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C O M M E R C I A L   O P P O R T U N I T I E S
F O R   S W A T H   V E S S E L S

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COMMERCIAL OPPORTUNITIES FOR SWATH VESSELS

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1 INTRODUCTION.

For about 20 years a fin stabilized SWATH concept has been known and yet relatively little widespread use has been seen worldwide, despite the advantages described so well in many past technical papers. Why is this? What will it take to get new building contracts done for SWATH vessels?

This paper identifies several factors that will likely have to be addressed before more widespread use of SWATH vessels can be expected, and identifies ingredients an owner may need to look for in contemplating the construction and operation of a SWATH vessel.

Based on discussions by the authors of prospective applications of SWATH vessels with different owners in different parts of the world, suggestions are made of what are believed to be the 6 most attractive SWATH candidates for commercial and military applications in 1989 and the early 1990's. Outline specifications and budget estimates of the total investment required are given for each of these 6 candidate projects.

The timing now appears right to apply the large volume of SWATH expertise that has been appearing in the technical press for so many years, and which has been so well well described at the first of these RINA conferences in 1985 and now again at this second conference. The discussion here is therefore aimed at stimulating discussion of the measures required to reach the goal of consummating newbuilding contracts for more SWATH vessels in the near future.

2 DISADVANTAGES TO OVERCOME.

2.1 Sensitivity to Loading:

The small waterplane area of the struts of a SWATH vessel means that large changes in trim can readily occur if large loads are not reasonably carefully arranged. For example, if a SWATH car ferry were being loaded, clear procedures would be necessary to ensure a balanced loading. The advantage of a large deck area with SWATH thus has to be carefully used.

Operationally, on long voyages where fuel becomes a significant proportion of overall displacement, it becomes necessary to pay more attention to maintaining correct trim than would be necessary with a conventional monohull of similar displacement.

Likewise, if the SWATH vessel is used for retrieving heavy equipment or launching it, more care in trim control is necessary than with a monohull. For example a SWATH multiservice vessel for offshore use would therefore be cumbersome or impossible to operate with large cranes for lifting offshore components or for lowering subsea templates, where the lifts are in the hundereds of tonnes. However the same vessel would be able to perform very well in a diver support role, handling bells or lockout submarines that are much lighter, and which particularly require minimal motions in the support vessel.

However none of these disadvantages is insurmountable. Designers simply have to either solve the problems or recognize the limitations of SWATH vessels in writing operating manuals. Owners and operators of SWATH vessels need to recognize these sensitivities.

Obviously the SWATH vessel is a poor candidate for several functions (such as routine transportation of heavy cargos) and is an excellent one for others (such as transportation of light cargoes that require large deck areas, and operations that must have minimal motions).

2.2 Novelty:

An investor in a new type of equipment is going to be skeptical of: (a) the commercial longevity of a new design of vessel, and (b) its performance and reliability. This is particularly so with the recent history of the large oscillations that have been seen in shipping and offshore business cycles in the last decade!

More importantly, what unknown factors might emerge only in actual operation over an extended period of operation?

"Unknown unknowns" may not be as much of a problem with SWATH as might initially appear. There have been few types of vessels that have been the subject of as exhaustive theoretical and model and prototype analyses prior to having entered service. The reason for this is simple when one recognizes how so many of the SWATH researchers have had military and/or aerospace backgrounds, where normal practice is for theoretical analyses to be far more exhaustive than typical with innovative commercial ship owners and operators.

The fact that all SWATH vessels built to date are still functioning without major problems speaks well for the SWATH concept.

2.3 Construction Cost:

Obviously a SWATH vessel is going to be more expensive to construct than a monohull vessel on the basis of dollars per tonne weight of payload: one is looking at a premium for the greater complexity and weight of the structure in a SWATH hull. Shipyards tell us that the fabrication cost of the structure of a SWATH vessel is a little more in dollars/tonne than a monohull, but as the complexity of the structure and its weight are greater than a monohull of equal payload, overall fabrication cost is thus significantly greater - of the order of 20% to 50% - for the same payload requirement.

A need therefore exists for the introduction of: (a) simple low cost lighter weight structural design concepts, and (b) simplification of fabrication and assembly. The unique shapes of SWATH vessels may mean that for smaller sizes of SWATH vessels, composite glass fibre construction may become attractive if series production ever becomes commercially feasible.

Similarly, the purchase and installation of the main power and propulsion equipment will sometimes cost more. Two elements are involved here: (i) the main power, propulsion and transmission equipment can be somewhat more complex and therefore sometimes more costly, and (ii) the detail design of the hull to allow ease of initial installation and reasonably efficient future maintenance may create arrangements which will be more costly than that typical of a monohull.

These potential capital cost disadvantages are subject to some reduction through careful choice of equipment and careful operational planning at the design stage, looking at the tradeoffs in the overall life cycle of the vessel.

This is where we SWATH enthusiasts have to demontrate that the the performance advantages of a SWATH vessel clearly outweigh capital cost disadvantages for the same payload. For the appropriate applications that should not be too difficult!

The marketing task we are faced with then becomes a matter of emphasizing the overwhelmingly attractive economics v. performance of a SWATH solution for certain selected tasks, and we get away from traditional payload v. cost comparisons.

2.4 Maintenance:

Major overhauls during the life of a SWATH vessel could be more time consuming and hence more costly, since a wider and deeper draft drydock will be required.

Access to propulsion equipment may be possible only through cutting the shell plating or using hatch openings in the lower hulls.

Solutions for certain applications may be to use the well tried SCR and diesel engine powered generator arrangements that have been so well proven in the offshore drilling industry, locating the diesel engines in the cross structure, where they are accessible without drydocking, and the DC electric motors in the lower hulls where they can be pulled and removed while afloat. Good acceleration and considerable operating flexibility become byproducts of such an arrangement.

2.5 Draft:

Since the torpedo-shaped lower hulls are fully submerged and provide most of the buoyancy, the draft required for a SWATH vessel is more than for a monohull of equal displacement.

Typically the draft is 30% to 50% greater than a monohull of equal displacement.

This may be a significant disadvantage of SWATH vessels for some ferry and other applications.

2.6 Automatic Control:

Some designs of SWATH vessels do not require automatic control while others must have it. In any case the benefit achieved by addition of an automatic control system to further reduce motions beyond the already low motions the SWATH vessel offers can be worthwhile, judging from calculations and experience.

But what happens if such a system malfunctions?

Can reliable system checks be installed to disconnect the control system if necessary, or switch in a backup when a malfunction is detected?

Can we reliably say that malfunctions can be detected automatically?

Is it possible for a particular SWATH vessel to be operated in sufficiently severe seas that loss of the control system could lead to loss of the vessel by one mode or another?

How does one assure a prospective owner that partial failure of the control system on a particular SWATH vessel, or lack of an automatic control system on another SWATH vessel, brings no harm at all to the vessel or its passengers, other than increased motions?

2.7 Beam:

The beam of a SWATH vessel can be as much as 50% wider than a monohull. Generally this is not a problem, but it could be in certain situations where dry dock, channel or ship width is critical. On the other hand, a SWATH vessel is shorter than an equivalent monohull, and more maneuverable at low speed, so it would require less dock length.

2.8 Freeboard:

Generally the main deck of a SWATH vessel is higher above the water than that of a monohull. In those cases where ready access is needed to the water surface, this greater height can be a problem. Different design solutions exist, including the ability to ballast down.

2.9 General:

The above problem areas are answerable by many of the SWATH experts here at this conference. Indeed, existing SWATH vessels and designs on the board have already solved many of the above problems.

Where large differences in the geometry of SWATH vessels exists, one can expect large differences in motion, seakeeping, controllability, power and the need for automatic control. By way of example the characteristics of SWATH vessels having 1 and 2 struts per side can be quite different.

However potential investors in SWATH vessels will likely need exhaustive reassurance that the problems have either been solved or are not critical to their application, and that these very same geometric characteristics that may cause these problems provide other positive features that far outweigh the problems.

3 ADVANTAGES OF SWATH VESSELS.

The superior motion response by a factor of four for a ship length, the lack of drag increase in waves, the large deck area offerred and the exceptional seaworthiness of SWATH vessels has already been fully covered by many authors (references 1, 2 and 3). These advantages are therefore not covered here.

A practical advantage of SWATH vessels that is not often emphasized is maneuverability at low speeds: this is usually enough to avoid the use of bow thrusters where normally they would be essential in a monohull.

4 PROVEN SOURCES OF SWATH CONSTRUCTION AND DESIGN EXPERTISE.

Taking the position of an investor considering the use of a SWATH vessel for a particular application, it always seems that there are numerous naval architects that say they will design anything you want: but where is there some proven experience that can justify all the long hours, anguish and investment of often years of management time and of hard won funds that goes into pioneering a new type of vessel?

To answer that question it is suggested that there are two categories of experience to look for: (i) previously built vessels that have operated well and can now be seen in action, and (ii) thorough design studies which have to be viewed as a less reliable indication but which nevertheless may represent an improved design.

4.1 Vessels Built and in Operation:

The first of these is the well known pioneer vessel, "SSP Kaimalino", shown in Figure 1, which was delivered in 1973 and has been described exhaustively in so many technical papers such as in reference 4. It certainly does offer the most reliable basis for new construction.

However since "Kaimalino" entered service, several larger and a few smaller SWATH vessels have entered service. These are identified in Table I: only vessels larger than 200 tonnes are included in this listing. The 200 tonne displacement was arbitrarily chosen as a break point between commercial uses and non-commercial applications. It is also believed to be a size level above which most shipyards would be interested in building.

There is now a range of experience in both service speed (up to 27 knots) and in displacement (up to 3,500 tonnes). A total of about 44 vessel-years of service history exists for SWATH vessels in the 200+ tonne displacment category.

When the conservative United States Navy contracts to build a SWATH vessel that requires an investment in shipyard work alone of about $27 million, it clearly indicates that SWATH is a vessel type that is now worthy of very serious consideration where it may be technically suited to an application.

It can be reasoned now that the SWATH vessels are well past the curiosity and prototype stages.

4.2 Thorough Design Studies:

The U.S. Navy, the U.S. Coast Guard, the British Navy, Lockheed Shipbuilding, Mitsui, Wartsila and Semi-Submerged Ship Corporation are all known in the SWATH community to have conducted such studies. In each case the level of effort involved many man years and is beleived to be in the million dollar plus category.

These studies have been made over a period of years, involving model tests, design tradeoff studies and exhaustive hydrodynamics and structural analyses.

This body of research and design may be reassuring to the prospective owner. It also demonstrates the considerable investment that has been made to achieve SWATH progress to date, and that SWATH vessels have received serious attention by some very substantial organizations which possess a considerable measure of management and technical sophistication.

5 NATIONAL AND ECONOMIC FACTORS:

The SWATH vessels that are discussed in this paper and the others at this conference generally all involve a relatively high proportion of their value in outfitting and equipment costs.

The structural fabrication is quite different from typical monohulls but could still be performed in many shipyards worldwide. However experience has shown that the procurement of equipment and the detail design of all systems means that the SWATH projects, such as these contemplated in this paper, are not of a magnitude that offer an opportunity for lower cost construction in the cheap labor, cheap steel countries since they are generally faced with importing equipment and specialized technicians, the costs of which counteract their low manhour rates.

Countries that have abundant cheap labor and cheap steel will therefore be unable to compete in building SWATH vessels until they can match the engineering, manufacturing and management infrastructure of the more highly developed countries.

It can therefore be concluded that SWATH vessels are well suited to the shipyards in the countries that over the last number of years have seen a decline in their traditional shipbuilding business, despite having available the best in engineering and management expertise, as well as the best in equipment sources.

So here is one type of vessel on which many of us at this conference can be competitive, without too much risk of the less developed countries undercutting us!

6 SWATH OPPORTUNITIES IN 1988 AND THE EARLY 1990'S.

The following six types of vessels are proposed as representing the most attractive applications of SWATH technology. The choice is based on reasons that are set forth below, and on recent test marketing experience by the authors.

The first 2 SWATH applications are deliberately chosen to use the "Kaimalino" type of design as a basis (including improvements) since this has proven to be successful in operation for many years, and offers the most operating history of any SWATH design. The novelty risk to an investor or pioneering SWATH vessel ship operator and owner is therefore minimized to the maximum extent possible.

The next 4 SWATH applications are substantially larger than "Kaimalino". The third proposed application is more than twice the displacement of "Kaimalino", while the last 3 are in the size range of the largest of the SWATH vessels now in existence. The closest existing experience would be the U.S. Navy's SWATH T-AGOS 19 vessel now nearing completion at McDermott Shipyard in Louisiana in the United States (about 3,380 tonnes displacement, 71.3 metres l.o.a.), and the "Kaiyo" built by Mitsui in 1984 (3,500 tonnes displacement, 60.0 metres l.o.a.). In contrast the proposed Research or Seismic Survey Vessel and the Cruise Vessel would each be approximately 2,500 tonnes.

The proposed V/STOL Aircraft Carrier would be slightly larger than any SWATH vessel built to date: about 4,500 tonnes displacement.

Obviously no radical departure from precedent is suggested in these proposed applications: rather the use of extensions from existing experience.

The 6 proposed SWATH applications are illustrated in Figures 2 to 7: principal characteristics and budget figures for the total investment required for each of them are given in Table II.

6.1 SWATH Ferry:

Starting with a "Kaimalino-like" hull form and structure, one can superimpose several different superstructures. The options proposed here are only two:

(i) Commuter ferry configuration of about 500 passengers, based on a maximum trip duration of about 1.2 hours, using a relatively high power rating of 5,195 HP in order to provide the 25 knots speed that will appeal to the market that is emerging for such ferries in the East and West Coasts of the United States, as well as near other urban areas with sea access in the world.

    One of the reasons for the growing popularity of ferries in urban areas near the water is that the ferry trip can be a relaxing interlude between office and home, where passengers can have a drink with friends, doze off or otherwise unwind. Thus the design of outfitting, bars and quick service restaurants is important.

(ii) Luxury configuration of about 350 passengers, intended to serve the tourist trade (day cruises) and the increasing popularity of the dinner cruise trade. There is then not the same need for speed and so investment in propulsion equipment and speed can be considerably reduced.

The SWATH ferry is shown in Figure 2. The unusually large deck area offerred means that there is a good opportunity to include attractive bar and observation lounge facilities to increase consumer appeal in both the commuter and luxury versions of the ferry.

6.2 SWATH Crewboat:

This design responds to a requirement in many parts of the world where frequent swell conditions make it very difficult to reliably use monohull crewboats, forcing oil companies to pay the additional cost of helicopter transport for workers.

The SWATH Crewboat can also serve as a means for transporting urgently needed supplies or spares, when normal supply boat operations have to be curtailed in severe swell or storm conditions, a function that can readily justify premium freight rates.

Figure 3 shows a perspective drawing of the Crewboat: a means of unloading is shown on the top deck, to handle the more extreme of sea conditions, as well as to speed up large crew changes. For smaller crew changes, the superior motion response of the SWATH Crewboat means that the old fashioned basket is generally all that is needed for personnel transfer.

The radical decrease in the price of oil over the last few years has focussed oil company attention more than ever on operating costs.

While in 1981 offshore workers could get away with refusing to take a boat ride of several hours, hard economic realities today mean that these same offshore workers will now accept transport by crewboat.

So the much more pleasent motion response of a SWATH crewboat could offer a more attractive working environment for 1989 onwards.

6.3 SWATH Patrol Vessel:

Again, the principle of superimposing different superstructures on a proven basic hull design allows consideration of the following options:

(i) Anti-submarine warfare "loiter" capacity combined with relatively high speed (22 knots) intervention.

(ii) Fishery and anti-drug smuggling patrol, again using the loitering and high speed options.

This design is more than twice the displacement of the "Kaimalino", and is shown in Figure 4.

Features include an aft helipad that offers the capability to land and service a reconnaisance helicopter such as "Sea Lynx", Bolkow 105 or Bell 206A/B. Armament is suggested as twin Emerlic 30 high speed machine guns, located forward. Twin Avon Searider SR5M semi rigid boats are also included for vessel boarding purposes.

6.4 SWATH Research or Seismic Survey Vessel:

Once again a basic hull form is used with 2 options for the superstructure. Reference 5 describes the Research Version of this design in more detail. In both applications considerable deck area for relatively bulky equipment is required, and good motion response is a key factor in the effectiveness of the vessel's work.

Oil companies have been known to use self propelled jackups for seismic survey work in shallower waters, such is the benefit obtained from having as stable a platform to work from as can be achieved. As a Seismic Survey vessel, reduced motion capabilities would therefore be obtained that are not available in seismic survey vessels today, e.g. the accuracy of work in areas with persistent swells, such as in the Campos area of Brasil, would be greatly improved.

Likewise, sidescan sonar surveys for construction work offshore and other applications can become more accurate when conducted from a SWATH survey vessel, and such surveys could be conducted in much worse weather than at present using a monohull survey vessel.

The displacement of this design is more than 10 times that of "Kaimalino": an artist's rendering is shown in Figure 5.

6.5 SWATH Cruise Vessel:

Many observers believe the cruise vessel market is becoming saturated and that an overcapacity and profit squeeze problem will likely emerge in the early 1990's.

However, a SWATH cruise vessel offers many options that may provide consumer appeal that conventional cruise vessel designs will be unable to offer for the same investment level. It is likely that a SWATH Cruise Vessel with skillful promotion could attract passsengers in a highly competitive, even over-saturated cruise market, drawing on these features and its novelty ("have you ever been on one of these new SWATH vessels ?" . . .), essentially taking customers away from traditional vessels and surviving better than traditional cruise vessels.

More specifically, a SWATH cruise vessel as illustrated in Figure 6 can offer:

+ Greatly reduced seasickness potential for even the most queasy of landlubbers!
+ Underwater observation.
+ Unusually large deck area.
+ Ability to launch observation submarines.
+ Sheer novelty from the use of new technology and an intriguing space age appearance.

The design proposed here is based on 250 passengers, i.e. it is at the small end of the cruise vessel fleet.

Motions will be comparable to these experienced by a monohull 10-30 times the displacement, and with the relatively high deck levels, passengers will have the impression they are on a much larger vessel.

Its capabilities means that a SWATH cruise vessel responds to the fastest growing segment of the cruise market: the action oriented, younger but well off part of the population who are excited by the adventure of the activities offerred on this new type of vessel. This is the "Me-now" segment of the cruise market that reference 6 discusses as one of the key growth markets.

The second growth segment in the cruise market is the older conservative group, which can be catered to also by minor changes in arrangement of the accommodation and public areas.

This design philosophy departs from that taken by Wartsila in proposing much larger SWATH cruise vessels comparable in passenger capacity to the largest of the monohull cruise vessels.

A single SWATH cruise vessel represents a much smaller investment than a conventional monohull cruise vessel. Consequently several smaller SWATH cruise vessels of the size suggested here may allow an owner more flexibility in responding simultaneously to different geographic markets, and redeploying vessels as market trends become apparent.

Returning to the more mundane issue of design characteristics, the same basic hull is used as was used for the Research or Seismic Survey Vessel, i.e. the displacement is 2,500 tonnes. This basic hull design had been developed for the Wood's Hole Oceanographic Institution for all oceans services and is more fully described in reference 5.

6.6 SWATH V/STOL Aircraft Carrier:

This application capitalizes on the superior motion response of SWATH vessels plus the large deck area, allowing construction of a modest size of capital ship, achieving substantial capability at a fraction of the usual investment for a smaller conventional aircraft carrier.

The design concept is based on using a steel structure throughout to minimize fire damage potential.

A fleet of 6 Harriers can be accommodated on the basis of providing up to an intermediate level of maintenance. This can be doubled to 12 if a lesser maintenance level can be accepted.

Alternatively an assault mission could be performed with this vessel, using "Sea Stallion" helicopters or similar.

The U.S. Navy's artist's rendering of a similar design to that proposed here is shown in Figure 7. If it had been a British artist he would have shown Harriers landing and taking off!

Fundamental strategic benefits become possible now as the taxpayers' funding can now buy a fleet of SWATH V/STOL aircraft carriers instead of a single conventional monohull vessel! Survivability equations can then change as an unprecedented dispersal of assets becomes feasible.

The possibility of an export market for European or U.S. builders of such vessels now becomes feasible.

This is the largest of the 6 SWATH projects proposed here: 4,500 tonnes displacement, with a 60,000 total horsepower.

7 CONCLUSIONS AND RECOMMENDATIONS.

7.1 Construction of SWATH vessels is ideally suited to the more developed countries and thus represents a particularly unique opportunity to shipbuilders in these nations.

7.2 The history in the last decade, compared with previous decades, of the accelerating decrease in life cycles for new types of marine equipment (e.g. pipelaying barges, heavy lift vessels, offshore supply vessels, and all types of mobile offshore drilling units) makes it more difficult to persuade prospective owners and investors to seriously consider SWATH vessels. Nevertheless there are several applications of SWATH vessels where no other type of vessel can come close in a performance v. investment comparison.

7.3 There are certain SWATH designs that have already been well proven. Consequently there are reliable starting points for owners to consider investment in new construction of SWATH vessels.

7.4 SWATH vessels use existing structural methods, existing propulsion systems, existing outfitting techniques and systems. Potential investors in SWATH vessels, designed by experienced naval architects, now have well proven options open to them.

7.5 This paper identifies 6 SWATH applications in markets that have active requirements, in the investment range of US$4.5 million to US$60 million. None of them depart much from proven precedents, implying there is a reasonable probability of their becoming "doable deals" in 1989 and the early 1990's.

REFERENCES

1. LANG, T.G.; SLOGGETT, J.E.: "SWATH Developments and Comparisons with Other Craft", RINA International Conference on SWATH Ships and Advanced Multi-Hulled Vessels, Paper No. 1, London, April 1985.

2. LEE, C.M.: "A General Overview of SWATH Hydrodynamics", Ninth Energy Source Conference, ASME, New Orleans, February 1986.

3. McCREIGHT, K.K.: "Assessing the Seaworthiness of SWATH ships", Annual Meeting, SNAME, New York, November 1987.

4. LANG, T.G.: "SSP KAIMALINO: Conception, Developmental History, Hurdles and Success", ASME Winter Meeting, Anaheim, California, December 1986.

5. DINSMORE, R.P.; LANG, T.G.: "Replacement of the University Research Fleet and a 2,500 ton SWATH Ship Candidate", AIAA 6th Advanced Marine Systems Conference, San Diego, California, September 22-24, 1986.

6. BUCHIN, S.I.; STELLER, M.E.: "The U.S. Market for Cruises", Maritime Reporter/ Engineering News, July 1987, pp. 53-55.

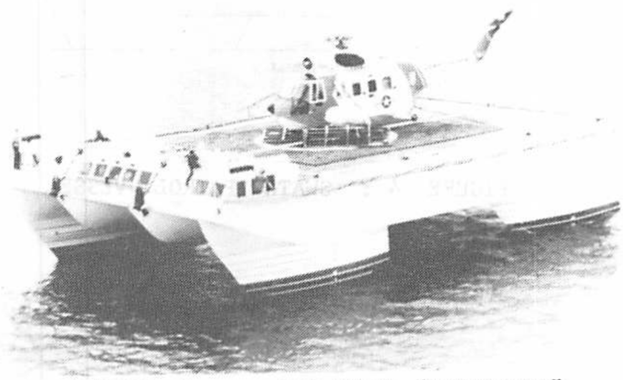

FIGURE 1 : 225 TONNE "KAIMALINO" (U.S. Navy Photograph)

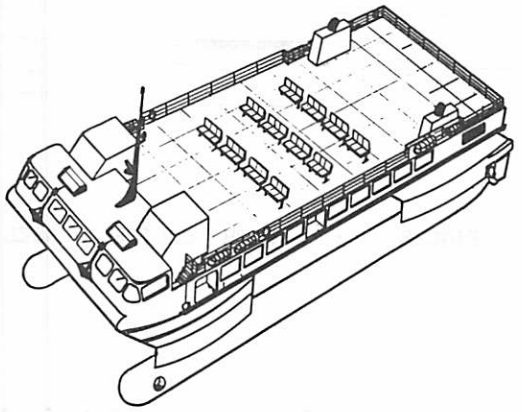

FIGURE 2 : SWATH FERRY

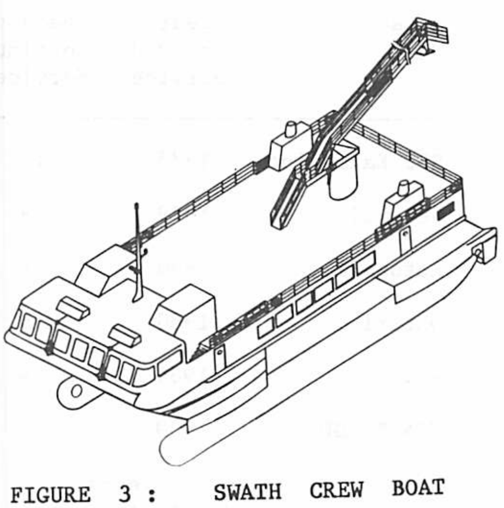

FIGURE 3 : SWATH CREW BOAT

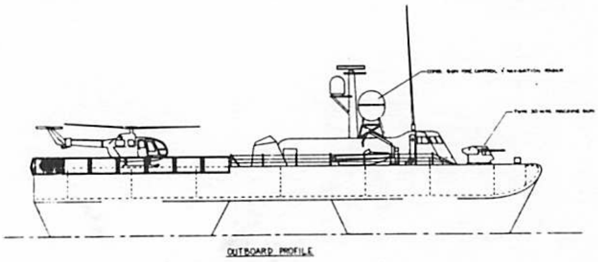

FIGURE 4 : SWATH PATROL VESSEL

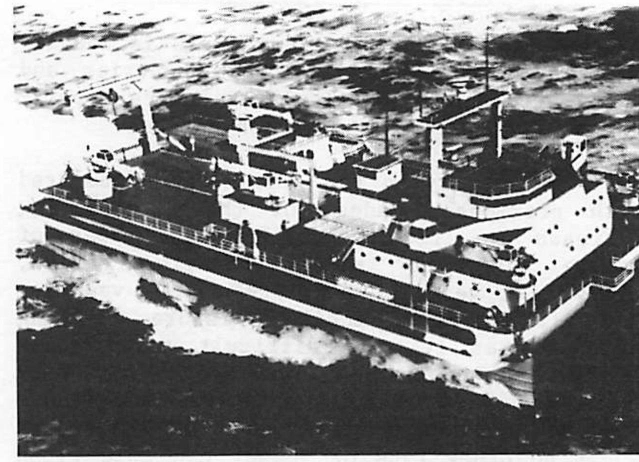

FIGURE 5 : SWATH OCEANOGRAPHIC RESEARCH OR SEISMIC SURVEY VESSEL

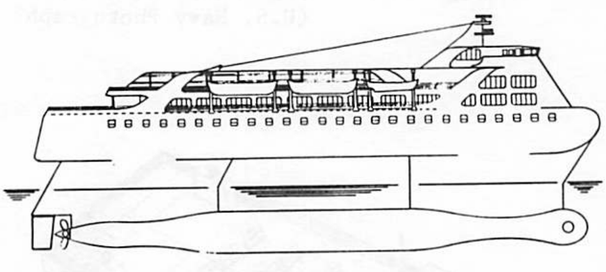

FIGURE 6 : SWATH CRUISE VESSEL

FIGURE 7 : SWATH V/STOL AIRCRAFT CARRIER (U.S. Navy artist's rendering)

TABLE I : SOURCES OF PROVEN DESIGNS - VESSELS NOW IN OPERATION , OVER 200 TONNES DISPLACEMENT

Vessel Name	Year entered Service	Years of Continuous Service	Builder, Location	Designer, Location	Displacement tonnes LOA, metres	Propulsion Power, HP
SSP Kaimalino	1973	15	U.S.C.G. USA	U.S. Navy USA	224 26.8	2 x 2250
Seagull	1979	9	Mitsui Japan	Mitsui Japan	343 35.9	2 x 4050
Kotozaki	1980	8	Mitsui Japan	Mitsui Japan	236 27.0	2 x 1900
Ohtori	1980	8	Mitsubishi Japan	Mitsui Japan	239 27.0	2 x 1900
Kaiyo	1984	4	Mitsui Japan	Mitsui Japan	3,500 60.0	4 x 1135
USN T-AGOS-19	1989	---	McDermott U.S.A.	U.S. Navy U.S.A.	3,380 71.3	2 x 800
Total vessel-years of service:		44				

TABLE II : CHARACTERISTICS OF PROPOSED SWATH VESSEL OPPORTUNITIES

Figure No.: Design Parameter	6.1 Ferry, Commuter/ Luxury	6.2 Crewboat	6.3 Patrol Vessel	6.4 Research or Seismic Vsl	6.5 Cruise Vessel	6.6 V/STOL Carrier
Displacement, tonnes:	225	225	500	2,500	2,500	4,500
Dimensions overall, Length x Breadth, m.:	30.5x16.1	22.5x16.1	46.9x17.7	75.3x29.0	75.3x29.0	91.4x32.0
Operating draft, m.:	3.4	3.4	4.3	7.3	7.3	7.9
Total installed power, horsepower:	5,195	5,195	5,400	6,200	6,200	60,000
Cargo, tonnes:	0.0	20.0	0.0	100.0	0.0	500.0
Cruising speed, kt.:	25.0	25.0	20.0	16.4	16.4	25.0
Maximum speed, kt.:	28.5	28.5	22.0	17.3	17.2	35.0
Crew:	10	8	26	25	100	150
No. of passengers:	500/350	250	-0-	35	250	-0-
Normal Range in km at cruising speed:	630	630	9,600	16,000	4,300	5,600
Investment budget, US$ million:	5.0	4.5	10.0 (excluding helicopter)	36.5 (excludes seismic equipment)	40.4	60.0 (excluding aircraft)