

**S@S WP0**

**Midterm Report  
(Consortium wide)**

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## 2 EXECUTIVE SUMMARY

The Safety-at-Speed project has the ultimate objectives of enabling the design of advanced high-speed craft (HSC) such that they meet the required safety level at the lowest possible through-life cost, and to enable a rational assessment of the cost implications of the variation of safety related parameters.

In present-day design methodologies for advanced HSC there is no support for the assessment of the balance between the issues of safety and cost. Hence, it is in practical terms not possible to complete a design at or near the through-life-cost optimum. For current designs, the tendency is to base design decisions on best practice, and while these designs fulfill current safety design requirements, it is unknown whether the resulting vessels are over-specified in one or more aspects – and hence in reality, are too expensive to build and operate.

To overcome this situation the aim of the Safety-at-Speed project is to develop a formalized methodology for design for safety of HSC using state-of-the-art techniques and tools. The global deliverable is this methodology, accompanied by supporting tools and information, which will enable the HSC designers to reach an optimal solution with regard to overall safety and through-life cost.

The Safety-at-Speed project has a three-year duration. During the first two years the risk and cost models are developed in the areas of collision and grounding; ship motion hazards; foundering; and containment of damage and fire. During the third and last year the individual models are integrated to a “tool” and this “tool” is demonstrated on a test case.

By the time of the mid-term of the project, the models have been formulated in all four main areas and data gathering has been performed through full-scale measurements, model tests and computer analyses. A common format for the models has been formulated, which will facilitate the integration, and implementation of the models has started. The project mainly follows the schedule set out from the beginning, with only small adjustments, which will not affect the overall completion date. Up to the mid term 88% of the planned resources have been spent, which corresponds well to the actual progress.

As far as concerns project management the schedule has been followed with quarterly consortium wide progress and management meetings, combined with Work Package workshops. In addition, two consortium wide workshops have been organized in order to achieve uniformity in the modeling of risk and cost. A project website has been established where all the relevant project information and reports are available to the consortium members.

Dissemination activities relating to the project are beginning to surface. Thus, a conference presentation will be given in May this year, and others are under

consideration by the consortium members. Exploitation of the project results are being considered by the industrial partners, and specific exploitation plans will be developed during the coming period.

### 3 OBJECTIVES AND STRATEGIC ASPECTS

#### 3.1 Project Background

Safety at Speed addresses directly the Key Action 'Land Transport and Marine Technologies': 'Critical Marine Technologies - Efficient, Safe and Environmentally Friendly Ships and Vessels (3.2.1)'. Additionally, Safety at Speed addresses focal points within other key Thematic Priorities: Safety Assessment in Waterborne Transport (2.2.3/3) and Cost-efficient Integration of New Safety Technologies to Improve Quality Shipping (2.2.4/4). In addition to the direct link to 5FP, the project also addresses a number of issues prioritized in the 'The Maritime Industry R&D Master Plan' (MP99), 1999, on the following subjects:

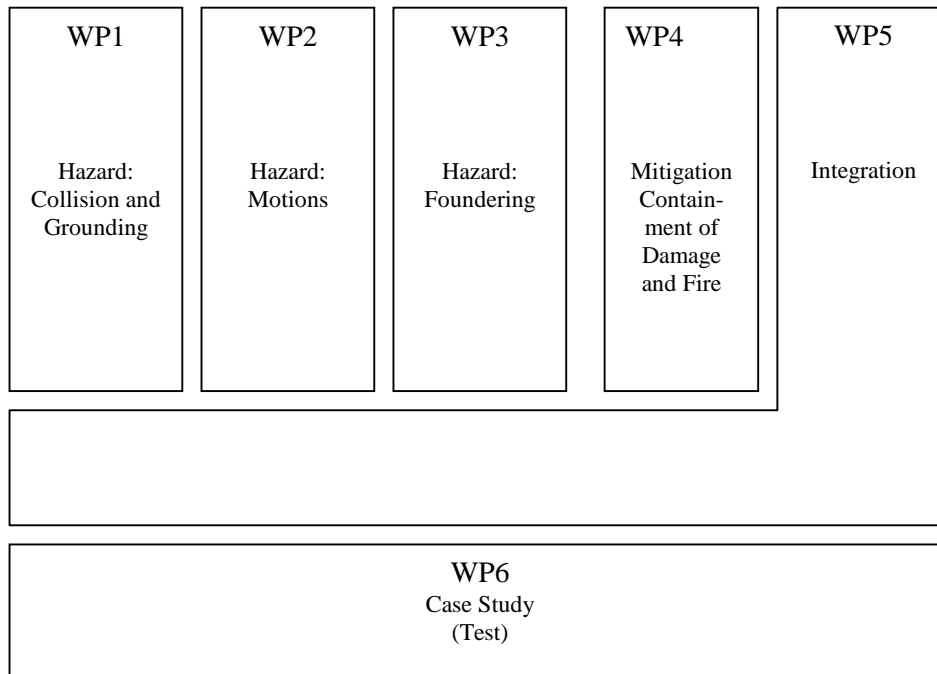
- Area 1.1.2 'Improvements of Competitiveness & Productivity - Design Tools', specifically in the areas of 'Design for Safety';
- Area 1.1.2 'Formal Safety Assessment for Development of Design'.
- Area 2.2.3 'Safety', addressing 'measures to reduce human errors (e.g. through layout optimization, ergonomics, standardization of man-machine interface, etc.)'.

#### 3.2 General Introduction to the S@S Project

The general purpose of the project is to develop a formalized methodology for design for safety of HSC using state-of-the-art techniques and tools. The global deliverable is this methodology, accompanied by supporting tools and information, which will enable HSC designers to reach an optimal solution with regard to overall safety and through-life cost. The specific objectives are:

- To analyse the results deriving from the safety assessment of HSC operation;
- To develop an HSC information model describing the risk/cost relationship;
- To use this model to identify safety enhancing design features;
- To analyse the cost-benefits of promising safety enhancing design features;
- To evaluate the effects of safety enhancing design features on ship performance and earning potential, and so develop a design decision support tool;
- To apply the decision support tool in a test case, and
- To utilise the experience from the test case to verify, validate and refine the design for safety methodology.

The scope may be illustrated by the figure shown below, which shows the project overview, and the relation between the different work packages.



### 3.3 Objectives and Strategic aspects

Safety considerations are generally relevant for all the different phases of ship design and have an impact on the whole ship level.

The general safety constraints and recommendations result from an assessment of the design specification taking into account dedicated studies, which are mostly related to critical hazards and national laws and regulations. Risk analysis is performed in order to define a risk level associated with the specific design, and if the risk is not acceptable, a new alternative design solution is developed. This procedure is traditionally part of a post process called safety case, which consists of documenting how safety has been considered and incorporated into the design or modification of the equipment, the systems and the whole ship. The safety case must also provide all the information necessary to effectively manage safety of the ship through its in service life, and therefore particularly on the residual risks.

During the design development the safety activities cover different fields starting from the ship requirements to the arrangement of the ship design and the design of equipment/workspace/workplace.

The useful output of a generic safety study is therefore a list of technical options, which could be integrated into the design in accordance with the different status of the ship.

The aim of the safety studies and the safety process can be summarised in the following different steps:

- to conduct a preliminary analysis and assessment of the listed hazards
- to complete analysis according to the most critical hazards
- to identify rules and measures to reduce/suppress hazards
- to define transversal architectural principles which contribute to the general safety of the ship and its crew
- to identify potential discrepancies with the state of design
- to propose alternative common solutions
- to define requirements related to constraints on design of installations on board

The more relevant scope of the present innovative project is therefore to create a dedicated tool which could integrate and organize in a well defined manner the safety studies performed for the more relevant hazards in order to improve the design in a constructive way during all the phases from the feasibility phase to the production phase in order to take the safety of the ship and of the people on board to the highest level.

Moreover, the present tool could be able to complete in a rational manner the safety case, which is a process so relevant for all the innovative high speed crafts.

Especially for military vessels, and for commercial vessels alike, the safety objectives are:

- to give assurance to the customers that the whole ship is compliant with the National laws and regulations and is safe and free from risks to health and safety as far as it is reasonably practicable ;
- to assure that in service support aspects are acceptable for the customers, who will assume responsibility for the safety management of the ship from the point when the ship enters operational service;
- to make appropriate use of standards which shall be international or NATO agreed standards. Where such standards do not exist, then an acceptable cost effective standard is to be contrived, reducing safety risks in compliance with the "As Low As Reasonably Practicable" principle, starting from the least demanding national standard;

- to apply a robust safety management system to ensure that health and safety hazards are identified, assessed and controlled such that the safety risks to the crew, other parties, property and the environment are as low as reasonably practicable.

## 4 SCIENTIFIC AND TECHNICAL ASSESSMENT

To implement the S@S work programme, the original Annex 1 to the contract 'The Description of Work' contains a detailed project schedule. In the below 6 sections the WP leaders have given their views on the status of their work packages.

### 4.1 WP1 - Collision and Grounding by DAP

The principal objective of Work Package 1 is to develop suitable risk/cost models for high-speed craft to be implemented in a risk-based design methodology, with reference to the key factors pertinent to collision and grounding.

The specific issues to be addressed include the confirmation of the main causes for collision and grounding, followed by the development and implementation of risk/cost models for the human error, mechanical and automation failure, and manoeuvring errors.

Work Package 1 comprises three work tasks: Task 1.1 (Confirmation of main causes), Task 1.2 (Formulation of models), which is further subdivided in three sub-tasks (models for human error, mechanical and automation failure, and manoeuvring errors, respectively), and Task 4.3 (Risk-cost model for collision and grounding).

During the reporting period, Tasks 1.1, 1.2 and 1.3 were planned to be active.

Because of the heterogeneity of the topics covered in WP1 (human errors, mechanical and automation failures, manoeuvring errors) and the different approaches necessary to tackle them, an harmonisation process was unavoidable at different stages of the work, which presupposed delays and adjustments with respect to the Description of Work (Annex I to the contract) in order to define a common view enabling WP1 to effectively contribute to the project objectives.

The internal review of the work done in Tasks 1.1 and 1.2 has enormously contributed to make WP1 outcome more respondent to WP5 requirements. Some refinements are still needed, but a stronger interaction with WP5 and the shipyard will make it easier.

The activity carried out within Task 1.1, Task 1.2 and part of Task 1.3 for the relative period is in line with what was originally planned in the Technical Annex. The only exception is the development of the Power Prediction Algorithm that has already anticipated what will be the final outcome of this project. Indeed, apart from the planned activities, a very interesting and promising outcome of WP1 is the Power Prediction Algorithm. This prototype application can already be seen as an anticipation of what will be the final implementation of the design tool, which will

take the form both of a “handbook” describing the proposed methodology for design purposes, as well as of a computerised decision support system.

## 4.2 WP2 - Ships Motions Hazards by SIREHNA

During the 1st half of the project, Task 2.1 “Confirmation of main causes” has been completed and Task 2.2 “Formulation of models” has started and is well in progress.

Achievements of Tasks 2.1 and 2.2 are further described hereafter. The following preliminary remarks may be given:

- Although not explicitly written in the work programme, all WP2 partners participated in the FMECA process performed within Task 2.1.
- The work programme identifies separately the consequences related to hull design on one hand, and to operational parameters on the other hand. This formal separation (sub-tasks 2.2.2 and 2.2.3) has no real meaning in practice since models related to hazards due to ship motion (e.g. excessive acceleration) always depend on both hull design (hull form,...) and operational practice (ship speed, heading,...) parameters. Consequently, partners involved in Sub-tasks 2.2.2 and 2.2.3 have been working together on both sub-tasks.

### 4.2.1 Task 2.1 - Confirmation of main causes

The confirmation of main causes for ship motion hazards and the specification of attributes were carried out in two phases, namely:

- First identification of hazardous events related to ship motions of a HSC in operation. This work has been performed in the form of a block diagram analysis, which also highlighted the possible interactions with other work packages. For each event, the event has been described in terms of a criteria (e.g. Loss of passenger comfort due to excessive rigid body acceleration expressed in term of Motion Sickness Indicator), and the general parameters (or attributes) influencing the criteria have been identified. In addition, a preliminary definition of the methodology to be later used in Task 2.2 to develop the models associated to the criteria has been done;
- Performing of a Failure Mode, Effect and Criticality Analysis (FMECA) and comparison with results from the first phase;

The results of this task were presented in the deliverable D210 (report S102.10.11.054.001, final issue on 2001-12-03).

The work performed in this task confirmed and complemented the main hazards related to ship motions identified in the work programme, which are:

- Crew and passengers disorientation and injury
- Large ship loading causing structural failure and foundering
- Loss of ship control

These hazards can be related to the occurrence of the next events:

- Excessive ship motions and accelerations
- Excessive elastic ship vibrations
- Excessive local and global wave loads
- Dynamic capsize (broaching)
- Excessive noise, vibration levels and bad indoor climate,

which will be modeled in Work package 2. Excessive elastic ship vibrations and excessive local loads will however be modeled in co-operation with WP3. The main factors affecting these hazards are as identified in the work programme, which are:

- Human factors
- Hull design (including hull shape and weight distribution)
- Operational practice, i.e. ship operation (speed/heading) for the encountered sea conditions.

#### **4.2.2 Task 2.2 - Formulation of models**

The work carried out in this task during the reporting period can be summarised as follows:

- Benchmark of seakeeping codes available between WP2 partners and comparison with existing seakeeping experimental data made available from a previous EU project (SEAWORTH), in order to determine the accuracy of seakeeping predictions and to determine which code has to be used, and for what purpose. The benchmark has been followed by a first series of seakeeping calculations on the SuperSeaCat 3 vessel.
- Development of simplified seakeeping models. A rational procedure able to predict the wave-induced motions and accelerations with sufficient engineering accuracy has been formulated. The procedure is solely based on the main particulars of the vessel: length, breadth, draught, block coefficient, bow flare coefficient, forward speed and operational profile. The formulas derived are semi-analytical such that the calculations can be easily implemented in a decision support system. Furthermore, the simplified models have been supplemented by a formula for the roll motion. The simplified models have been compared with extensive calculations performed using various strip theories and shortcomings in the simplified models have been identified and adjustments made. Further adjustments might be necessary when model test results and full scale measurements become available.
- Establishment of the list of input parameters required by the models (list then passed to WP5).
- Specifications and performing of the parametric seakeeping numerical simulations. The numerical calculations for the parametric study were done by means of two computer programs (SHIPMOPC for motions and vertical bending moment and SEAWAY for accelerations). These calculations were done for the same ship length but with 5 different B/L ratios and 5 different T/L ratios. The basis vessel for the calculations was the SuperSeaCat 3 and the ratios used were  $\pm 20\%$  and  $\pm 10\%$  of original values. In total 25 simulations

were carried out. The speeds for each simulation were 5 knots and 40 knots and the wave heading varied from  $0^\circ$  to  $180^\circ$  with increments of  $30^\circ$ . The results were calculated for the following points:

- Motions: at Centre of Gravity.
  - Bending Moment/Shear Force: at Mid-ship and Forward Perpendicular.
  - Accelerations: at Centre of Gravity and Forward Perpendicular.
- Specifications and performing of seakeeping model tests. The purpose of model scale experiments was mainly to deliver complementary data for large Froude numbers (0.6), and to check short term statistics on irregular seas. Model scale experiments have been performed at scale 1:20, on a segmented (two segments) elastic model (separation at midship). The longitudinal 2-node frequency of the model was scaled. Two bow geometries have been tested in order to vary the bow flare coefficient. Tests have been performed at 40 kn speed, on head regular and irregular waves, with measurements of pitch and heave motions, VBM at midship, accelerations at midship and FP, and pressure on the hull, in the fore segment. Data analysis is in progress and the results are planned reported in early 2003.
  - Review of existing models and data for noise, vibration and indoor climate.
  - Specifications and performing of sea trials. The purpose of sea trials was to give complementary seakeeping data for codes and model validation, to provide data on indoor climate, noise and vibration, and to collect information on their influence on human. Sea trials have been first specified and then carried out on board the SuperSeaCat 3 vessel, during trips between Liverpool, Dublin and the Isle of Man, from 10 to 12 October 2002. Measurements consisted in ship motions, accelerations (3 axis) at the aft, at midship and in the fore part of the ship, noise, humidity and temperature, vibrations in the aft part of the ship, and wave measurements. Measurements were complemented by a questionnaire related to motion sickness and to noise and vibration delivered to all passengers during the sea trials. Data analysis is in progress and the results are planned to be reported in early 2003.
  - Review of available data, simplified models and methodologies to analyse and model dynamic stability and development of a broaching model. A yaw-roll model was developed with the intention to be used in an analysis concerning the global dynamic behaviour of the system and its stability properties. More specifically, the aim of the proposed model was not the accurate representation of the vessel motion during capsize by broaching, but the identification of the occurrence of these phenomena. The interest is on how the broach and capsize zones are modified. This will give a measure of confidence for the trends and boundary curves derived through this model. The accurate prediction of broaching behaviour is served through the correct modeling of the yaw wave moment and its counteracting yaw water jet moment. These are the most influencing parameters and their calculation will be performed in a precise manner for the instantaneous position of the ship. The capsizal resistance of the ship is largely defined by the roll restoring moment which is also modeled in a precise manner for the instantaneous position of the vessel. Therefore both the occurrence of broaching and the ability of the vessel to resist capsize will be rightly addressed.

A common deliverable D222/D223, describing the formulation of models related to hull design and operational practice has been issued for review on 2002-11-12. Deliverable D221 related to human factor is under preparation with an expected date of issue for review on 2003-01-31.

### **4.3 WP3 - Foundering by ABS**

This section lists the results for the period, as compared to the plan.

#### **4.3.1 Task 3.1 - Confirmation of main causes**

The deliverable D310 was completed and the conclusions drawn from the analysis are as follows:

- HSC could founder due to global or local structural failure.
- The risk of foundering due to global structural failure is low.
- The risk of foundering due to local structural failure is of the medium order.
- A HSC could suffer permanent global damage due to unexpected loads.
- The risk of a HSC sustaining local structural failure is high.
- The risk of HSC sustaining second order causes of structural failure is high.

Furthermore, based on the results of the analysis sufficient information has been obtained to identify the causes that lead to first order structural failure.

From the list of causes, further analysis can be carried out to determine the extent of finite element modeling (and associated load cases) that is required to be undertaken to support the task 3.3 probabilistic modeling.

For generic analysis, WP3 need to establish and develop the design parameters and examine the effect on design to establish risk/cost relationships.

#### **4.3.2 Task 3.2 - Formulation of Models**

The following is a summary of the progress so far for the Sub-Tasks of 3.2:

- The results from the simple expression for the midship vertical bending moment developed by Technical University of Denmark has been compared to numerical results from the sea-keeping prediction software I-ship, and to experimental results from model tests, for details see Document ID Code: S102.00.13.060.001. Generally the bending moments predicted by the simple expression are lower than the I-ship results, and they agree better with the experimental results.
- The development of the 3D Finite element model for the full vessel has been completed and is being employed in the local 2D analysis work.
- The partial 3D finite element model for non-linear collapse has been completed and the results are being evaluated

- The 2D finite element analysis being carried out by The American Bureau of Shipping for selected areas of interest based on the SuperSeaCat3 inspection is progressing.
- The Classification Rule comparison and loading scenarios being undertaken by The American Bureau of Shipping is nearing completion.
- The University of Newcastle's work on simplified ultimate strength methods is nearing completion. It addresses the objectives listed in the WP3 Storyboard, specifically addressing the applicability of previously proposed simplified methods to HSC. A preliminary report documenting the performance of the LR.PASS simplified methodology for aluminium HSC has been issued (S@S Document S103.23.13.058.001b). Work on the other simplified methods is dependent on work from other Partners and WP's. However, completion is expected to meet the revised Deliverable dates.
- The University of Newcastle's work on a fatigue model has been completed. A successful reliability-based calculation scheme has been developed and a user-friendly design tool developed, which will enable WP3 to adequately address the storyboard objective of "quantifying the fatigue problem in HSC". The deliverable D324 was completed on time.

#### **4.3.3 Task 3.3 – Hazard Area Risk/Cost Model**

As previously stated Task 3.3 has been started in line with the scheduled timing of the Technical Annex. The research and collation of data is in its infancy and it is expected that the deliverable will be completed in a timely manner.

### **4.4 WP4 - Containment of Damage and Fire by SSRC**

#### **4.4.1 Objectives and Work Content**

The principal objective of Work Package 4 is to develop suitable risk/cost models for high-speed craft to be implemented in a risk-based design methodology, with reference to the key factors pertinent to damage and fire containment.

The specific issues to be addressed include the confirmation of the main means of containment, followed by the development and implementation of risk/cost models for: the human factor, passive design systems and active design systems, as these are described in the Technical Annex (Annex II) to the Contract.

Work Package 4 comprises three work tasks: Task 4.1 (Confirmation of the main means for containment), Task 4.2 (Formulation of models), which is further subdivided in three sub-tasks (models for containment of damage and fire relevant to the human factor, passive and active design systems, respectively), and Task 4.3 (Risk-cost model for the containment of damage and fire).

#### **4.4.2 Work and Achievements in the Period**

Task 4.1: Confirmation of the main means for containment

SSRC, D' Appolonia and DMI were the partners responsible to carry out the work in Task 4.1. According to the Technical Annex (Annex II) to the contract, the work in this task was scheduled completed by the end of month 3 of the project (2001.09.30), with a review date set by the end of month 6 (2001.12.31). Following internal discussion and approval by the EC, these deadlines were extended for a period of 2 months.

The work carried out by all partners responsible is reported in Deliverable No. D410 "Confirmation of Main Means", first issued on 2001.11.30 (Document ID Code: S104.10.09.054.001). The final version of the deliverable (following internal review, where no comments were made), was issued to the EC and the Co-ordinator on 2002.02.22 (Document ID Code: S S104.10.09.054.001A). These dates are in accordance with the revised deadlines.

Three complementary approaches have been used in the process of identifying the main means for containment of damage and fire:

- Search and analysis of accident reports;
- Categorisation of the available means according to their relevance to the effect of the human factor, to passive design systems and finally to passive design systems;
- Results from a FMECA (Failure Modes, Effects and Criticality Analysis) workshop, held at Newcastle on 19-21 November 2001 with the participation of all the participants in the project.

Deliverable D410 presents in detail these analyses. Following the description of the methodology adopted, relevant results from the FMECA session are reported and main causes identified, before drawing conclusions. Finally, the identified means of containment are included in three separate appendices, together with an appendix presenting example event trees for outcomes of collision and fire.

#### Task 4.2: Formulation of Models

SSRC, D' Appolonia, DMI and University of Newcastle were the partners responsible to carry out the work in Task 4.2. According to the Technical Annex (Annex II) to the Contract, the work in this task was scheduled completed by the end of month 15 of the project (2002.09.30), with a review date set by the end of month 18 (2002.12.31).

The work carried out by all partners responsible is reported in Deliverable No. D420 "Formulation of Models", first issued on 2002.09.30 (Document ID Code: S104.20.09.054.001). The final version of the deliverable (following internal review, where no comments were made), was issued to the EC and the Co-ordinator on 2002.12.23 (Document ID Code: S S104.20.09.054.001A). These dates are in accordance with the planned deadlines.

Following the work undertaken in Task 4.1 on the identification of the main means for containment of damage and fire, work in this task has primarily focused on the

derivation of models suitable for application during the early stages of the design process (conceptual and early preliminary design).

Models relevant to the effect of the human factor, passive design systems and active design systems have been developed. The approach adopted involves the identification of the design parameters relevant to each of the above mentioned systems, the development of the models based on first-principles tools and applicable regulations, as well as representation of the processes involved into suitable risk analysis constructs. In this respect, event trees have been developed since the work was focusing on the identification of the outcomes (consequences) of any relevant potential incident.

#### Task 4.3: Risk-Cost Model for the Containment of Damage and Fire

SSRC, D'Appolonia, Fincantieri and SeaContainers are the partners responsible to carry out the work in Task 4.3. According to the Technical Annex (Annex II) to the Contract, the work in this task is scheduled completed by the end of month 24 of the project (2003.06.30), with a review date set by the end of month 27 (2003.09.30). Deliverable D430 "Risk/Cost Containment Model" will report on the work being carried out in this task.

The principal aim of Task 4.3 is to synthesise a systematic method, which contrasts risks and associated costs pertaining to the containment of damage and fire incidents onboard monohull high speed craft. For project coherence, the method should be suitable for integration into the overall design tool under development in Work Package 5.

The input will consist of the developments in Tasks 4.1 and 4.2 (this work is detailed in project deliverables D410 and D420). A link between the incidents considered in the project and potential societal and economic consequences (losses/gains of human life, cargo, money, environment etc.) will be established, through the development of an appropriate formalised framework. Example applications will be undertaken to assist in the refinement of the work.

## **4.5 WP5 – Integration by BV**

### **4.5.1 Overview of the technical state of the research**

During this period Task 5.1 "Verification and validation of interim results" was active and a deliverable had to be issued. Tasks 5.2 "The Risk Model" and 5.3 "The Through life Cost Model and risk/cost assessment methodology" begun after 6 months, no deliverables had to be produced. Task 5.4 "Design for safety methodology" is scheduled to start month 30 and is not active.

The challenge of the project is to produce a "Tool" able to compare in terms of risks and costs several alternative preliminary designs of an HSC. This can be done through the main parameters the variations of which have an impact on risks level and costs.



Human factors model is much more detailed compared with the other models, it includes numerous non-quantifiable parameters, which could lead to difficulty of integration and difficulty to use the final "Tool".

The assessment of the significance of these non quantifiable parameters (also found in the others WP models) need to be performed to support decision regarding possible simplification necessary to obtain a Tool easy and sufficiently fast to operate within the constraints of early design.

#### **4.5.2 Task 5.1 – Verification and validation of interim results**

Participants: BV, DAP, ABS, FIN, SSRC, SIREHNA, UNEW.

The objective of the task is to verify and validate the techniques during their development in Work Package 1 to 4 against typical, real-life designs, current rules and regulations and techniques made available from other industrial sectors to assure the applicability and quality of results.

During the first year of the project, the objectives were to validate the main causes for WP1 to WP4 topics. A set of deliverables had to be issued. Then the work had to go on with the validation of the WP1 to WP4 models.

A FMECA session was held in Newcastle in November 2001. All partners were present, hence experts from diverse backgrounds were represented. The results, in coordination with historical data allowed validation of the interim results.

The first deliverables from WP1 to WP4 concerning the confirmation of main causes of hazards have been examined and agreed. The task is closed for the first deliverables and ongoing for the formulation of models.

#### **4.5.3 Task 5.2 – The Risk Model**

Participants: BV, UNEW, DAP

The objective of this task is to provide a risk-based integration of the achievements of Work Packages 1 to 4 in order:

- To develop a methodology for assessing the risk level of the HSC design and operation;
- To identify appropriate Safety Enhancement Features (SEFs);
- To provide the necessary input data for assessing the cost-benefit ratio of alternative high-speed craft designs (see task 5.3 for details).

A benchmark has been established in order to find the most relevant software for the purpose of the project. Regarding decision making it was proposed to use DPL software due to its user friendliness and its universal Ms Excel interface which will allow an easy communication with other pieces of software of the Project. The decisionmaking Software is intended to be a help to the designer to make a final choice between the various designs through a risk-cost optimisation. The core software of the

risk model will be recognised FT/ET software. At this stage of the project and for practical reasons we use Star Studio from EC JRC, but the intention is that the Tool be not strongly linked with a particular commercial mark.

The Risk Model will be worked out based on the merging of the WP1 to 4 Individual Risk Models.

For each basic event a procedure must be established that allows the calculation, or estimation, of the probability of that event occurring, with reference to all parameters:  $Pr = f(P1.1, P1.2, P1.3, \dots Pn.m)$ . These procedures will allow calculation of Risk of End Events. The introduction of confidence in probability calculation will allow an estimation of End Events reliability.

A preliminary list of parameters was drawn from the work-packages 1 to 4 deliverables and then discussed. The parameter list has been reviewed and updated. The list is now in circulation and partners have been invited to take ownership of the parameters. A review process is continuing to ensure the viability of the list. The list will be finalised when the risk models of work-packages 1 to 4 will be frozen. A functional analysis of a HSC has been undertaken to serve as an umbrella under which all risk models will be integrated.

The review, validation and integration process for the individual risk models has just begun, however there are still WP models outstanding

#### **4.5.4 Task 5.3 - The Through life Cost Model and risk/cost assessment methodology**

Participants: UNEW, SSRC

The stated aims of task 5.3 are as follows:

- To develop a general purpose integration methodology to apply life cycle costing to high speed craft, able to incorporate the effect of alternative SEFs;
- To assess the benefits of the SEFs, in terms of reduced losses of people, payload and vessels;
- To indicate those SEFs having the most favourable cost-benefit ratios for given operational conditions (i.e. capacities, speeds, routes, and weather).

Work on task 5.3 commenced in month six of the project. We are therefore very much still dealing with the first of these aims, the development of an integrated tool. To achieve a working integrated tool it was important that the methodology was developed with input from the other work packages and partners. These led to UNEW taking on an educational role in the form of workshops. To date there have been three workshops concerned with cost.

*The first workshop (Paris, May 2001):* gave an overview of how cost models have been created and operated in the past. In addition to this there was an introduction to economic criteria such as Net Present Value and Implied Cost of averting a Fatality.

A meeting was arranged with FIN to discuss the process that they go through to estimate costs at present.

The cost calculations are absolute values and are calculated very simply but estimating the following three values:

- Quantity of material or units
- Cost of Material or Units - historical data or quotations
- Complexity of production - man hours per unit

*The second workshop (Helsinki, September 2002):* presented these ideas to the group to see how this could be developed into a model that could be used in Safety at Speed. There were two major concerns that were raised by the group. The first was that it was better and easier to use a relative approach than an absolute one. By this we mean the partners felt it would be more realistic to calculate changes in cost in relation to the basis vessel than the actual cost of producing a design. The second concern was how second order effects to a design change could be calculated.

*The third workshop (Nice, November 2002):* presented the results of UNEW's development of the ideas discussed in Helsinki, and which are outlined below.

**First Cost or Capital Expenditure (CAPEX)**

First we assume that the basis vessel has a cost of 1. We can then proportion this to the different systems, which are taken from the WBS. Now when a parameter is changed, it will change the costs associated with 1 or more systems. Figure 1 demonstrates now a breakdown of what can be achieved.

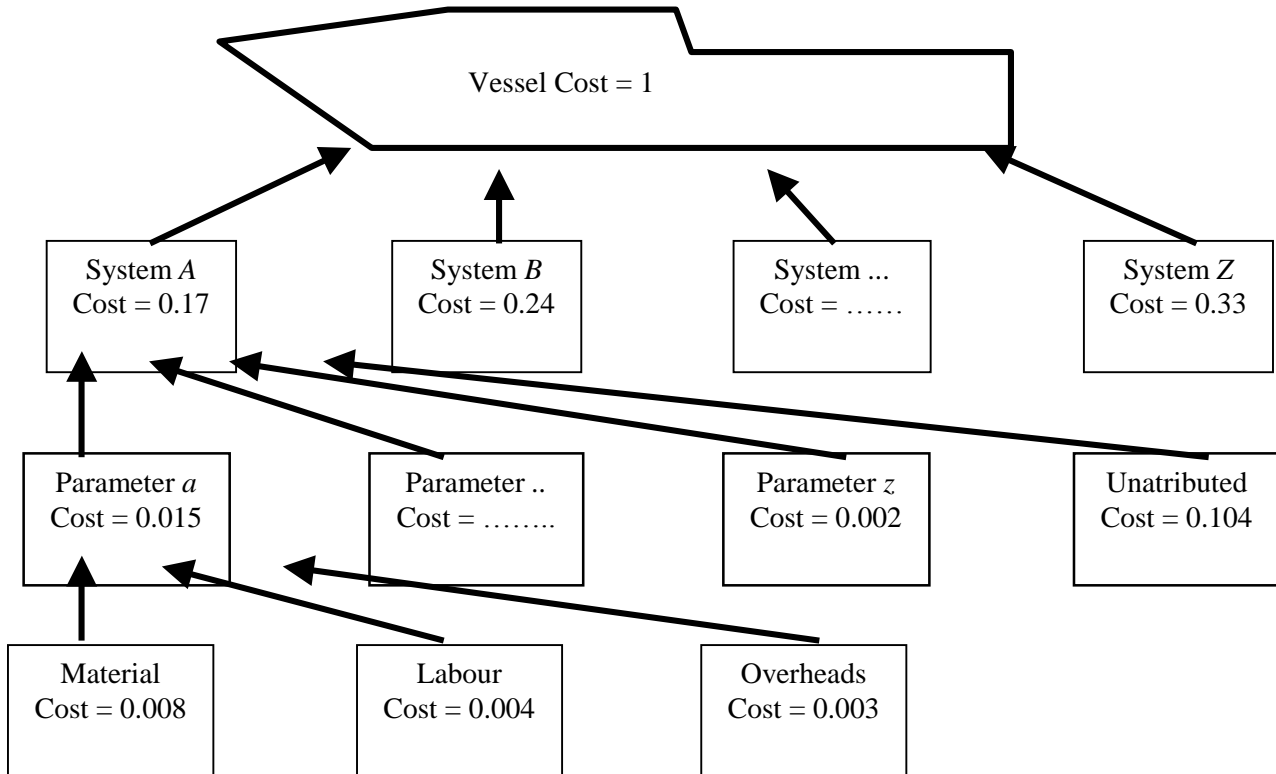


Figure 1 - The cost model is based on basis vessel cost of unity. (Indicated cost proportions are by way of example only)

The parameters are then linked to a system or systems and for every parameter a Cost matrix will need to be produced.

The cost matrix is demonstrated below in figure 2.

Par $a$	Mass Kg	Material €/Kg	Labour Man Hour/Kg	Main- tenance €/Year	Crew number	Average crew cost €
$x$ max	$1+\delta$	$1+\delta$	$1+\delta$	$1+\delta$	$1+\delta$	$1+\delta$
$x$	$1+\delta$	$1+\delta$	$1+\delta$	$1+\delta$	$1+\delta$	$1+\delta$
$x$ basis	1	1	1	1	1	1
$x$	$1+\delta$	$1+\delta$	$1+\delta$	$1+\delta$	$1+\delta$	$1+\delta$
$x$ min	$1+\delta$	$1+\delta$	$1+\delta$	$1+\delta$	$1+\delta$	$1+\delta$

Figure 2 Example parameter matrix

From the matrix it is a simple matter to derive the change in cost for materials, labour and overheads. (Maintenance, crew number and average crew cost will be described in through life costs, below.) The changed costs are then summed back up to give a new relative value of the ship, for example 1.02 of the basis vessel.

### Through Life Costs or operational expenditure (OPEX)

The through life cost) model has been developed with the aid of SEA's experiences. We can split through life costs into two types of cost, incident costs and operational costs.

Operational costs important to the through life evaluation of the ship have been identified. Only a part of these costs will be estimated by the tool, the remainder will have to be provided by the designer operating the tool.

The costs that will be estimated by the tool can be considered in turn:

- *Build Costs* - As previously stated. However this will be converted to Euros by multiplying the relative costs by a default value for the basis vessel. It will be possible for the end user to change this value to increase the accuracy for the specific shipyard.
- *Fuel Costs* - A tool is being developed by VBD that estimates the required powering of the vessel. It is then only a small matter to convert this into fuel consumption and then into an estimate of how much fuel is used.
- *Cost of Other Engine Room Consumables* - This is to be taken as a proportion of the fuel costs.

- *Crew Costs* – From the work into the risk model it was acknowledged that crew training was a fundamental part to risk reduction. In addition to this, the number of crew and the levels of pay are also factors that will affect the risk level of the ship. It was therefore decided that the matrices should include two extra columns:
  - The first column is “number of crew”. This will be directly influenced by the parameter “number of crew” but will also be affected by other parameters, for example level of system automation.
  - The second column is “average crew costs”. This includes all costs associated with ‘one average crew member for 1 year’. Therefore if you change the required qualifications, training or pay and conditions for the crew this will affect this value.

The crew cost is then the product of the number of crew and the average crew cost.

- *Maintenance Costs* – This is a major through life cost and, from experience, will have an enormous impact on the safety of the vessel. There are two ways the maintenance costs can vary:
  - Voluntary: the level of maintenance may be deliberately changed in the knowledge that it is an important risk reduction variable.
  - Forced: a design change may change maintenance costs, even if the level of maintenance is unchanged.

These changes in maintenance are recorded in the maintenance cost column of the parameter matrices in the standard manner.

## 4.6 WP 6 – Case study

Essentially not started according to the plans

## 5 LIST OF DELIVERABLES

The following table shows the status of the submitted deliverables as compared to the 'Description of Work' originally planned.

Type of Deliverable	Deliverable Number and Title	Classification	Completion of Review Date	Date of cover letter for delivery to EC
WP0	Management Deliverables according to Contract	CFP	-	-
Report	First Annual Report	CFP	Month 14	08-11-2002
WP1				
Report	110 Confirmation of Main Causes	CFP	Month 8	01-03-2002
Report	120 Formulation of models	CFP	Month 18	31-01-2003
WP2				
Report	210 Confirmation of Main Causes	CFP	Month 8	06-03-2002
Report	222/223 Formulation of models (Intermediate report)	CFP	Month 18	Feb 2003
WP3				
Report	310 Confirmation of Main Causes	CFP	Month 8	06-03-2002
Report	324 Fatigue & Longevity model	CFP	Month 18	22-01-2003
WP4				
Report	410 Confirmation of Main Means	CFP	Month 8	01-03-2002
Report	420 Formulation of Models Containment of Damage and Fire	CFP	Month 18	22-01-2003
WP5				
Report	510 Verification and validation procedure/scheme - Main Causes	CFP	Month 9	11-06-2002

Key to abbreviations:

- CFP = Confidential for the Duration of the Project

The above list includes three deliverables, which were finished according to schedule within the midterm date, but forwarded to the EC in January 2003. Only the joint deliverable 3.2.1/3.2.2/3.4 from WP 3 are missing from the anticipated list due to the change in scheduling as explained in section 7.6.

## **6 PLANS FOR USE AND DISSEMINATION**

### **6.1 General**

The S@S Project will be presented by UNEW at the IMDC conference to be held in May 2003.

### **6.2 Exploitation and dissemination strategy for each individual partner, including plan of actions and resources necessary**

For the time being it can be stated that the chapter 10.1 in the 'Description of Work' is still valid, however of course as the project develops more concrete ideas on exploitation and dissemination have emerged. In the following section some of the partners have given such ideas, which soon will be included and most likely further adjusted in the Technological Implementation Plan, which at the time of writing is registered, but appears in an infancy state. It is expected that far more extensive considerations and ideas will appear during the rest of the project as input to the final TIP submitted by the consortium by the end of the project.

#### **6.2.1 Exploitation and dissemination strategy for Bureau Veritas**

Upon completion of the project, Bureau Veritas intends to increase its range of services offered to shipyards and owners in the field of HSC design, aiming at further expanding their share of the worldwide market for classification of these types of ships.

Bureau Veritas will disseminate and exploit the methodology through marketing towards the maritime shareholders: shipyards, ship owners, Authorities; and in relevant public forums (magazines, conferences, etc.). This dissemination has already started during the project through joint papers, which will be presented at IMDC 2003 and FAST 2003 conferences.

The predictable milestones for the three years after the end of the project will be:

- Disseminate the methodology and its regulatory framework within the society, IMO and IACS, likely through study cases (0-24 months),
- Implement operational tools internally for the verification of risk-based designs (0-24 months),
- Promote the methodology, mainly to shipyards, and designers and Authorities (24-36 months)

The utilisation of the methodology is immediate after the end of the project. Collaborations are foreseen with other entities for further research and development, marketing improvement, information exchange and training, consultancy services.

### **6.2.2 D'Appolonia status**

No official dissemination and/or exploitation of the results have been carried out in the first 18 months mainly because the project has just come out from the early development stages. However, the S@S 'philosophy' has been taken as reference for submitting a proposal for a RTD project within one of the 6<sup>th</sup> Framework Programme Integrated Project.

Thanks to the involvement of some WP1 members in other EC funded projects, fruitful discussions have been taken place across these projects, such as THEMES and THOPIC to name a few.

### **6.2.3 VTT statement**

The methods and knowledge developed during this project will be utilised in the research services by VTT. The results of the project will be presented in some suitable international conferences and periodical journals.

### **6.2.4 METTLE dissemination plans**

Mettle will come out, first, with a new methodology for the design of High Speed Craft; specifically in order to improve safety and comfort for passengers. As a research centre and consulting engineering company, Mettle is already involved in activities related to the rationalisation of design activities and adoption of risk based design approach. In this way the S@S project's results will be exploited by enlarging the range of services, such as methods for assessing controllability of HSCs, methodological framework for the design of safer High Speed Crafts at reduced cost.

The results of our market study will allow us to design the most appropriate strategies, methodologies and innovations and therefore to ensure the success of the future exploitation of the project. Our mission is to obtain all relevant information about the target group as well as the industry and to identify the real and potential market. We will interact with all actors of the industry including not only large companies but also small and medium enterprises. Various techniques will be used to gather the information on the industry. A short questionnaire will for instance be designed and addressed to a wide audience throughout Europe. Its aim will be to outline the end-users' current working habits and expectations for the future. This questionnaire will have an important role in the dissemination, as it will contribute the experiment of the project concept.

Our disseminating actions will mainly target the main actors and stakeholders of the maritime and transport industry. The S@S project will in fact provide significant added value to all companies involved in these fields. Therefore, we will focus our promotional efforts towards the following companies:

- ❖ Ship Management Companies
- ❖ Ship Design Companies
- ❖ Ship Operators

- ❖ Ship Building Companies
- ❖ Ship Repair companies

The consortium, comprised of well-established businesses, benefits from a unique network of corporation involved on this industry. Each partners of the project have developed privileged relationships throughout Europe, which will facilitate the dissemination of the results. Therefore the partners will serve as the point of contact with these companies and will ensure that the dissemination activities are going forward. In order to reach these targets, we will use all appropriate communication and dissemination channels available.

Moreover, Mettle will strictly follow the dissemination plan of the [S@S](#) project, respecting the protection of the results as it has been defined.

#### **6.2.5 UNEW comments in email of the 23<sup>rd</sup> January**

Dissemination - We seek to make the marine community aware of the substantial progress made by the S@S Consortium in the field of "Design for Safety". We intend to achieve this by publishing articles in international journals and presenting at relevant international conferences.

Exploitation - The "Design for Safety" methodology developed by the S@S Consortium could be applied to other vessel types and with alternative focus such as design for comfort, the environment and security. We seek to exploit the results of S@S through continued research in these related areas.

#### **6.2.6 SEA comments in email of the 22nd January**

The models being developed as part of the project are seen as a preliminary design tool to evaluate the safety implications and financial cost associated with any change in a design parameter.

The design tool arising from the combination of these models will by automatically not give a detailed or precise analysis, but will present a qualitative evaluation of a parameter change.

Sea Containers in common with most other operators are primarily customers of high speed craft designers/builders will not directly benefit from the use of the model but should benefit from enhanced safety without incurring excessive costs in new build or running costs.

Via designers (e.g. Hart Fenton) the tool will allow the comparison of new designs in any future build program

The tool may offer benefits to legislative bodies to target new safety law in a cost effective manner.

#### **6.2.7 CETENA comments in email of the 22nd January**

No update or review to the preliminary plan for use and dissemination of the results is foreseen.

No new remarkable partner agreements have been carried out for the exploitation of results but fruitful discussions have been taken place and the potential for exploitation confirmed.

### **6.3 S@S web-site**

S@S has been established as planned on the World Wide Web, with the web-address: [http//www.safetyatspeed.org](http://www.safetyatspeed.org)

The general, static information is in place on the web-server and it is continually being updated with relevant project information such as Minutes of Meetings, workshop presentations, progress presentations and reports.

## **7 MANAGEMENT AND CO-ORDINATION ASPECTS**

### **7.1 The performance of the consortium**

There is a general understanding within the consortium that all partners display a genuine interest in and dedication to the project. The Work Package Leaders are doing an excellent job in coordinating the input from the partners in their Work Packages and in planning the Work Package activities. Several Work Packages have held separate meetings outside the scheduled workshops in order to progress the work and this has shown to produce results in a very efficient manner. It has also meant that some partners have had large travel expenses and may exceed their travel budgets, but nevertheless, it is the general impression in the consortium that this has been well spent and plays a major part in the good coordination of the technical work.

Seen from the Project Coordinator's chair the project is running very well and there has been few occasions where it has been necessary to put pressure on any of the partners. The small schedule changes that have occurred are only what one may expect in a project of this type, where planning inconsistencies will invariably show up at one time or another.

## 7.2 Consortium Cost

The below shown cost figures have been calculated based on the 1st year's cost statements of the partners and on estimated figures of expenditure for the remaining six months to the mid-term of the project, the latter being subject to changes until the 2nd year's statements are submitted to the EC.

### S@S - INTEGRATED COST ESTIMATE IN EURO - MIDTERM

For period from 2001.07.01 to 2002.12.31

Contractors	Costs										
	Personnel	Durable equipment	Subcontracting	Travel and subsistence	Consumables	Computing	Protection of knowledge	Other specific costs	Administrative and financial coordination costs	Overheads	TOTAL
FORCE-DMI Technical	76.969,00	0,00	0,00	8.122,00	1.002,00	0,00	0,00	0,00	0,00	76.969,00	163.062,00
FORCE-DMI Coordination	63.855,00	0,00	0,00	10.256,00	2.457,00	0,00	0,00	1.891,00	0,00	66.659,00	145.118,00
Contractor BV	80.803,00	0,00	0,00	17.288,30	0,00	0,00	0,00	0,00	0,00	64.636,80	162.728,10
Contractor DAP	156.000,00	0,00	0,00	14.000,00	0,00	0,00	0,00	0,00	0,00	142.800,00	312.800,00
Contractor DTU	30.000,00	3.200,00	0,00	9.200,00	0,00	4.000,00	0,00	0,00	0,00	9.280,00	55.680,00
Contractor ABS	63.856,23	0,00	0,00	7.935,88	1.568,00	0,00	0,00	0,00	0,00	36.398,05	109.758,16
Contractor VTT	37.100,00	0,00	0,00	17.200,00	0,00	0,00	0,00	0,00	0,00	34.950,00	89.250,00
Contractor FIN	30.881,00	0,00	0,00	8.500,00	0,00	0,00	0,00	0,00	0,00	19.408,00	58.789,00
Contractor SSRC	64.442,40	0,00	0,00	11.536,39	0,00	0,00	0,00	0,00	0,00	15.195,77	91.174,56
Contractor VBD	33.663,28	0,00	0,00	10.316,77	0,00	0,00	0,00	0,00	0,00	0,00	43.980,05
Contractor SIREHNA	139.000,00	0,00	41.000,00	14.000,00	2.000,00	0,00	0,00	1.000,00	0,00	93.000,00	290.000,00
Contractor METTLE	36.478,00	0,00	0,00	2.148,00	0,00	0,00	0,00	0,00	0,00	29.183,00	67.809,00
Contractor UNEW	115.949,75	0,00	0,00	28.245,53	468,07	3.613,96	0,00	0,00	0,00	29.655,43	177.932,74
Contractor NTUA	74.300,00	0,00	0,00	15.331,20	0,00	25.000,00	0,00	0,00	0,00	22.926,24	137.557,44
Contractor SEA	26.148,27	0,00	0,00	5.366,72	0,00	0,00	0,00	110,73	0,00	0,00	31.625,72
Contractor CETENA	39.793,46	0,00	0,00	15.990,82	0,00	0,00	0,00	586,29	0,00	44.667,37	101.037,94
<b>TOTAL</b>	<b>1.005.384,39</b>	<b>3.200,00</b>	<b>41.000,00</b>	<b>185.181,61</b>	<b>5.038,07</b>	<b>32.613,96</b>	<b>0,00</b>	<b>1.697,02</b>	<b>0,00</b>	<b>619.069,66</b>	<b>1.893.184,71</b>

	TOTAL	Total revised budget	% Used
FORCE-DMI Technical	163.062,00	300.643,00	54,2
FORCE-DMI Coordination	145.118,00	305.000,00	47,6
Contractor BV	162.728,10	434.126,00	37,5
Contractor DAP	312.800,00	696.020,00	44,9
Contractor DTU	55.680,00	118.800,00	46,9
Contractor ABS	109.758,16	216.457,00	50,7
Contractor VTT	89.250,00	151.000,00	59,1
Contractor FIN	58.789,00	343.637,00	17,1
Contractor SSRC	91.174,56	271.276,00	33,6
Contractor VBD	43.980,05	92.750,00	47,4
Contractor SIREHNA	290.000,00	488.131,00	59,4
Contractor METTLE	67.809,00	205.510,00	33,0
Contractor UNEW	177.932,74	471.840,00	37,7
Contractor NTUA	137.557,44	158.546,00	86,8
Contractor SEA	31.625,72	121.720,00	26,0
Contractor CETENA	101.037,94	257.911,00	39,2
<b>TOTAL</b>	<b>1.893.184,71</b>	<b>4.633.367,00</b>	<b>40,9</b>

### 7.3 Consortium effort

Consolidated Consortium Effort spent until 2002.12.31 page 1

S@S Consortium wide manmonthly comparison budget versus spent during the 1st half of the duration: 2001.07.01-2002.12.31																		
	DMI			BV			DAP			DTU			ABS			VTT		
	Budg	Done	Diff.	Budg	Done	Diff.	Budg	Done	Diff.	Budg	Done	Diff.	Budg	Done	Diff.	Budg	Done	Diff.
WP0																		
0	9,1	10,4	-1,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0
WP1																		
1.1	3,5	3,5	0,0		0,2	-0,2	2,0	2,0	0,0			0,0			0,0			0,0
1.2	4,0	3,3	0,7	2,0	1,2	0,8	8,0	7,2	0,8			0,0			0,0			0,0
1.3	0,2	0,1	0,1			0,0	3,0	1,0	2,0			0,0			0,0			0,0
SUM	7,7	6,9	0,8	2,0	1,4	0,6	13,0	10,2	2,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
WP2																		
2.1			0,0			0,0			0,0			0,0			0,0	1,0	1,0	0,0
2.2			0,0			0,0			0,0	6,0	7,0	-1,0			0,0	9,0	6,7	2,3
2.3			0,0			0,0			0,0			0,0			0,0	2,0	0,0	2,0
SUM	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	6,0	7,0	-1,0	0,0	0,0	0,0	12,0	7,7	4,3
WP3																		
3.1			0,0			0,0			0,0			0,0	1,5	1,5	0,0			0,0
3.2			0,0			0,0			0,0	1,5	1,0	0,5	9,0	6,5	2,5			0,0
3.3			0,0			0,0			0,0			0,0			0,0			0,0
SUM	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,5	1,0	0,5	10,5	8,0	2,5	0,0	0,0	0,0
WP4																		
4.1	2,0	2,0	0,0			0,0	2,0	2,0	0,0			0,0			0,0			0,0
4.2	4,0	3,1	0,9			0,0	10,0	9,0	1,0			0,0			0,0			0,0
4.3			0,0			0,0	2,0	0,0	2,0			0,0			0,0			0,0
SUM	6,0	5,1	0,9	0,0	0,0	0,0	14,0	11,0	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
WP5																		
5.1			0,0	6,0	4,5	1,5	2,0	2,0	0,0			0,0	0,3	0,3	0,0			0,0
5.2			0,0	4,0	2,8	1,2	2,0	1,0	1,0			0,0	0,2	0,2	0,0			0,0
5.3			0,0			0,0	0,0	0,0	0,0			0,0			0,0			0,0
5.4			0,0			0,0	0,0	0,0	0,0			0,0			0,0			0,0
SUM	0,0	0,0	0,0	10,0	7,3	2,7	4,0	3,0	1,0	0,0	0,0	0,0	0,5	0,5	0,0	0,0	0,0	0,0
WP6																		
6.1			0,0			0,0	0,0	0,0	0,0			0,0			0,0			0,0
6.2			0,0			0,0	0,0	0,0	0,0			0,0			0,0			0,0
6.3			0,0			0,0	0,0	0,0	0,0			0,0			0,0			0,0
SUM	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
GT	22,8	22,4	0,4	12,0	8,7	3,3	31,0	24,2	6,8	7,5	8,0	-0,5	11,0	8,5	2,5	12,0	7,7	4,3

Consolidated Consortium Effort spent until 2002.12.31 – page 2

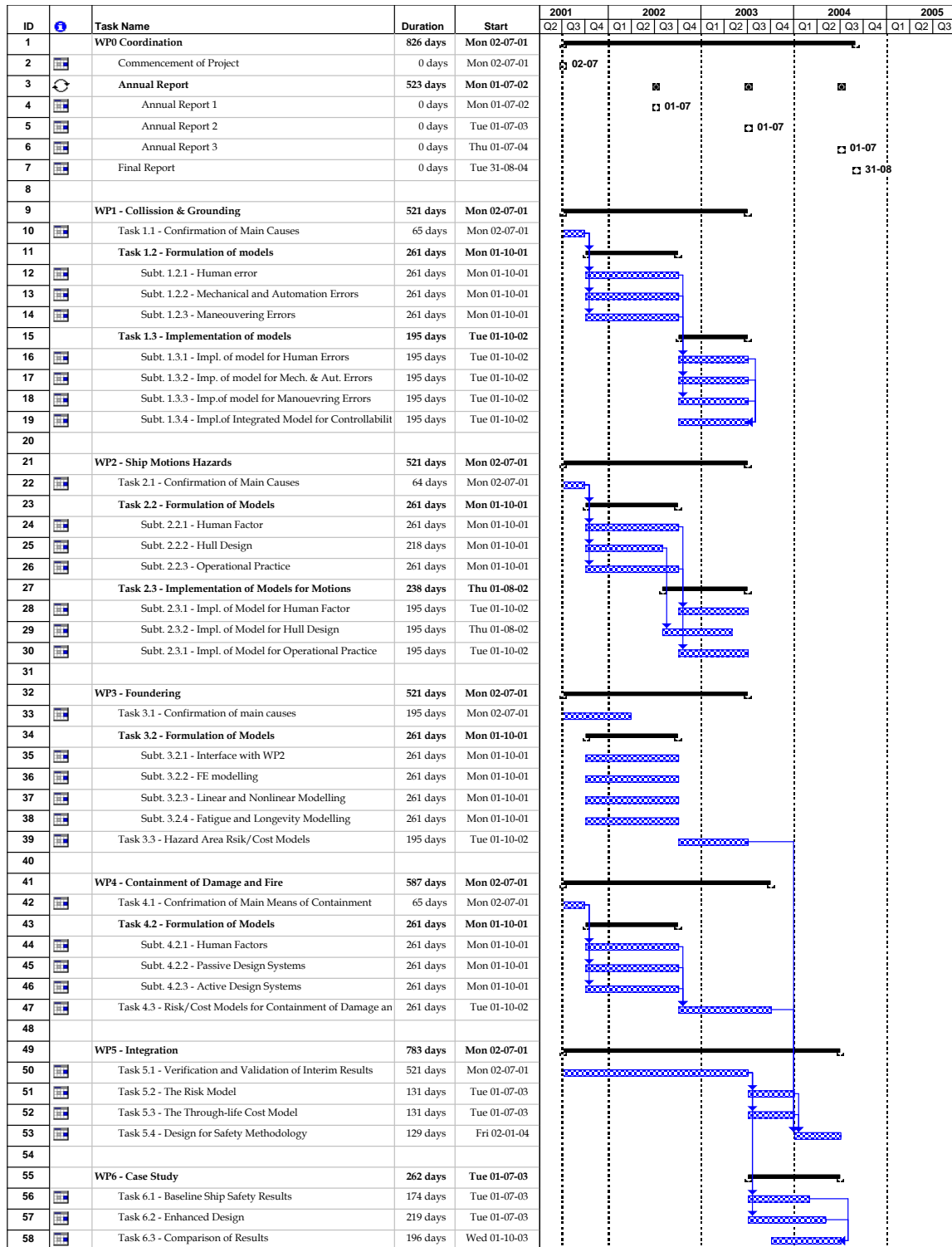
S@S Consortium wide manmonthly comparison budget versus spent during the 1st half of the duration: 2001.07.01-2002.12.31																		
	FIN			SSRC			VBD			SIREHNA			METTLE			UNEW		
	Budg	Done	Diff.	Budg	Done	Diff.	Budg	Done	Diff.	Budg	Done	Diff.	Budg	Done	Diff.	Budg	Done	Diff.
WP																		
0,0	0,0	0,0	0,0	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0
WP1																		
1.1			0,0	0,0		0,0			0,0			0,0			0,0			0,0
1.2			0,0	0,0		0,0	4,0	3,0	1,0	5,0	4,0	1,0	5,8	4,9	0,9			0,0
1.3			0,0	0,0		0,0	1,0	1,0	0,0	1,5	1,0	0,5	1,0		1,0			0,0
SUM	0,0	0,0	0,0	0,0		0,0	5,0	4,0	1,0	6,5	5,0	1,5	6,8	4,9	1,9	0,0		0,0
WP2																		
2.1			0,0			0,0			0,0	2,0	2,0	0,0			0,0	1,0	1,0	0,0
2.2			0,0	4,0	4,0	0,0			0,0	18,0	16,0	2,0			0,0	5,0	5,0	0,0
2.3			0,0			0,0			0,0	0,0	0,0	0,0			0,0			0,0
SUM	0,0	0,0	0,0	4,0	4,0	0,0	0,0	0,0	0,0	20,0	18,0	2,0	0,0	0,0	0,0	6,0	6,0	0,0
WP3																		
3.1	3,0	3,0	0,0			0,0			0,0			0,0			0,0	0,0	0,3	-0,3
3.2			0,0			0,0			0,0			0,0			0,0	12,5	12,5	0,0
3.3			0,0			0,0			0,0			0,0			0,0	1,8	1,8	0,0
SUM	3,0	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	14,3	14,6	-0,3
WP4																		
4.1			0,0	3,0	3,0	0,0			0,0			0,0			0,0			0,0
4.2			0,0	18,0	18,0	0,0			0,0			0,0			0,0	6,0	6,0	0,0
4.3	0,0	0,0	0,0			0,0			0,0			0,0			0,0			0,0
SUM	0,0	0,0	0,0	21,0	21,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	6,0	6,0	0,0
WP5																		
5.1	1,0	0,0	1,0	0,5	0,5	0,0			0,0	1,5	0,5	1,0			0,0	1,7	1,7	0,0
5.2			0,0	0,5	0,5	0,0			0,0			0,0			0,0	0,7	0,7	0,0
5.3			0,0			0,0			0,0			0,0			0,0	6,1	6,1	0,0
5.4			0,0			0,0			0,0			0,0			0,0			0,0
SUM	1,0	0,0	1,0	1,0	1,0	0,0	0,0	0,0	0,0	1,5	0,5	1,0	0,0	0,0	0,0	8,5	8,5	0,0
WP6																		
6.1	0,0	1,5	-1,5			0,0			0,0			0,0			0,0			0,0
6.2	0,0		0,0			0,0			0,0	0,0	0,0	0,0			0,0			0,0
6.3	0,0		0,0			0,0			0,0			0,0			0,0			0,0
SUM	0,0	1,5	-1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
GT	4,0	4,5	-0,5	26,0	26,0	0,0	5,0	4,0	1,0	28,0	23,5	4,5	6,8	4,9	1,9	34,8	35,1	-0,3

Note: The man-months stated for SSRC and UNEW are estimated, and represent the percentage of scope of work completed, but in order to fit the purpose of the spreadsheet, namely to measure the pace of the project, the coordinator has transformed the % into man-month figures. The coordinator finds, that the error introduced in this way is of a second order of magnitude.

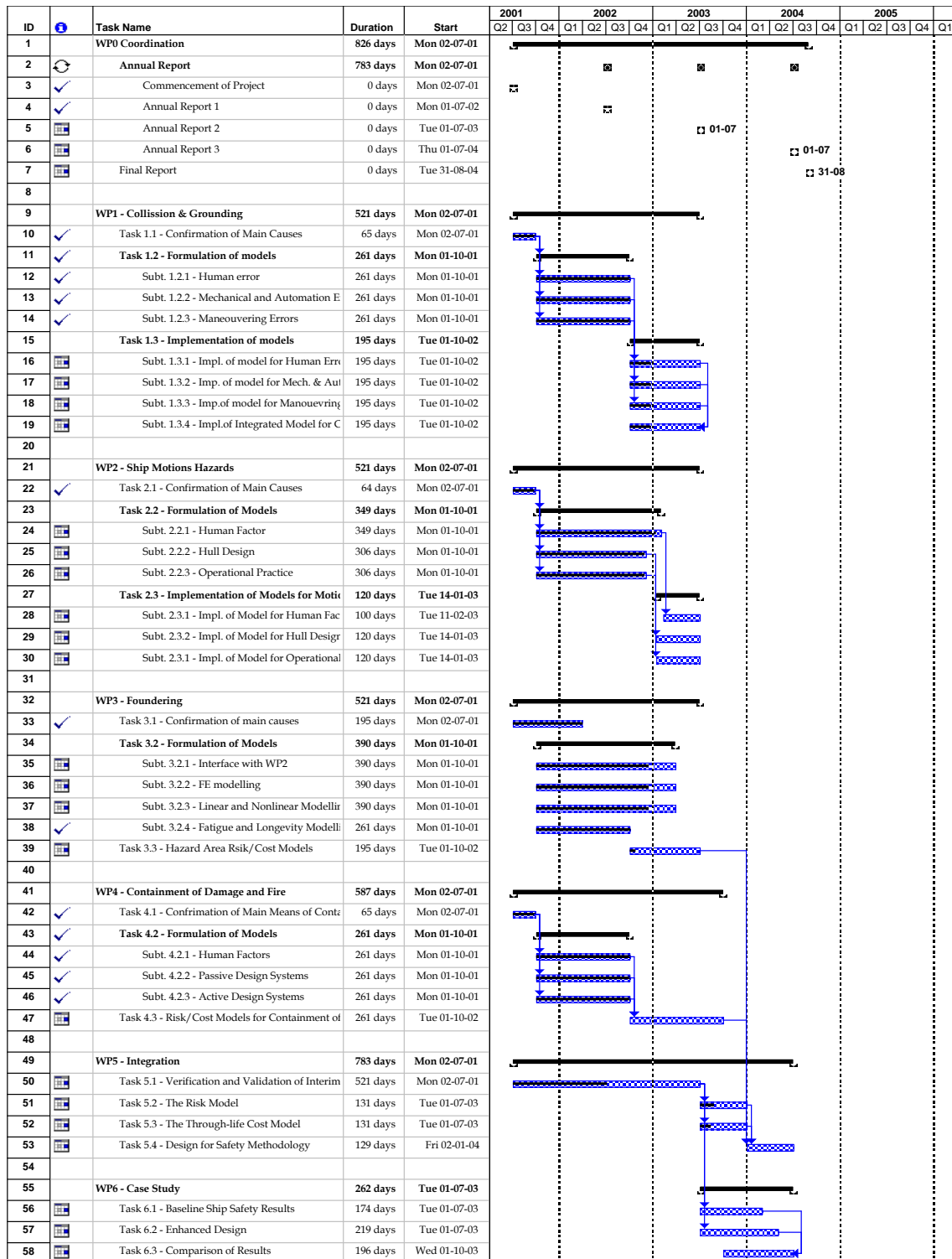
## Consolidated Consortium Effort spent until 2002.12.31 – page 3

S@S Consortium wide manmonthly comparison budget versus spent during the 1st half of the duration: 2001.07.01-2002.12.31													
	NTUA			SEA			CETENA			Consortium totals			% done
	Budg	Done	Diff.	Budg	Done	Diff.	Budg	Done	Diff.	Budget	Done	Difference	
WP0													
0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0	9,1	10,4	-1,3	114,3
1.1			0,0			0,0			0,0	5,5	5,7	-0,2	103,6
1.2	2,0	2,0	0,0			0,0	5,0	5,0	0,0	35,8	30,6	5,2	85,5
1.3			0,0			0,0	2,5	2,5	0,0	9,2	5,6	3,6	60,9
SUM	2,0	2,0	0,0	0,0	0,0	0,0	7,5	7,5	0,0	50,5	41,9	8,6	83,0
WP2													
2.1			0,0			0,0			0,0	4,0	4,0	0,0	100,0
2.2	8,0	7,6	0,4	1,8	1,2	0,6			0,0	51,8	47,5	4,3	91,7
2.3			0,0			0,0			0,0	2,0	0,0	2,0	0,0
SUM	8,0	7,6	0,4	1,8	1,2	0,6	0,0	0,0	0,0	57,8	51,5	6,3	89,1
WP3													
3.1			0,0	0,5	0,6	-0,1	3,0	3,6	-0,6	8,0	9,0	-1,0	112,5
3.2	10,0	8,7	1,3			0,0			0,0	33,0	28,7	4,3	87,0
3.3			0,0			0,0			0,0	1,8	1,8	0,0	100,0
SUM	10,0	8,7	1,3	0,5	0,6	-0,1	3,0	3,6	-0,6	42,8	39,5	3,3	92,3
WP4													
4.1			0,0			0,0			0,0	7,0	7,0	0,0	100,0
4.2			0,0			0,0			0,0	38,0	36,1	1,9	95,0
4.3			0,0	2,0	0,6	1,4			0,0	4,0	0,6	3,4	15,0
SUM	0,0	0,0	0,0	2,0	0,6	1,4	0,0	0,0	0,0	49,0	43,7	5,3	89,2
WP5													
5.1			0,0			0,0			0,0	13,0	9,5	3,5	73,1
5.2			0,0			0,0			0,0	7,4	5,2	2,2	70,3
5.3			0,0			0,0			0,0	6,1	6,1	0,0	100,0
5.4			0,0			0,0			0,0	0,0	0,0	0,0	#DIV/0!
SUM	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	26,5	20,8	5,7	78,5
WP6													
6.1			0,0			0,0			0,0	0,0	1,5	-1,5	#DIV/0!
6.2			0,0			0,0			0,0	0,0	0,0	0,0	#DIV/0!
6.3			0,0			0,0			0,0	0,0	0,0	0,0	#DIV/0!
SUM	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,5	-1,5	#DIV/0!
GT	20,0	18,3	1,7	4,3	2,4	1,9	10,5	11,1	-0,6	235,7	209,3	26,4	88,8

### 7.4 S@S Gantt-chart at project start



### 7.5 S@S Gantt Chart at midterm



## **7.6 Comments to performance**

### **7.6.1 General remarks by the coordinator**

The tables above show that until the mid term 41% of the total budgeted project cost has been incurred and that 89% of the effort planned has been spent.

By comparing the Gantt chart for the project start with the revised chart it is observed, that Task 2.2 and 3.2 have suffered a delay of 4-6 months. This delay became apparent during the summer 2002 and was partly due to inconsistencies in the original planning, where some dependencies between activities were overlooked. This was discovered early enough for the consortium to make the necessary adjustments to the plans, so that the following tasks could be adequately compressed, and the overall model results be ready in time for the integration activity and for use in the case study WP6.

The coordinator therefore feels that the project is progressing satisfactory and is confident that the project in all respects will meet the obligations set out in the 'Description of work' and including finish at the stipulated time 30<sup>th</sup> June 2004 without exceeding the budget.

In the following sections 7.6.2- 7.6.5 some of the work package leaders have given their comments to the performance within the WPs.

### **7.6.2 For WP1 by D'Appolonia**

On the basis of the above reported tables, it seems that there are no important differences between scheduled and actual manpower used for any of the tasks or by any of the partners of WP1, there are only minor adjustments that can be considered normal due to the size of the project and, especially, to the novelty of the approach undertaken. Similarly, no important differences between scheduled and actual progress of a given task have to be reported.

### **7.6.3 For WP3 by ABS**

The project start was later than expected which meant that the project scheduling was also affected.

Furthermore, after the project commencement and ensuing workshops it was also apparent that task 3.2 was dependent on results obtainable from the model tests and sea trial proposed for WP2.

These have caused a deferment of some of the deliverables for Task 3.2.

However, the sub-tasks within 3.2 are being co-ordinated with Task 3.3 and it is not expected to have an undue effect on the completion of all tasks within WP3, or to cause concern in the timely completion of the project.

Some changes have been made to the work content of Task 3.2 in that the Technical Annex proposed the use of Non-linear loading of the finite element models. This was found to be an impossible proposition within the project framework and time scale. Alternative means of loading the structural models have been devised based on Classification Society Rules, which are readily available to the designer at the preliminary stages of the vessel's design. This alternative method will be verified and calibrated by using the results of the structural inspection, results of the model tests and full-scale measurements of the SuperSeaCat3.

It is expected that on completion of the tasks WP3 will achieve the objectives of the project.

- Simplified design tools to determine the global and local strength requirements of the preliminary design of a High Speed Craft will be provided.
- A tool for determining the fatigue capability of structural details used in the vessel's construction will be provided.
- Design Guidelines will be developed for the implementation of the tools that have been developed.
- Satisfactory risk/cost models will be provided to WP5 for integration into the total project.

#### **7.6.4 For WP4 by SSRC**

Discussion of Results in the Period

The work performed and results achieved within Tasks 4.1 and 4.2 have been produced according to plan, in terms of milestones and deliverables. Indeed, work on integration of the risk/cost model for containment has already been carried out as part of the activities in Task 4.2.

Task 4.3 is active and work within the reporting period was concentrated in detailing the elements of the risk/cost model. The Task is not yet complete, but it is expected that it will be completed in line with the schedule of the project.

#### **7.6.5 For WP 5 by BV**

The Deliverable D5.1.0 concerning the validation of main causes was issued and delivered in accordance with the revised schedule.

Regarding tasks 5.2 and 5.3, achievements can be related to presentations issued before and after the Paris meeting in May 2002, the listing of parameters and their format in an iterative procedure will be finalised after the WP1 to 4 models are finished, but the delays in WP 2 and 3 will not effect the milestones for the validation of models and the Integrated Risk Model, which still is 2003/06/30.

## **8 CONCLUSIONS AND POSSIBLE DESCRIPTION OF WORK REVIEW**

### **8.1 General**

In this section we have included the statements of each partner regarding their willingness to carry out the project to the end of the project and it is a pleasure for the coordinator to conclude, that all partners without any cautions have confirmed this. By reading through their comments it appears that this confirmation is done with little or approximately no changes to the scope written in the 'Description of work'.

#### **8.1.1 FORCE Technology technical**

In view of the achieved results to date and the potential for exploitation FORCE Technology intends to continue the project in accordance with our obligations as stipulated in the technical annex.

#### **8.1.2 BV statement**

In view of the achieved results to date and the potential for exploitation Bureau Veritas wish to continue the project.

#### **8.1.3 Quote of DAP email of the 12<sup>th</sup> January**

In view of the achieved results to date and the potential for exploitation, D'Appolonia wish to continue the project. Based on the critical assessment of the results achieved, the planning of the work for WP1 for the second period of the research does not need to be reviewed. Slight modifications to the Description of Work (Annex I to the contract) might occur but they will not affect the fulfillment of the final objectives.

#### **8.1.4 Quote of DTU email of the 17<sup>th</sup> December**

DTU finds the achieved results promising and want to continue the project.

#### **8.1.5 Quote of ABS email of the 23<sup>rd</sup> January**

We refer to the up and coming midterm review for the Safety @ Speed project. We confirm that ABS Europe wish to continue with this project through to its completion.

#### **8.1.6 Quote of VTT email of the 8<sup>th</sup> January**

VTT wish to continue the S@S project. From VTT's point of view the planning of the work for the second period of research does not need any modifications.

#### **8.1.7 Quote of FIN email of the 23<sup>rd</sup> January**

In accordance with the relevant scope of the project to define a dedicated tool for Safety and integrate it into the different phases of design FIN wants to continue the project.

**8.1.8 Quote of SSRC email of the 27<sup>th</sup> January**

In light of the research carried out so far and the results obtained in all tasks of the project where we participate, which are in agreement with the set project objectives and milestones, we would expect the project to continue to allow us to fulfill the overall project aim and specific objectives set out for the work still to be carried out.

**8.1.9 Quote of VBD email of the 22nd January**

VBD declares, that she wants to continue with the project S@S.

**8.1.10 Quote of SIREHNA email of the 8<sup>th</sup> January**

Please also note that for Mid Term, SIREHNA supports the continuation of the project.

**8.1.11 METTLE's Conclusion for continuation of the work.**

The basis of the [S@S](#) tool has been established. The work done to date is very encouraging and the tool will have a very strong opportunity to be implemented within the maritime world. During the second part of the project Mettle will have to take part of the case studies of the tool. A strong validation of the project's results is necessary to ensure the possibilities of exploitation of the tool. During this phase, Mettle will work hard to demonstrate the effectiveness of the tool as a HSC design support tool. In particular, a real life test will be done to demonstrate the efficiency of the project's results. The comparison with the traditional design approach will also provide a benefit input for the exploitation plan as it will define the added value of the [S@S](#) tool.

**8.1.12 UNEW confirmation in email of the 7<sup>th</sup> January**

In preparing for the mid-term report (and with reference to Item 8 of the Guidelines for the Mid-Term report) please note that in view of the results achieved to date and the potential for exploitation of the results, Newcastle University wishes to continue with all aspects of the Safety at Speed Project in which it is involved.

**8.1.13 Quote of NTUA email of the 23rd January**

In view of the achieved results and the potential for exploitation, NTUA wishes to continue participating in [S@S](#) project.

**8.1.14 Quote of SEA email of the 22nd January**

With regard to Sea Containers continued involvement in the project, I have spoken to John Geldard and he has confirmed that Sea Containers will continue to participate in the program. Therefore unless you require a more formal notice e.g. letter of confirmation please accept this E-mail as confirmation.

**8.1.15 Quote of CETENA email of the 22nd January**

According to the achieved results and the potential for exploitation, CETENA wish to continue the project.

The planning of the work for CETENA for the second period of the research does not need to be reviewed. No remarkable modifications to the Description of Work of CETENA (Annex I to the contract) are at the moment foreseen; slight modifications might occur but they will not affect the fulfillment of the final objectives.

## 9 APPENDIX 1

### 9.1 Agenda for the Mid Term Session on the 5th February 2003

Meeting Place:

Holiday Inn hotel - 1, boulevard des Martyrs Nantais, 44200 Nantes, France

09:00	Midterm session	Action
	1. Welcome.	FORCE Technology-DMI
	2. Presentation of the <a href="#">S@S</a> project general	FORCE Technology-DMI
	3. <a href="#">S@S</a> Visions	University of Newcastle
	4. Presentation of WP 1	D'Appolonia
	5. Presentation of WP 2	SIREHNA
	6. Presentation of WP 3	American Bureau of Shipping, Europe
	7. Presentation of WP 4	University of Strathclyde
	8. Presentation of WP 5	Bureau Veritas
	9. Presentation of WP 6	CETENA
	10. Summary	FORCE Technology - DMI
	11. General Discussion of the Project	EC/All
	12. Final Remarks	EC
	13. Closing of the meeting	FORCE-Technology

The slide presentations given by the consortium under the agenda item 2-10 are shown below in the following section 9.2 - 9.10.

## 9.2 Presentation of the S@S Project General

### 9.3 S@S Visions

## 9.4 Presentation of WP1

## 9.5 Presentation of WP2

## 9.6 Presentation of WP3

## **9.7 Presentation of WP4**

## **9.8 Presentation of WP5**

## **9.9 Presentation of WP6**

## 9.10 Summary

Here goes the counter for total number of pages