operation

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Tele-Maintenance and Support through Intelligent Resource Management for Ship Operation

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Tele-Maintenance and Support through Intelligent Resource Management for Ship Operation

List of Abbreviations /Glossary

AMOS	Planned maintenance software from manufacturer Xantic
APML	Application Process Markup Language, data format based on XML
Application	The word "Application" is used, as the generic term, to represent the set of features, combining communication and document processing, on which end-users may perform operations. The "Applications" may depend on working methods and on allowed processing of documents. Examples of "Applications" are: open interchange of processable documents, co-operative working, etc.
ASP	**A**pplication **S**ervice **P**roviding. ASP offers individuals or enterprises access over the Internet to applications and related services that would otherwise have to be located in their own personal or enterprise computers. ASP services are expected to become an important alternative, not only for SMEs with low budgets for information technology, but also for larger companies as a form of outsourcing and for many services for individuals as well. ASP is an own workpackage within the TELEMAS project (Workpackage 07 "ASP")
ASCII	American Standard Code for Information Interchange
Bearer	The telecommunication service that provides the capability of transmission of signals between access points.
Broadband	Broadband technology allows multitasking of applications. In other words, broadband communication systems are capable of handling numerous simultaneous channels of communication. For example, running a video conference and exchanging data at the same time. In the TELEMAS context the term broadband communication is used in respect of wireless data transmission.
CBT	**C**omputer **B**ased **T**raining. CBT is a training method in which the student learns by executing special training programs on a computer. CBT is an integral part of the TELEMAS Workpackage 06 "e-learning".
CGI	**C**ommon **g**ateway **i**nterface. CGI is a specification for transferring information between a World Wide Web server and a CGI program. A CGI program is any program designed to accept and return data that conforms to the CGI specification. The program could be written in any programming language, including C, Perl, Java, or Visual Basic.
Co-ordinator	The co-ordinator is responsible for the Project management and represents the consortium at EU and deals with all matters of administration, finances, production and submission of progress reports, plus the logistics for the execution of the project. At the TELEMAS project

	the co-ordination is done by ISSUS.
COTS	**C**ommercial **o**ff **t**he **s**helf. COTS describes ready-made products that can easily be obtained in the market.
Data security	Prevention of access to or use of data or programs without authorisation. The safety of data from unauthorised use, theft, or purposeful destruction.
Dxx/xx	Deliverable [workpackge]/[number within workpackage]
DEE	Dynamic Learning Environment - Dynamic learning is the ability to assess in real-time, the success of the learner's understanding of the content being presented, and to dynamically react by modifying the content, content level, or modifying the instructional techniques being used with that learner.
E-learning	An umbrella term to describe the act of learning online. Taking a course or training via the the World Wide Web. "e-learning" is an integral application workpackage within the TELEMAS project (Workpackage 06 "e-learning").
EJB	Enterprise Java Beans
Familiarization	To make known, recognised, or familiar. The experience of becoming familiar with something e.g. the use of software, a sub-system or even on-board procedures.
Fault tolerance	The ability of a system to respond gracefully to an unexpected hardware or software failure. There are many levels of fault tolerance, the lowest being the ability to continue operation in the event of a power failure. Fault tolerance systems are being analised within Workpackage 03 "Safety".
FP	Framework Programme
GUI	graphical user interface
HCI	**H**uman-**c**omputer **i**nteraction. HCI is a discipline concerned with the study, design, construction and implementation of human-centric interactive computer systems. A user interface, such as a GUI, is how a human interacts with a computer, and HCI goes beyond designing screens and menus that are easier to use and studies the reasoning behind building specific functionality into computers and the long-term effects that systems will have on humans.
HMI	Human-Machine Interface
HTML	**H**yper **t**ext **m**arkup **l**anguage. HTML is the authoring language used to create documents on the World Wide Web.
iBOS	Intranet Business Operating System; ISM software tool from K-NET S.A.
IMO	International Maritime Organization
Interoperability	The ability of software and hardware on multiple machines from multiple vendors to communicate.
Intranet	An Intranet is a private network that is contained within an enterprise. The

	main purpose of an intranet is to share company information and computing resources among employees. An intranet uses TCP/IP, HTTP, and other Internet protocols and in general looks like a private version of the Internet.
IP	Internet Protocol
ISM	**I**nternational **s**afety **m**anagement code. ISM requires development and implementation of a safety management system which addresses all of a company´s activities onshore and on board its ships. The code places the responsibility for the safety of ships and the prevention of pollution where it truly lies, within the company managment structure. The application of ISM is an integral part of the TELEMAS project and is handled in the Workpackage 04 "ISM Interface".
ISO	**I**nternational **o**rganisation for **s**tandardisation.
ISPS	International code for the security of ships and of port facilities
IST	**I**nformation **s**ociety **t**echnologies. IST is a major theme of research and technological development within the European Union's Fifth RTD Framework Programme (1998-2002). IST is a single, integrated research programme that builds on the convergence of information processing, communications and media technologies.
IT	**I**nformation **t**echnology.
JAVA	Java is a network-friendly programming language invented by Sun Microsystems. Java is often used to build large, complex systems that involve several different computers interacting across networks, for example transaction processing systems. Using small Java programs (called "Applets"), Web pages can include functions such as animations, calculators, and other features.
Knowledge Base	The part of an expert system that contains the facts and rules needed to solve problems. In the context of the TELEMAS project a concept for a distributed knowledge database is being developed within Workpackage 02 "Data Standards & Knowledge Base" to ensure easy and reliable access to required information.
Meta Data	suitable descriptions to categorise, store and retrieve data
Middleware	Middleware is a general term for any programming that serves to "glue together" or mediate between two separate and usually already existing programs. Regarding the TELEMAS project an "Integration Middleware Platform" was developed to access and integrate different applications such as Resources Information, Safety Management Systems, Web Services, Application Service Providing, ISM software and e-learning applications.
Multimedia	The property of handling several types of representation media. A key capability is the ability to synchronise and control delivery of information from disparate sources (e.g. voice and data).
.NET	Microsoft's framework for Web services and component software

Peer Review	During the Peer Review Process a professional from outside the TELEMAS consortium evaluates the reports and major developments.
REMAX	A WWW-based remote maintenance application by Herberg Engineering.
Remote Maintenance	Functionality of an easy and reliable shore-based experts' support solution in case of failures and dysfunctions of technical systems on board. Within the TELEMAS project the Workpackage 05 "Tele-Maintenance" was defined for this purpose.
Scenario	Hypothetical set of conditions and sequence of events constructed for the purpose of analysing or training a problem.
SFI Group System	The SFI (**S**kiptechniks **F**orsknings **I**nstitutt) Group System serves as a system for classification of technical and economic ship information within the offshore industry. It is an international standard which provides a highly functional subdivision of technical and financial ship or rig information.
SOLAS	International **S**afety **O**f **L**ives **A**t **S**ea. SOLAS is an international IMO convention.
TELEMAS	**Tele**-**M**aintenance **A**nd **S**upport through Intelligent Resource Management for Ship Operation.
TIP	**T**echnological **i**mplementation **p**lan. The TIP describes the results of an RTD project and the plans of the partners how to make use of their results and to encourage others to use them. It is a contractual obligation at the end of the project.
TU or TUT	TELEMAS Umbrella (Tool)
UT	Umbrella Tool
Umbrella Tool	Central development of the TELEMAS project. The TELEMAS Umbrella Tool provides a single access point of information for the user on board. The benefits for the users are: Access to all relevant information regarding ship operation at one point, increased availability and easy delegation and suport of maintenance tasks. These tasks are: remote maintenance management, training, condition monitoring, ship knowledge base etc.
User Groups	Groups involved in validating the application. The TELEMAS User Forum is a composition of competent and representative users and user groups where existent. The establishment of the User Group is a main task of Workpackage 08 "User Forum".
User Requirements	The User Requirements are the starting points for all developments within the TELEMAS project. External experts are comprised where needed.
W3C	**W**orld **W**ide **W**eb **C**onsortium. W3C works with the global community to establish international standards for client and server protocols that enable on-line commerce and communications on the internet.
WP	Workpackage
Web Services	A business and technology term encompassing the possibility of openly

	working with other business, developers, and programs through publicly-available open interfaces. Usually, the network used is the World Wide Web.
Workpackage Leader	Within the TELEMAS project the Workpackage Leader is the responsible partner for the single workpackages including the detailed planning of the work package drafting and the final work package reports.
XML	E**x**tensible **m**ark-up **l**anguage. XML is an open standard for describing data from the W3C. It is used for defining data elements on a Web page and business-to-business documents. It uses a similar tag structure as HTML; however, whereas HTML defines how elements are displayed, XML defines what those elements contain.

1 Executive Summary

TELEMAS is a research and development project initiated to develop new uses in IT technology on seagoing vessels. The project is sponsored by the European Union (DG Information Society, FP5, IST-2001-35397). Nine partners from six different European countries started on 1 April 2002 to work together for 25 months. The aim of the TELEMAS technology is to increase the efficiency and safety of ship operations by combining specific TELEMAS outputs with existing IT systems and tools.

The central deliverable of the TELEMAS project is the development of an integration middleware software platform as an "umbrella" tool to manage shipborne as well as external data resources distributed in the world-wide information pool. Different aspects of the potential for IT usage have been investigated and tested leading to the design of a management tool for effective interaction in modern ship operation. The Umbrella Tool and other related project results have successfully been accomplished and presented to the public and are described in detail in this report.

One major requirement in the design of the Umbrella Tool was to be as interoperable with other data formats and IT systems as possible. There are already countless proprietary solutions for specific applications on the market with very restricted flexibility and limited ability to interact with other systems. The present problems cannot be with another proprietary development. The consortium was ideally composed with a broad range of competences in the maritime sectors and this helped to ensure the premise of maximum interoperability was kept in sight. The applications developed in parallel to the Umbrella Tool, were besides their specific functionality, also a valuable proof of the interoperability and flexibility of the whole concept.

These developed applications verify the concept of interoperability, and are:

- Safety related applications: hardware and software for intelligent fire and gas sensors,
- ISM interface with integration of web services technology,
- Platform for remote access control of onboard systems,
- Platform for providing, distributing and adapting e-learning content,
- Application Service Providing solution for distributing content for e-learning as well as for other systems.

Besides these main applications and services which will result in new products that will be marketed in the near future, background research was performed; basic concepts elaborated upon, and an XML based data standard was developed.

The major achievement of the project is the flexibility of the concept and its technical design which enabled the project outcomes to address a variety of issues and user requirements. This success in covering a broad scope of needs and objectives which is representative of the maritime industry was accomplished by approaching the project from a number of perspectives:

- Developing concepts to satisfy end-user requirements,

- Involvement of users before, during and after the development phases,

- Early implementation of technical proto-types,

- Broad Consortium Composition

- Centralized and professional project co-ordination and management

These approaches were also reflected in various demonstration, validation and dissemination activities undertaken during the project with wider audiences to ensure that TELEMAS reflects the maritime markets' and users' needs as well as dealing with approved and future technologies.

Beside the propagation of the project outcome through websites, forums, presentations etc. 23 deliverables were produced; most are classified as public. There are 15 usable results that are the measurable output of TELEMAS. These very usable solutions can be applied to various aspects of industry operations and offer a sustainable concept to deal with information, data and systems onboard seagoing vessels and the required data exchange with land based institutions.

2 Introduction

Ship operation as well as ship management is becoming more complex as digital technology drives the commercial, regulatory compliance and technical aspects of the industry. Advanced tools are available that aim to support the work of seafarers onboard and to bridge the gap between the ongoing traditional tasks such as navigating and the growing workload caused by administrational duties. In fact, new difficulties have arisen as many of these tools have been developed to concentrate on specific problems without context to overall operations resulting in non- continuous workflows, proprietary solutions, little or no data exchange etc. Furthermore, information provided onboard isn't sufficiently connected to the related ship management processes and procedures on shore.

The aim of TELEMAS is to increase the efficiency and safety of ship operation by combining specific TELEMAS developments together with existing IT systems and tools. The integral development is the TELEMAS umbrella tool (UT) as a middleware platform giving access to all relevant tools and information on board. This gives the nautical staff the ability to get an overview of all needed information, or to demand necessary data from world wide resources if not directly available from the vessel.

This report gives a comprehensive overview over the TELEMAS project and its various aspects. It is organized as follows:

After a general introduction in chapter 2, the following chapter 3 summarizes general project facts such as objectives and methodology, and introduces the consortium members with their specific responsibilities within the project.

Chapter 4, the Approach, presents the workplan and the organisation of the workpackages. The various functions and details of the suggested solution of the TELEMAS concept and their advantages are explained.

Chapter 5 gives a detailed description of the project results and achievements. Included are the main project results, concepts and products, as well as consortium activities for demonstration, validation and dissemination. The chapter presents the software functionality, interfaces and technical background of the software developments and discusses further impacts of the project results on the community and markets.

In Chapter 6 an overview over the project deliverables is given. These are mainly written reports, assigned to specific workpackages and/or regular reports (e.g. quarterly management reports). There are also special publications such as brochures, flyers and a CD Rom.

Chapter 7 deals with the Project Management and co-ordination. The cooperation and administration of nine partners from six countries was supported and regulated by different means and are presented in detail in this chapter.

As the issues addressed by the TELEMAS project appeared to become more and more important within the projects lifetime, future developmental activities have also become more highly desired. Possible fields of future activities are discussed in chapter 8, the Outlook, which closes this report.

3 Project Overview

3.1 Project Summary

3.1.1 Introduction

TELEMAS contributes to the terms of reference of IST2001 - I.5.1 "Intelligent Transport Systems", i.e. development of advanced driver assistance systems and integration of advanced processing and decision support tools. The Project started on 01 April 2002 running for two years until 30 April 2004. The range of issues addressed by TELEMAS would have normally lead to a 36 months period development, but as software developments in the market are steadily overcome a proof of concept was the aim. Marketable products will be the result in a mid term.

TELEMAS was co-founded by the European Commission DG Information Society, 5th RTD Framework Programme, FP5/IST/Systems and Services for the Citizen/Transport and Tourism/Intelligent transport systems.

3.1.2 TELEMAS Background and Initial Requirements

The user requirements as well as the market surveys confirmed that many advanced technical solutions already exist, but integration remains as an open issue. So, technical systems monitoring and control tools have been in use for some years but there is still a lack in comprehensive concepts for making information accessible in a user centred manner. The seafarer, the shipping companies, but also the manufacturers are facing the following situation:

- There is no ship-borne resources inventory providing an overview of what is available. Status information has to be retrieved from different sources and information is stored in various media and formats.

- There is a lack of standardisation in both categorization and exchange of information. Manufacturers use their proprietary systems. Nevertheless, established and upcoming standards (SFI-Code, XML-based languages etc.), covering a wide range of applications, exist.

- The complexity of technical systems has increased. Concrete examples are safety systems with a considerable number of sophisticated sensors, of which the condition and operational readiness have to be monitored continuously. Failures occur especially if this is not the case and warnings are overlooked.

- The problem of getting well-trained and qualified seafarers and relatively short service periods aboard continuously widens the gap between the potential of available technical resources and their actual utilisation.

- There is a complexity of rules, recommendations, guidelines, advices and forms. Furthermore, inconsistent filing of documents can lead to a manifold of non-identical versions, bringing up questions of validity. This leads to fuzzy workflows.

▪ This complexity of data and resources also leads to an information flood. The seeker of information has to spend more and more time with sifting and weighing loads of data by its relevance to the respective query.

▪ More and more manufacturers of marine equipment have implemented functionalities allowing them to monitor their equipment from ashore, a promising facility to reduce costs and down times. Despite this, remote services are of low acceptance as there is no tool for the ship command to reliably keep remote actions under surveillance.

▪ The limitation of bandwidths is still a problem. Communication via satellite is expensive so that the amount of data to be transferred has to be managed suitably. Efforts like "least cost routing system" exist; their relevance is limited though, as usually contracts between provider and shipping company are fixed.

▪ The problem of making effective use of technical systems is mirroring the insufficient transparency of responsibilities and authorization rights.

TELEMAS addresses these difficulties.

3.1.3 Objectives of the Project

The objectives of the TELEMAS project can be outlined as follows:

1. System supported guidance of personnel through available resources and operational processes.

2. Development of an HMI for presentation of distributed information.

3. Scalability of data access for different groups of onboard and ashore users.

4. Provision of an operational platform for shipborne application tools through an open format for data exchange. In particular these are:

    A. Safety: Safety management solution considering integration, adaptability, fault tolerance and remote access in order to simplify operators decision process under normal conditions, during maintenance and in critical situations.

    B. ISM: Support in fulfilling the requirements according to the International Safety Management Code (ISM).

    C. Remote Monitoring and Maintenance: Remote system access for condition monitoring, maintenance and troubleshooting.

    D. e-learning: Shipborne access to training tools available ashore.

    E. ASP: Provision for shore-based software support in cases beyond daily routine not covered by vessel software repository.

5. Identification of requirements for standardisation.

6. Development of specific XML standards in respect of current and evolving data standards.

7. Identification of the most appropriate data transfer system(s), taking into account bearer availability and reliability, available bandwidth and usage costs.

8. Centralised access of distributed knowledge base.

9. Communication management for remote data transfer.

10. File compression and replication of data.

11. Verification of the correct functioning of the equipment.

12. Validation of the TELEMAS concept by demonstrations to stakeholders.

3.1.4 Methodology of the Project

The project methodology is based on expert rating to assess the state of the art in practice and to verify the appropriateness of tools in the most efficient way. The integration of experts was achieved through user fora of very different formats, such as continuous, regular and one-time fora, some of them public and some restricted to selected individuals. In detail, the User fora were:

- A Web User Forum

- The Steering Committee

- The Virtual Ship

- A Variety of Use Cases

- A Demonstration site

These approaches to user involvement are explained in detail in Deliverable D08/02 "Final task report". In addition the user fora serve as a basis for validation (WP 09) and a platform for dissemination & exploitation (WP10).

The selection of tools and methods were devoted to achieve solutions at minimum costs for product, adaptation and communication in order to facilitate the exploitation of the results. As far as possible an object oriented approach has been followed to foster IT-supported project work and flexible application of results in practice. For data exchange XML (eXtensible Markup Language) was chosen to provide appropriate solutions, leading to an own development APML (Application Process Markup Language), which is W3C compliant.

3.1.5 Project Assumptions

Defining the aims and the strategy of TELEMAS there are a number of assumptions.

- The primary users of any TELEMAS products are ship commands and shipping companies.

- Surveillance of any ship-related process is a crucial point to ship command and ship owners. TELEMAS can become a versatile tool offering a maximum of this desired supervision to its users, as it can bring together the relevant information/resources and the ability to control and restrict access to it. It should always be pointed out that this "power tool" is transparent to the ship command/owner and completely in their hands. E.g. regarding Remote Services it should be emphasized that no remote *actions* will be allowed without acknowledgement by the ship command and that information retrieved from onboard systems is transparent.

- When adapting the TELEMAS Umbrella Tool (UT) and the related applications the main effort will be on the side of the manufacturers of any systems or subsystems. They will benefit from the UT as a selling argument and a method to administer their products (after sales service, guarantee service, etc.).

- Costs and effort for the Shipping Companies will be as low as possible to enhance the acceptance of TELEMAS. Existing solutions will be identified and used in an appropriate way. This applies also to the following points.

- Using the UT and related TELEMAS applications will be intuitive without need for mandatory training.

- Use of COTS hardware. No additional hardware e.g. for communication purpose will be mandatory.

- Existing workflows won't be altered, but made more transparent by TELEMAS. Data integration and reduction of workload is the aim.

3.1.6 Project Achievements

TELEMAS addresses the following tasks:

- To master the information flood on board, both in situations of technical and administrative nature, the approach of an "individualized information kiosk" was developed.

- The management of ship - shore communication processes with respect to costs, data actuality, data security, and ship safety was implemented by the concept of a "Common Gateway/Interface" for communication management.

- Access to different onboard systems and subsystems will be enabled as well as data exchange between those. The approach of a single point of access for a variety of applications was realized.

These tasks were achieved, both on the conceptual level and the development of software tools. So, the proof of concept was performed at first as a mobile solution, enabling the linkage of the different applications and its appropriate hardware. Secondly, a web server was set up giving the opportunity to test, maintain and demonstrate the developments via the internet.

To handle these rather diverse aspects an integrative data exchange format, which enables interoperability between common solutions of the three categories mentioned above, was developed: APML (Application Process Markup Language). The main properties of APML are:

- XML-based file format (XML schema),

- ASCII format, platform independent,

- Combination of any data with meta data (see above),

- "Wrapping" of any data format in a uniformed way so that other applications can further process them.

The main outcome of TELEMAS that combines these requirements is the Umbrella Tool (UT). It is mainly a thin middleware platform providing a set of services enabling the interconnection of different applications based on web technologies. The main features are that the UT supports the linkage between shipborne and shore based business processes. Besides the control of documents and its distribution the redundant-free storage is enabled (file replication). Furthermore, it supports the information query and access through a concept of operational areas. A browser based User Interface is provided.

The single-point-of-access-functionality enables the user to start applications from the UT used in a vessel. So, the user is provided with a screen from where he can switch between applications instantly. The application integration is not restricted to TELEMAS applications. By offering a common data format unrestricted integration of soft- and hardware is enabled. Therefore, also proprietary systems can be implemented as the specific manufacturer adds a regarding interface to his existing solution. This possibility was achieved by enabling the UT to deal with web services.

The first TELEMAS application is the safety system which consists of hardware and basic software for intelligent fire and gas sensors. It has several supporting functionalities such as status information, simplified onboard maintenance, remote maintenance and remote repair.

The ISM Tool is based on a best practice model supporting quality relevant processes. A set of Web services facilitating the interaction of ISM systems with other applications.

The remote maintenance feature offers a platform for remote access of onboard systems. Aspects of data security have been investigated and specified. Modules for communication and data management were developed and implemented. The aspect of remote access management was realized by installing a central interface giving the ship's command control over any remote session.

A platform for providing, distributing and adapting e-learning content was also developed. Computer Based Training can be built by cooperation of e.g. a shipping company and a company offering e-learning solutions. This content can be distributed to selected vessels or even fleet-wide and can be adapted to the individual needs of the users onboard.

The ASP (Application Service Providing) solution offers a possibility for distributing the content for e-learning as well as for other systems. The idea behind is that due to the information flood on board it is more efficient to keep non-relevant information, needed only rarely, on a centralized server on land. ASP offers a solution to provide information as well as software when needed onboard.

3.1.7 Time Scale

The project started on 01 April 2002 and runs for 25 months, thus ending on 30 April 2004. The original project life time was 24 months and was extended for one additional month.

3.2 Consortium Composition

The consortium was co-ordinated by the Institute of Ship Operation, Sea Transport and Simulation, Prof. Jens Froese and comprised 9 partners, all at the level of contractor as indicated below:

	Participant	Participant short name	Country
CO1	Institute of Ship Operation, Sea Transport and Simulation	ISSUS	Germany
CR2	Consilium A.B.	Consilium	Sweden
CR3	CBT Soft Oy.	CBT Soft	Finland
CR4	Herberg Engineering GmbH	Herberg	Germany
CR5	intermari.net GmbH	inmari	Germany
CR6	Kalmar Maritime Academy	Kalmar	Sweden
CR7	K-NET S.A.	K-NET	Greece
CR8	Teekay Shipping (Glasgow) Ltd.	Teekay	United Kingdom
CR9	Columbia Ship Management Ltd.	CSM	Cyprus

Table 1: Consortium Composition

3.3   Role of Participating Organisations

3.3.1   ISSUS

- Co-ordination and overall project management. Leader of workpackages 08 User Forum and 11 Project Management.

- Technical co-ordination, quality assurance and the Peer Review process for the deliverables. Assistance in dissemination and exploitation.

- Responsible for the preparation of D08/01 "Terms of reference and availability of web tools for the User Forum", D08/02 "Final Task Report", D08/03 "Demonstration", D10/01 "Technological Implementation Plan (TIP)", D11/01 "Final Report".

- Major contributions to D01/01 "Prerequisites for Shipborne Resources and Management and Development Scenarios", D01/02 "Human Computer Interface", D02/01 "Data Standards & Knowledge Base", D05/01 "Tele-Maintenance for Vessels", D09/01 "Draft Validation Plan", D09/02 "Final Validation Plan and D10/02 "Dissemination and Use Plan".

- Internal review of D01/03 "Documentation, Familiarisation and Training Repository", D03/02 "Safety Interface to TELEMAS Umbrella System", D04/02 "ISM Interface to TELEMAS Umbrella System", D05/02 "Maintenance Interface to TELEMAS Umbrella System", D06/02 "e-learning interface to TELEMAS Umbrella System" and D07/02 "ASP Interface to TELEMAS Umbrella System".

- Preparation of the Steering Committee Meetings and the Final Demonstration.

- Attending at consortium meetings.

- Presentation of the project at various events and conferences.

3.3.2   Consilium

- Leader of workpackage 03 Safety.

- Development of hard- and software for integrating intelligent sensors and a Linux based central unit; interface to other systems (e.g. ISM) and functionalities as remote monitoring and predictive maintenance.

- Responsible for the preparation of D03/01 "Safety" and D03/02 "Safety Interface to TELEMAS Umbrella System".

- Participation in the technical workpackages WP 01, 02, 05, 06 and 07.

- Major contribution to development of exploitation strategy.

- Organisation of technical meetings.

- Presentation of the project at various events and fairs.

3.3.3   CBT-Soft

- Leader of workpackages 06 e-learning and 07 Application Service Providing.

- Within WP06 development of a platform for providing, distributing and adapting e-learning content. Within WP07 development of an Application Service Providing solution for distributing the content for e-learning as well for other systems.

- Responsible for the preparation of D06/01 "e-learning in nautical environment", D06/02 "e-learning interface to TELEMAS Umbrella System", D07/01 "ASP for Shipborne Applications" and D07/02 "ASP Interface to TELEMAS Umbrella System".

- Participation in the technical workpackage WP 02.

- Contribution to dissemination and exploitation.

- Organisation of the 1st Steering Committee Meeting.

3.3.4   Herberg Engineering

- Leader of workpackages 01 Resources Management Documentation & Familiarisation and WP 05 Tele-Maintenance.

- Within WP 01 development of the Umbrella Tool, a middleware solution for integrating existing and future software tools. Development of APML, an XML scheme as the common namespace. Within workpackage 05 development of a platform for remote access control of onboard systems.

- Responsible for the preparation of D01/01 "Prerequisites for Shipborne Resources and Management and Development Scenarios", D01/02 "Human Computer Interface", D01/03 "Documentation, Familiarisation and Training Repository", D05/01 "Tele-Maintenance for Vessels", D05/02 "Maintenance Interface to TELEMAS Umbrella System".

- Participation in the technical workpackage WP 02.

- Contribution to dissemination and exploitation. Presentation of the project at various events and fairs.

3.3.5   intermari.net

- Leader of workpackage 02 Data Standards & Knowledge Base.

- Within WP 02 major development of the Umbrella Tool concept and APML.

- Responsible for the preparation of D02/01 "Data Standards & Knowledge Base".

- Participation in the technical workpackages WP 01, 04, 05 and 06.

- Major contribution to the validation process.

- Contribution to dissemination and exploitation. Presentation of the project at various events and fairs.

3.3.6   Kalmar Maritime Academy

- Leader of workpackage 09 Quality Assurance, Assessment and Evaluation.

- Responsible for the preparation of D09/01 "Draft Validation Plan", D09/02 "Final Validation Plan" and D09/03 "Validation Results".

- Assistance in dissemination and exploitation.

- Presentation of the project at various events and conferences.

- Organisation of consortium meetings and validation events.

3.3.7   K-NET

- Leader of workpackages 04 ISM Interface and WP 10 Dissemination & Exploitation

- Within WP 04 development of ISM interface with integration of web services technology.

- Responsible for the preparation of D04/01 "ISM Interface", D04/02 "ISM Interface to TELEMAS Umbrella System", D10/01 "Technological Implementation Plan (TIP)" and D10/02 "Dissemination and Use Plan".

- Participation in the technical workpackages WP 01, 02, and 07.

- Development of an exploitation strategy.

3.3.8   Teekay

- Participation in the technical workpackages WP 01, 02, 04 and 06.

- Input for User Requirements.

- Assistance in dissemination and exploitation.

3.3.9   Columbia Ship Management

- Participation in the technical workpackages WP 01, 03, 04 and 05.

- Input for User Requirements.

- Assistance in dissemination and exploitation.

- Organisation of consortium meeting.

4 Approach

4.1 General Description

TELEMAS is a research and development project aiming at promoting innovative solutions for ship operation. So, the focus was to produce prototype software as well as fundamental concepts leading to exploitable solutions for the maritime society. The overall project objective, i.e. to establish a comprehensive tool to manage shipborne resources and to support vessel - land data exchange, is being mirrored by the workplan structure:

Work-package No.	Workpackage Title	Lead contactor	Start	End
1	Resources Management, Documentation & Familiarisation	Herberg Engineering	Apr. 2002	Jan. 2004
2	Data Standards & Knowledge Base	intermari.net	June 2002	Sept. 2003
3	Safety	Consilium	June 2002	Jan. 2004
4	ISM Interface	K-NET	June 2002	May 2003
5	Tele-Maintenance	Herberg Engineering	July 2002	Jan. 2004
6	e-learning	CBT-Soft	Sept. 2002	Jan. 2004
7	ASP	CBT-Soft	Nov. 2002	Oct. 2003
8	User Forum	ISSUS	Aug. 2002	March 2004
9	Quality Assurance, Assessment & Evaluation	Kalmar	April 2002	March 2004
10	Dissemination & Exploitation	K-NET	Aug. 2002	Feb. 2004
11	Project Management	ISSUS	April 2004	March 2004

Table 2: Overview of workpackages

The Umbrella Tool is the focus of WP01 and WP02 and is the central outcome of the TELEMAS project.

To enable the Umbrella Tool (UT) to communicate with other applications and to ensure the data exchange between the applications themselves, APML (Application Process Markup Language) has been established.

The data exchange through the UT offers the possibility e.g. of form handling and replication which leads to a consistent administration, storage and handling of data. Information can be exchanged between ship and shore (e.g. the shipping company's office) by ensuring a redundant-free data management. Furthermore the UT offers a single point of access.

The TELEMAS application workpackages 03 Safety, 04 ISM Interface, 05 Tele-Maintenanc, 06 e-learning and 07 ASP are developments for enhancing the efficiency and safety onboard, focussing on innovative aspects and technologies. The applications are coupled by different interfaces with the Umbrella Tool giving the user access through one interface allowing also data exchange between the different applications.

The application integration is not restricted to TELEMAS applications. By offering a common data format unrestricted integration of soft- and hardware is enabled. Therefore also proprietary systems can be implemented when the specific manufacturer adds a regarding interface to his existing solution.
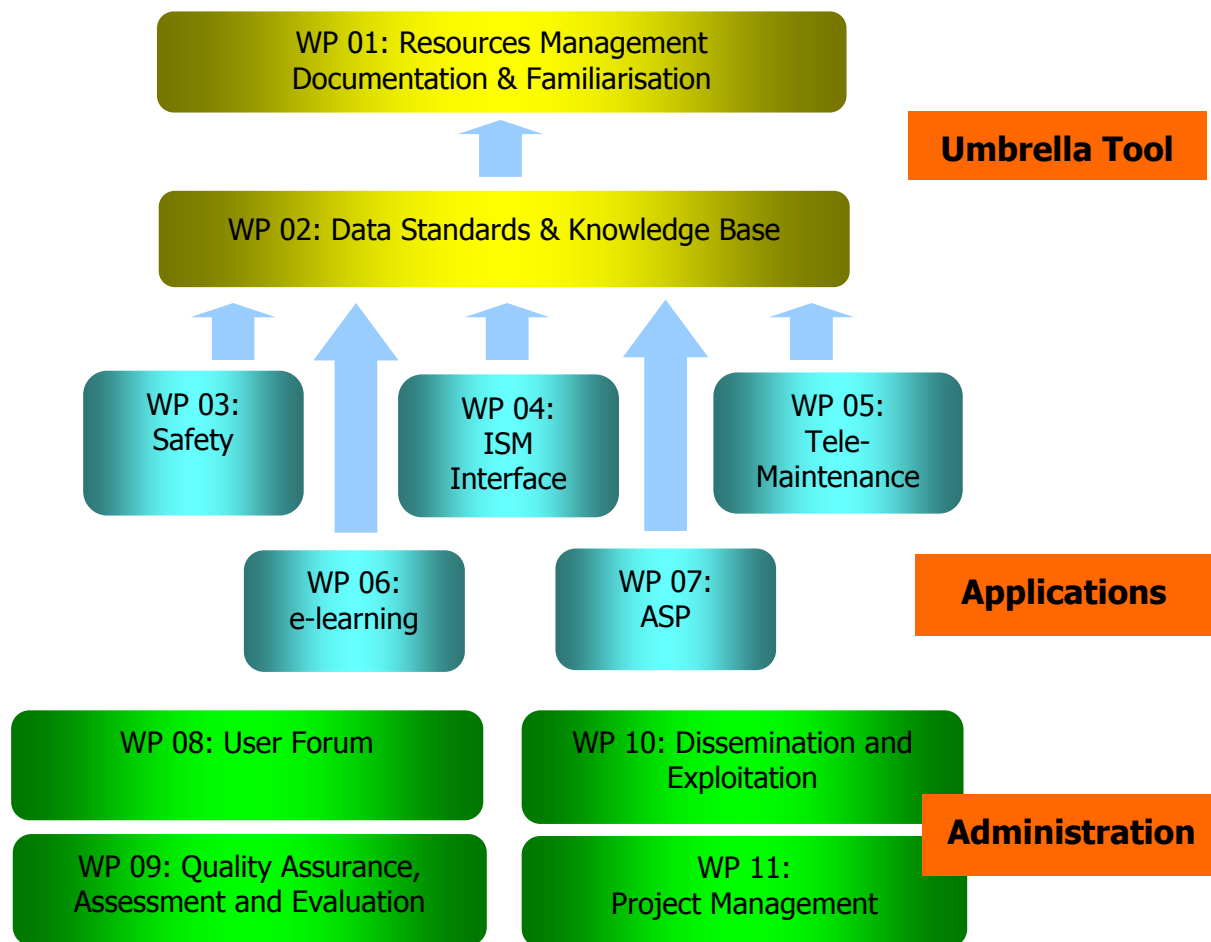
Figure 1: Structure of TELEMAS workpackages

The administrational workpackages 08 User Forum, 09 Quality Assurance, Assessment and Evaluation, 10 Dissemination & Exploitation and 11 Project Management supported the development, assuring that all requirements were met.

A permanent user forum composed by key users from all relevant areas, to continuously work together by e-communication and meet for workshops at defined milestones has been established. The user forum at the same time is an excellent platform for dissemination, thus

both project activities "user involvement" and "dissemination" are combined in one work package, i.e. WP 08 "User Forum & Dissemination".

WP 09 "Quality Assurance & Validation" is organised according to ISO 9001 as an independent WP to establish quality rules for all project work, to audit procedures and to assess results.

WP 10 "Exploitation" provides access to market considerations by an exploitation plan. After having tangible results available from WPs 01 - 07 a concrete programme how to best exploit results is being evaluated.

WP 11 "Project Management" aims at an efficient and stringent project organisation from the consortium and the Commission point of view.

4.2 Advantages of the TELEMAS Approach

The development of the thin layer middleware platform in TELEMAS called UT allows the integration of software tools already in use of the vessels. If integration is not desired because of the costs or difficulties by implementing an interface, the interoperability (the lowest level of integration in the UT) of those software tools with the UT can be realized. The UT handles these software tools as different modules with different levels of integration.

The UT as software tool is easy to handle, the HMI has been developed to be used intuitively as possible. It was conceived based on Microsoft Outlook tool. Therefore normal computing office skills are sufficient to use the UT.

When conceived, the UT and the other software applications took into account the state of the art technology. This has been continuously revised during the development phase. Where possible and available, Commercial-Of-The-Shelve (COTS) tools have been applied (more in chapter 5).

Furthermore common "Operational Areas" aboard where defined to show the functionality of the tool. These operational areas are customizable to avoid changing workflows, as the aim has been to support but not change workflows.

5 Project Results and Achievements

5.1 User Requirements Capture

The user requirements for the overall TELEMAS approach were mainly gained in workpackage 01 and 02 since the Umbrella Tool is the main project's outcome. But also in the individual technical workpackages 03 to 07 user requirements were obtained, both for the specific intended development as well as for the project as such. Furthermore several market surveys were conducted.

The user requirements capture process covered a wide range of users. The main ways of user involvement were the Web User Forum, the Steering Committee, and the results of ongoing discussions of the partners with their customers and within their companies, the TELEMAS website and the cooperation and interaction with other EU co-founded R&D projects / thematic networks.

5.2 Technical Concept

As mentioned in chapter 3.1.6 the central outcome will be the Umbrella Tool building the connection to the applications serving as a thin layered middleware. The Umbrella Tool has to integrate three main functions:

1. Data Exchange: When linked to the UT data between different applications can be exchanged.

2. Integration platform: Integration of existing and future onboard systems from various suppliers and manufacturers.

3. Presentation: The Umbrella Tool is able to process data and displaying formats so that it is accessible and usable for the personnel onboard.

The technology of the Umbrella Tool can be described as follows:

- It is based on wide spread web technology which is state of the art in shore based industry.

- The Umbrella Tool is able to deal with Web Services which is expected to be the most promising standard procedure for data exchange within the next years.

- It combines widely based and well known off-the-shelf-tools to avoid depending on any proprietary solutions.

- It is based on an open architecture as well as on a non-proprietary data format.

- It is extensible in means of future standards or technologies.

TELEMAS Umbrella Tool

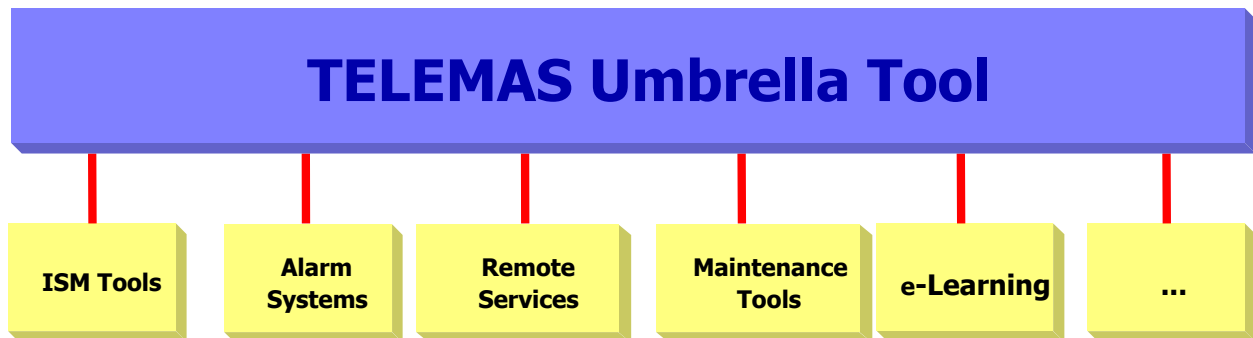| ISM Tools	Alarm Systems	Remote Services	Maintenance Tools	e-Learning	...

Figure 2: The TELEMAS Umbrella Tool and Applications to be integrated

To achieve this openness to deal with all kind of data and systems the TELEMAS consortium developed an open standard XML schema called APML (Application Process Markup Language). The main characteristics of APML are:

- APML is the integral element serving as a link between the functions of Presentation, Integration and Data Exchange.

- The development has already concluded. The next step will be the description and publishing.

- It is an open format which means that manufacturer can design specific interfaces for their products enabling the Umbrella Tool to exchange data.

- APML is a www-consortium compliant XML schema.

- APML offers a common name space. A namespace is a unique name of a collection of defined tasks. Namespaces are used to make unique tags.

- It combines the content of data with a standardized description, meta-data, which offers the opportunity to categorize and administer information to not always wade to big data amounts or cryptic content.

5.3 Functionality Specification

As mentioned in chapter 3.1.6 TELEMAS addresses the following:

- To master the information flood on board by the approach of an "individualized information kiosk", its functionalities are given in sections 5.3.1 to 5.3.3.

- To give a concept of a "Common Gateway/Interface" for communication management, described in sections 5.3.4 to 5.3.8.

- Single point of access for a variety of applications is shown in 5.3.9.

As TELEMAS shall be a multifunctional entity rather than a bundle of independent applications, links and entanglements between the functionalities are intended and an exclusive allocation to one of the two focal points is neither possible nor wanted. However, TELEMAS on the other hand doesn't have to rely on specific applications in order to function properly.

5.3.1 Desktop

The user interface of TELEMAS gives a comprehensive, easy-to-handle overview over the resources available on board of the vessel. The UT shall also assist in retrieving information or updates from shore side, and display them as an integrative part of its resources inventory.

Exemplarily questions are: What can I find where, what has been done regarding maintenance over the last month, which spare part orders are outstanding etc. If a person comes on board today, he has to gather all that information from different locations and different systems. The goal is to make this information available through the UT.

Clearly enough, TELEMAS can't account for all the proprietary solutions in use today. But a reasonable, well considered choice of existing and upcoming standards will allow the integration of a wide range of given and future applications and systems.

5.3.2 Individualized Information

With the UT it is possible to identify a "data request model" towards the individual vessel as well as to the individual ranks, or at a later stage down to the user level. That way the UT is able to filter information available to it appropriately, preventing the user from unnecessary information, which is often the overwhelming majority of a request output. This is achieved by correlating major operational areas with the responsible persons affected by the different procedures.

5.3.3 Business Process Manager

Specific business processes or procedures recur regularly, e.g. if a certain spare part is needed a request form has to be filled in and sent to the office or the engine data extract is transmitted every month.

Here the UT can be two things. It can be a repository of business processes and procedures, providing instructions and related forms and documents, thus acting as an information terminal. From this aspect it is closely related to the desktop functionality.

The second function is the (form) data exchange with the office in order to support these processes.

5.3.4 Communication Management

To keep communication costs low the UT has to find a suitable solution to route communication. Until today there are several solutions for least cost routing by choosing the cheapest provider by a static scheme. Another approach is to make exclusive agreements with selected providers to obtain a certain discount.

The UT is supporting an approach to do a qualitative categorization of data for an effective bearer management. This categorization depends on the content to be transferred based on business process modeling.

5.3.5 Information Management - Using File Replication for Ship-Shore Communication

Replication can be used for checking if the valid/actual documents are in respective directories onboard/ashore. The aim is to not exchange whole directories every time a few bytes have changed.

On the shore side, for example the Superintendent can define a directory, whose contents are recursively mirrored onboard and vice versa for the ship command. These directories can be used to implement communication queues. Due to the fact that it is important to reduce communication costs, there must be no constraint on how the information is passed. Additionally, the update mechanism must ensure the minimization of patches to bring files up to date. So for example the initial exchange might be done using a 1:1 copy on a CD. For the further exchanges a small daily update of a log file should be compressed and send via satellite.

5.3.6 Data Security

Data security is an issue of increasing importance. Rising data exchange by a growing number of involved persons or institutions offers the possibility of attacks by spying on confidential information or jeopardizing the safety on board by generating failures (e.g. by viruses).

First of all the UT and the supported workflows which are specific and defined by the customer have to fit in a general data security strategy. In the second stage firewall functionality is intended to prevent the network on board from non authorized access.

The TELEMAS approach is supporting this issue by making workflows more transparent and offering data encryption.

5.3.7 Common Gateway/Interface for Remote Monitoring

This functionality of the UT assumes that more and more manufacturers of marine equipment have implemented functionalities that allow them to monitor their equipment from the shore. These functions will help both, the shipping companies and the manufacturers to safe money and time. Service engineers can come on board, already prepared to do their job by having the correct spare parts on hand. The ship command can also save time through instructions by shore based experts.

5.3.8 Administration of Different Remote Logins

In order to control the access of manufacturers to the vessel, systems are necessary that allow the responsible person on board to deal with such access enquiries. The problematic becomes even clearer if not one but maybe dozens of manufacturers want the permit to access. Until today there are only some manufacturers who offer a solution for their own system. That would mean that there would be a number of different systems and procedures with a number of manufacturers.

5.3.9 Running Different Applications from the UT

In order to provide a single point of access the user shall be able to start applications from the UT. In this case the UT will only function as a starting engine for different applications being used in a vessel. The intention here is to provide the user with a screen from where he can switch between applications instantly e. g. CBT-Software, ISM Tools.

5.4 Technical Specification

During the draft of use cases for the TELEMAS project it became evident that a powerful data exchange format is necessary to satisfy all addressed scenarios.

There are a number of well-known data formats already available in the maritime and IT industry designed to fulfill a given set of tasks, however, none of these completely encompasses the functionality needed.

Here is a set of requirements for the data exchange format:

- It must be very easy to extend the data format (open standard)

- It should be possible to import / include existing data standards

- There should be a broad range of software tools available

- The data format should be easy to understand

- The data format should cover all use cases

Technical problems in the maritime environment were considered during the development of the tools. Briefly it could be said that the bandwidth limitations in communication are still a problem for any devices requiring communication with shore based systems. The products offered by providers are solving the problem, but it will take some time till it reaches the majority of vessels addressed by TELEMAS. Therefore, the file replication was based on meta data to minimize the amount of transferred data.

The integration of different systems onboard is a good example for a matter which can be very problematic as many system providers use their proprietary formats to handle data in their systems. Therefore, there are different levels of integration within the UT.

The TELEMAS approach has been to define a data standard, which was called APML, encapsulating access to external resources, for example Relational Database Management Systems, such as Sybase (AMOS), which had been chosen for the realization of the demonstration during the meeting in Kalmar. In connection with database access APML acts as a wrapper that allows vendor-independent database access

The data format only describes the content, not the communication. We are however aware that some of the elements within the data format imply an abstract protocol. However, the data format places no restraints on how the data are transmitted and what kind of software tools deal with the data

The file replication in TELEMAS will lead to a redundant free storage of information. The UT aboard replicates only meta data for example to an UT ashore or vice versa. Only on demand further data is transmitted.

The UT is also conceived to be flexible regarding the processes onboard, as every vessel has specific processes. The tool has some exemplary operational areas, which are customizable,

and in combination with the Task Engine of the UT those processes onboard can be described or represented.

Moreover, as there are rank specifications in the maritime environment, for a better account management TELEMAS Umbrella tool includes an identification requirement for each user.

5.5 Architecture

The Umbrella Tool as the linking entity of TELEMAS consists of a number of logical (abstract) components: The user interface (HMI), a web server and a data model.

The following diagram shows a simplified overview of the UT architecture. It is very important to point out that the UT only serves as a shell for the data within the data storage, the embedded applications and data handling capabilities. Except for a few basic functions (e.g. the presentation layer or the communication between the layers) the UT has no functionality of its own.
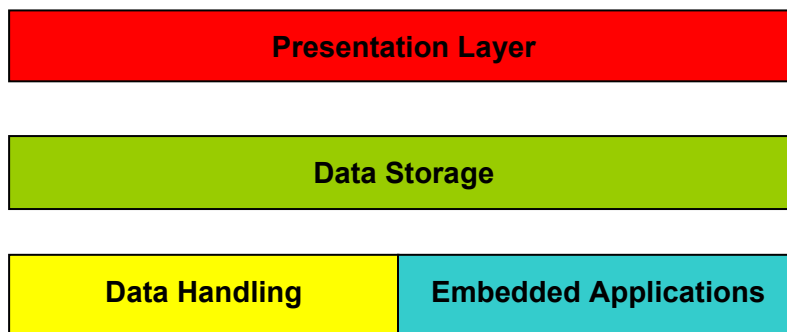
Presentation Layer

Data Storage

Data Handling	Embedded Applications

Figure 3: General Architectural Overview

Presentation Layer

The purpose of the presentation layer is to show the contents of the UT to the user via the HMI. Each presented element is associated with meta data, that may modify the elements appearance (e.g. user permissions, priority levels) or may induce the display of additional GUI (graphical user interface) components like buttons (e.g. add a „retrieve file" button to a remote data element). The GUI also allows the user to filter the display according to the meta-data.

Data elements can be of these categories:

- Static elements: e.g. manuals, text, reports, and other static document data.

- Imported/linked applications: Frontends and GUIs of external applications can be imported in the UT if they are webbased. Example: Java Applets, Flash programs.

- Database access: Database access is limited to predefined queries that retrieve information that the user needs to access frequently. This can be viewed as „shortcuts" for fast information gathering.

- Application messages: These messages can be either directed to other applications (UT acting as a gateway) or to the UT itself (e.g. alarm messages, continuous temperature readings or automatically generated status reports).

Data Storage

The data storage has been designed as a simple file system tree that holds all relevant information. The data storage is organized through the operational areas. It does not include the scripts and programs necessary to run the presentation layer. The data storage can be automatically generated from a XML document that defines the operational areas.

Operations on the data storage:

- Providing data elements along with the meta-data (read access).

- Adding / deleting / modifying data elements and meta-data (write access).

Data Handling

The data handling system consists of a series of programs that run in the background ("daemons") and act as the primary interface of the UT. They do not have a user interface. These programs were designed to exchange the standardized APML data packages with external applications or other UT installations.

Embedded Applications

In the UT embedded applications are not self-running programs but rather plug-ins into the UT itself that provide additional functionality. These are not stand-alone applications.

5.6 Interfacing

5.6.1 Human Machine Interface

The TELEMAS Human Machine Interface (HMI) is described in deliverable D01/02. There the current state of the art of interface design has been evaluated by analyzing norms, guidelines and recommendations for commercial and open-source software projects, as well as for web development. The findings where categorized in principles (of user interface design) and recommendations on HMI design. The requirements and special conditions for ship borne user interfaces have been collected to refer to the crew, physical conditions, special hardware etc.

As a maritime environment project, the TELEMAS umbrella tool is designed with default blue color. Respecting the HCI and HMI specifications, the user may change the color (Blue – Green – Brown - Red).

The interface design is similar to the Microsoft Office tool Outlook taking into account shipborne requirements if it is meaningful and has been developed considering general HCI requirements and principles. This is illustrated in Figure 4.
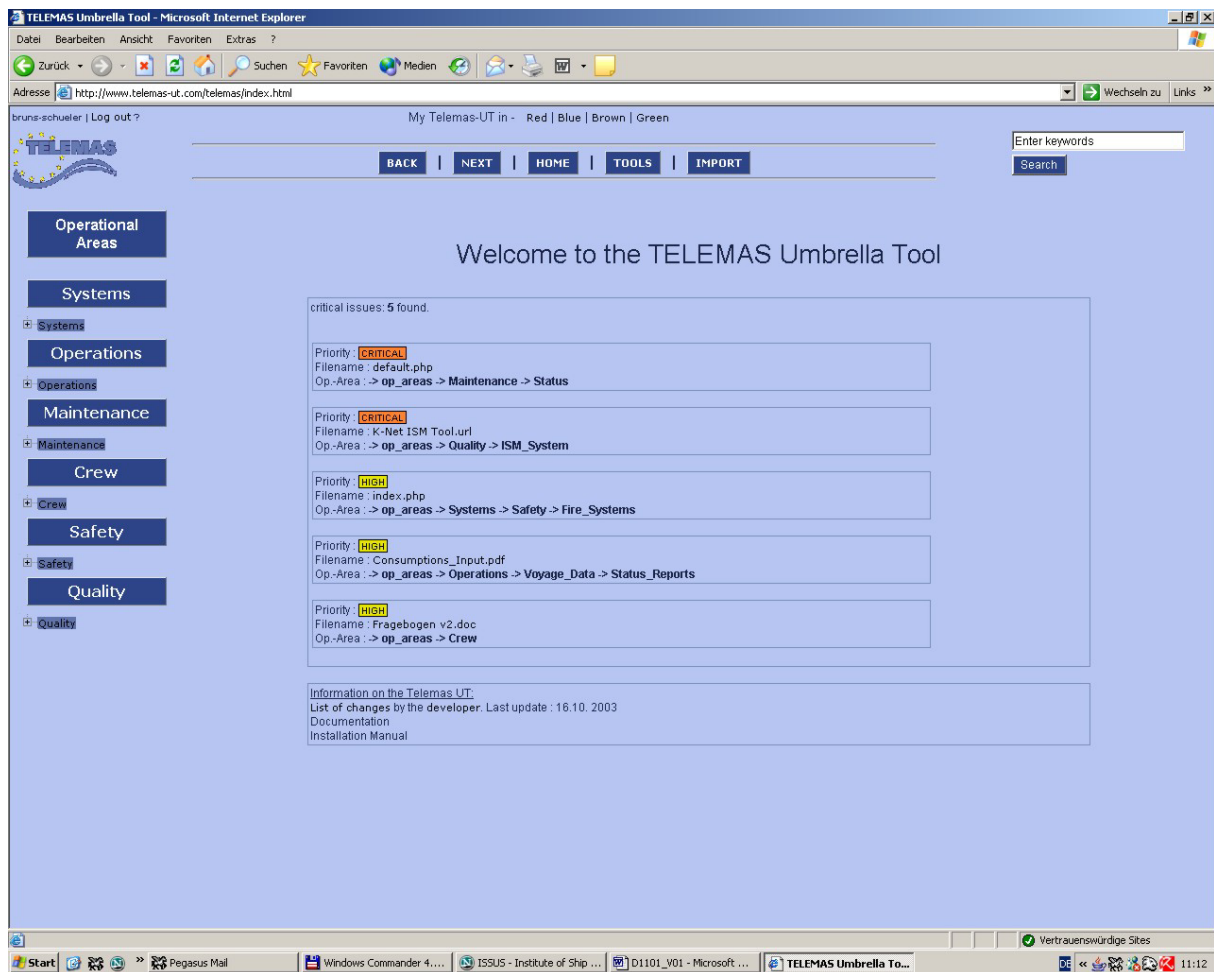
Figure 4: Screenshot of the TELEMAS Umbrella Tool

The tool consists of three main frames.

The Top frame (Status) includes a menu bar with the following functionalities:

- User identification and logout option

- Back and next button

- Color choice

- Search option on the available documents

- A menu tool in which it is possible to re-index the search engine.

The left frame (Tasks) is composed of operational areas, through which the user can browse.

A collapsing /expanding menu is used for easier navigation through this rich and wide menu.

Clicking on a task or in one of the status frame functionalities, shows the results in the main frame.

5.6.2 Interface to Applications

Since the Umbrella Tool is based on web technologies several solutions to interface applications exist. Technically this was achieved mainly by using XML and the TELEMAS development APML as well as Web Services.

Three ways of interfacing applications were implemented: embedded, interfaced and linked.

Embedded applications are implemented and are part of the Umbrella Tool software code. They are running in the background or are accessible by buttons of the tool bar. The following list gives examples of the possibilities that exist for the UT in the future. It is important to note that each of these applications can be replaced by a version that is of maximum benefit for the specific customer.

- Task Engine: handles simple tasks by linking static data elements to form a task.

- Form Handling: If a static data element is marked as a form during the import of data, the presentation layer adds the option to fill out the form and to review the form history.

- File Replication: Allows files to be mirrored between two different UT instances (e.g. a ship and the shore office).

- Remote Service Control: Allows the user of the UT to determine the state of a remote maintenance application.

- Full Text Search Engine: Simple search engine that allows searching for local documents.

- Database Queries: For demonstration purposes a query with an AMOS database was realized resulting in information on due/overdue maintenance.

Interfaced applications are separate tools or independent software products which are displayed in the main frame of the Umbrella Tool. These are especially:

- CBT Soft e-learning platform: scriptwriting tool for developing and adapting individual Computer Based Trainings (CBT); learning management system as distribution and control platform for e-leaning contents.

- TeeKay e-Learning Content: various CBT applications for different ranks and skills.

- Consilium Safety Application: control screen to monitor and maintain safety related hardware such as intelligent fire and gas detectors.

- Herberg Engineering REMAX Monitoring Application: system to monitor and maintain automation and control systems.

Furthermore, linked applications are accessible, opening appropriate tools e.g. in the main frame of the browser window. The linkage is mainly realised through Web Services e.g.

- K-Net ISM Tool iBOS: web based ISM application that allows automatic data exchange with other applications by use of Web Services.

- CBT-Soft ASP Solution: tool for providing information, data or software on request.

- Further external Resources, e.g. through Web Services

5.7 Standards

Since the Umbrella Tool is functioning as an integration broker for implementing all sorts of maritime hard- and software no further recommendations for standardisation in this field are made. The TELEMAS approach enables all manufacturers to adapt their products and tools so that it is possible to interface with the Umbrella Tool e.g. by usage of Web Services.

The aspects of standardisation are especially described in the deliverable D 02/01 "Data Standards & Knowledge Base".

In summary, one can say that XML has become the leading standard for data exchange on the internet and on intranets in enterprises and in many other structures. Different approaches have been proposed to efficiently manage, store, query, and present XML data from diverse sources (database, office document, html file, etc.)

The TELEMAS approach is to define a data standard called APML (Application Process Markup Language), which encapsulates access, to external resources. In connection with a database, APML acts as a wrapper that allows vendor-independent database access (s. also chapter 3.1.6).

On the sector of application integration as basis for further development mainly three technological approaches can be seen:

- Powerful, easy to use and inexpensive standards for exchange of information. The most prominent example is XML.

- Platform independent software based on the technology of "virtual machines". Java and Microsoft's .NET framework will share the market in the future.

- Worldwide exchange of platform independent software components like e.g. EJBs or Web Services.

Another standard worth mentioning which was adapted is the SFI-Group System code which is formally used to classify the installations on a vessel. It allows to filter and group data, and most important, produce statistic reports. It is logically constructed as a 3-digit decimal classification code covering all functions included in ship or rig operation.

5.8 Development of Software Tools

The TELEMAS software tools developed were:

- The TELEMAS Umbrella Tool: a thin middleware platform providing a set of services enabling the interconnection of different applications based on web technologies; developed within workpackages 01 and 02, described in deliverable D01/03,

- The Safety Interface to TELEMAS Umbrella System: software to maintain intelligent fire and gas sensors. It has several supporting functionalities such as status information, simplified onboard maintenance, remote maintenance and remote repair; developed within workpackage 03, described in deliverable D03/02,

- The ISM Interface to TELEMAS Umbrella System: developed within workpackage 04 described in deliverable D004/02,

- The Maintenance Interface to TELEMAS Umbrella System: platform for remote access of onboard systems by installing a central interface giving the ship's command control

over any remote session; developed within workpackage 05, described in deliverable D05/02,

- The e-learning Interface to TELEMAS Umbrella System: platform for providing, distributing and adapting e-learning content; developed within workpackage 06, described in deliverable D06/02,

- The ASP Interface to TELEMAS Umbrella System: developed within workpackage 07, platform for distributing information, data as well as software when needed onboard by making an inquiry at a central based server; described in deliverable D07/02.

Due to the modular, non-proprietary approach and the use of APML, web technologies and web services, the tools can be interfaced but also work independently with other platforms.

5.9 Demonstration

A public demonstration of the TELEMAS concept was given in February 24th, 2004, at ISSUS in Hamburg. Intention of the demonstration was to achieve feedback of the potential users as well as dissemination of the concept.

The event was announced in local and trade medias, and more than 50 participants joined the demonstration and subsequent discussion. The auditory were representatives of shipping companies, ship management companies, maritime associations (pilots, shipmasters), charter companies, maritime consultants, suppliers, vendors, and communication providers.

In the subsequent discussion (speakers and auditory) the following topics arose:

- Existing solutions of the different shipping companies, related to TELEMAS

- Integration facilities of TELEMAS

- Standardization vs. proprietary solutions

- Availability of the Umbrella Tool as a product

- On board testing

- File Replication / Bandwidth

- Meta Data

- Extension to other areas, e.g. pilot support

- Document management

- Integrability of existing IT-solutions

- Workflows

- Safety, ISPS Code

The overall feedback was markedly positive and the participants showed high interest to receive further information of the progress of the project.

5.10 Validation of the TELEMAS Concept

The validation method as described in the first stage of the project has been enhanced. It was stated that the statistical approach ("compliance assessment") which was foreseen in

the Deliverable D09/01 "Draft Validation Plan" is not the appropriate approach to evaluate the TELEMAS outcome. To get the most usable results the methods of performing individual qualitative interviews was developed within D09/02 "Final Validation Plan". The results and the analysis is given in the Deliverable D09/03 "Validation Results".

A Pre-Validation at the Kalmar Maritime Academy took place proving the original validation concept with students and lecturers. An introduction to the main TELEMAS developments was given which was surveyed and evaluated by the attendees.

Even though the results were positive the consortium decided to change to a more qualitative method. It was realised that any further validation had to be directed towards experienced persons with more seafaring background, preferably from senior positions or to persons with experience from management level in shipping companies or other organizations within the shipping community.

Since TELEMAS addresses very experienced maritime users it was not possible to guarantee that enough experts could be involved in the original validation process. To gain meaningful statistical results, at least a number of 30 persons, would have had to join the evaluation procedure under the same conditions. This seemed not to be feasible within the maritime environment since the users and stakeholders addressed by TELEMAS are normally travelling a lot, are short in time and working abroad.

Furthermore it is very important and valuable to gain a qualitative feedback by the involved experts. So the Final Validation procedure was performed through 18 individual interviews of experienced seafarers by six TELEMAS partners. The interview method was chosen although it differs from the original validation plan as described in the Draft Validation Plan. The consortium realised that only a qualitative assessment method is suitable for the TELEMAS project leading to meaningful validation results.

Since the approach of TELEMAS is very complex and lead to 18 exploitable results, the subject of the validation procedure focussed on the Umbrella Tool as the central outcome linking the other developments. The aim was to focus on the user's interaction and the intended benefits and not to distract the experts with technical details.

The interviewed persons became an introduction to the Umbrella Tool and were faced with the web based version of it. A predefined set of questions were asked allowing the interview partners to give qualitative statements instead of measurable and categorised ratings. Following these approach, appreciations were gained which allow only few statistical statements.

One can say that the given assessment was rather positive, underlining the relevance of the Umbrella Tool approach and the TELEMAS project in general. The majority considered the UT to be a useful tool onboard almost any vessel. There is a consensus that the work onboard can be eased and made more efficient, although a variety of further suggestions and propositions for enhancements came up.

The usage of the Umbrella Tool seems to fit to ship operation tasks and is in line with the onboard procedures. The answers to some questions made obvious that further testing is desired e.g. when looking at possible effects on safety or costs.

At large the TELEMAS goals and the overall project's approach have been validated. When looking at the specific objectives such a general statement is difficult to give, since the interview partners had to some extend very diverse appraisals. But it is obvious that the

TELEMAS applications are up-to-date and considered as important, especially tools which are related to any data exchange from ship to shore and vice versa.

The validation procedure gave valuable statements for further research and development activities as well as for the exploitation of resulting products of the project.

5.11 Dissemination and Concertation Activities

During the project one brochure was produced during the early stages to raise awareness in the maritime community.

An active programme of papers, presentations and representation at potential technology transfer events was pursued as shown in the following table.

Date	Event	Number of persons attended + other information
12.04.02	SWAN Meeting in Paris	20
24. to 25.09.02	SWAN workshop in Hamburg	30
August 2002	TELEMAS related article in "thedigitalship"	
24. to 28.09.02	SMM 2002 fair in Hamburg	presentation of TELEMAS at ISSUS and Consilium stand
27.09.2002	Launch of the Web User Forum	
04. to 06.11.02	Congress on Maritime Technological Innovations and Research in Bilbao	60
March 2003	Article about the project in the CESMA newsletter	
24.01.03	MISTIC workshop	30
11 to 12.02.03	CBT@Sea conference	
05.05.03	KONBIN '03 Conference	40
May 2003	Publishing of the TELEMAS presentation of the KonBin 2003 in conference proceedings, Gdynia	
05 to 06.05.03	SWAN Workshop in Barcelona	30
27 to 30.05.03	KonBin 2003 Conference, Gdynia	200
03 to 06.06.03	Nor Shipping, Oslo	presentation of TELEMAS at Consilium stand
07.11.03	SWAN workshop in Piraeus	40
24.02.2004	Final Demonstration in Hamburg	25

Table 3: Dissemination Events

Furthermore the results and developments of other European projects as EPDIS, ARETOPS, ATOMOS IV, COMMAN, DISC II, IDES, ISIS, ITEA-DS, MANATEE, MARINET, MISTIC, OPTINAV, PISCES, SHIDESS, TeleSHIPping and MARITECH among others have been discussed and analyzed when conceiving the UT and its applications.

To fulfil the aim of using state of the art technology market surveys regarding the application workpackages were realized. The results can be found in the deliverables corresponding to the applications.

5.12 Exploitation & Implementation

The TELEMAS approach has a number of results which can be applied in marketable products (see table below). As the tool is a proof of concept, the cost benefit analysis was discarded at the change of validation approach. The consortium partners Columbia Ship Management and Herberg Engineering are working on the implementation of the Umbrella Tool, the central outcome of the project, and APML, the data exchange format, onboard of a few vessels as well as land operating stations. Further exploitations activities in this matter are expected.

No	Self-descriptive title of the result	Category*	Partner owning the result & involved in their further use
1	DESIGN SOLUTION FOR INTELLIGENT SENSORS (SALWICO OAP130)	B	Consilium A.B.
2	FAULT TOLERANT CENTRAL UNIT FOR SAFETY APPLICATIONS (SALWICO CS4000)	B	Consilium A.B.
3	Object Database Handler for Safety Management Solutions (SALWICO SMS)	B	Consilium A.B.
4	INSTALLATION AND COMMISSIONING SUPPORT CONCEPT	B	Consilium A.B.
5	REMOTE MAINTENANCE CONCEPT FOR SAFETY SYSTEMS	B	Consilium A.B.
6	LAND BASED SAFETY CENTER CONCEPT	B	Consilium A.B.
7	Manuscript – Online script development tool	B	CBT-Soft Oy
8	Telemas PPT add-on - Course development & publishing Power Point Add-on	B	CBT-Soft Oy
9	iCompas - Learning Management System	B	CBT-Soft Oy
10	Administration and delivery process and tool for Manuals and E-learning courses	B	CBT-Soft Oy

No	Self-descriptive title of the result	Category*	Partner owning the result & involved in their further use
11	„Umbrella Tool" – User Interface and middleware	A	Herberg Engineering GmbH
12	Umbrella Tool Data Handling – APML data management implementation	B	Herberg Engineering GmbH
13	Remote Maintenance Application and Software Interface to the Umbrella Tool	B	Herberg Engineering GmbH
14	ASP Form Management Concept	B	Intermari.net GmbH
15	SEABOS.ISM: ISM Web Services and ASP Services	B	K-NET SA

A: Externally usable results; B: Internally usable results; C: Non-usable results

Table 4: Results as described in the Technological Implementation Plan

5.13 Expected Benefits and Added Value

Technically the outcome of the project can be subsumed as follows. TELEMAS offers:

- A strategy and technical concept for integration of existing and future proprietary systems onboard
- The possibility of increased remote access from land of onboard systems under the control of the ship's command.
- Integration of third party services onboard
- Remote database queries
- Ship-shore file replication
- Data communication between applications through the UT
- Queuing and forwarding of messages
- Reduction of transmission costs through meta data exchange only
- One single format for data exchange by APML
- Information and documents on demand through ASP
- Platform independent web based system, realized e.g. internet/intranet service
- Ship-shore data integration and vice versa
- Design solution for intelligent fire and gas sensors, central unit, related object database, remote maintenance and support solution
- E-learning development and distribution tool as a tailor made maritime distance learning system

- ISM tool bases on Web Services and ASP services.

5.14 Contribution to European Interest

5.14.1 Community Added Value and Contribution to EU Policies

TELEMAS has a share in increasing safety and efficiency in intelligent transport systems through investigation, research and development in order to make advanced technologies available to the shipping community and to introduce ambient intelligence concepts into IST based systems through the thin UT middleware (Umbrella Tool) for the use onboard as well as on land. As a result the knowledge of vessels, shipping companies, equipment manufacturers, software producers and distributors, consultants and universities are linked in a more efficient way and hence will be more competitive.

The TELEMAS project integrates different states of the art and future technologies from diverse on- and off-shore applications using mainly COTS products. The attempt of a Europe-wide research and development is an essential approach to deal with coherences originated by globalisation.

One indicator for the globalised trend is the lack of accepted standards within the maritime hard- and software industry. The current situation is characterized by competition and incompatible data formats and specifications of interfaces resulting in proprietary systems cumbersome to handle by users. The development of accepted and extensible standards for maintenance and management for land based and shipborne systems is faced by TELEMAS by introducing the developed APML format and the Umbrella Tool that allows the interoperability of different systems exchanging their different data formats "wrapped" with the APML format.

On the other hand conventions such as SOLAS (Safety Of Lives at Sea) or the ISM (International Safety Management) code are valid world wide and harmonised with the European law. TELEMAS takes this into account and provides an approach to transfer these regulations to evolving technologies within the maritime industry.

5.14.2 Contribution to Community Social Objectives

TELEMAS provides the interfaces for much better access to information sources aboard and ashore in order to not only better meet operational requirements, but also to foster individual development through distant education, culture and leisure. European seafarers do not usually stay aboard vessels for very long periods. So the TELEMAS approach is to offer them flexible further education programmes well suited to their needs, to preserve the public investments for their initial education and training and exploit it in shipping and transport related areas ashore.

Besides all interests in the development of a marketable product, the TELEMAS approach clearly contributes to reducing the deprivation of information that seafarer's experience, thereby avoiding their increased exclusion and also making this profession more attractive for Europeans. Having a kind of redundant free knowledge base of the vessel ashore (e.g. through file replication) helps the different users and stakeholders to do their duties faster

and in accurate manner such as maritime administrations, pilot organisations and classification societies etc.

The TELEMAS project contributes to improve safety within the waterborne transport sector because experience, training and education besides of appropriate working conditions are the most important factors to avoid human errors.

A more efficient use of technology also helps preventing casualties by improving the state of maintenance or by better linkage of safety related software. Another impact is the specific use of resources e.g. by predictive maintenance.

6 Deliverables and other Output

6.1 Deliverables

The deliverables produced within the project were as shown below:

Deliverable Name	Code	Type*	Security**	Delivery month
Prerequisites for Shipborne Resources Management and development Scenarios	**D 01/01**	R	Pu.	10
Human Computer Interface	**D 01/02**	R	Pu.	16
Documentation, Familiarisation and Training Repository	**D 01/03**	S	Rest.	22
Data Standards & Knowledge Base	**D 02/01**	R	Pu.	18
Safety	**D 03/01**	R	Pu.	10
Safety Interface to TELEMAS Umbrella System	**D 03/02**	S	Rest.	22
ISM-Interface	**D 04/01**	R	Pu.	05
ISM Interface to TELEMAS Umbrella System	**D 04/02**	S	Rest.	22
Tele-Maintenance for Vessels	**D 05/01**	R	Pu.	18
Maintenance Interface to TELEMAS Umbrella System	**D 05/02**	S	Rest.	21
E-learning in nautical environment	**D 06/01**	R	Pu.	19
E-Learning Interface to TELEMAS Umbrella System	**D 06/02**	S	Rest.	22
ASP for Shipborne Applications	**D 07/01**	R	Pu.	18
ASP Interface to TELEMAS Umbrella System	**D 07/02**	S	Rest.	22
Terms of reference and availability of web tools for the User Forum	**D 08/01**	R	Pu.	06
Final Task Report	**D 08/02**	R	Pu.	23
Demonstration	**D 08/03**	D	Pu.	23

Deliverable Name	Code	Type*	Security**	Delivery month
Draft Validation Plan	**D 09/01**	R	Pu.	07
Final Validation Plan	**D 09/02**	R	Pu.	22
Validation Results	**D 09/03**	R	Pu.	23
Technological Implementation Plan	**D 10/01**	R	Rest. /Pu.	23
Dissemination and Use Plan	**D 10/02**	R	Pu.	07
Final Report	**D 11/01**	R	Pu.	23

Table 5: TELEMAS Deliverables

Key: *: R: Report; S: Software; D: Demonstration

   **: Pu.: Public; Rest.: Restricted (Commission and Consortium members only)

6.2 Other Project Output

Other output produced within the project included:

- The project Fact Sheet
- The Project Brochure
- The Quality Assurance Manual
- The Project Management Manual
- Quarterly Management Reports
- Periodic Reports
- Reports (in CD form) for two Annual Reviews
- Three Cost Statements

Furthermore, a final CD-Rom will be delivered after the project lifetime to disseminate the TELEMAS project concept and its results to the maritime public.

7 Project Management and Co-ordination Aspects

7.1 General

Project Management and Co-ordination were undertaken by the Institute of Ship Operation, Sea Transport and Simulation (ISSUS). Overall co-ordination was exercised by Prof. Jens Froese and he was assisted in the daily project management by Mr. Karsten Bruns-Schüler and to a considerable extent by Mr. Angel León and Mrs. Antonia Franke-Wiekhorst. With nine partners from six different European countries it was clear that the majority of business would have to be conducted by e-mail. The necessesity of concertated meetings was realised but it was agreed from the outset that these should be kept to a minimum and be combined with other events wherever possible. So, the overall number of consortium meetings was six. Furthermore, various technical meetings were held between two or more partners mainly to discuss technical issues and to align development activities.

7.2 Quality Assurance

The Quality Assurance was undertaken by the Kalmar Maritime Academy, exercised by Mr. Christer Bergquist. Based on the Quality Assurance Manual of the project plan it was mainly the task to track completion of deliverables and to put necessary pressure on partners being late in finalizing their contractual obligations. This was done in close cooperation with the project management.

7.3 Finances

Financial management was controlled by ISSUS, with the whole money being received and paid from its account. Since the majority of project partners participated in EU co-founded projects for the first time, a considerable effort had to be spent on explaining and assisting in financial questions.

All Deliverables indicated as reports were undertaken a Peer Review process.

To support the institution of the Steering Committee travel expenditures were covered from those experts who weren't able to charge their company or organisation for these costs.

The processing of the second Cost Statement was done in two separate rows. Since some partners were delayed, the EU commission decided to treat the Cost Statements of the partners which submitted their documents in time separately. The delayed partners had to wait for their payments until the submission of the Final Cost Statements.

Three Cost Statements were submitted during the course of the project but the processing of the final Cost Statement was not helped by the fact that, at the time of its presentation, the result of the second statement was not known by all partners.

7.4 Project Infrastructure

The delivered management and quality plans were amended by templates for all written project deliverables. A website http://telemas.de was set up and maintained throughout the project. This had both public and consortium-only sections. The latter contains a part called "procedures and guidelines" which provides all necessary templates, guidelines, contractual documents, etc (s. Figure 5).

For testing, demonstration and interfacing purpose a dedicated server was installed ("Virtual Ship") where all major software developments of the partners were installed.
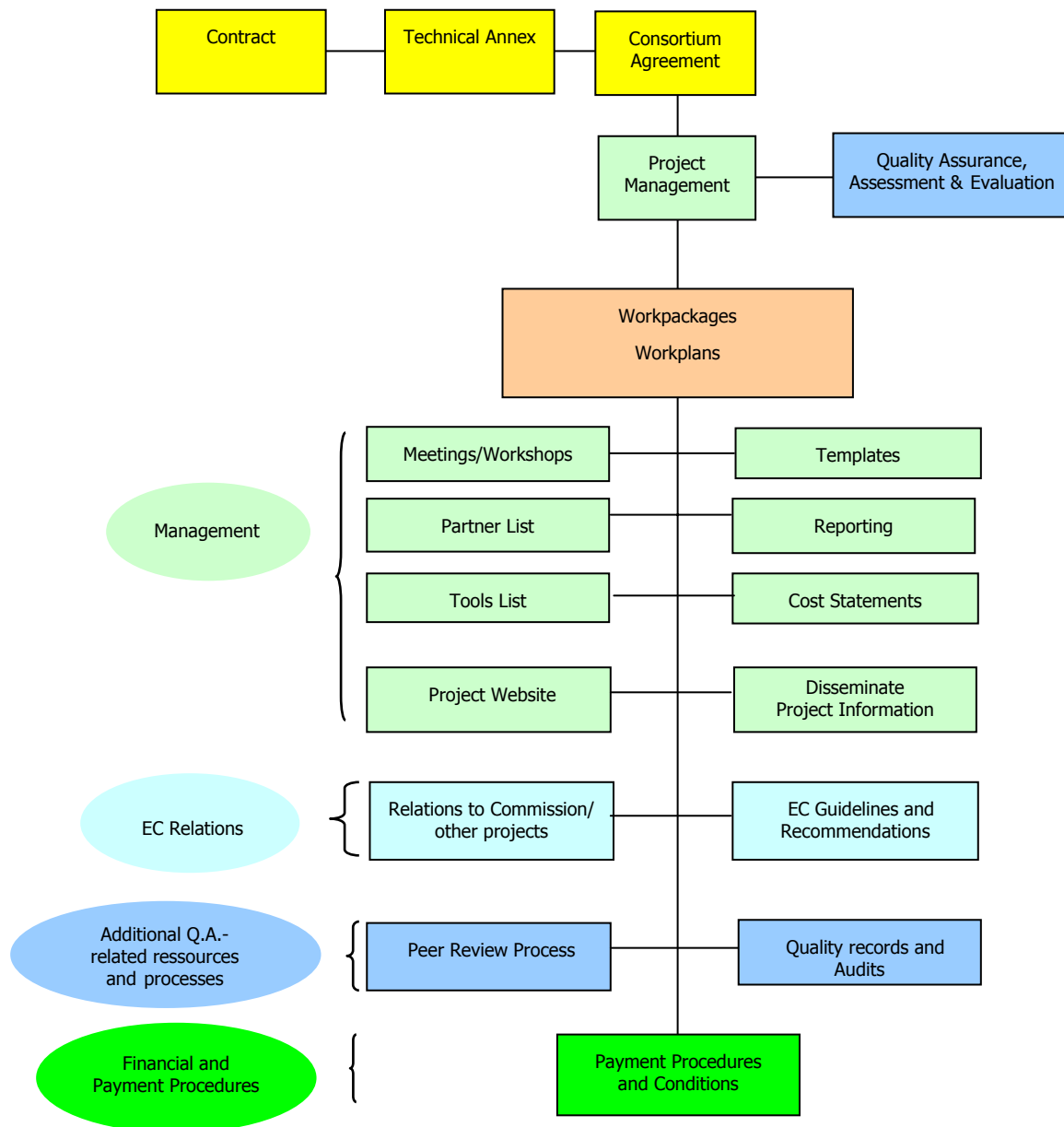
Figure 5: Online Archive for Project Procedures and Guidelines

7.5 Contract Amendment

Two contract amendments were submitted:

The first contract amendment was due to changes of details of the coordinator ISSUS. The official name of the head organisation changed from "Fachhochschule Hamburg" to "Hochschule für Angewandte Wissenschaften Hamburg" which coincided with the change of the postal address and the bank account.

The second contract amendment was also submitted due to further organisational changes of details of the coordinator ISSUS. The entire research unit of ISSUS has been integrated into the Technical University of Hamburg-Harburg. Commencing 01 April 2004, the Technical University Hamburg-Harburg is responsible for the research activities regarding the TELEMAS project with all methods and conduct of business as well as location remaining unchanged.

7.6 Project Extension

Due to the second contract amendment and also to finalise minor parts of the remaining administrative contractual obligations, the coordinator ISSUS, in agreement with the whole consortium, asked for an extension of the project for one additional month. Therefore, the project concludes 30 April 2004.

7.7 Administrative Barriers

During the project lifetime several minor concerns occurred on administrative level but were all solved without further impacts for the progress of the project.

Two contract amendments had to be performed. This lead to additional work and pressure for the project management since it the payments for the partners had not to be delayed. For most efficient handling all partners gave mandates to the coordinator to sign the contract amendment on their behalf.

In the beginning of the project communication between the project partners was sometimes difficult due to minor knowledge of other partners' responsibilities and changes of personnel assignment. To overcome those difficulties the internal area of the project website was established and a mailing list was setup to distribute emails to the whole consortium when sent to one central email address. Furthermore, most partners were acquainted with each other personally ensuring unhindered communication flow.

Further to reporting it has to be stated that some deliverables were delayed according to the original plan given in the Annex I of the contract (Technical Annex). In some cases this was caused by the time consuming peer-review process which took up to several weeks. To keep the deadlines, this procedure was sometimes shortened by handing in the peer review report later to the European Commission. In those cases where the peer reviewers made important remarks changes were applied and an enhanced version was sent to the European Commission subsequently.

The software documentation deliverables D03/02, D04/02, D05/02, D06/02 and D07/02 were postponed since necessary adjustments had to be applied to other outstanding development results. In particular the adaptation to the Umbrella Tool became necessary, because regarding interfaces and standards are defined in it. To ensure control of this

procedure all software interfaces were made available as prototype versions and tests were performed at the Consortium Meeting in Kalmar (27 to 28 September 2003). Subsequent minor supplements were applied and additional test were performed.

7.8 Cooperation with EU Commission

From 01 April 2002 to 29 February 2004 the EU project officer in charge was Mr. Christos Pipitsoulis. Commencing on 01 March 2004 until the project end Mr. Brice Lepape is his successor. The cooperation with the officers was considered as fruitful and very pleasant.

Two Annual Reviews were performed:

The 1st Annual Review took place in Brussels on 21st November 2002. The reviewers were Mr. Harald Sleire, Mr. Lars Brödje and Mr. Nikitas Nikitakos.

The 2nd Annual Review took place in Athens/Piraeus on 7th November 2003. The reviewers were Mr. Michael Lloyd, Mr. Gerry Trant and Mr. Nikitas Nikitakos.

Both audits were considered as fair and fruitful by the participating consortium members.

8 Outlook

When summing up the overall development within the maritime environment on the one hand and the technological on the other, it can be stated that the issues addressed by TELEMAS became even more important during the project lifetime. The partners were aware that one project isn't able to solve all their very complex problems in the field of today's knowledge management, the lack of standardisation, the increasing overload of legislative needs etc. But TELEMAS achieved usable solutions for specific aspects and offers a sustainable concept to deal with information, data and systems onboard seagoing vessels and the data exchange with land based institutions.

The TELEMAS achievements will be valuable for further research and development efforts. Fields of future activities might be:

- Standardization of vessels and the continuity from its design phase to implementation, installation and commissioning of onboard systems.

- Handling of rules, recommendations, guidelines, advices and forms to gain a consistent system allowing the personnel onboard and in the shipping company to act compliant to laws and rules to reduce the administrative extra work. This would also help to ensure that the staff can concentrate on its core duties, laws and rules to be more respected and to make workflows more effective. One attempt could be the creation of new services such as the provision of situation dependent rules and regulation.

- Implementation of security services and systems. This needs a complex approach for data security, protection against fraud, terrorist attacks and piracy as well as safety aspects and emergency support in case of critical situations.

- Further optimisation of bandwidth and minimizing communication restrictions to deal with the still widespread limitation of bandwidth but also to make efficient use of new and evolving broadband systems and its related services.

- Integration of sea transport into the whole transport chain. Vessels can not longer be regarded as isolated. The need for seamless information e.g. from the manufacturer to the addressee of goods is becoming more and more important and includes also the knowledge about status, exact time of arrival, possible incidents etc. Furthermore national or international authorities have to be involved e.g. when handling dangerous cargo or sensible goods.

- Office integration between vessel and the shipping company's office and vice versa. The vessel can be regarded as the main factor of production. The interlinking of shipborne and shore-based business processes has to be ensured at reasonable communication costs. This implicates the understanding of available resources, effective knowledge management and the allocation of responsibilities and authorization rights.

- Integration of third parties such as pilots, charterers, classification societies. The exchange of information is not restricted to the vessels' command and the shipping

company. So the delivery and reception of information can be automated to a certain extend with possibilities to distinguish between time critical and basic information.

- Improved working and living conditions for multi national/cultural crews. Many problems in seafaring arise from lack of understanding and deprivation from land based information sources. This includes also "normal" interpersonal relations, exclusion from knowledge or entertainment sources or even the prevention from basic citizen rights.

- CBT - Platform for the DDE (Dynamic Learning Environment) technology. The role of the Umbrella Tool could be to store/warehouse data, analyze and deliver appropriate information to the learner via a handheld. The UT will be an excellent tool for the Dynamic Learning, making it close to "online" even though being not.

These topics collected by the TELEMAS consortium are not exhaustive but present many issues in the environment of TELEMAS which have to be addressed in the medium and long scale. Research and development on a European level seems to be very suitable since the problems and their solutions not only exist on a national level and are not restricted to certain technologies. TELEMAS offers an approach and did valuable background research.