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THE FAMILIES OF MILITARY HELICOPTERS :

A FASHION, A NEED OR CONVENIENCE?

Emidio Valente - Antonio Giovannini

Agusta S.p.A.
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ABSTRACT

1) FOREWORD

- The helicopter and the military requirements of:
 - ARMY
 - NAVY
 - AIR FORCE

- The future trends in the medium-long term foresee three main classes of helicopters
 - light
 - medium
 - heavywith basic models and derivative to satisfy different requirements

- Differences between U.S. and European trends.

2) THE CONCEPT OF "FAMILY"

- Family as a key factor for R.S.I. of military equipments
- Relationship between family
- Extension of the concept to systems, subsystem and equipments
- Pros and Cons
- Benefits for Civil Market

3) FAMILIES HIGHLIGHTS

LHX: Operational meaning and technological programs
A-129: Genesis, developments, "family", perspectives
EH-101: Programme highlights

4) CONCLUSION

The military requirements are not a fashion, the "family" is a mandatory need which translates in technical-economic convenience.

FOREWORD

- According to the Webster Dictionary "family" is:
 - a group of persons of common ancestry: CLAN;
 - a group of individuals living under one roof and under one head: HOUSE HOLD;
 - a social group composed of parents and their children;
 - a group of related person, lower animals or plants;

also

- A GROUP OF THINGS HAVING COMMON CHARACTERISTICS.

- Speaking of helicopters today it is currently used to refer to families and evidently the meaning attributed to this word is the last one of those recorded by the dictionary: "a group of things having common characteristics".
- Nevertheless, the simple reference to common characteristics is far away from the original concept from which the development process of helicopter families started.
Once again the military requirements have solicited a new approach to the great number of problems arising from the exigency of replacing lines of obsolete means, requesting solutions able to rationally combine the best operational results with the restraints and limitations imposed by economic factors.
- We'll see later that, within the helicopter sector, these new military exigencies will also have a positive impact on the civil market which is looking for less expensive, better performing and safer means.
- Presently the helicopter, even more than in the past, appears to be an essential factor for turning into reality the most advanced operational doctrines and it is also accredited to allow essential variations of the conventional procedures of the ground combat.

- A significant prove of the new operational image of the helilcopter is given by the not renounceable level of offensive and logistic mobility requested by the ground forces for meeting the targets defined by the "Air-land battle 2000 concepts", especially for acting against the second echelon forces.

- Obviously not only the Army considers the helicopter an indispensable mean for reaching its operational capability. The Navy infact will more and more rely upon the rotary wing not only for the naval roles like the antisubmarine and antisurface ships warfare, but also for amphibious operations and for logistic support, considering the helicopter both integral part of the ship, intended as a weapon system, and an autonomous system to employ for combined operations with the ships.

- At first sight the helicopter does not appear to be a priority mean of the Air Force for performing its istitutional duties. But if we only remind the responsability of this Service for the Search and Rescue in peace time and in war time and for the air transport, it's evident that the helicopter reaches a not negligeable level of importance in respect of the traditional combat and transport aircraft.

- Consequently, from the military point of view, we can see that in the near and medium terms future all Services shall face problems for renewing and reinforcing their helicopter fleets and that, in such optics, the subsequent activities shall be conducted according to Rationalization, Standardization and Interoperability principles on three different planes:
 - within each Armed Force;
 - among the Services of one Country;
 - among the various Countries within the frame of their Alliances.

- Alternatively to this procedure there would be a sort of anarchy that, looking for indipendent solutions, would determine a general weakening of the operational effectiveness and an absurd dispersion of technical, financial and human resources.

From the industrial point of view, considering the European situation, for meeting their requirements of the European Armed Forces only coordinated programs will reach an acceptable level of cost/effectiveness if compared with the correspondent programs of the United States.

HELICOPTER CLASSES AND FUTURE REQUIREMENTS

- Considering the perspectives of replacing the present helicopters lines, it's evident that in Europe three helicopter classes shall be necessary for meeting the entire spectrum of exigencies. The correct definition of these classes is an old problem never solved. Although specific NATO Agencies are responsible also for the standardization of the terminology, it has never been possible to rationally classify the NATO helicopters according to technical or operational concepts. Therefore - being to adjectives questionable - instead to refer to light, medium and heavy classes, I think it could be clearer to refer directly to the weight, as an order to magnitude, for configurating categories of aircraft able to satisfy different requirements. So, in the light of the present military trends, the future requirements shall be satisfied by helicopters:
 - of 4/5 tons, essentially for the basic airmobility requirements of the Ground Forces in terms of information, protection, fire, light utility transport;
 - of 7/9 tons, able of meeting the Ground Forces needs for tactical transport and heavy combat duties. The Navies will use same category aircraft for the antisubmarine and antisurface vessel warfare departing from light ships. The Air Force instead could use these helicopters for tactical search and rescue, for liaison and general logistic support to their own basis;
 - of 14/18 tons for mass logistic transport of personnel and material by Army and Air Force, for long range search and rescue operation by Air Force, for antisubmarine and anti surface vessel operations by Navy departing from ground bases or from helicopter carriers.

- If these are the European orientations let us give a look at the U.S. situation. In this Country recently very important programs have been accomplished within the intermediate class. I'm referring to the UTTAS and AAH programs.

At the present time the most significant R&D activities are not only in the lower and upper classes but also in the field of the heavy transport considering the orientations of the U.S. Army to resume the Heavy Lift Helicopter program, presently named ACR, Advanced Technology Army Cargo Aircraft

Among the programs already started or only enunciated, probably only one is clearly a "family program". Others, at least at the present time, seem to be oriented to the development of single aircraft for specific requirements.

- We'll discuss later this aspect. For now let me underline some significant differences between the European and US programs, to which calling the European Operator's and Industrial's attention. Considering the medium-long term developments, it seems he can say that the Americans - I mean both the military users and the constructors - have the intention to let the helicopter making a real technological jump, considering all the possible improvements of the machine in all the applicable sectors. Some years ago, in occasion of a previous Forum, by a lecture titled "Military requirements: too much or too little?", I tried to answer to the industrial preoccupation that the military requirements with their heavy implications, especially referred to the survival problems, could result in an obstacle to the diffusion of the helicopter on the civil market for the unacceptable cost increase. I said that, in my opinion, if the military requirements would have been interpreted as a technological challenge for promoting a new way of "thinking" the helicopter, this aircraft would have recovered within the aeronautical sector the lost time and reached the level of other aviation sectors together with substantial benefits not only for the military users but also for the civil ones in terms of performance, safety, costs. And now that is what is happening in the U.S. since the military environment - really interested to the true progress of the helicopter considered an essential mean for the operational capability - have based the development of the new machines according to unprejudiced criteria, promoting a real progress in all technological sectors even before starting specific programs. Europe - although there are some encouraging signals - is lacking a precise and coordinate willing in the sense I mentioned before: no adequate funding for advanced technology research programs, scarce manifestations of cooperative efforts which only would allow a real jump also for the European Helicopter.

Consequently the industrial efforts are characterized by a slow and prudent passage from the conventional to the advanced just for this lack of a common European willing on the political and military plans and consequently on the industrial plan. While the Americans boast the "giant leaps" of their helicopters, the advancement of the European Helicopters - with some exeptions - will be only by little steps.

THE FAMILY CONCEPT

- At the beginning of my speech I said that the "family concept" could be a key element for tendering actual the process of rationalization standardization and interoperability of the military equipments. But I have not yet explained what has to be understood, in my opinion, as "family" due to the fact that the commonality of some characteristics is certainly not the only factor to be considered.

- When from a certain helicopter, born for meeting a specific exigence, in the course of the life we obtain different configurations and versions, we have not a family but adaptations to other functions by more or less acceptable compromises.

- Family instead is a complete of means conceived for different requirements since the design phase, timely identifying the points to be concialiated for fullfilling without compromises requirements which are different but within a coherent operational context.

- Therefore it's a question of a continuous process from the expression of a variety of homogeneous and compatible exigencies to the production. The same process can also be extended beyond a single program in a certain aircraft category to other close categories, especially as far as applied researches and advance technologies are concerned.

But it's not enough.

The same concepts can also be applied, when possible and convenient, to systems, sub-systems and equipments not in the standardization sense - that is obvious when it's possible to utilize the same item for different types of means - but in the sense of developing systems, sub-systems and equipments from a single matrix having taken in account different exigencies.

- In my abstract I was referring to pros and cons of the family concept. In reality I don't see negative aspects except a certain limitation for the users for expressing their requirements outside of a scheme in which other but not contrasting requirements must be included. From the industrial point of view the difficulties of finding out solutions without compromises will solicitate that technological imagination which always was the key of the progress.
If a family is been born from a objective, realistic and coordinated vision of the operational picture in which it shall operate, and if for its realization all the necessary premises have been set, we can obtain nothing else than benefits under every aspect: operational, technical, economical.

- But what about the requirement of the civil market?
We must be realistic: until the civil market will not require helicopters like cars, only the military programs will offer sufficient bases for mass production maintaining the costs at acceptable levels. But - once again - the military exigencies, viewed as a new way of designing a helicopter, can have a positive impact also on the civil market provided the requested operational capabilities are not obtained by mean of constructional complications or weight increase not acceptable by civil operators. On the other hand a clever constructor, while is putting the bases for a military family, will try since the beginning to find out a space for a civil son!

FAMILIES HIGHLIGHTS

- Considering the weight classes I have described before, let's give now a look at the European programs.

- In the 4 - 5 ton class there is the A.129 program of the Italian Army that envisages the acquisition of three helicopters in subsequent helicopter times starting from an antitank aircraft followed by a scout and a light general purpose helicopter. The "first-born" of the family is already flying and soon will enter service into the Italian Army for filling the existing gap for an airmobile antitank platform.

- Another program in the same category has been announced: it is the so called PAH-2/HAP/HAC french-german program aimed to developing an aircraft able in a first time to meet the german requirement for a second generation anti-tank helicopter and the french requirement for a support and protection helicopter later followed by a third generation antitank helicopter for the french Army.

It is questionable if this program has a sense if examined in the light of the conclamed concepts in favour of the European cooperation in the helicopter field. A similar program already exists at a very advanced phase and completely open to any form of cooperation. We don't know what kind of industrial, operational or political reasons are stronger than the apparent logic of having in the nineties an European fleet of many hundreds of light helicopters born from a same family. However if the situation at the present time is like this, we can hope that soon or later the real evaluation of the common interest could allow for changing the present decisions.

- In the intermediate class of 7 - 9 ton during the next decade many European Countries shall acquire new helicopter for replacing different types of machines presently employed by the Armed Forces in different roles. In total hundreds of PUMAs, Hueys, WESSEX and LYNX will progressively go out from the active service and should be replaced by new aircraft able to meet various and often contrasting requirements.

Starting from the requirements expressed by the Armies for a tactical transport helicopter, by the Navies for a naval helicopter suitable for the eomployment from the NATO frigates of the nineties and by the Air Forces for a helicopter essentially dedicated to the search and rescue role, there are solid bases for carrying out an European program. The program infact was announced as an initiative in cooperation by France, Italy, Federal Republic of Germany, The Netherlands and the United Kingdom with the denomination of NH-90, that is "NATO helicopter for the nineties". The NATO label is due to the fact that the different requirement have been combined and harmonized in the NATO context.

At the moment the NH-90 is not a family program because only one basic machine with different configurations and arrangements shall meet all the various requirements.

But it is to be hoped for proper considerations by operators and technicians before definition of the final design, should new exigencies arise in the future, for example for a heavy attack helicopter.

I personally believe that, if the family concept was already defined when the United States Army expressed its requirement for a tactical transport helicopter and for an advanced attack helicopter, today instead of having two complete different aircraft, like the UH-60 BLACK-HAWK and the AH-64 APACHE, with only some equipment commonality, it could have been developed only one basic machine with the variants suitable for the different roles.

- In the upper class of 14-18 tons there is at a very advanced phase the anglo-italian EH-101 program. This program is mostly known as replacement of the present SH-3D and SEA-KING helicopters for the italian and british Navies. In the reality since the beginning other requirements have been taken in the account before defining the project and starting with the development: infact besides the naval roles other possibilities of employment in different military and civil mission have been considered. That means that practically three helicopters will be developed within the family concept: a Navy helicopter, a civil transport helicopter, a military medium transport helicopter.

- Considering the importance and the status of the two main european programs:
 - the italian A-129
 - the british-italian EH-101I believe that it is of general interest to have a description of their characteristics situation and perspectives.

A-129 FORERUNNER OF A NEW GENERATION OF HELICOPTERS

The A-129 has been in the news for some time now.

We think it is important to stress that this achievement extends well beyond the national borders of its Country of origin, both as regards the technological innovation it represents and because of the increasing international interest it is currently attracting as a result of the new operational concepts it embodies.

As mentioned the Italian Army has introduced, in the A-129 program, an equally new and undoubtedly interesting concept: that of the "family of helicopters" referred to the future combat helicopter generations, which must possess those characteristics already mentioned such as survivability, all weather operations, etc., from which battlefield support helicopters with low-weight would be derived and designed to replace, in the near future, the bulk of helicopters bearing different designations.

The new generation of helicopters originates in fact not only from the pressure exercised by the military requirements, but also following a different evolution of the importance attached to design criteria which from the out-set consider as primary objective the feasibility of expanding the roles and operations within the frame of a strategic envelope, in which reliability and Life Cycle Cost are normal parameters of work tools which can be safely achieved through the correct use of modern technology.

The first element of this new generation of helicopters is the A-129, a completely new helicopter to satisfy the Italian Army Requirement for an anti-tank helicopter able to cope with the ever evolving requirements.

In this respect we must envision the use of the A-129 against other helicopters considering that the Soviets have deployed increasing number of armed helicopters like the MI-24 and, in the future, the HOKUM and HAVOC. Therefore the A-129 MANGUSTA will be employed in the following three types of combat:

- operations at the forward line of own troops (FLOT)
- rear area combat operations (RACO)
- deep attack.

In FLOT operations Scout/Attack helicopter teams are used primarily as tank-killers during the close-in battle. In this case the scout must also be able to protect against an enemy air attack. During combat assaults deep into hostile territory, the same scout/attack teams become escorts of assault transport helicopters and provide short range, close air support.

During RACO missions, helicopter engage in an offensive air-to-air role: seeking out enemy A/C bold enough to penetrate the defending rear areas. All this can be done by the A-129.

The Italian Army requirement called for such integrated weapon system, capable of adapting to the changing requirements and evolving operational systems (growth potential). This practically meant distinguishing the platform from its operational systems, in a sense that the former had to be of such an advanced concept as was necessary for it to retain its validity for a long period of time, while the latter had to be the best current-generation systems available on the market, with provisions for a phased replacement any time that other more advanced systems would become available.

LEADING FEATURE OF THE A-129

As already mentioned before, the A-129 is now well known world-wide. I think therefore I do not need to give a general description of the aircraft, but would rather illustrate the criteria implemented for the materialization of the military requirements touching upon those aspects which have proven to be the most relevant elements of the project and that will remain common in all the derivatives of the family.

An interesting aspect of design was the criterion adopted for securing the Survivability aspect, through:

- Reduction of the possibility of being detected with minimization of reflected and also providing the crew with adequate systems for the identification of the enemy. The slides clearly show the measures implemented for achieving the desired results.
- Possibility of escaping direct threat, relying on the helicopter flight qualities (evasive manoeuvres) and on the use of active electronic countermeasures against weapons with target homing capability or acquisition and radar systems.

On a modern combat theatre we must also account for situations in which the aircraft may be subjected to direct and indirect threats requiring adequate protection measures. For the A-129, a threat level has been considered which refers to 12,7mm piercing/incendiary machine gun hits and protection was achieved in terms of:

- ballistic tolerance or capability for components and systems to continue operation after being hit;
- redundancy and separation of systems;
- armour plating for the crew and some vital components;
- crash absorbing capability in the event of a forced landing.

As regards crashworthiness the objectives set were to:

- hold within the physical tolerance limits of the human body the effects deriving from violent accelerations upon impact with the ground;
- provide sufficient vital room for the crew in the inhabited area of the cabin;
- ease crew escape from the cabin;
- avoid or drastically reduce the fire risk following a crash, caused by spilling of fuel and of other inflammable liquids.

The slides clearly show the criteria we have adopted in achieving the desired results.

I wanted to mention and underline first the aspects relating to the A-129 survivability, for these are most directly linked to the operational credibility of a weapon system for the 90ies. I wish now to revert to the principle performance of the helicopter and point out that the mandatory data reported in the relevant Specification, at the current progress status of the development, has already been fulfilled and in some instances, even exceeded. This superior performance originates from the happy combination of basic machine and power plant installed to provide the required ratings.

The adoption of the British GEM 2 Mk 1004 engines was a choice made after due consideration and because of the proven reliability of this power plant which was actually developed to perform military tasks.

In addition, this engine has been subjected to a process of optimization, adaptation and customerization for installation in the A-129 helicopter. We have seen so far that the A-129 has high chances of surviving in a hypothetical operational theatre and that its performance fully meets the requirements.

Let's see now how it responds to requirements concerning the capability of performing the assigned missions:

- operating in adverse weather conditions, day and night;
- reacting against:
 - ° armoured point-targets
 - ° protected and unprotected aerial targets.

Of the equipment with a major impact on operations, it is worth mentioning the HIRNS/IHADDS system which provides for night vision, night flying capability and training of the observation and sighting system. This system also provides the essential information for flight management.

A special mention deserves also the system which in a certain way constitutes the "heart" of the machine, the adoption of which provided an optimal solution to operational and technical-logistic-functional problem linked to survivability and weight reduction aspects.

I am referring to the computation structure by microprocessors, called Multiplex, which in response to a specific requirement of the Army for an integrated control and management systems of on-board installations and systems. The Integrated Multiplex System, which is compatible with MIL-STD-1553B data bus, controls, with measuring and sensing devices, all on-board system (from transmission to engines, from chip detectors to visionics etc.).

All systems on board are sending through the data bus, individual messages to the system computer (actually two for redundancy).

All the various different messages are integrated in the computer to provide, in real time, the pilot and copilot/gunner with precise information about all the on-board systems. All the messages are sent in a sequential way (Multiplex) into the data bus at exactly the right place and the right time.

In this way it is possible to exchange and process all data and information reducing the complexity of the global system and, at the same time, increasing the reliability and the speed response.

The A-129 IMS is, thus, a real time control and display system which integrates the following functions:

- Navigation, Communication, Identification;
- Tactical Navigation;
- Autopilot;
- Fly-by-Wire;
- Control and recording of power drive, fuel, electrical and hydraulic system's data;
- Computation of performance data;
- Management of Warning and Caution lights.

Because of the vital importance of this system, it goes without saying that system operation as regards mission continuation and survivability is guaranteed by duplication of the vital components and by the appropriate location of the same within the aircraft.

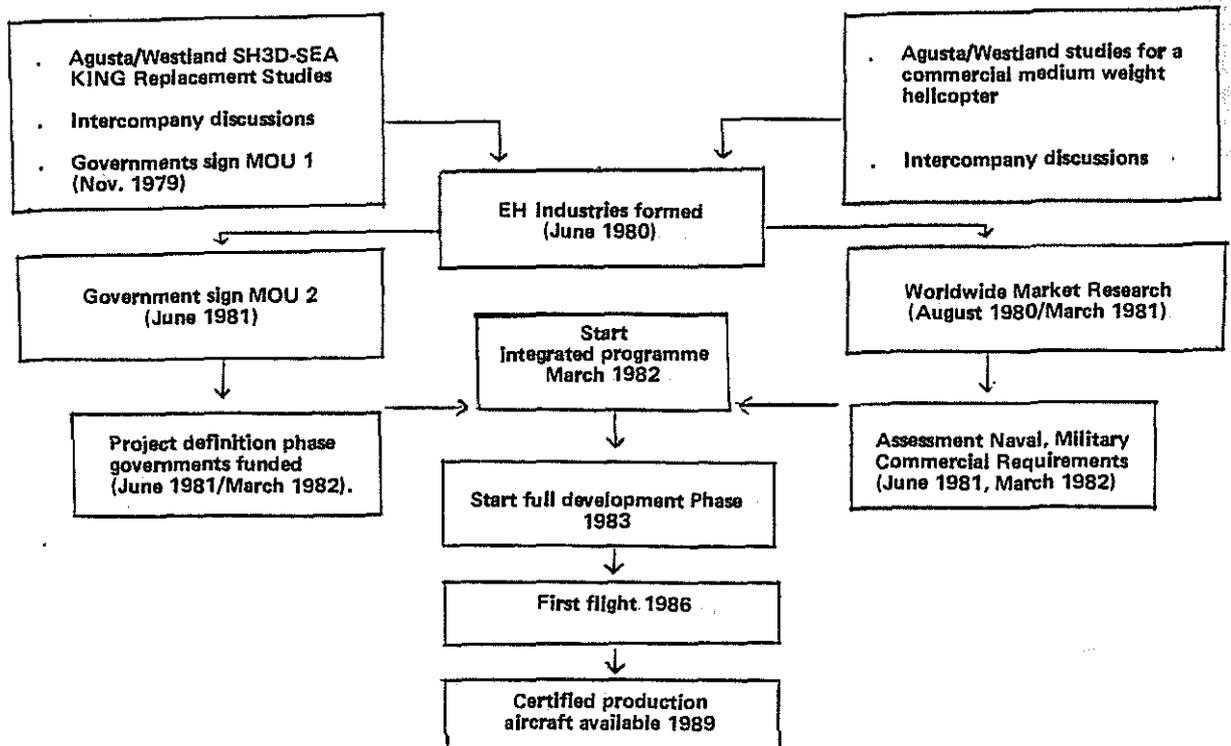
The A-129 MANGUSTA is a reality of today, quite suitable for carrying out essential operational tasks on the battlefield. Its primary role is Anti-Tank Warfare. However when fitted with the appropriate specific equipment it is capable of other roles. With the installation of a different observation and sighting system on the main rotor head, of a trainable turret with machine gun pods, to air to air missiles, the A-129 is in fact fully configured to perform the multimission combat role covering attack, reconnaissance, support and protection.

The growth potential of the A-129 calls for and incorporates provisions for further developments including prospective and welcome international collaborations. This may be achieved because as I said before, the A-129 was born with the "family" of helicopter concept in mind. Specific reference is made to the battlefield support version, specifying that this machine will be capable of fulfilling the basic airmobility requirements covering liaison, light transport, medical evacuation, airborne Command duties, observation and survey of the battlefield and eventually fire missions thereby proving the inherent great flexibility of the helicopter. This version will be developed retaining the basic A-129 dynamic components and building around it an airframe featuring the most advanced design criteria (composite structure, FBW/FBL, crashworthiness, etc.). It shall be capable within the weight and design limitations of the present A-129 (4300-4500 Kg) of carrying 8-12 fully equipped troops, operating in all weather conditions over a 500 Km. range. The same A-129, through proper reconfiguration, can also be used to sustain antiship operations both taking-off from ashore and small/medium vessels. The Naval A-129 will retain the survivability aspects, the all weather capability, the full redundant integrated management system (multiplex), the new maintenance free rotor system, the protected controls, Fly by Wire (F.B.W.), modular transmission, etc. In supporting the Navy's sea control mission the anti-ship A-129 will be used as an elevated platform that, with its sensors, gives early warning and provides the data for targeting the threat beyond the horizon. At this point the threat is directly attacked, from stand-off position, by the A-129 with its own missiles either the Sea-Skua or the Marte MK2. As an alternative a ship's surface cruise missile (as the OTOMAT) may be launched using targeting and classification data provided by the A-129.

EH-101 PROGRAMME

If the A-129 family covers the military requirements in 4 tons. class helicopter, the EH-101 satisfies the need for a helicopter in 14 ton. class. But while the A-129 has been optimized especially for military roles the EH-101 is the first example in which trade offs have been made taking into account naval, military and commercial requirements. Behind the new design philosophy of the EH-101 is a new approach to the whole development programme. The Royal Navy and the MMI both required a new naval helicopter.

A harmonisation study showed that, despite using different tactical philosophies the mission requirements of the two Navies could be met by the same helicopter design. Market Research meanwhile had established the desirable payload and range for a civil helicopter and showed that it too was within the design points of the projected helicopter. This made possible the integrated EH-101 development programme which allowed different variants to arise from a single basic airframe and power plant concept. Development for different roles thus began early enough to meet the needs of all users. While producing a maritime helicopter to the demanding requirements of the MMI and the Royal Navy, simultaneous design, build and test programmes will run for civil, military and para military variants with mutual benefits and cost savings.



The EH-101 will mark a new stage in the art both of basic helicopter design and control and instrument technology. The basic airframe design includes a number of innovative features which combine to give improved performance levels and increased integrity compared with earlier helicopter generations. Next technology has also contributed to lower operating costs.

COCKPIT SYSTEMS

Cockpit systems of the EH-101 are based on an Aircraft Management Computer. Interfaced with a duplex microprocessor-based AFCS, and providing effective information management for communications, navigation, instruments and sensors, the computer provides, as standard, highly flexible multiple CRT displays. These offer a new high level of information on screen, permitting considerable reduction in the number of separate instruments required. The EH-101's sophisticated health and usage monitoring systems will provide detailed information allowing structure and component lives to be extended to the maximum possible. This is intended to give a considerable reduction in operating costs.

ROTOR

Composite rotor blades utilise advanced aerodynamic airfoils and planform. Electrical de-icing can be provided. The metal cored composite hub with elastomeric bearings is designed to a multiple load-path concept with fail-safe characteristics.

POWER PLANT

The EH-101 triple engine configuration is based on a proved variant of the General Electric T-700 series. This power plant combines advanced technology with low SFC and long life in both scheduled operation and demanding military applications. Modular construction has been designed for low-cost on-condition maintenance. The new helicopter will offer 550 m.m. range with 30 passengers or 5 hours of endurance fully equipped with ASW M.E.P. The cabin gives airline-comfort to passengers, and the required space for the ASW equipment.

The three engine configuration makes the EH-101 a true Category A vertical take off transport capable of scheduled flights into inner cities under tomorrow's more rigorous civil operating rules. The same three engines give unrivalled OEI performance with a fly away from hover in the event of engine failure, the ability to dip within minutes of launch and to extended endurance on two engines for sonobuoy or surveillance operations. In the EH-101 design philosophy, many characteristics combine to reduce operating costs. Composites are used in the airframe, rotor head and rotor blades. Built in test equipment and a comprehensive health monitoring system simplify maintenance and ensure availability. The combined support of Westland and Agusta give EH Industries Worldwide backup capability.

RESULT

For a commercial operator lower-bottom-line costs for more competitive helicopter economics, for the military low L.C.C. and higher availability. These are just a few examples of how the requirement of each will make a continuous contribution to the whole:

THE EH-101 INTEGRATED PROJECT.

U.S. PROGRAMS

In the U.S. besides the already mentioned ACR program for an Heavy lift helicopter, there are two very important programs that, in a certain sense, appear as a revolutionary thinking in the helicopter field. I only mention the JVX program, that is not a family-program at least at the present time, but is really a new approach at the employment of the rotary wing aircraft for high speed/long distance liaisons. The real "family-program" is the LHX program of the U.S. ARMY. I'm sure that everybody knows the main technological and operational aspects of this program based on numerous preliminary and parallel R&D programs supported by Governmental adequate financial resources. Very shortly I remind that the Family LHX will totally or partially replace four types of the current light helicopter force of the U.S. ARMY by an aircraft characterized by:

- improved reliability
- higher readiness
- standardization/commonality
- lower support costs
- fewer personnel exigencies

Practically only two versions shall meet all the requirements:

- a scout/anti-tank version for pure combat roles:
- a light utility version for all the basic airmobility exigencies.

I want not to describe the technical aspects of these helicopters but I take the opportunity to underline that the LHX is an emblematic prove of a new way of designing helicopters although it remains in the conventional rotor configuration. It is also an evident expression of the industrial capability, adequately supported by Governmental good willing, to allow the helicopter making what is may be the last step before other and more convenient forms of vertical flight. Again the LHX should remind the european users and constructors that the narrow-minded policy of commercial competition and of consequent parallel programs does not allow the european helicopters to reach the same level of the american ones. On the other hand, a good european cooperation could also be the key of a U.S.-Europe cooperation on equal bases.

CONCLUSION

- The "family concept" starts from precise military requirements in order to achieve better operational capabilities together with a substantial reduction of costs in term of acquisition, maintenance, employment and personnel. In this sense the concept is not a to-day and transient fashion but a need - a "must" - which also translated in absolute convenience with a positive fall-out on the civil market.
- Looking beyond the military aspects, this concept - if widely applied and, why not? Also in other sectors - will result in substantial benefits for the european interests from both the military and industrial point of view, helping also for building-up the "EUROPE FAMILY".