EIGHTEENTH EUROPEAN ROTORCRAFT FORUM

OS.2

WHAT KIND OF EVOLUTION FOR THE HELICOPTER

by

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It is the heavy responsibility of the technical community gathered here today to suggest the best ideas as regards techniques, products and new formulae for our very specific industry to survive and develop.

I shall try in this short exposé to explain what I believe the market is expecting, to analyse the recent past and to suggest a few ideas in relation with our common preoccupations.

1. WHAT ARE THE FUNDAMENTAL BASES OF OUR INDUSTRY?

As Mr Bigay explained earlier, the market is still more demanding, uncertain and contradictory and although the civil market characteristics are stabilizing, this does not apply to the military market.

- The civil market's development is now fairly slow (3% a year) and it would seem that the helicopter is today unable to significantly extend its fields of application.

The customer's requirements are very restrictive and offer little motivation for the technician.

The customer wants his helicopter to be economic, reliable and comfortable. He is satisfied with the level of performance currently available; the purely economic factors are, consequently, predominant and the fact that the helicopter remains expensive is obviously a limiting factor in the development of new applications.

- The military market is probably much more uncertain, contrasted and, in a way, more difficult.

The characteristics of a large part of the market or missions certainly are close to those of the civil market and we shall have to meet the same type of expectations (economy and reliability) to succeed; but, and this is new in Europe, specialized versions are, at the same time, developing rapidly with AG109 and Tiger while naval and tactical transport versions (NH90) are becoming increasingly complex as they meet very demanding technical specifications.

Military requirements shall, overall, be very different from civil requirements with vehicle and system performance first, then the cost of ownership and, finally, the development of new formulae (tilt rotor or compound helicopter).

Environmental constraints shall play an increasingly significant role and noise will be the main danger for us all. The French authorities are actively involved in population protection at least in and near urban areas. Should we prove unable to make considerable progress in this field, they shall not help us develop helicopter applications, they shall refuse to open heliports in large enough numbers, they shall limit access to helicopter routes next to urban areas and they shall not establish air traffic rules that migh ease helicoper operation.

As regards certification regulations, it is hoped that the emergence of a common European regulation (JAR) which is being harmonized with U.S. regulations (FAR) will make things easier for us. However, some of the current regulation evolutions would seem unsuitable if they cannot be controlled and I shall now quote three examples:

- **Crash resistance:** Rather than a passive crash resistance system increasing the empty weight, would it not be better to improve active safety and use the weight thus generated at the right place and for the right function?

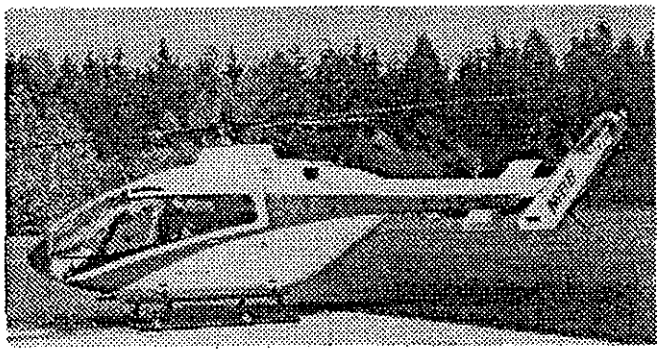
- **Power plant:** Since operating costs are the helicopter's fundamental problem, is the current trend limiting single engine operation really reasonable?

- **Existing helicopter uprate:** The administration tends, whenever a helicopter is being uprated, to request the application of the last regulatory standard; this generates additional development costs and leads the industry to curtail uprating, thus running paradoxically against the administration and the customer's expectations.

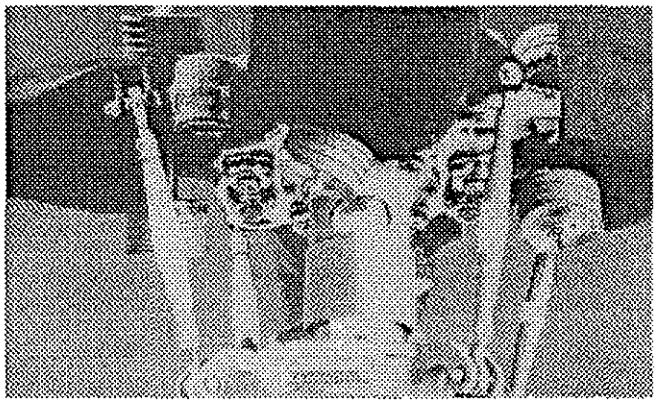
However, the capability to enlarge the helicopter's applications is, for a large part, in our hands, for example, in difficult geographical areas such as for offshore, polar regions, mountains etc. by mastering the elements i.e. snow, ice, changing winds etc.

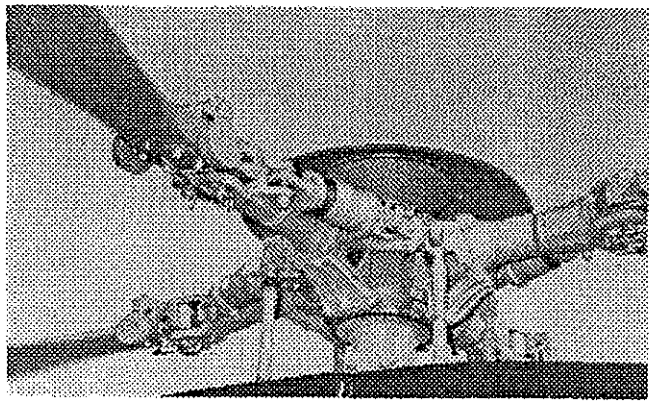
2. **Before moving into the future, it may perhaps be useful to analyze the results obtained over the last few years in terms of product evolutions or research results and technical cooperation. I shall limit my presentation to Eurocopter which I, naturally, know best.**

Two new civil produts have retained my attention, BO 108 and Super Puma Mk2, and our preoccupations are very close as regards those two helicopters: Maximum mechanical simplification and transmission sizing which help reduce Direct Maintenance Costs.



The Spheriflex Rotor Head for Super Puma and Bearingless Main Rotor Head for BO108 are good illustrations of the point I am trying to make:





- Large utilisation of composite materials in the fuselage to contain empty weight increases as best as possible.

- Safety improvement with the development of a Super Critical Power helping offset engine failures at all-up weight.

- Development of a modern cockpit with scopes and optimisation suitable for man/machine interface.

- Provision of a Health and Usage Monitoring System (HUMS), of the passive type to begin with, where active functions shall progressively be integrated.

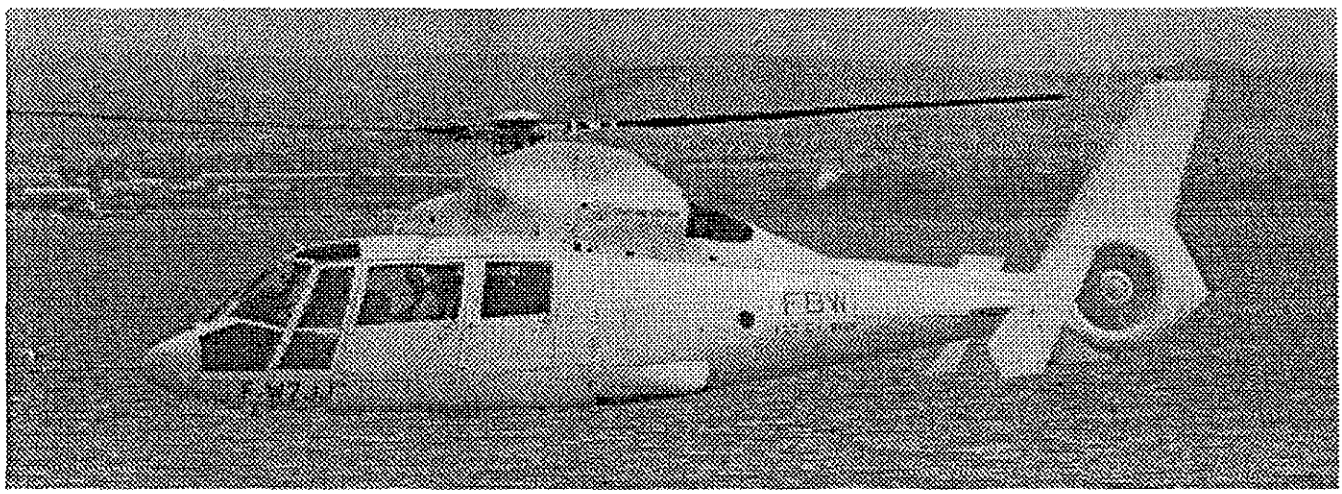
- Noise level reduction by several dBs below the current standard.

- Habitability (passenger, luggage) and comfort optimisation with special emphasis on vibratory comfort.

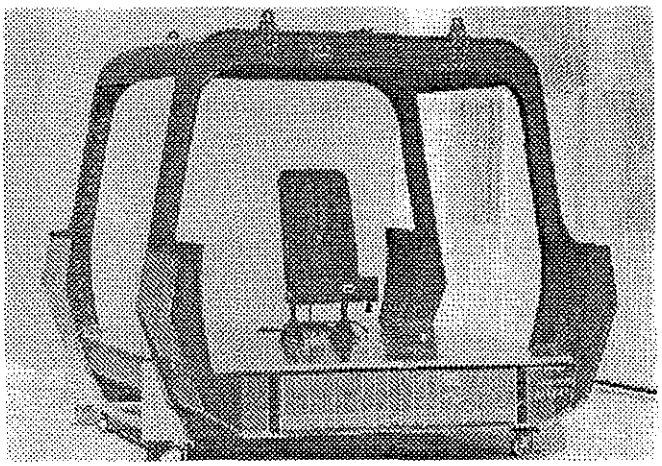
Some significant research results were retained:

- **High speed:** It has been possible on a Dauphin helicopter to reduce drag by 25 to 30% and, with moderate efforts, a 5-blade rotor and a slightly reinforced engine, to fly up to 200 kt in perfectly comfortable conditions for the crew. The helicopter has thus matured in terms of performance to such a point that we can now offer a 170 kt cruise speed for a medium size helicopter against 110 kt 20 years ago.

- **Flight controls:** A Dauphin helicopter has now been flown with Fly-By-Wire controls, a conventional stick to begin with and now a mini-stick. It is thought that this technique is now mastered well enough to be on offer in NH90. Most of the work now involves assessing new piloting laws (piloting by objective).

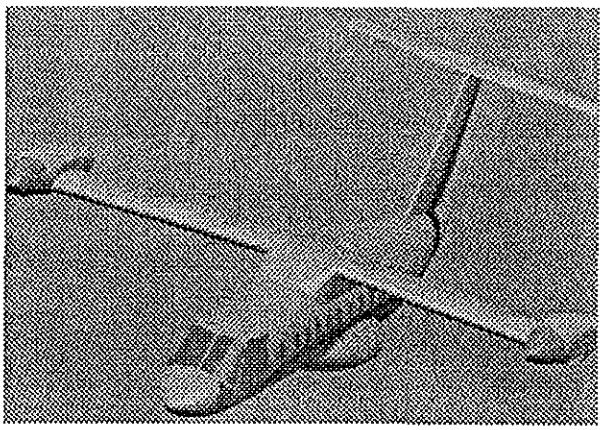


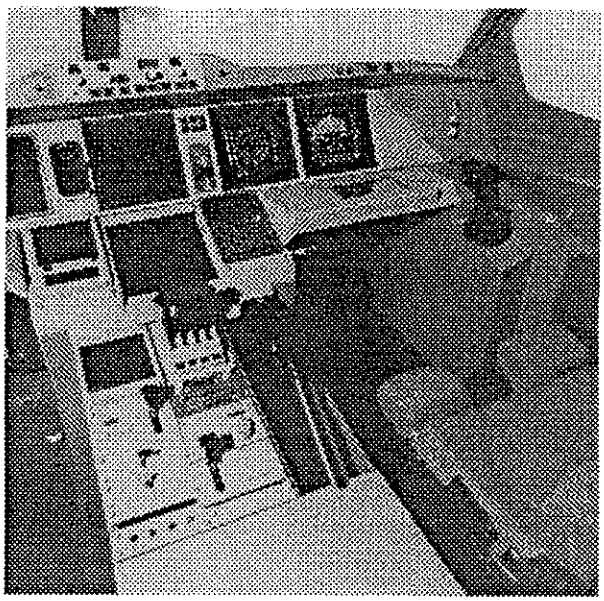
- **Composite materials use:** Tiger fuselage is all-composite and this is a first for a helicopter of this type. An all-composite fuselage section of NH90 size has also been successfully tested and this manufacturing technique will thus be retained for this helicopter.

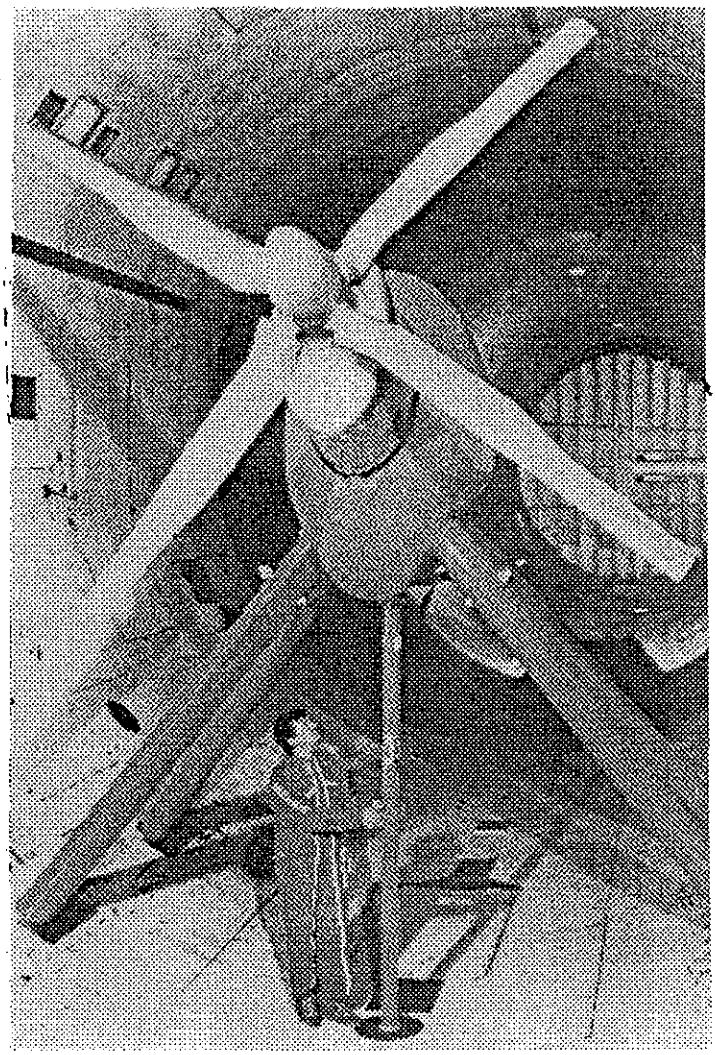


Finally, it can be said that the full completion of a few reseach programmes in cooperation with other partners was a very good thing. I shall quote here two examples:

- **Eurofar**, the civil tilt-rotor aircraft. The cooperation with other partners went very well. A feasibility pre-project now exists and has been comforted with significant experimental work i.e. pressurized composite fuselage section, rotor tests in the wind tunnel and advanced cockpit simulation.







- **Active Control Technology (ACT)** programme with 4 and then 3 partners. This programme was intended to find out what the application of fly-by-wire or fly-by-light controls as well as multi-axis mini-stick to helicopters really involves in terms of technology and regulation. This programme is taking place with simulators and Dauphin or BO 105 helicopters.

Research in cooperation with other partners is interesting not only because highly positive results are obtained but also because it promotes cooperation and confidence between the design officies involved and this is what we need for new programmes in Europe.

3. **However, we should ask ourselves whether the customer is satisfied with those advances and should we not give more thought to what should really be done to develop the helicopter's field of application.**

I believe I can summarize by stating that:

- The operator wants savings and reliability
- The operator and the passenger want safety
- Both want comfort and nuisance limitation in flight and on the ground
- Those requirements are significant for our industry in terms of
    - Vehicle architecture
    - Sizing criteria
    - On-board systems

- **Vehicle architecture:** Previous drag reduction preoccupations have led Eurocopter to design, with due consideration for the installed power available, highly streamlined helicopters where space was sometimes lacking. The customer, on the other hand wants inner space, large accesses, well proportioned luggage compartments, excellent visibility. Up to us, to manage the weight and drag analysis around a nice looking cabin.

This is enough to justify and activate a considerable amount of research work involving new materials, rotor improvements (finesse, vibrations, noise) within Eurocopter and at the engine manufacturers.

- **Sizing criteria:** Some figures such as the empty weight/all-up weight ratio are magic but perhaps should we now accept to lose a few kilogrammes in the transmissions to improve the Mean Time Between Failures (MTBF).

Likewise, the internal and external noise level will not be improved without some performance losses (empty weight and rotor efficiency) and, to do this, rotors will have to be sized differently, air intake and exhaust sound proofing will have to be improved and upholstering weight will have to be increased.

Likewise, as regards vibratory comfort, 0.1 g can now be guaranteed throughout the flight envelope but this means a higher percentage must now be devoted to the helicopter's empty weight.

Damage tolerance consideration upon sizing is a very recent preoccupation which will probably not be without consequences for the helicopter.

Efforts should now, in my opinion, be directed not towards a performance level improvement but, rather, towards a stabilization of this level by improving in our helicopter drawings those points for which we are being criticised i.e. reliability, comfort, nuisances and D.O.C. as well as by properly allocating those kilogrammes or kilometers/hour that have been saved elsewhere.

- **On-board systems:** Considerable progresses were made over the last few years and those now remain to be used. I shall only quote three examples:
- Cathode ray tubes or flat screens integration to the cockpit for easier piloting workload via man/machine interface optimisation

- Passive and active helicopter health monitoring with a dual safety and maintenance costs reduction objective

- Obstacle detection, a point which to me seems essential considering that a high number of accidents are related to this problem where advances are least significant.

The technologies are or will be available and they shall have to be sold but convincing the customer is difficult today because the equipment is not reliable enough, the operating costs are too high compared to conventional solutions, the man/machine interface has not been sufficiently optimized, the crew's workload remains high in some flight phases and the maintenance concepts are to be revised if those technologies really are to be used.

Finally, a new customer requirement calls for very different responses whether we are talking about

- light helicopters with large and varied, mainly VFR, modes of operation

- or heavy helicopters that are to meet highly restrictive operational requirements imposing sophisticated technologies such as, for example, composite fuselage and fly-by-wire controls for NH90

- or, again, medium helicopters, always too small or too large but especially too expensive and thus most difficult to manage

This shows that our research efforts are to be differentiated markedly between extremes:

- Simplification and search for maximum efficiency of proven solutions on the one hand

- Considerable efforts to improve the reliability of new solutions needed for sophisticated helicopters on the other hand

The operator thus probably no longer expect us to revolutionize our products but, rather, that we let them mature and that we listen to his requirements.

4. DOES OUR RESEARCH WORK ALLOW PREPARING THIS HELICOPTER OF THE FUTURE?

There are not many research programmes in cooperation with other partners.

- Phase 1 of EUROFAR has now been completed

- ACT will probably come to an end at the end of 1992 or beginning of 1993

and the natural framework of our future cooperations will very probably be that of the Economic European Community (EEC) with BRITE-EURAM.

Phase 1 of BRITE EURAM is in progress and the reflections of the different European manufacturers seem quite coherent with the *helicopter's maturity objective. Allow me to summarize those thoughts here:*

- Advanced calculation methods
- Rotor/fuselage aerodynamic interactions
- External noise
- Damage tolerance

Unfortunately, these do not include anything that might lead to the demonstration in flight of a series of coherent improvements and the finances allocated to those tasks are limited.

It is to be noted that the themes retained after arbitration in the preparation of phase 2 are of the same type: Helicopter noise and damage tolerance. The finances that are being proposed are also limited and represent less than 10% of the sums allocated by the EEC for the aviation industry. Must we then consider ourselves as poor relatives?

Positive point: The Industry and the EEC representatives are reasonably agreed as regards priorities:

- Rotor aerodynamics, handling qualities and materials for research upstream

- Research intended to improve helicopter safety and protect the environment

- Pragmatic research intended to continuously improve the helicopter's Direct Maintenance Costs

Negative point: *Common efforts as well as the support available from the EEC remain limited.*

It is thus probably necessary:

- to consolidate the technicians' consensus as regards the selection of research themes that will help ensure the survival of our industry

- to organize those research themes around a European demonstration programme with effective results and why not a silent helicopter demonstrator, for example

- to use and reinforce the existing organizations that may help us obtain this support,and the European Rotorcraft Forum (ERF) is one of those organizations.

Perhaps should we imagine an ERF dependent structure mandated to promote our industry and to find every support our community needs.

I would not want to finish this exposé without a word on new formulae. Although the market requirements will impose that we adopt a very pragmatic approach as regards our products' maturation, the fact remains that the helicopter as the aircraft have operational limitations related to physics. Nevertheless, we have devoted considerable research efforts to the EUROFAR programme over the last few years and are now entering a more difficult phase where it is attempted to launch a demonstrator with new partners and governmental support. The market conditions are not favourable today but we are working, in this case, for the next century.

I am personally convinced that the development of this demonstrator will help us progress and generate highly beneficial fallouts for the helicopter.

This is then for us an ambitious and most interesting work programme where cooperation between technicians, if it cannot solve every problem, shall however be favourable for our industry.

I hope this forum will make a concrete reality of our will to cooperate and intention to move forward.