PROJECT HORIZON
DESIGN MANAGEMENT IN A MULTINATIONAL ENVIRONMENT

BY

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ABSTRACT

The article examines the challenge of producing a common warship design in a multinational environment. Set within the background of the overall procurement strategy, the article outlines in particular the approach, techniques and procedures to be used for design management in project HORIZON—covering both platform and combat system areas. The article also describes the role and responsibilities of government organizations and industry in the design process.

INTRODUCTION—ORIGINS OF PROJECT HORIZON

NFR 90—Lessons learnt

A requirement has existed for a number of years amongst western navies for new anti-air frigates, to enter service early in the 21st century. The first serious attempt to meet this need co-operatively resulted in the NATO NFR 90 project, involving 8 nations (6 European, the USA and Canada). This project was abandoned during the Project Definition (PD) phase, in 1990, principally because of programme misalignment between the ship and its Combat Systems (CSs), and because of the proliferation of national variants which undermined the benefit of cost sharing.

2 new approaches

New attempts were soon made to find alternative bases for a collaboration and eventually 2 new 'clubs' emerged from the 6 European partners of NFR 90:

1. Involving the UK, France and Italy—Project HORIZON.
2. Involving the Netherlands, Germany and Spain.

These 2 projects differ in the extent of commonality being attempted:

- Project HORIZON is dedicated to a common warship design (with the exception of very few identified variants) involving both the ship and the CS. It is being procured using joint or common organizations. The cardinal dates in its development are shown in (FIG.1).
- The Netherland, German and Spanish co-operation adopts a different approach, targeting co-operation to some common equipment procurement. The warships are being designed and procured using national organizations.

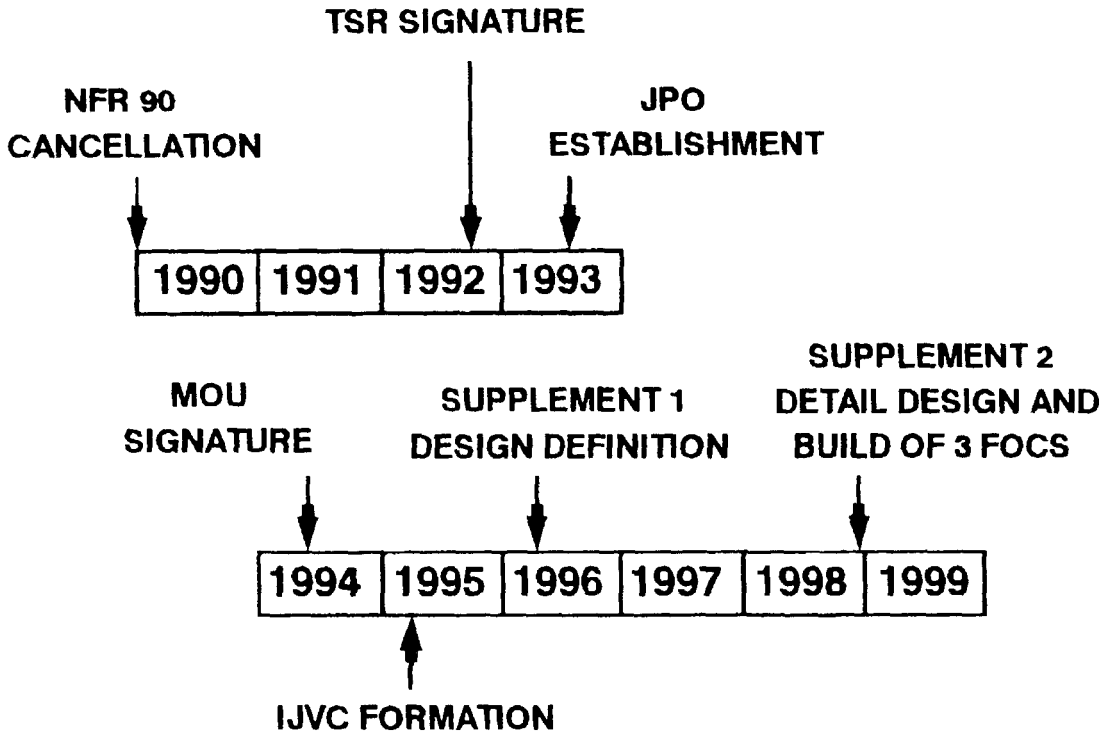

FIG. 1—HISTORY AND PHASES OF PROJECT HORIZON

This article therefore outlines the manner in which the international route adopted by project HORIZON is being tackled. It examines the joint organization structures being put in place, the management arrangements and procedures necessary to confront the very significant challenge of producing a common design.

OUTLINE OF THE REQUIREMENTS FOR THE COMMON NEW GENERATION FRIGATE (CNGF)

Tripartite Staff Requirement (TSR)

The TSR for the CNGF was signed by the three Chiefs of Naval Staff at the end of 1992. It foresaw the need to replace the following ships:

UK	12 Type 42 class.
France	4 SUFFREN and CASSARD classes.
Italy	6 DORIA and AUDACE classes.

The main operational requirements being:

(*a*) Anti-air warfare (AAW) (emphasizing a layered defence concept, including area defence).

(*b*) Command and control of a Task Group.

(*c*) Anti-surface warfare/naval gunfire support.

(*d*) Anti-submarine warfare.

The main likely scenarios for the use of the ship are:

- Unit in a Task Force
- In support of lightly armed or unarmed vessels
- Operating as a single unit
- In non-combat operations.

Overview of the CS

The CS is composed of the following major sub-systems:

(*a*) *Principal Anti-Air Missile System (PAAMS)*

This is the major AAW weapon sub-system carried on the ship and is the prime means by which the CNGF performs its layered area defence role. It is constituted of:

1 Multifunction radar (either EMPAR or SAMPSON).
48 ASTER 15 and 30 missiles deployed from vertical launch silo modules.
1 Command and control unit.
1 Long range radar.

This system is being procured through a separate collaborative programme based in Paris and will be supplied as Government Furnished Equipment (GFE) (i.e. an item for which responsibility lies with the Governments not the prime contractor) to the HORIZON programme. Its requirement is however covered in the TSR.

(*b*) *Full Development Items (FDI's)*

The FDI's are the CS sub-systems where a major development programme is required to be funded by the project. There are three such items:

Combat Management System (CMS).
Fully Integrated Communication System (FICS).
Electronic Warfare System (EWS).

(*c*) *Non Development Items (NDI's)*

These are the remaining 20 sub-systems of the CS where it was felt that the military need could be met by systems already 'off the shelf', or by a minimal amount of adaptation funded by the potential suppliers. Examples of such sub-systems are the medium calibre gun and the surface to surface guided weapons.

General warship characteristics—special features

The following general warship characteristics have been emphasised in the TSR:

- Signature reduction
- Survivability
- Reduced manning and automation
- Female integration
- Environmental cleanliness.

PROCUREMENT STRATEGY AND ORGANIZATION

Memorandum of Understanding (MOU) and phases of programme

The programme MOU is the share holders agreement between the three Governments providing the framework for both project management and the long term procurement strategy. It was signed on 11 July 1994. The financial commitment is given phase by phase through supplements which commit the necessary funds to launch each phase of the project. A preliminary supplement covering the first segment of definition studies was signed with the MOU in 1994. Supplement 1 (signed early 96) covers the remaining part of the definition phase. If all goes well supplement 2 covering full development, including the build of the three First of Class (FOC), should be signed about 2½ years later. Supplement 3 would cover a commitment to follow-on production (see FIG.1).

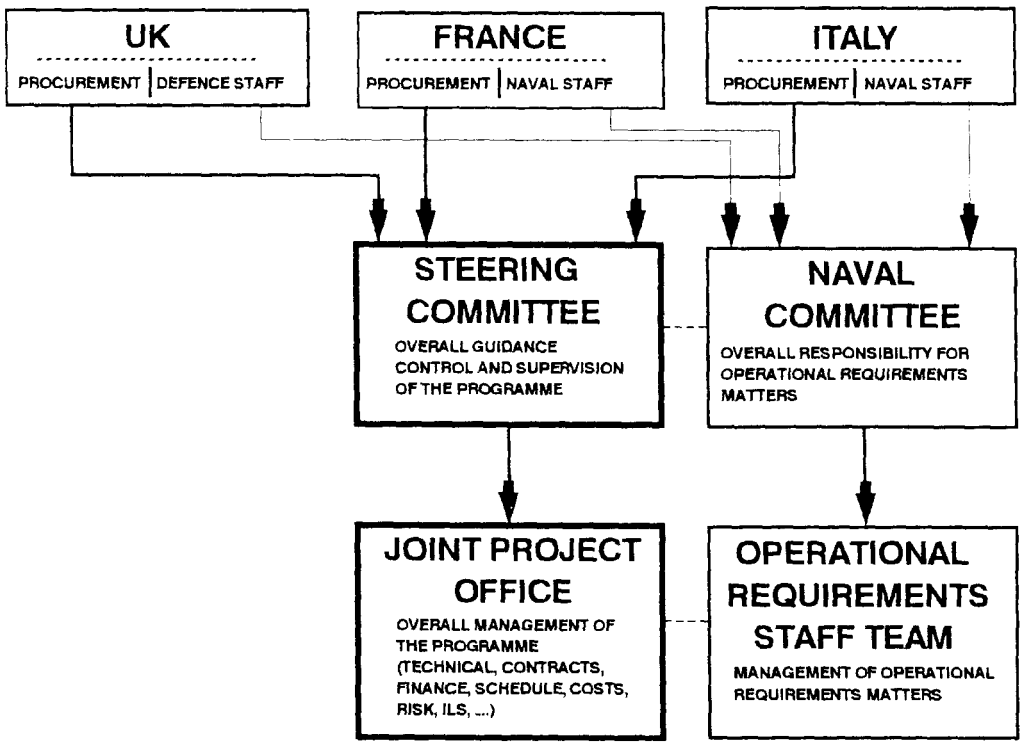

FIG. 2—GOVERNMENT ORGANIZATION

Government organization (FIG.2)

The Joint Project Office (JPO) which is located in London has exclusive executive authority to run the project and is accountable only to its Steering Committee (SC). At present it has about 75 permanent staff. Its terms of reference, signed by the three National Armament Directors (NADs) in sum-

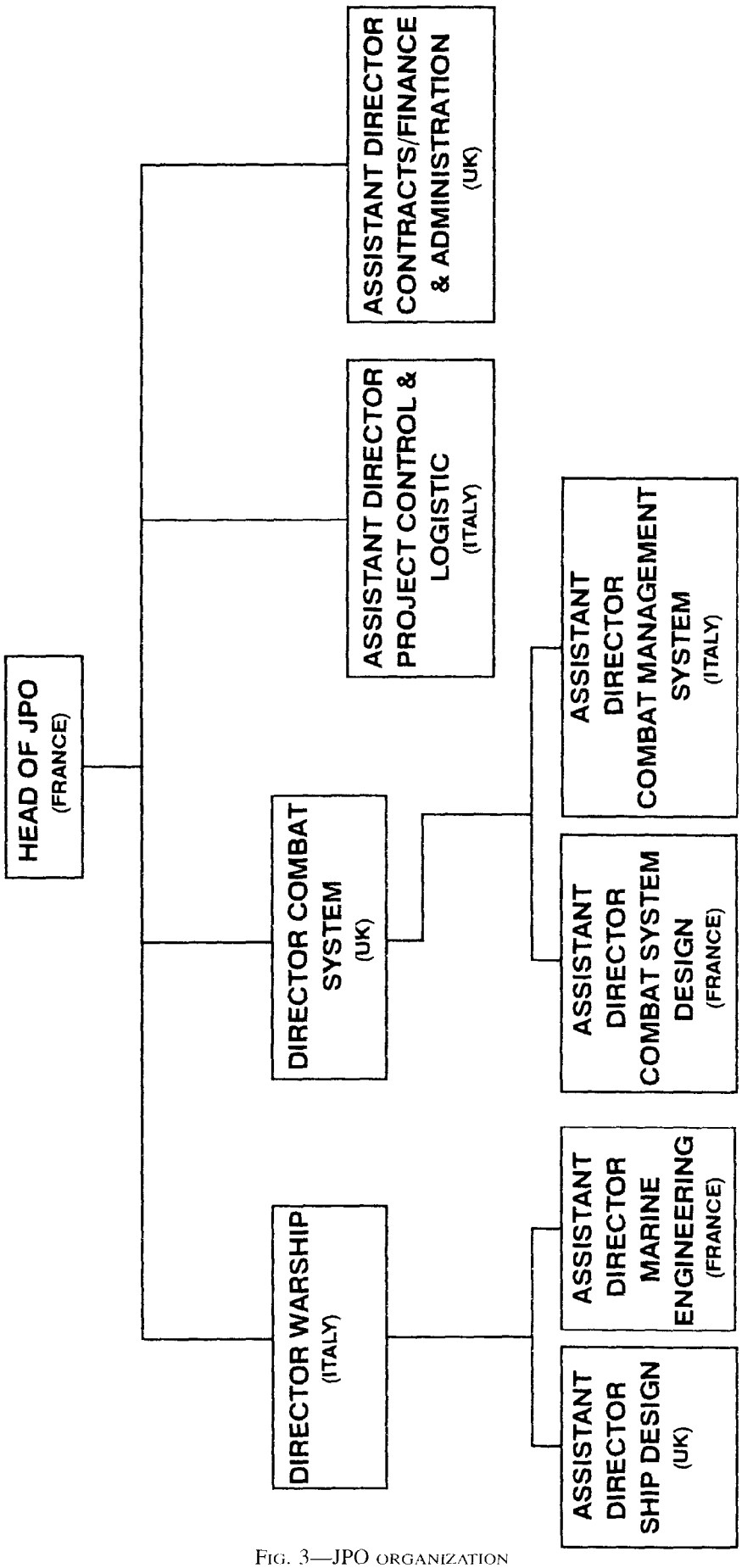

FIG. 3—JPO ORGANIZATION

mer 1993, represent a significant advance on previous collaborative projects, in that they provide the JPO with the authority to make technical and design related decisions. (A significant disadvantage of the traditional working group structure is that difficult decisions are avoided or vetoed and generally passed up the chain of command to higher level working groups who have no real accountability for the progress made.) With the JPO there is a strong central 'motor' to make proposals, with the check that the SC must approve important decisions and major contract documentation. The structure of the JPO is shown in (FIG.3), showing there is no triplication of senior functions for nationality reasons, but that instead the major posts have been shared. The conduct of JPO members is governed by a JPO charter, signed by the three NADs.

Co-located with, but organizationally separate from, the JPO is the Operational Requirements Staff Team (ORST) who provide interpretation and clarification of the tri-national staff requirements (see below) as well as providing a channel for operator input into the design process.

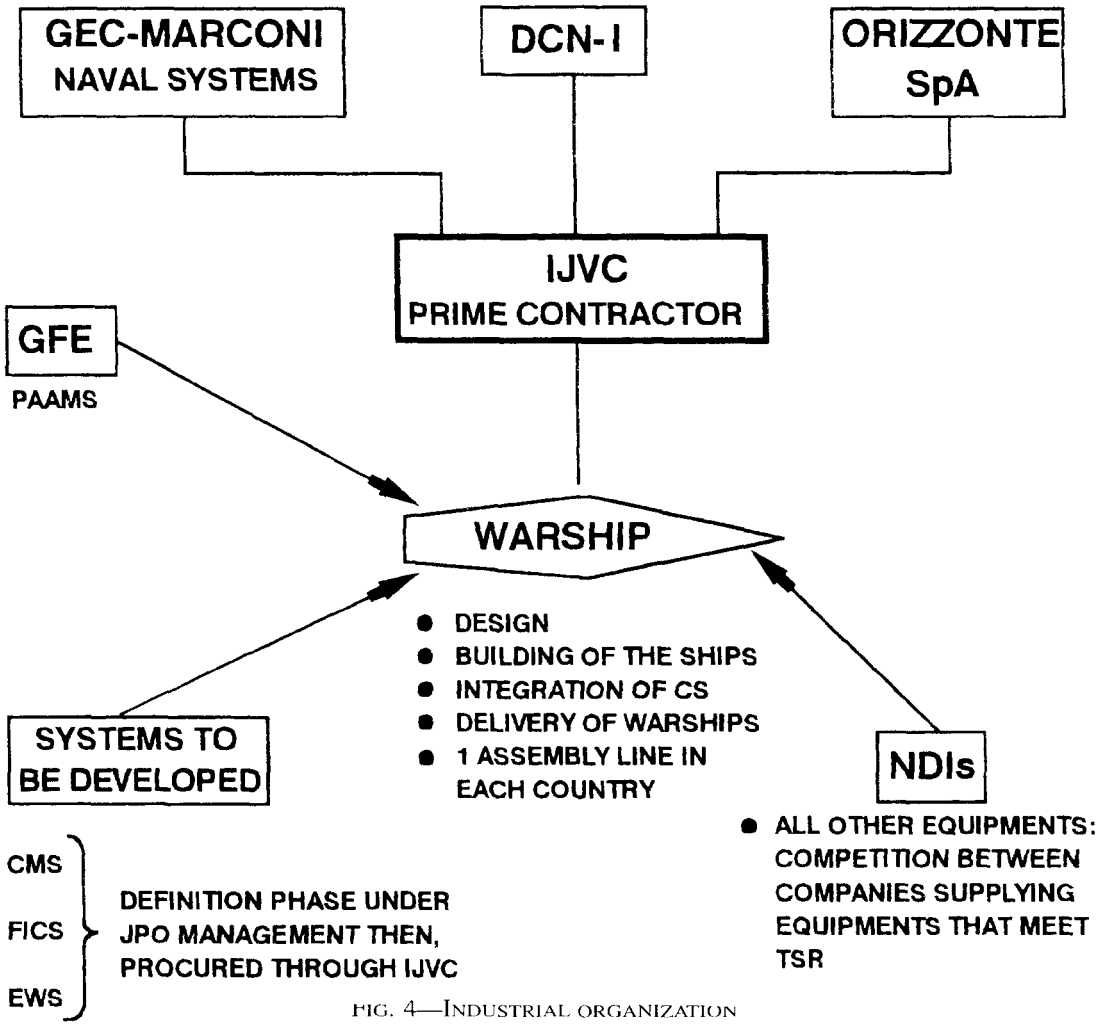

FIG. 4—INDUSTRIAL ORGANIZATION

Industrial organization (FIG.4)

The prime contractor designate is HORIZON IJVC Limited (the IJVC being an International Joint Venture Company) set up specifically for project HORIZON as a UK registered limited company. It is based in London, like the JPO, but is not colocated with it and the share holders are:

- GMNS—UK
- DCN International—France
- Consortzio Orizzonte (50/50 Fincantieri/Finmeccanica)—Italy.

From phase 1 it is intended that the IJVC will be responsible for the warship design, the integration of the CS and for making recommendations to the JPO for the selection of NDIs (see above). In parallel three competitive PD contracts will be let by the JPO for the three FDI's (CMS, EWS and FICS) and for participation of the IJVC in the functional design of the CS. From the start of phase 2 it is the intention that the IJVC, acting as the Prime Contractor, will manage the whole of the warship design and build (including the full development and initial production FDI contracts) with the exception of PAAMS. The governments shall obviously at that point need to be convinced that the IJVC proposal for taking this responsibility offers the best value for money with acceptable terms and conditions.

Commonality and alignment of procedures

For a collaborative project to work efficiently the need for a common set of staff requirements and a common procurement strategy is self evident. Less evident is that there are many other aspects where it is essential to achieve commonality, or at least close alignment. Among these are:

- Approval procedures for authorizing the transition from one phase to another (both in timing and scope) and release of the corresponding funding.
- Acceptance procedures for common design and in particular safety and security aspects.
- Agreement on common cost caps for non-recurring, and recurring costs.

Other common organizations in project HORIZON

It is also desirable to set up a number of tri-national 'clubs' to work with or support the JPO in project HORIZON. In addition to the SC, JPO, ORST and IJVC, the other principal common organisations are:

- The Joint Acceptance Authority (responsible for acceptance into service).
- The Common Support Working Group (advisory tri-national group examining scope and implementation of collaborative-in-service support)
- The Joint Certification Panel for information and technology security.

Support to the JPO

Although the JPO is the technical authority for the project, it has limited staff resources, and needs to receive support in specialist areas, or to commission studies from a source independent of of its main contactors, or simply to have additional people to meet a temporary surge in activity. It is essential that this support represents the views of the three participants. The following support arrangements and organizations have therefore been set up:

(*a*) National Focal Points (NFP's) for project HORIZON within the three nations, to provide national MoD experts as required for ad-hoc advisory groups to the JPO.

(*b*) Co-operative Technical Assistance by Governments (CTAG). The club of government research labs and test facilities (DERA/CSN/STSN). It provides impartial tri-nationally agreed reports to the JPO on areas of technical analysis.

(*c*) Project Support Agency—The private sector 'customer friends.' Currently the Consortium Of HORIZON United Support (CHORUS) consists of BMT/Cisdeg/SRTI, who competitively won the Project Support Agency contract.

DESIGN MANAGEMENT ISSUES

Government and industry responsibility for design

In broad terms the division of responsibility between the JPO and industry is:

JPO

Responsible under the authority of the SC for definition of technical specification, review of progress of work against specifications, and acceptance-off-contract of deliverables: (either design or physical hardware) such that the nations will be delivered a warship that meets the performance requirements within an agreed cost and timescale.

Industry

Responsible for delivering a warship to meet its contractual performance requirements which includes being responsible for design/development work to meet the specification, and for presenting design deliverables and/or physical hardware for acceptance.

Because of its overall co-ordination role between the warship, PAAMs and for phase 1, a number of industrial contractors, the JPO will be the warship procurement authority. It will however delegate design authority to industry for the definition and development phases through contracts. With the exception of CS functional design in phase 1, where the JPO has direct influence (see below), it will retain a supervisory role only, policing the performance of the contractors.

For the in-service phase it is currently unclear whether the design authority (FIG.5) delegated to the IJVC for the development and build phases will remain with industry, or will eventually be passed to the in-service authorities of the three nations or to another joint government body.

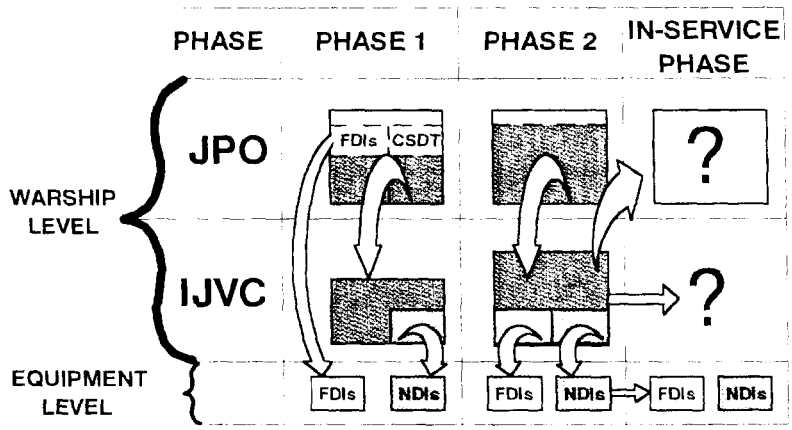

FIG. 5—DESIGN AUTHORITY ALLOCATION

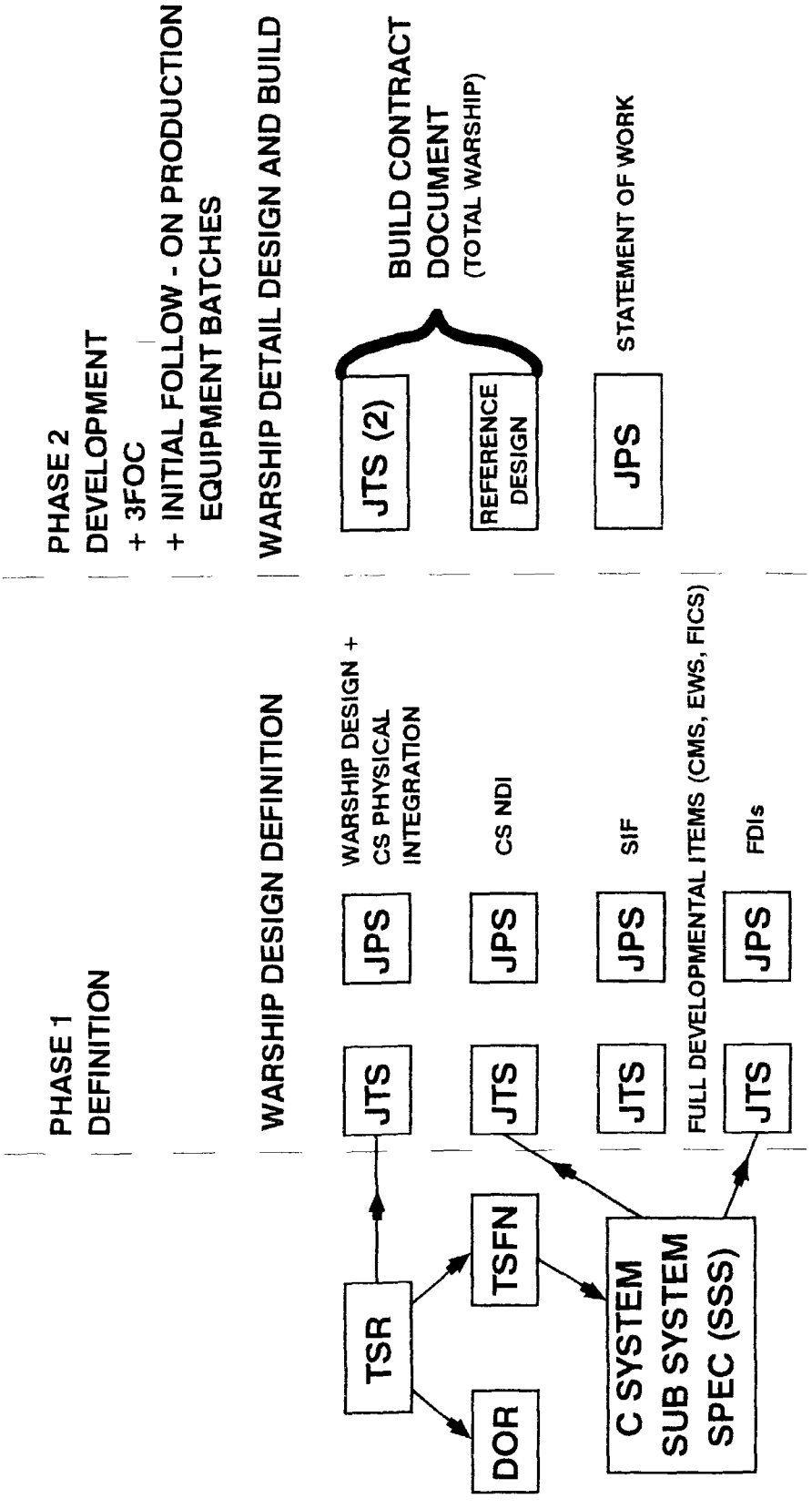

FIG. 6—HORIZON OPERATIONAL REQUIREMENTS AND TECHNICAL DOCUMENTATION

Operational and technical requirements documentation (FIG.6)

Overview

A pre-requisite for a common design is a joint expression of the operational requirements, which can then form the basis for the more detailed technical specifications used in the definition and development contracts. As explained above, for HORIZON this is the TSR which covers the requirement for the CNGF in its totality, including AAW/PAAMS performance. For the CS area the TSR is supplemented by the Tripartite Statement of Functional Need (TSFN) and a number of Detailed Operational Requirements (DOR). The TSFN provides the basis for the functional design of the CS (see below).

Joint Technical Documentation (JTD)

For each contract, JTD is produced comprising:

(*a*) Joint Technical Specification (JTS)
Defines the technical requirements and standards for the hardware product.

(*b*) Joint Procurement Specification (JPS)
The statement of work defining the deliverables of the contract.

In addition non mandatory background information and data is provided in an information pack. This includes feasibility work carried out by the JPO and the nations (see below). For phase 1 (definition phase) this has been produced for the following contract areas:

(*a*) Warship design definition—comprising:
Project management.
Warship design + CS physical integration.
NDI equipments.
Shore integration facility /CS integration.

(*b*) FDIs (i.e. CMS, FICS, EWS)

For phase 2 (development and build of 3 FOC) it is anticipated that JTD will be produced for a single combined contract with the IJVC.

The JTD is organized in accordance with the product work breakdown structure (ESWBS) tailored to project HORIZON from MIL Std 881. Wherever possible existing international standards (e.g. ANEPS/STANAGS) are used as the basis of agreed standards; where this is not appropriate specific HORIZON requirements have been agreed.

Drafting of the JTD was initially undertaken by tri-national working groups starting in 1992, but was completed by the JPO (supported by national experts where necessary) following signature of the Programme MOU in July 1994. Before release to industry, each major invitation to tender and contract comprising its JTD, must be formally approved by the SC.

CS functional design and sub system specification management

A critical area of the CNGF design is that of the CS, in particular its functional design and performance modelling. Because it underpins the production of the technical specifications, but also because of the need for a large degree of ORST input into the early stages of the process, the work of the Combat System Design Team (CSDT) is under direct JPO management during Phase 1, with a progressively increasing execution of and responsibility for the work by the IJVC, becoming fully effective by the end of Phase 1. It is intended that continuing CS design becomes a full part of the IJVC's contractual responsibility for the phase 2 development and build contract.

The products of the design work are:

(*a*) A high level CS specification.

(*b*) Approximately 20 Sub-System Specifications (SSS)—covering the various CS equipment areas. These are periodically updated ('Versions') to reflect operational and procurement decisions.

(*c*) An implementation model, representing the data flows of the CS at both system and sub-system levels.

(*d*) Data exchange specifications.

The implementation model provides the basis for ensuring interface coherency between the various SSS and for performance modelling of the whole CS. The principal method of performance modelling is 'thread analysis' which analyses data flows through the system, and therefore the ability of the system to respond in a timely fashion to specific threats.

It is important to appreciate that CS design and the definition of SSS is not a once only 'top-down' activity, but needs periodic reiteration during the procurement process. Although the SSS (at a given version) form the basis for starting PD (for the FDIs) and equipment selection (for the NDI's), they will require amendment as a result of procurement and operational decisions, involving, for example, Cost Capability Trade-Offs (CCTO). As these equipment decisions are made—following modelling of the consequences to the overall CS—it will be necessary to amend the implementation model and the SSS to reflect the real functionality, and to record the difference from the baseline assumption. A summary of this process is shown in (FIG.7).

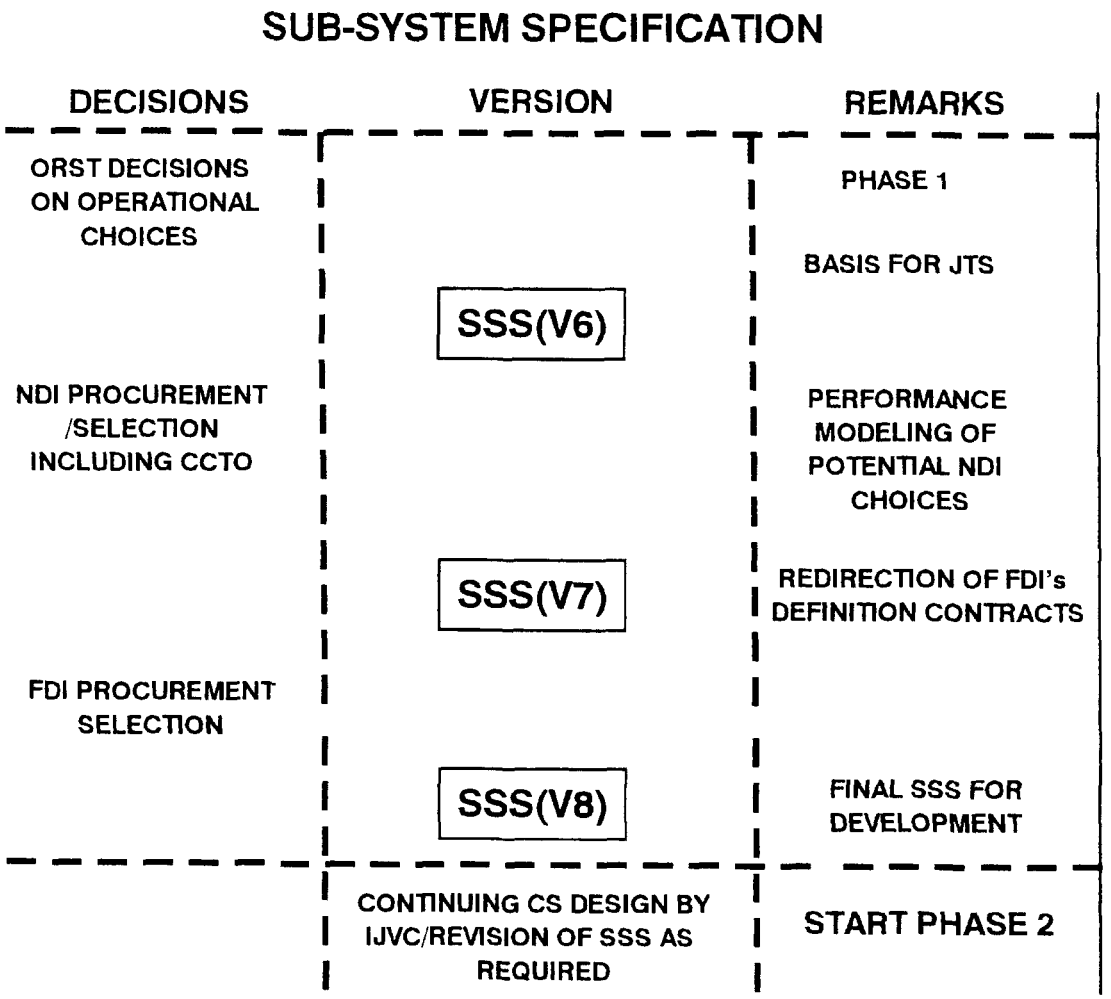

FIG. 7—COMBAT SYSTEM DESIGN PROCESS

Management of PAAMS interface.

As PAAMS is the primary component of the CNGF CS, but which is outside the JPO's responsibility in respect of its stand-alone performance, it is vitally important that there is a clear definition of responsibilities for the management of activities and interfaces between the two programmes. This is specifically being addressed by a formal charter between the HORIZON JPO and the PAAMS project office in Paris, and by an industrial working group to be set up between the two contractors (IJVC and EUROPAAMS, once it is formally constituted) for the transfer of information. In the future it is envisaged that this could be extended to a formal contractual link between the two industries.

Management of national variants

A basic pre-requisite for a common design and therefore successful collaboration is the elimination, or at least minimization, of national variants. In order to control the inevitable pressure for national variants, the following strict procedure has been adopted:

(*a*) Seven 'approved' national variants are defined in the TSR. These are mainly limited to interfaces with existing CS equipment which are already in the fleets of the three nations (e.g. torpedoes, helicopters etc.), and habitability because of the different rank structure of the three nations.

(*b*) Any additional national variants must be approved at NAD /Chief of Naval Staff level.

(*c*) Individual nations must bear any clearly and easily identifiable additional costs of a new national variant.

These conditions, taken together, ensure that any temptation to avoid technical compromise in the search for common solutions is severely constrained by an exceedingly difficult approval process. Only in very compelling cases therefore will approval be achieved.

One of the approved national variants—that authorizing different crew breakdowns for the three navies—has potentially far reaching layout variations for the ship design. This has been managed by ensuring that any layout variations can be contained within common total areas for specific functions (e.g. for dining/hall recreation area). It has required modelling in feasibility studies (see JID studies below) and mutually compatible compromises by the three nations in their space requirements to be fed back into the JTS.

Selection of equipment

One of the most important aspects of warship definition and development is the selection of equipment. The principles underlying this process are as follows:

(*a*) With the exception of PAAMS, and some of the national variants, there are no pre-selected or mandated items of equipment.

(*b*) All other common items of equipment will be selected by:

(1) Competitive tendering for NDIs and all ship equipment.

(2) Competitive PD followed by down-selection of the CS FDI.

(*c*) Value for money is the most important criterion for selection, achieving this, where sufficient, by competition in the three participant nations.

(*d*) No formal worksharing is defined as a requirement. However, it must broadly equate to costshare through the duration of the programme. Thus, in general, workshare must be achieved overall by the balance of selection within the three nations and not at indivi-

dual equipment level. For each of the definition and development activities of major importance (PAAMS, FDI's and SIF), a significant participation of the industries of each nation, in terms of quantity and quality of work is to be ensured.

A feature of the HORIZON programme is the enforced widening of choice, with no assumptions about equipment selection from items previously developed under national programmes. This means, however, a proliferation of technical options (as opposed to national variants) which poses particular problems for the management of the higher level CS functional design and for the naval architecture of the physical warship. This problem needs to be solved by the careful adoption of baseline assumptions with suitable margins for design work carried out in advance of equipment selection.

Affordability

A major issue for any project, whether in a multi-national or national environment, is that of affordability. Achievement of this objective has particular implications for the manner in which the design process is managed, and when design has to be carried out.

It is particularly important not to be faced with an unaffordable design at the end of PD, requiring an expensive and timewasting descoping process before being able to enter into the development and build phase. There are two causes of such unaffordability:

(*a*) A mismatch between the level of technical requirements and the budget available.

(*b*) A mismatch between the price offered by the contractor and that estimated by the JPO/nations.

While it is impossible before the event to insure completely against the second problem, the resolution of the first can and should be tackled. It requires the following elements:

(*c*) A defined budget with suitable margins.

(*d*) An accurate and realistic cost estimate.

(*e*) A cost-capability trade off process.

These apparently simple conditions are however not so simple when set in a multi-national context. Nevertheless it is essential that a **jointly** agreed budget is set, and that there is a common assessment of the warship cost.

Because these issues should be addressed in advance of PD, it is necessary to develop at the feasibility phase a physical model of the ship to generate sufficient parameters to enable cost estimation to be carried out. (see below)

For this, and a number of other technical reasons, the JPO produced the Joint Indicative Design (JID) (see below) using a preliminary contract with the IJVC. Such a physical model is also essential to carry out any CCTO studies affecting the overall design.

Acceptance

As a necessary complement to the production of common specifications it is necessary to develop a common acceptance procedure. Acceptance Of Contract (AOC) of the warship by the JPO will be conducted progressively in the following stages:

Stage 1

Completion of all acceptance events related to basic warship performance (i.e. propulsion, CS setting to work).

Stage 2

Completion of acceptance events related to the CS performance at sea.

Stage 3

Completion of any acceptance events related to availability, reliability, maintainability and support.

Acceptance—Into—Service (AIS) of the common warship will be the responsibility of the Joint Acceptance Committee (JAC). The warship will be presented by the JPO to the JAC on completion of stage 2 acceptance-off-contract for entry into active naval service.

INITIAL DESIGN STUDIES

In order to examine the implications of the TSR and the emerging technical documentation (as described above), a number of initial design studies were undertaken whose major features are described below.

Joint Indicative Design 1 (JID1)

Early in 1993, a team comprising technical representatives of the three nations involved in the project was constituted in order to assess the feasibility of the project, to help the on-going discussion for drafting of the Joint Technical Specification (JTS), and to give a first basis for the cost estimate of the ship. This work, called JID 1, conducted with support from national MoD's and companies (BMT for UK, DCN(Ing) for France and Maristat/ Fincantieri for Italy), was completed by the end of 1993. It then enabled the JPO to identify the weak points of the design as currently envisaged. This, together with the comments from the nations, set the groundwork for some follow-on studies in specific areas, called JID Further Studies (JFS).

JFS

The main goals of these studies, which were managed by the JPO using the resources of the companies already involved in JID1, were:

- To examine in a more comprehensive manner various technical options.
- To reach an agreement on the ship layout regarding the various crew breakdown (see above).
- To tackle the problem of national variants within a common design.
- To optimize some weak areas of JID 1 resulting from time constraints, lack of information or conflicting national requirements.

These studies, conducted throughout 1994, covered both naval architecture (including CS implications) and marine engineering. The former was mainly addressed through general layout studies while the latter focused on the various options for propulsion with their associated electrical systems.

After review by the nations, the results of these studies allowed the JPO to produce a re-iteration of JID 1 in order to get a full updated picture of the ship.

JID 2

The main objectives of this second, and final, iteration of the JID (FIG.8) were:

- To provide a model of the ship for cost purposes in order to assess its affordability (see above).
- To check the feasibility of the JTS in order to update (if any) the JTD before the award of Warship Design Definition contract
- To provide the IJVC with background feasibility studies in critical areas to facilitate design defintion.
- To identify feasibility of producing a 'common basis' layout.

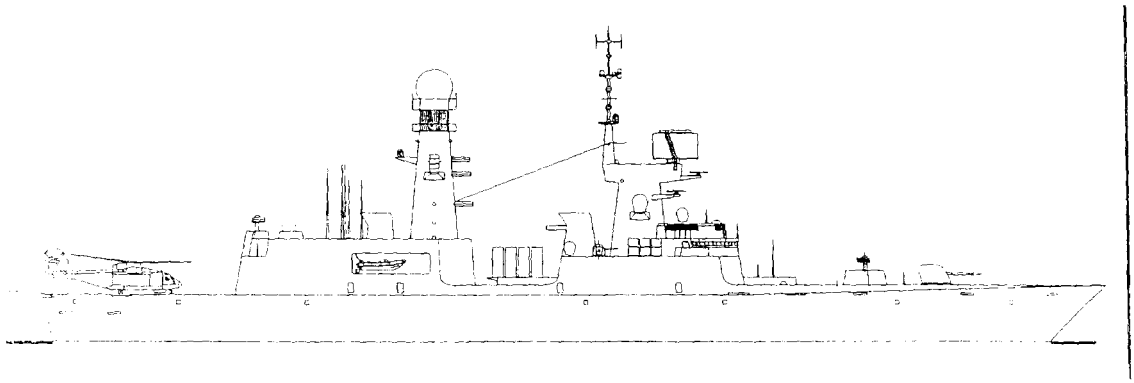

FIG. 8—AN OPTION FROM THE JID 2 STUDIES

- To reach a design for the ship which is agreed by the 3 nations as a possible solution in order to be used as a reference during the discussions with the prime contractor.

It took the first half of 1995 for the companies teamed within the IJVC to complete the work managed by the JPO and enabled the IJVC to have a better knowledge of the project in advance of the main contracts.

Finally, the clear and unambiguous status of the JID forwarded to the IJVC as part of the information pack (see above) must be noted:

- It is only indicative of a solution which meets the JTS requirements.
- It identifies the contentious areas to be further investigated.
- It is in no way mandatory for the IJVC but provides a basis for further discussion.
- If some or all of its conclusions are followed by the IJVC, then they need to be formally validated by the IJVC which assumes full responsiblity for their use.

Risk reduction studies

Currently, there are a number of studies in progress either with CTAG for general considerations such as survivability, radar cross section and ship/helicopter dynamic interface or with the IJVC for studies in advance of design definition. The main areas covered by the latter are affordability as described above, propulsion to decrease the number of options to be addressed and project management issues (planning activities, information systems, integrated logistic support, etc.).

CONCLUDING REMARKS

With the ever increasing cost and complexity of developing and supporting major 'state-of-the-art' warships, international collaboration offers one of the principal tools available to governments to afford such programmes. Although this direction for procurement has been actively encouraged for some time at the political level, closely supported by defence procurement and naval chiefs, the 'devil is in the detail' and such high level commitment can be thwarted by the technical environment, long cherished national customs and conflicting industrial interests.

This article has presented some of the ways these problems are being overcome, and has outlined the very significant work already completed in the early years of the programme. The organizations and procedures described are both new and original, and are certainly without precedent in the naval sphere. Perhaps they can best be summarized simply by noting that there has been an effort to make an international project office as efficient as a national project in its role and authority rather than just acting as an interface bureaucracy with no real power. For this to work properly, however, mutual trust and fully integrated teams are essential.

The HORIZON programme is a 'total system' collaboration and, as such, represents an extremely ambitious project. While recognizing that this presents greater exposure to the risk of disagreement, it has been undertaken because it offers the greatest economic, technical and operational potential benefits. The achievment of a common design provides the foundation for two types of cost saving: the gains of a shared development and construction process, but equally important, the benefits of sharing to the maximum possible extent the support costs through the future life of the programme. The latter could be as significant as the development savings for each nation.

Finally, the larger the scope of the collaboration today, the greater the potential for comparing solutions and methodologies and for developing mutual understanding in the defence communities of each nation on which future co-operation can be built. This should (hopefully) make similar endeavours more routine with (perhaps sadly) some of the pioneering excitement removed!

Acknowledgements

The views expressed are those of the authors and do not necessarily represent those of the Ministries of Defence of the three participant nations.