2. WORK ACHIEVED

In this chapter all aspects of the technical work are presented. The first two sections provide an overview, and a discussion of user requirements. Sections 2.3 — 2.5 detail thework carried out and provide individual conclusions and recommendations following from each work package. Section 2.6 lists the formal project deliverables. Combined conclusions and recommendations are given in Chapter 3.

2.1 Overview

The technical work for COMKISS was separated into three individual work packages, according to the client organisation involved. Table 2.1 indicates all the Work Packages in COMKISS, the three technical Work Packages are highlighted: WP3000, Ship Design (Bureau Veritas); WP4000, High Speed Craft (Corsica Ferries); WP5000 Unconventional Transportation (Dockwise).

Work package	**Responsible partner**
WP1000: Project Management	University of L nd, Georg Lindgren
WP2000: Project Definition	Satellite Observing Systems, David Cotton
WP3000: Ship Design	**Bureau Veritas, Guy Parmentier**
WP4000: High speed craft	**OPTIMER, Raymond Nerzic**
WP5000: Unconventional transportation	**Dockwise, Cees Leenaars**
WP6000: Demonstration Modules	IFREMER, Michel Olagnon
WP7000: Validation, Verification, Exploitation	Satellite Observing Systems, David Cotton

- **Table 2.1 — COMKISS Work Packages, and responsible partners.**

Work Packages 1000 and 2000 were concerned with Project Management and Project Definition. Work Package 6000 concerned the preparation of Demonstration Modules, and was performed by IFREMER. The Demonstration Modules were seen as a very important part of the COMKISS project in that, in addition to satisfying part of the requirement to disseminate the COMKISS results, it was intended that they would be available to potential industrial users to enable them to verify the circumstances under which satellite data can generate real benefits to their own maritime activities. WP7000 (Validation, Verification, Exploitation) is also important. This activity brings together of the results from WP3000, 4000 and 5000 to form coherent and specific recommendations: for future developments to optimise effective use of satellite EO data, and for disseminating advice so that industrial users are made aware of the capabilities of presently available data sets.

2.2 User Views and Practice, and Project Requirements

It was important to first ascertain the current practices and requirements of the three users involved in COMKISS. This enabled the team to define the applications to be developed and tested. After the three user representatives had identified their most important expectations on the project, some compromises had to be made to economise with time and money available for archive data. Whilst the work packages of the project that were originally designed for the three types of users remained, some modifications to individual work packages were made. These aspects of the project development are reported fully in the COMKISS User Requirements document (COMKISS 1999a) and in the Revised Technical Annex (COMKISS 1999b).

The user views and requirements, as discussed within the project, are presented below.

2.2.1 WP3000 Ship Design

Within COMKISS, Bureau Veritas represented the ship certification sector, and presented requirements both on regular shipping operations and on High-Speed ferries.

For conventional shipping certification, wave models and ship response functions based on Global Wave Statistics (BMT, 1990) are used to assess the fatigue life on critical parts of a ship s hull.

Bureau Veritas has observed unexpectedly large damage on ships at certain routes in the Mediterranean. These could be attributed to inaccuracies in the database, and it was thought advantageous for future certification strategies to find out if more accurate wave statistics, with directional information, can be extracted from the satellite archives.

Also related to fatigue is the topic of *fail safe construction*. Much of the fatigue loading on a ship s hull is experienced during loading and unloading in port. Inspection for fatigue cracks is routine, but it might happen that a ship leaves port with an undetected crack. This can still be safe, provided that no long period of rough sea-states is experienced during a crossing. Bureau Veritas wanted to know if satellite archives provide sufficient information on the frequency of long spells of rough (and smooth) sea-states along selected routes where this type of safety risk may occur.

The certification industry also has a strong interest in better rules for the certification of High-Speed craft and ferries. These requirements are presented in Section 2.2.2.

The summarised requirements from the ship certification sector are given in Box 1:

Box 1: Requirements from Bureau Veritas

A long regular ship route should be selected for which an extensive database on ship performance exists and for which a satellite metocean database can be obtained. The ship response models used in the certification process should be combined with metocean data and the results compared to those obtained using the Global Wave Statistics database (BMT, 1990). If deviations are detected it proves that the more detailed information from satellite data are useful in design and certification.

A new procedure is needed to assess the possibility of fatigue crack growth during an ocean crossing of specified duration. Investigations should therefore be made to see if satellite data could provide reliable statistics on persistence of severe wave conditions during the crossing period. The requirement of BV is that the project should demonstrate to what extent this could be done with present or future wave surveying satellites.

2.2.2 WP4000 High Speed Craft (HSC)

The interests of the HSC industry have been formulated both by the HSC operator Corsica Ferries (CF) and by Bureau Veritas (BV).

Certification of HSC

BV wished to investigate use of satellite derived data in making early assessments of conditions encountered by HSC during normal operation. They receive measurements of ship stresses and estimates of sea-state from operators. These measurements may then be used in setting sea-state dependent rules for the operation of these craft.

In particular, BV has carried out HSC trials in the Mediterranean (S of Nice) in June 1998. Ship stress measurements are available, and BV wished to see if improved estimates of actual sea state information, directional wave spectra if possible, might effect assessments, which consider possible modifications to models and maybe also to ship design.

Operational aspect of HSC

CF identified their specific need for near real-time wave height and direction information from satellites. CF co-operates with M t o France on forecasts of wave conditions on their routes in the Mediterranean.

Data are required in near real-time and as forecasts for short term (less than two hours and up to 24 hours). The usual metocean data requirements for Corsica Ferries are: an assessment of the accuracy of the forecast from M t o France (Aix en Provence).; information about the evolution of the sea state.; warning of possible severe conditions; advice on clear weather windows.

There were possible problems associated with the Corsica Ferry routes, because of the high temporal and spatial variability in conditions around Corsica and the local enhancement of winds

due to topography. Hence it was thought that satellite data alone may have limited impact, and that some combination with high-resolution local models may be required.

The Corsica Ferry routes are Nice/Bastia, Nice/Calvi, Savona/Bastia, Civitavecchia/Golfo Aranci. The most critical locations are around Cap Corse, and at the Eastern End of the Straits of Bonifacio.

The user requirements for HSC are summarised in Box 2.

Box 2: Requirements from HSC

The most important issue for the High-Speed craft sector is to see if satellite information can be made available with sufficiently high resolution in Near real-time to decrease downtime on scheduled routes due to limits on sea state criteria. Satellite data can only assist meteorological predictions. The study should reveal the sampling interval needed for the satellite data to be useful in that assistance.

Ship response models for high-speed craft are presently developed for sea state models with direction dependent specification. CF (and BV) wanted to know how the use of a satellite directional wave database for the Mediterranean could help to compare actual measured stress levels on board ship with predicted stress levels.

2.2.3 WP5000 Unconventional transportation

Dockwise has two main operational modes for predicting/responding to environmental conditions. The first is an office-based system which is used to run a risk evaluation for proposed operations by running Monte-Carlo simulations of the operations through an archive of environmental parameters. The second mode is an on-board system that provides route and decision making support, and monitors conditions en-route.

We first consider the office-based system. The use of Monte-Carlo simulations is an important feature of Dockwise s procedures. Rather than extracting a single set of predicted/expected climate conditions for a given route, multiple model runs of the proposed operation are made through the archived climate data, incrementing by date/location so that statistics of loads/stresses/exceedances can be generated and failure probabilities (e.g.) assessed.

The COMKISS programme complements the SAFETRANS project, of which Dockwise is a partner, and whose main aim is to reduce risk during transport and offshore installation. However, some key items are not included in the SAFETRANS programme, i.e.

- The ability to analyse, after the event, the exact conditions at the time of an operation.
- The development of a package to predict movements and stresses on board a ship during planned operations.

Dockwise identified further areas where improvements were desirable:

- Improved accuracy in forecasts, to aid short term planning.
- Improved information for (semi-) enclosed seas where model data are often unreliable (e.g Black Sea, Caspian Sea, Philippines, Indonesia). They currently use global statistics derived from models (covering a period of 5 years). They were interested to compare these global statistics with those derived from satellite data.

In summary, Dockwise hoped to assess the potential improvement that could be achieved over existing practices through the application of satellite data, as summarised in Box 3.

Box 3 Requirements for Transportation of Unusual Loads

Design database. Currently Dockwise uses a database from Oceanweather Inc. (Connecticut, USA). Would satellite data be more reliable/accurate?

Near Real Time Data. They need a better description of the wave field during operations.

Surface Currents. Could satellite data be used to improve or modify the available information on surface currents? For instance could satellite data provide time variability to add to the steady state maps that are already available?

With regard to the 2nd mode of operation (the ship-bases system), the specific requirement is to assess whether satellite data can improve the accuracy of forecasts fed into the on-board systems. Different opinions have been expressed.

On one hand it was argued that it would be preferable to improve a single source of information sent to shipmasters. On the other hand it was suggested that it would be better to provide the satellite-derived information separately to enable a decision to be made after comparing the two sets of information

2.2.4 Summary

Common application themes emerge from the user requirements, Box 4.

Box 4: Summarised, combined requirements of satellite data from COMKISS End-Users

Trials of satellite derived wave climate databases over routes and periods specified by the COMKISS client partners. How do satellite derived databases compare to other databases? Can they provide reliable information where more conventional sources fail?

The need for near real-time measurements for all 3 Work Packages, and, for each, an assessment of the usefulness of the fast delivery data stream of ERS-2 and other near real-time data. Forecasts can be inaccurate, and modern operations (e.g. cable laying, heavy lifts offshore, high-speed craft) can have precise operational limits. More accurate forecasts with a heavy emphasis on measured data are seen as highly desirable. However, is the density of satellite measurements sufficient to provide a useful service?

Improved reconstruction of the sea-state that prevailed during classification and certification trials. This will involve the best use of satellite archives and wind/wave models. The latter may be more appropriate for actual hindcasts at the time and place of the trials. Are satellite data preferable to gridded output from long term historical re-analysis models?

Can other useful parameters be derived (e.g. surface currents) by combining satellite data from various sources?

In the next three sections, 2.3 —2.5, we consider separately the work carried out for the technical work packages, WP3000 (Ship Design), WP4000 (High Speed Craft), and WP5000 (Transport of Unusual Loads).