NEW CONCEPTS OF OPERATION FOR

NEXT GENERATION MEDIUM LIFT HELICOPTERS

By

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Abstract

The rapidly changing and increasingly complex world-wide strategic situation, together with the proliferation of sophisticated military capabilities to regions of political instability, have ensured that today's threats are becoming more unpredictable.

The uncertainty, combined with growing pressure to reduce defence spending, has resulted in wide ranging reviews of conventional operational concepts.

On the naval side, the emphasis is shifting from blue water to brown water operations which require quite different tactics and capabilities. With land forces, the move is towards increasing airmobility and rapid reaction capabilities. Common factors in all theatres of operation are the need for maximum flexibility and greater cost effectiveness.

This paper will examine the factors which impact upon the selection criteria and concepts of operation for the new generation of naval and army support helicopters typified by the multi-variant, multi-role EH101

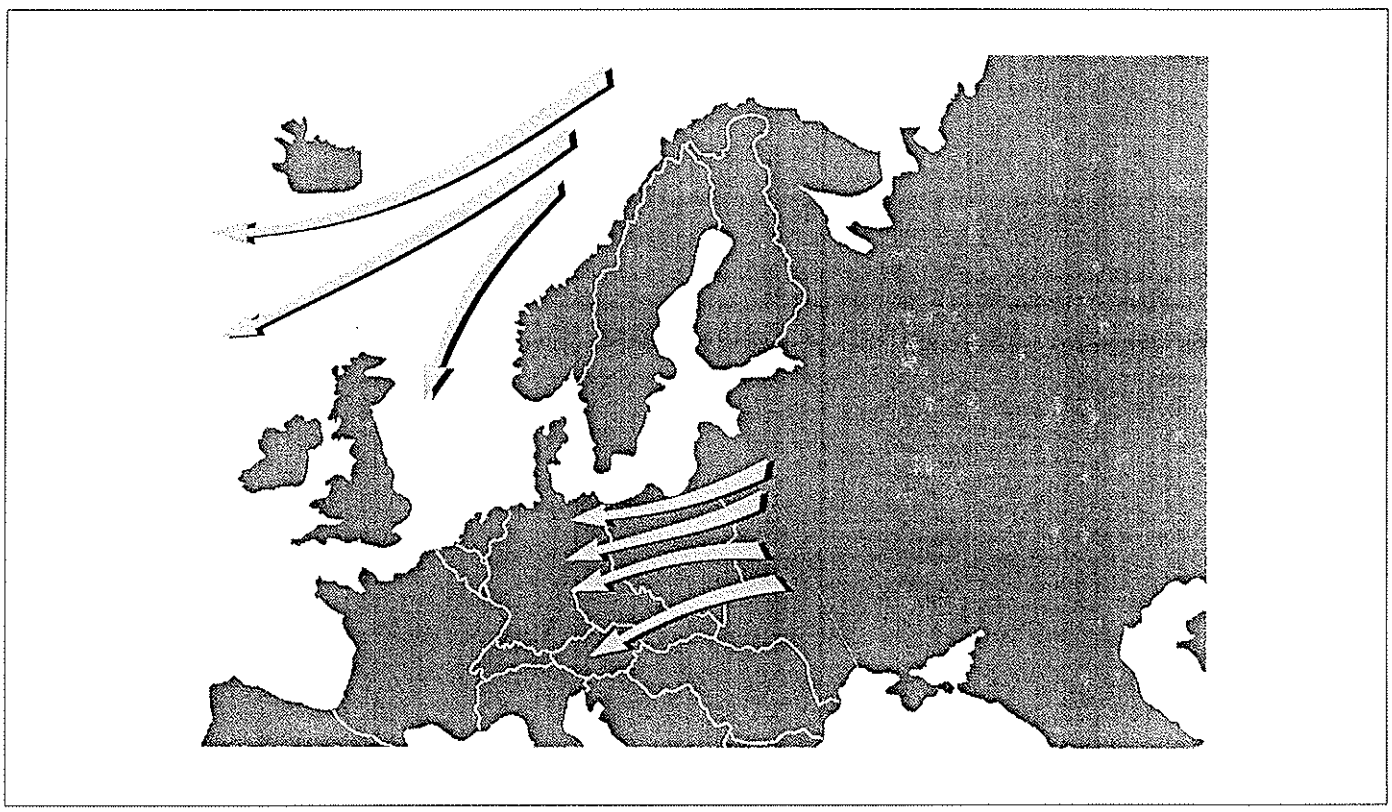
Introduction

Ten years ago, the world-wide strategic military situation was relatively clear. Matters were dominated by the East/West struggle; the USA versus the USSR, the Warsaw Pact against NATO, communism challenging democracy.

As far as we in Europe were concerned, the main strategic focus on land was the North European Plains and at sea it was the North Atlantic. Of course there were other flash points and areas of tension but, for us, they were comparatively minor to the threat posed by the Warsaw Pact.

For decades the military strategic and tactical concepts of the two major power blocks were dominated by this fairly clear cut situation.

Defence of the central region against a massive concentration of forces in the air and on the ground and defence of lines of supply and reinforcement across the North Atlantic, at least defined the type of defence and the general region, if not the precise area, of the expected conflict as being in the heart of NATO territory. This allowed the optimum balance and deployment of defence forces to be determined implemented and maintained

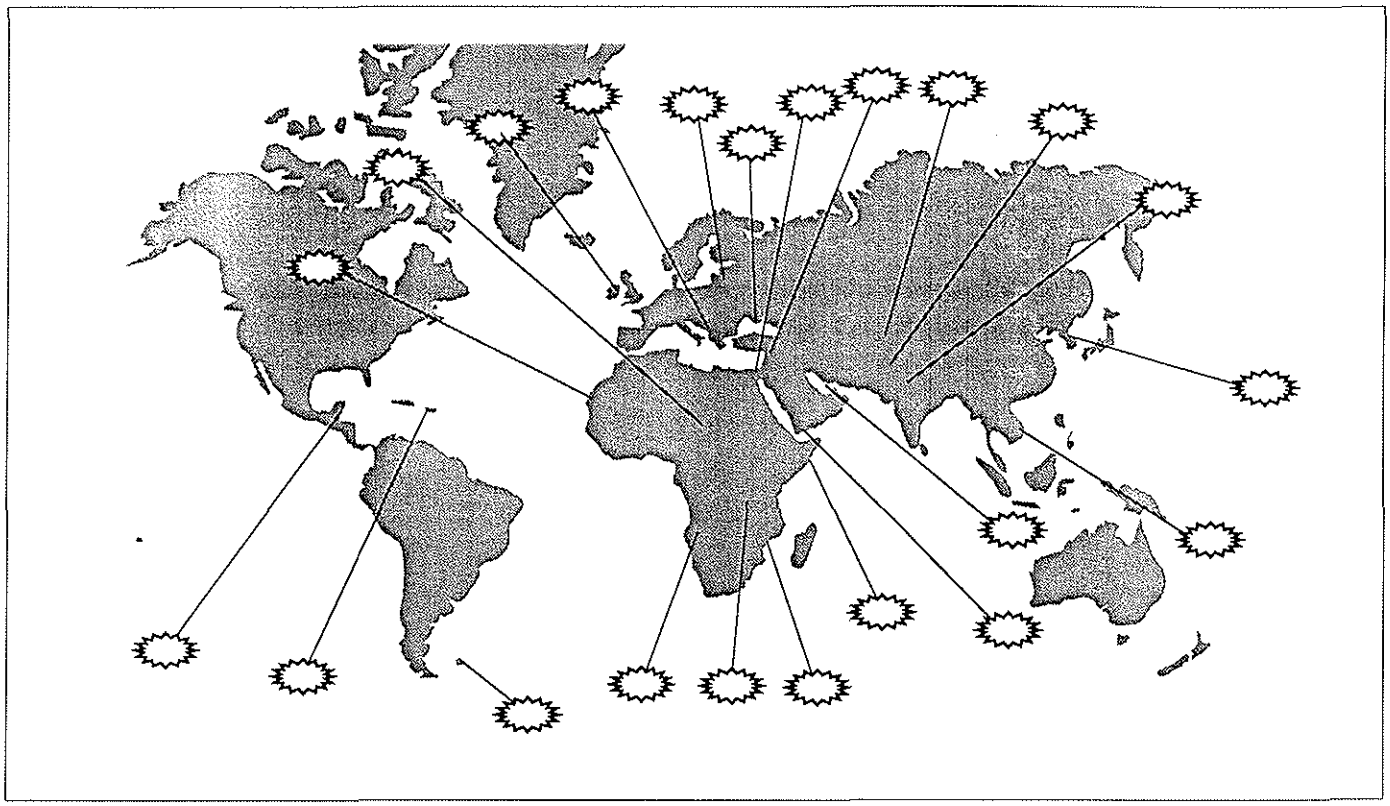


The dismantling of the Berlin Wall symbolised the beginning of the end of the relatively neat and tidy old world order.

The break-up of the Soviet Union, the demise of the Warsaw Pact and the proliferation of sophisticated military equipment, to regions of political instability, have helped to ensure that today's threats are becoming ever more unpredictable.

The old world order has been replaced by the new world disorder. The cold war is over and we are now entering a period some are calling the 'hot peace'.

Today the threat to the central region seems to have evaporated. The emphasis has shifted from general or global tension to regional conflicts. For NATO that implies that Germany, the Central Plains and the North Atlantic are no longer the main areas of concern. The focus has shifted to its flanks, periphery and possibly even further afield.



The number of independent nation states has more than doubled since the second world war. This increase explains, partially, why regional conflicts are becoming more numerous. These can be driven by ethnic, religious, economic, territorial or general nationalistic factors and may be fuelled, in part, by the vast quantities of weapons made surplus by the easing of tension between the major powers. Because of the delicate balance of the world trade infrastructure and the generally increasing interdependence of nations, some regional disputes have strategic implications far beyond their immediate boundaries and thus attract the attention of other nations or power blocks such as NATO or, more frequently, the UN.

In recent years, we have seen a large increase in peace making, peace keeping, humanitarian and counter terrorism operations requiring diverse capabilities at short notice.

Another major factor in the defence equation today is the pressure, within NATO and elsewhere, for the so called 'Peace Dividend'. This has led to significant reductions in the defence budgets of the major Western nations and in the majority of the old Soviet Union.

The nature and regions of emerging threats are diverse and sometimes unpredictable. Uncertainty prevails! This uncertainty, combined with cost cutting pressures, has resulted in wide ranging reviews of defence requirements.

The various reviews have highlighted that flexibility and cost effectiveness are among the most important prerequisites for defence forces today. These two factors have helped to reinforce the fact that helicopters are a vital element of any task force today and for the foreseeable future. It is within this context that I will focus on the factors which impact upon the selection criteria and concepts of operation for the new generation of naval and army support medium lift helicopters typified by the multi-variant, multi-role EH101.

For the first time, three variants of the same basic machine have, from the outset, been designed, developed and produced in a totally integrated and mutually supportive programme, to meet differing maritime and land operational requirements without compromise.

Maritime Helicopter Operations

The emphasis of naval activity is shifting from blue water to brown water operations, from the open seas to the littoral waters. How has this impacted upon maritime helicopter requirements?

In the period of the Cold War one of the dominant factors was the very large number of conventional and nuclear attack submarines at the disposal of Soviet forces. The most modern of these were becoming faster, quieter, deeper diving and with an increasing weapon danger zone, all adding up to the most serious threat to NATOs lines of supply.

The nature and magnitude of the threat was well defined and the justification for dedicated ASW helicopters was firmly established. The ASW helicopter had to be capable of operating from ships in adverse weather conditions day or night, it had to carry a full suite of mission equipment for detecting, classifying and attacking submarines at ranges of over 100 nm from the mother ship, it also had to be able to operate autonomously or as part of a team.

Although it was desirable for the ASW helicopter to be capable of performing other roles, such as Vertical Replenishment, SAR and ASUW, these were definitely of secondary importance.

In today's circumstances, with the threat or threats becoming ever more unpredictable and defence budgets being squeezed even harder, the case for a true multi-role capability is much stronger.

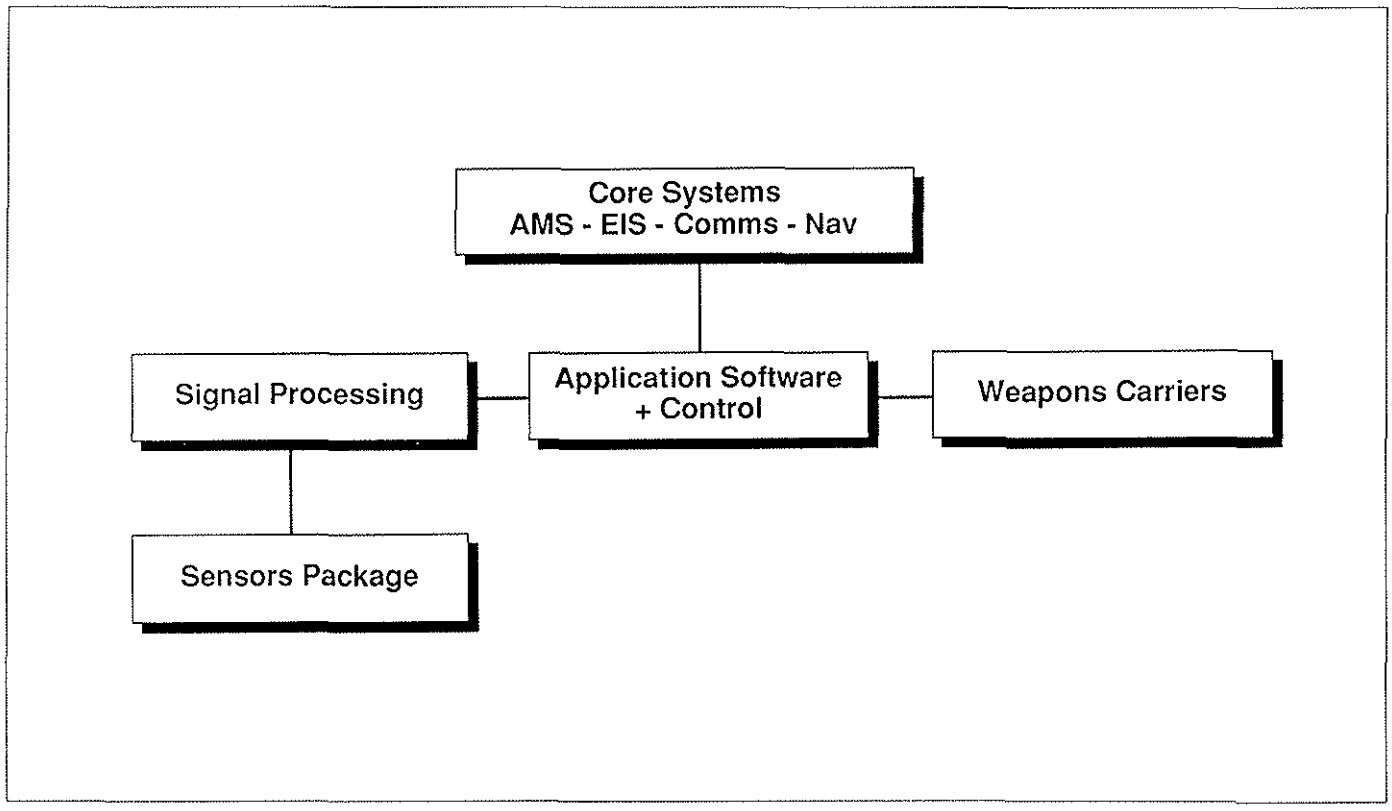
As I mentioned earlier, flexibility and cost effectiveness are becoming paramount considerations. How are these two factors reflected in today's maritime helicopter requirements?

First, I believe that the days of the dedicated, single role maritime helicopter are numbered and in future it may only survive in a few of the larger, more sophisticated navies.

The basic helicopter is inherently a flexible machine. However, much of the specialised mission equipment, which is fitted, reduces the flexibility by taking up space and weight and by imposing various operational restrictions.

Although a quick role change capability has always been one of the stated requirements, the optimisation of the primary role effectiveness has usually been achieved at the expense of a rapid role change capability. Factors which compromised rapid role changes were the move towards greater systems integration and the increasing dependence upon specialised mission software imbedded within the various systems.

All that is now changing with the development of palletised role equipment and modular software. The concept is illustrated in this diagram.



The core systems, such as the Aircraft Management System (AMS), the Electronic Instrument System (EIS), the Automatic Flight Control System (AFCS) and the communications/navigation systems will be common to all roles while the sensors, weapons carriers, signal processing, application software and the control functions will be either multi-function or easily removable to facilitate rapid role changes.

Trade off studies will help to determine the optimum balance between common and dedicated applications of hardware and software. For example the radar system could be common to a number of roles and the weapon carriers could be capable of accommodating different weapons such as torpedoes or anti-ship missiles.

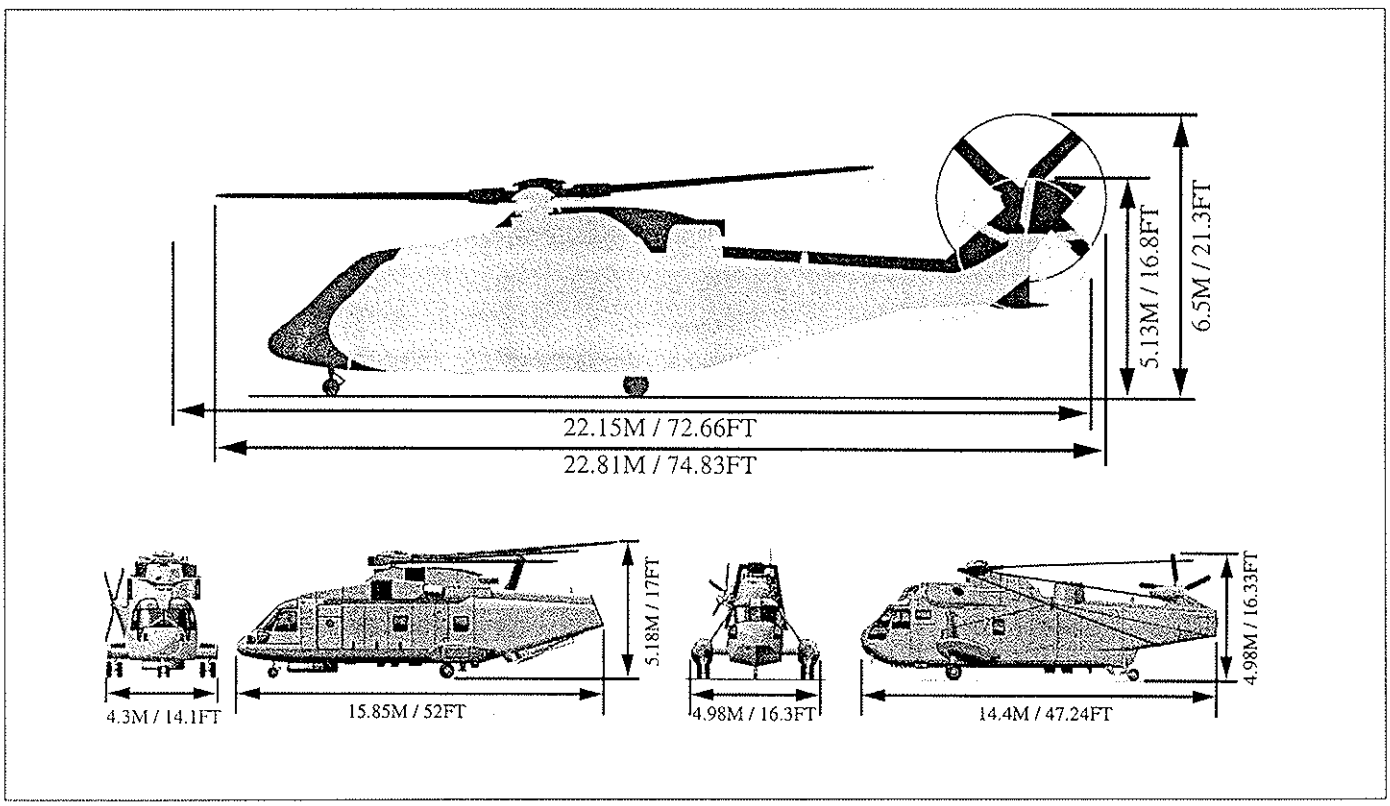
Among the disadvantages of this approach are that the aircraft would have to incorporate fixed fittings for all the removable equipment and the common carriers would be more complex than dedicated carriers which add up to weight and cost penalties. However, these can be minimised by careful design, for example, by ensuring common methods of attachment for the range of weapons.

The advantages are in enhanced adaptability and therefore greater utilisation and cost effectiveness.

Size and capacity are fundamental elements of flexibility. A true multi-role helicopter must have adequate capacity for the carriage of all likely combinations of equipment, stores and personnel. The larger the capacity the greater the flexibility! However, the converse is true when it comes to overall size. The larger the size the more restricted becomes the operating capability from ships and, to a lesser extent, from shore bases.

What is needed is the largest usable volume within the most compact overall dimensions coupled with a high lift capability.

This diagram illustrates how effective modern design has been in these areas.



The overall dimensions of the new EH101 helicopter are only slightly greater than the Sea King/SH3, yet the EH101 has 15% more usable volume and has a 40% increase in lift capability. The naval variant incorporates an automatic main rotor blade and tail section folding system. In the folded configuration, the EH101 fits into a similar hangar space as the Sea King.

There are some other relevant points worth noting on this diagram:-

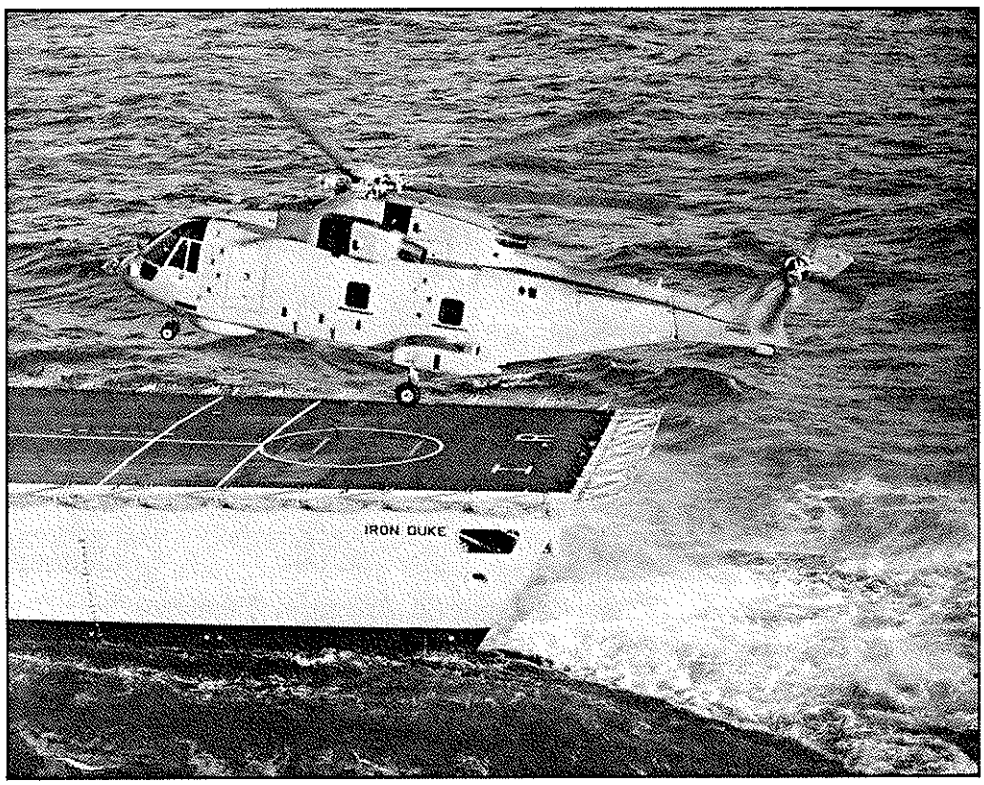
The compact rotor diameter on the EH101 has been made possible by the greater efficiency of the advanced aerodynamic rotor blades which are of composite construction and have a much longer fatigue life.

The large diameter tail rotor gives much greater yaw control for operation in high cross winds, which, together with greater power margins from the 3 engine configuration, contributes towards the agility necessary for operating safely from ships in high sea states.

The layout of the undercarriage is also significant. The distance from the rear wheels to the forward edge of the rotor disk is considerably less than that of the Sea King thus allowing the EH101 to operate from a relatively small deck space.

In fact, ship based helicopter operations pose many challenges such as taking off and landing from a small, unstable platform, securing and handling on deck in rough weather, coping with limited maintenance resources and the problems of corrosion at sea.

Helicopter/ship compatibility involves matching the ship and helicopter design in areas such as deck lock devices to secure the helicopter firmly to the deck and in deck handling systems for moving the helicopter safely from the deck into the hangar and vice versa.



The solution to limited maintenance resources at sea is quite simply to design for increased reliability and ease of maintenance, but more on that later.

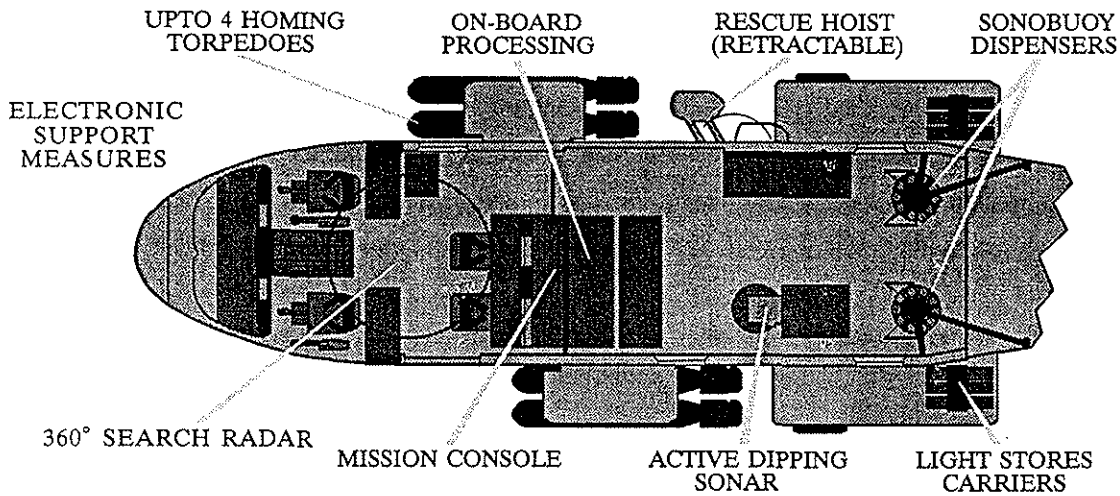
The problems of corrosion in a maritime environment have no easy, high technology solutions. This is an area where experience plays an important part in designing to avoid corrosion traps and in the selection of the optimum materials and anti corrosion treatments. The extensive experience gained from the Sea King and more recently the Lynx, which is operated by the navies of 11 countries, have helped to ensure that the EH101 is highly corrosion resistant.

In the current climate of uncertainty, a multi-role capability must be complementary to an ability to operate world-wide, from arctic to tropical regions and from deep seas to coastal waters. In fact, whenever there is potential for conflict.

The EH101 has successfully completed cold weather trials in Canada last winter during which the aircrafts anti-icing systems was proved. Comprehensive hot and high operational trials are planned for this summer involving two aircraft based in Colorado, USA. When it enters service the EH101 will be cleared for operation in temperatures from -40°C to + 50°C.

Hunting fast, deep diving nuclear submarines in the depths of the North Atlantic in the middle of winter require quite different techniques and combinations of sensors than those needed to detect silent running diesel electric submarines in the warmer, shallower and more saline waters of the Arabian Gulf.

Even within these diverse areas, submarine operating conditions can vary quite considerably so that a full range of senors, including radar, ESM, variable depth sonar, active and passive sonobuoys, MAD and FLIR plus a comprehensive on board processing capability must be available so that the optimum combination of sensors can be selected to match the prevailing conditions.



Options:
- Magnetic Anomaly Detector
- Thermal Imaging
- Depth Charges
- Anti-ship Missiles

Although it is usually assumed that maritime helicopters operate from ships, an increasing number are in fact shore based. This can be explained in part by the growing concern over the protection and enforcement of sovereignty over Exclusive Economic Zones (EEZ).

Coastal states are now permitted sovereign and exclusive rights to explore, exploit, conserve and generally manage resources in their EEZ up to 200 nm out to sea. Jurisdiction covers enforcement of fisheries legislation, the control of offshore installations and the management of sea-bed resources. Coastal states also have a responsibility for Search and Rescue (SAR) within their region. Foreign states retain rights of freedom of navigation through the EEZ.

Land based maritime helicopters, in conjunction with Offshore Patrol Vessels (OPVs) and fixed wing Maritime Patrol Aircraft (MPA) are ideally suited to the EEZ protection role.

Once again flexibility is essential in order to cover the many possible applications and threats including surveillance, fishery protection, counter terrorism/piracy, search and rescue and general defence of sovereignty.

In the EEZ protection role, the maritime helicopter is capable of rapid response and is able to carry out many of the functions of a fixed wing MPA. In addition, a helicopter is able to insert boarding parties, pick up survivors and refuel from ships or platforms. In other words, greater flexibility!

Army Support Helicopter Operations

Throughout the history of conflict on land, the ability to move troops and equipment rapidly has often been the key to success. The quest for greater mobility has taken us from the humble foot soldier to the cavalry and then on to the mechanisation which really developed during and after the first world war and which so transformed military capabilities and strategy.

An important feature of the mechanisation revolution was the dramatic improvement in mobility which accelerated during and after the second world war with the development and refinement of air transportability and airmobility.

There are many definitions of 'Air Mobility' but for the purposes of this paper I will consider air mobility as being the tactical capability to move forces and their equipment rapidly in and around the battle area, by helicopter, relatively unhindered by terrain or weather. This helps to distinguish it from strategic air transportability which covers the deployment of forces over long ranges by fixed wing aircraft.

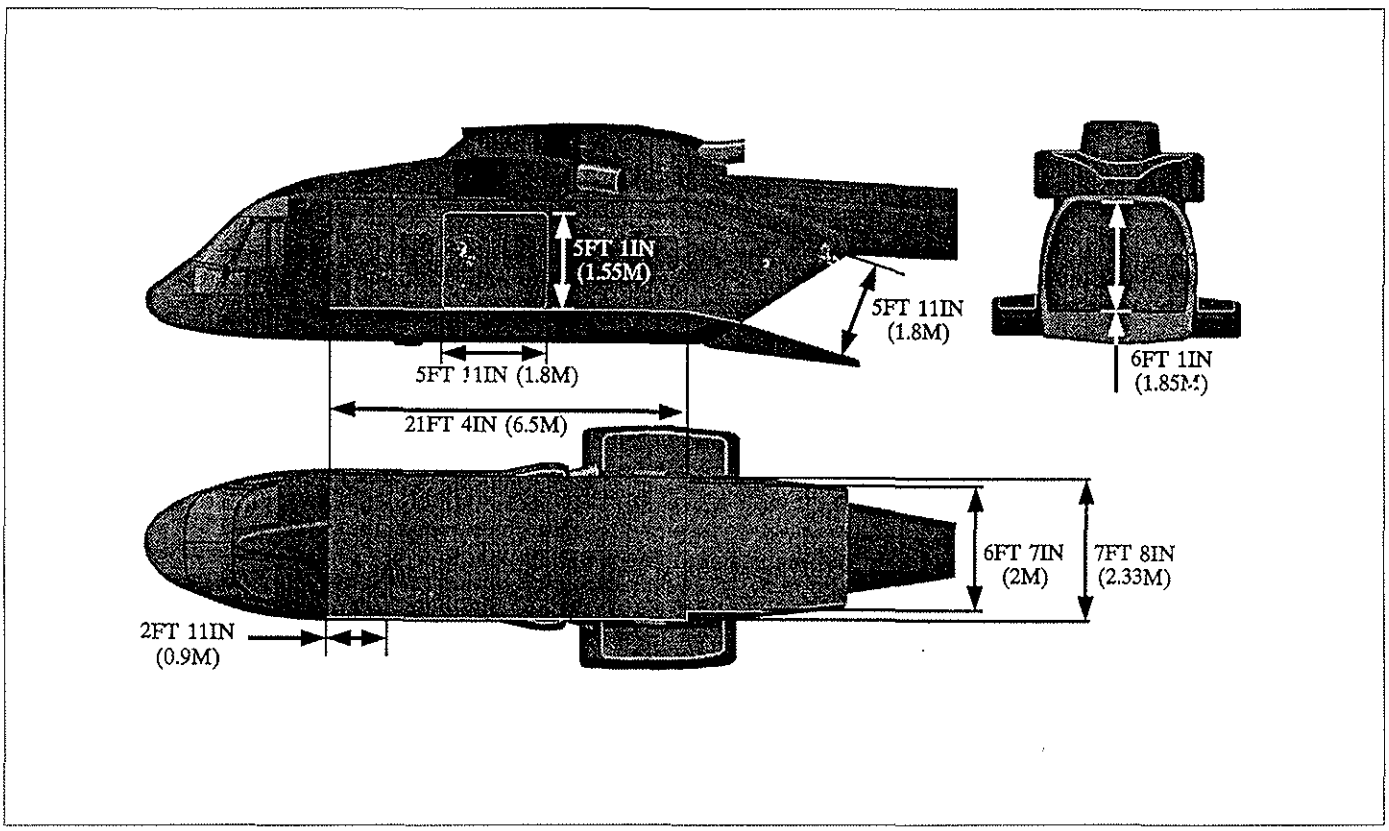
Today's unstable political and military climate and the shift in emphasis from general to regional tension has helped to focus the need for a rapid and flexible military response capability and has led to the formation of Air Mobile Brigades by many national forces within NATO. These come together in the Multi National Airmobile Division (MNAD) which in turn is part of the Allied Rapid Reaction Corps (ARRC).

Helicopters are a vital element of mobility and rapid reaction. I would like to concentrate in particular on the medium lift category of army support helicopters.

What are the main requirements and how are they met?

As with the maritime helicopter, among the most important characteristics must be flexibility and a multi role capability. Once again size and capacity and the optimum balance between usable volume, overall dimensions and lift capability are crucial. So is the ability to load and unload troops or stores in the shortest possible time.

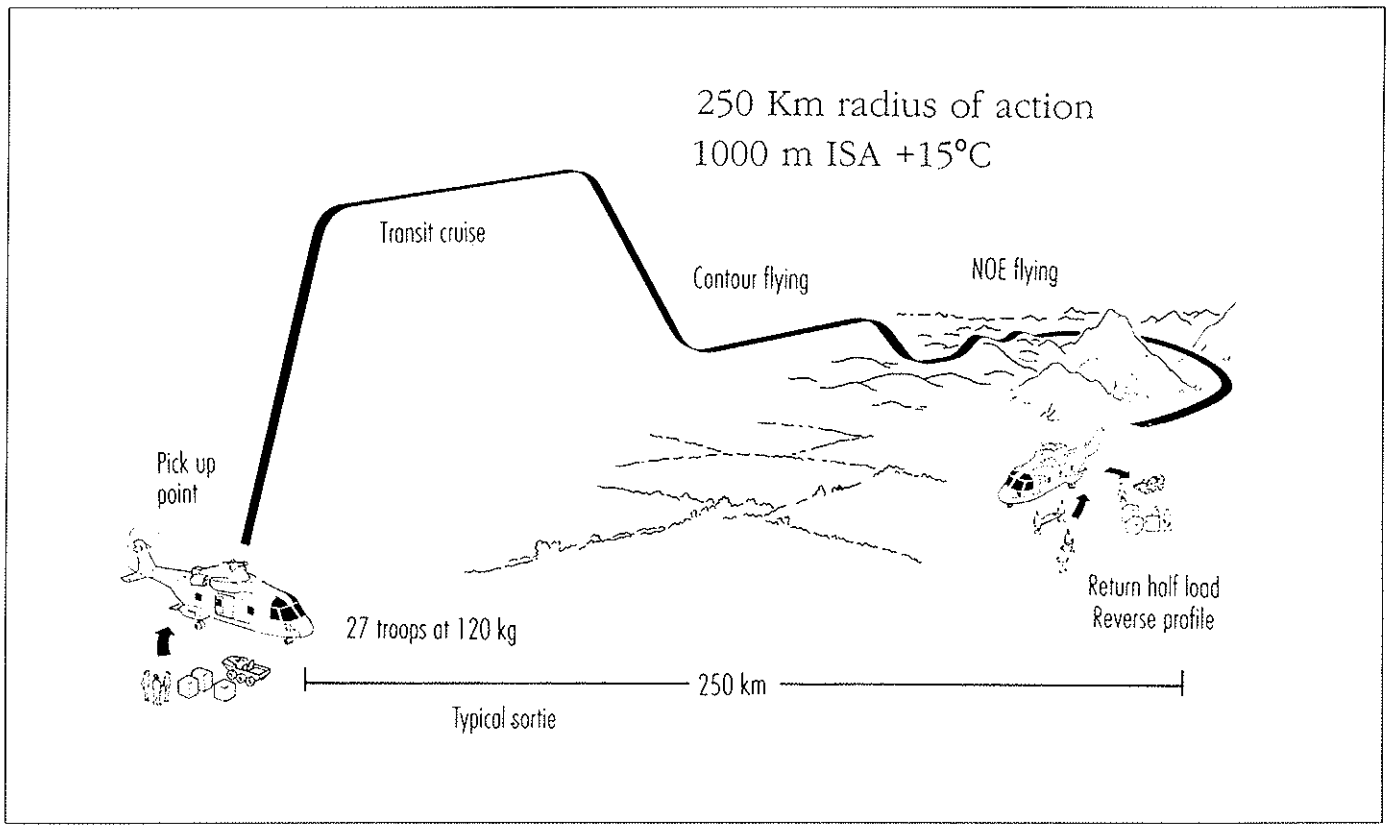
This diagram shows the large unobstructed cabin, of constant section, giving the EH101 approximately 32 cubic metres of usable space and allows the cabin to be quickly reconfigured for a number of roles.



Another important feature shown here is the full width rear ramp which enables troops or stores, including light strike vehicles, to be loaded or unloaded in the shortest possible time. In addition to the ramp a large sliding door is located on the starboard side and an airstair door is on the port side to give unprecedented ease of access.

The combination of large cabin and rear ramp allows the EH101 to carry bulky load internally which most other helicopter types would have to carry as an underslung load, with consequent increase in vulnerability and decrease in speed. Whereas the EH101 would still be able to fly Nap of the Earth (NOE) at high speed. Underslung loads of up to 4,500 kg could be carried when necessary.

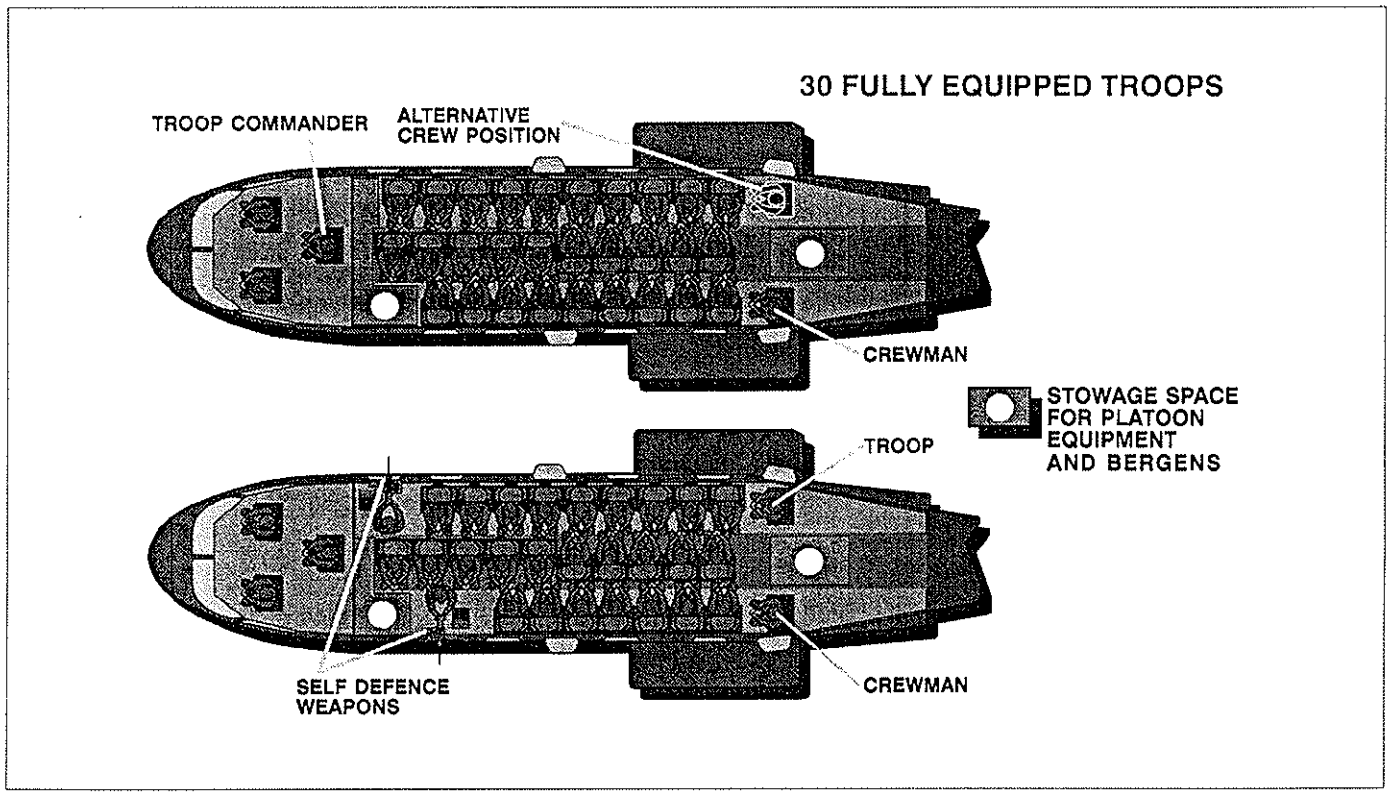
This diagram illustrates a typical air mobility tactical sortie and shows the flexibility of the EH101, combining large capacity, rear ramp access, long range, high speed and agility for NOE flying.



Other aspects of flexibility which could apply to this sortie are the EH101's ability to operate day and night in adverse weather including icing conditions. It would be equally at home in hot, dusty or humid conditions.

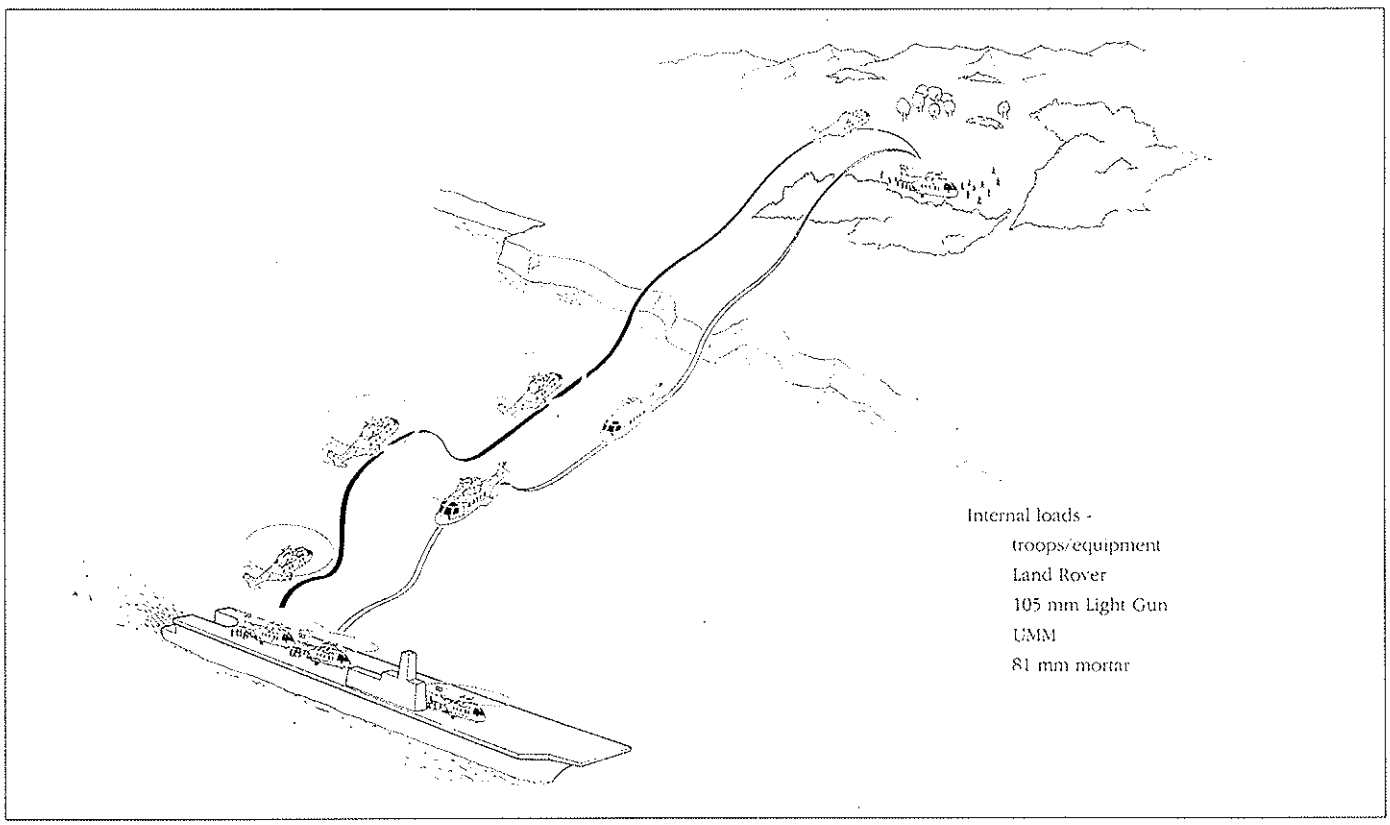
Rapid role changes would enable the same aircraft to fly the same sortie profile in a number of different roles.

In the trooping role, up to 32 fully equipped soldiers may be carried with some trade off between numbers of troops and fuel for longer ranges.



In the freight carrying role, NATO pallets or a light strike vehicle and its crew can be accommodated and in the casualty evacuation role up to 16 stretchers plus 2 attendants and a crewman can be carried.

The ship compatibility and marinisation inherited from the naval variant of the EH101 help to make the utility army support variant ideal for the amphibious support role illustrated here.



Another important role I should mention is Search and Rescue (SAR). The basic naval or utility EH101 could be converted to the long range SAR role with a range up to 750 nm and able to rescue up to 28 survivors.

Long range also gives the EH101 the ability to self ferry over ranges in excess of 1,000 nm without refuelling. This has strategic as well as tactical advantages.

Development EH101 aircraft have made many flights between the Agusta factory in northern Italy and the Westland factory in southern England, a distance of approximately 1000 miles. This has been flown by aircraft with standard internal fuel and with a significant weight of development instrumentation and flight engineers. Fitted with auxiliary fuel tanks and fuelled to the maximum all up weight of 14,600 kg, the EH101 would be able to make the trip in one hop. This would be more than sufficient range to self ferry from the heart of NATO territory to, for example, Bosnia without refuelling and to the Middle East with two refuelling stops at the most.

Cost Effectiveness

Having looked at the arguments for greater flexibility and how that is being achieved, let me now turn to the subject of cost effectiveness.

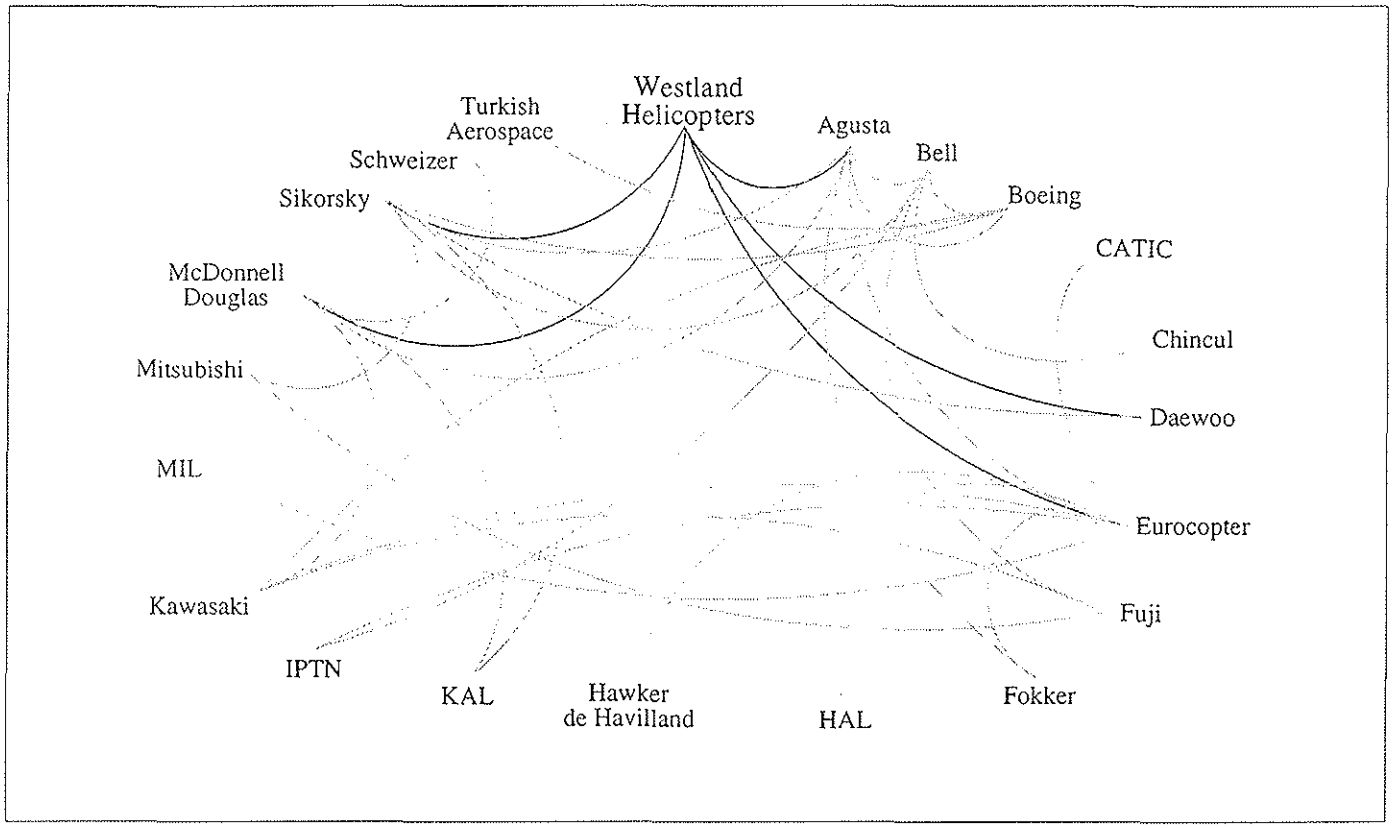
In an era of rapidly changing defence priorities, cost effectiveness becomes more difficult to define. At the height of the cold war, the submarine threat in the North Atlantic was sufficiently well defined and serious enough to justify having the most operationally effective counter, with cost as a secondary consideration. Today, with the immediate military threat to NATO apparently removed and economic issues coming to the fore, cost is a primary issue.

One of the most important elements of cost effectiveness is affordability. Including initial affordability of the first cost and longer term affordability of the total Life Cycle Costs (LCC).

Within first cost I include the initial investment in development and production as well as the unit production cost.

One obvious way of reducing the massive cost of national investment in new helicopter projects is to share costs through collaboration. The investment in the EH101 is shared equally by Italy and the UK and by Agusta and Westland. The NH90 is also a collaborative programme.

This diagram of helicopter collaborative links is by no means complete, but it does indicate the growing scale and importance of international cooperation and joint ventures.



Keeping the unit costs as low as possible is more vital today than it has ever been. In this respect, we in Europe have often been at a disadvantage compared to the USA because of their relatively large home order base, which helps to spread investment costs over a much greater production run. However, because of more effective collaboration within Europe and through the concepts of integrated multi-variant development and production, we can also enjoy the benefits of economies of scale.

Collaboration helps to ensure the largest possible initial order and provides the confidence in the product which is so necessary for success in export markets.

The EH101 integrated programme involves the concurrent development and production of Naval, Military Utility and Civil variants based upon common structure and core systems but optimised for each specific application. By addressing this larger market from the outset, unit costs can be kept to a minimum.

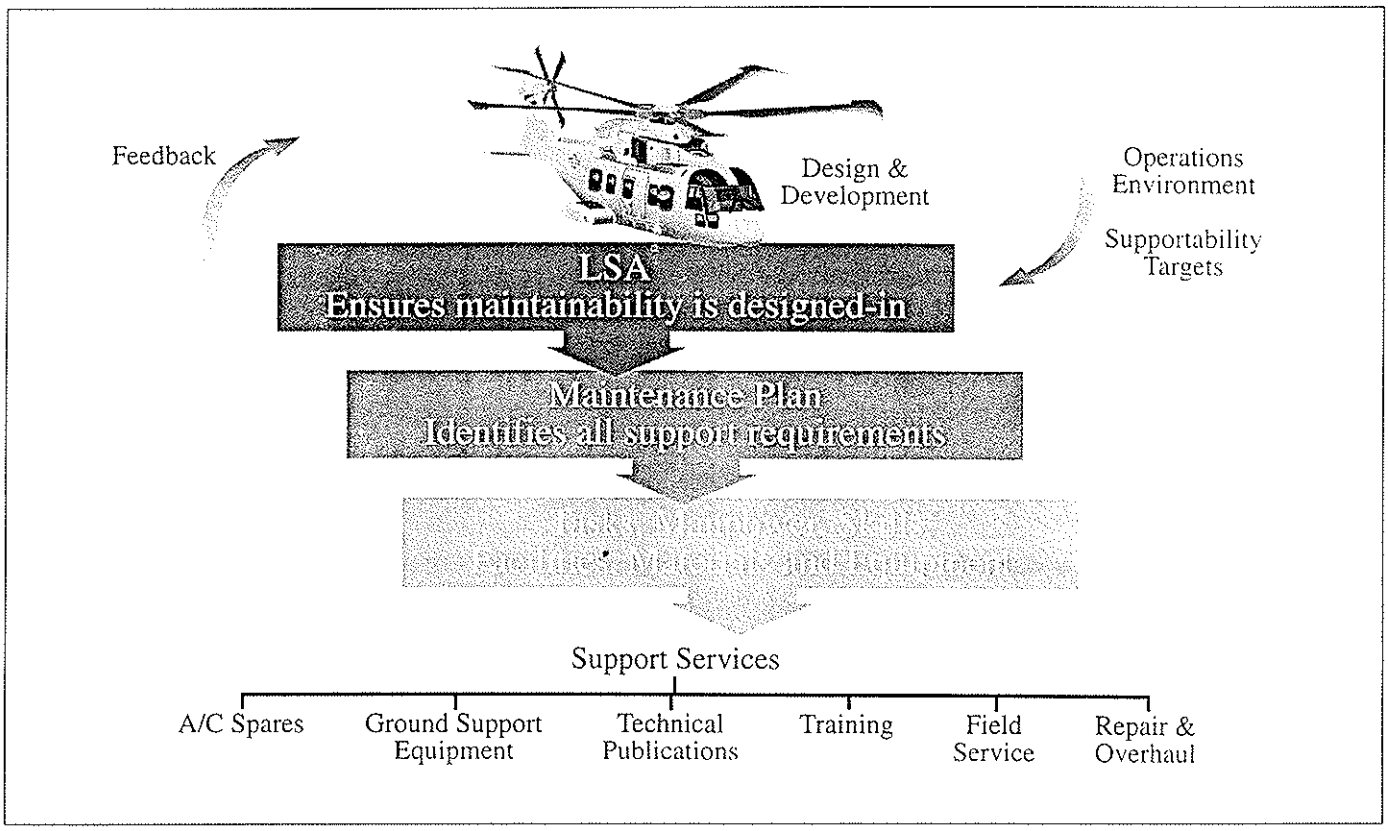
Cost effectiveness also means greater productivity which is achieved through a combination of features such as capacity, lift, speed and also through improvements in data processing and designing to reduce crew workload. This allows the EH101 to be flown by a single pilot and enables the Naval EH101 and its crew of 3 to perform a mission which takes up to 11 operators in a typical 1970s technology Maritime Patrol Aircraft still in service today.

Initial costs pale into relative insignificance when compared to life cycle costs over a typical period of 25 to 30 years.

One of the major benefits of the application of advance technology and design concepts to the new generation of helicopters is the reduction in life cycle costs through significant improvements in maintainability, reliability and supportability.

This is a subject which could justify a symposium of its own so I will confine myself to mentioning just a few examples.

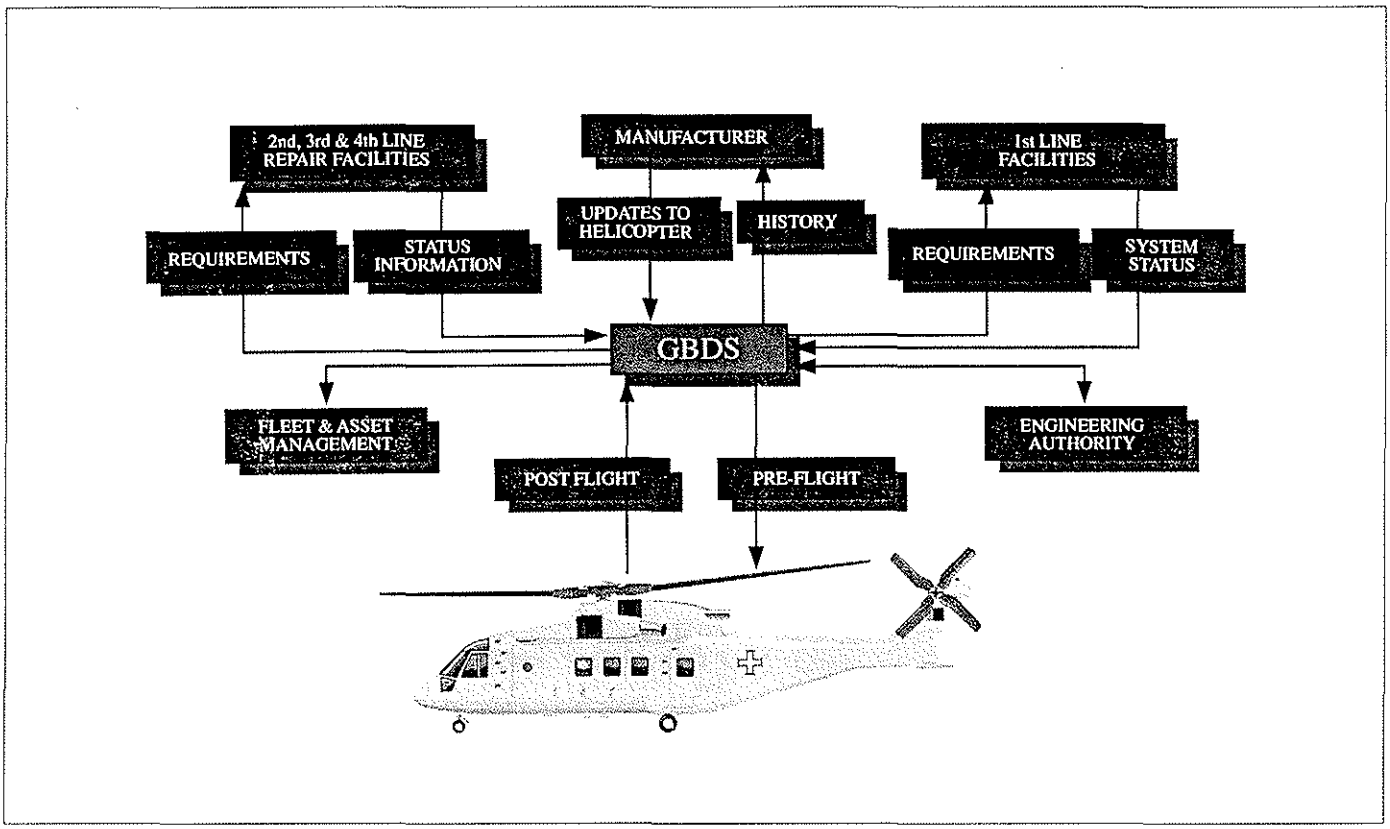
The concept of Integrated Logistic Support (ILS), has been adopted by Agusta and Westland to provide effective support for the EH101. This has included full Logistic Support Analysis (LSA) from the early design and development stages which provided feedback to ensure the optimisation of maintainability and supportability aspects.



Reliability has been enhanced by a comprehensive Failure Reporting and Corrective Actions System (FRACAS) and by an intensive Maturity and Reliability Enhancement (M&RE) programme involving 2 lead aircraft flying a total of 6,000 hours to accelerate the achievement of full reliability and to extend the Time Between Overhaul (TBO) of critical components.

Improvements to maintainability and supportability are provided by health and usage monitoring and status monitoring systems incorporated within the basic EH101. These systems record a great deal of data including vital parameters of flight critical systems. This data may be down loaded after each flight, via a solid state data transfer device, to a Ground Based Data System (GBDS).

The GBDS is a computer based diagnostic and fleet management system. The concept is shown in this diagram.



The post flight data is processed by the GBDS which then provides the maintenance engineers with precise details of scheduled and unscheduled maintenance requirements. It also shows long term trends which can give warnings of impending failures before the situation becomes critical.

The system builds up a historical data base of individual aircraft and of the operators fleet, to assist with efficient long term management and control.

The GBDS may be integrated into a wider logistic support information and management system, giving instant access to the manufacturers data base covering the world-wide fleet of a particular aircraft type and including areas such as materiel support, technical publications, repair and overhaul, modification and configuration control status, plus other key areas concerned with the support and management of a helicopter fleet.

The integrated programme concept also provides life cycle cost benefits through the commonality between naval, army support, SAR and other variants operated by the same country and benefiting from a common support infrastructure.

Conclusions

We live in a fast changing world in which uncertainty, combined with growing pressure to reduce defence spending, has led to demands for greater flexibility and cost effectiveness in new defence equipment and to new concepts of operations requiring world-wide, all weather, multi-role capabilities.

These are reflected in the new generation of helicopters typified by the multi-variant EH101 which is now entering full scale production.

I believe that concepts of operation will continue to evolve from the inherent flexibility of helicopters and that future development will be aimed at enhancing both flexibility and cost effectiveness.