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THE FRANCO-GERMAN HELICOPTER PROGRAMME HAP, PAH-2/HAC

by

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1. Introduction

The two national aerospace companies engaged in this programme – Aerospatiale and MBB – have cooperated for about 25 years on a variety of aviation and space programmes.

When the West German army considered initiating the PAH-2 (2nd-generation antitank helicopter) in addition to the PAH-1 (1st-generation antitank helicopter) and France also started to feel a similar need for both an antitank helicopter (Hélicoptère Anti Char HAC) and an escort/support helicopter (Hélicoptère d'Appui-Protection HAP), the two countries decided to combine their efforts to develop a common helicopter.

This has led to the HAP, PAH-2/HAC which is the first joint Franco-German helicopter development.

The technical features of this programme were presented at last year's European Rotorcraft Forum in Arles [1].

The European Mission Equipment Package (EUROMEP) for the common PAH-2/HAC will be presented in a separate paper in the course of this forum [2].

General programme aspects are dealt with in the following chapters.

2. Brief Retrospect

The original idea was for a common antitank helicopter to fulfil both the PAH-2 and the HAC requirements. The HAP variant would use the same basic airframe and systems, but would differ as regards mission equipment.

In May 1984, a Memorandum of Understanding (MoU) for the development of HAP, PAH-2, HAC-3G was signed by both governments.

But the national mission equipment requirements for the antitank helicopter versions diverged:

- The French HAC-3G was equipped, from the very beginning, with TRIGAT using European visionics including mast-mounted sight. The air-to-air missile was Mistral.
- The Germans required that the PAH-2 be equipped with the American TADS/PNVIS together with the antitank missile HOT2 (in a first step) and the air-to-air missile Stinger. The fire and forget antitank missile TRIGAT was scheduled to follow in a second step.

It was evident that the different customers' requirements for the antitank versions would lead to somewhat different configurations (PAH-2, HAC-3G). Therefore, development costs would exceed the planned budgets. Consequently, a long period of studies and arguments ensued before the German and French approaches converged.

However, after having carried out numerous extensive studies of alternative configurations and technical solutions as well as of possible total cost reductions (about thirty studies: e. g. side-by-side, one/two engines, mast-/roof-/nose-mounted sight, work sharing, bilateral programme office) for several years, an optimum solution was found: A tandem helicopter with two engines and European visionics with mast-mounted sight.

This was reached by making use of “synergy”, e. g.:

- Successful matching of the German approach (design to requirements) and the French approach (design to budget) as well as
- The multiplicity of German/French engineering and management perspectives

The solution selected not only fulfils the Franco-German military requirements, but also takes into account the most modern helicopter and equipment technology as well as the requirement of cost effectiveness.

Finally, at Fahl/Schwarzwald in Germany in June 1987, both countries – guided by the strong desire to cooperate – agreed on a common antitank helicopter (Fig. 1) with a common European Mission Equipment Package (EUROMEP), which led to a substantial cost reduction for development and production.

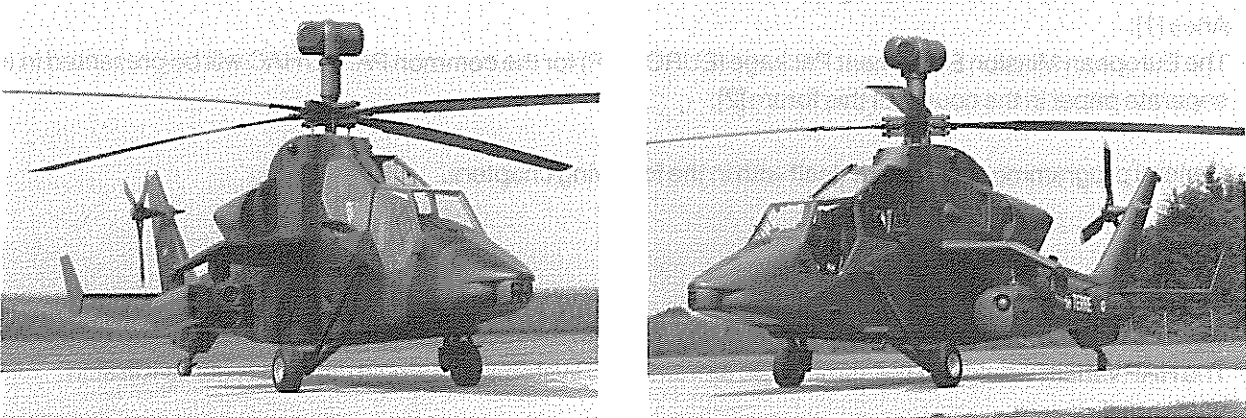


Fig. 1 Common Antitank Helicopter

All of the basic definitions on weapon system performances, work sharing, cost and scheduling were defined and agreed in November 1987, and the 1984 MoU was amended accordingly and signed by both governments.

The TRIGAT programme, which forms an important subsystem of EUROMEP, is carried out as a separate programme with a different group of participants (France, Germany, Great Britain) under a separate contract. The trilateral MoU was signed in April 1988.

3. Scope of Development Phase

The main objectives of development are as follows:

- To manufacture and to flight-test 5 prototypes
- To demonstrate weapon system performance according to specifications
- To achieve type certification
- To produce the drawing sets for serial production (serialization)
- To prepare logistics maturity

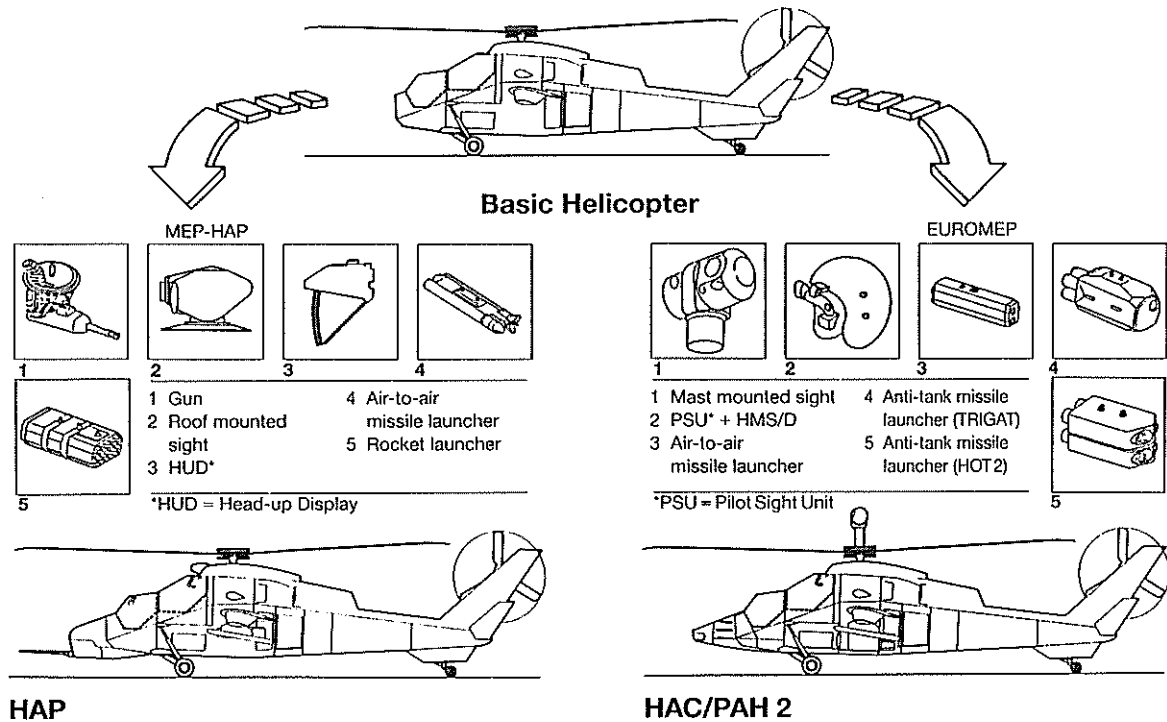


Fig.2 Concept Philosophy

The development work is based on the concept philosophy as shown in Fig. 2 and comprises the following main sections:

- The development of the basic helicopter (including engine integration) and the basic avionics system common to both PAH-2/HAC and HAP
- The development of the EUROME P (see Paper No. 31 at this Forum [2]) as well as installation and integration into the basic helicopter
- The installation and integration of the French mission equipment package (MEP) of HAP, which is undergoing development under the leadership of the helicopter division of Aerospatiale (AS) under a French government contract
- The development of the MTR 390 engine, which is a government-furnished item

4. Work Sharing

The leading principle for work sharing between France and Germany is 50 : 50 in quality and quantity.

Detailed work sharing was set up for subsystem development and for technology activities, which can be handled in a relatively isolated manner.

4.1 Basic Helicopter

The work shares for the basic helicopter are now as follows (Fig. 3):

- The German partner company has complete responsibility for the main rotor, front and rear fuselage sections including cockpit, hydraulics and flight control, prototype assembly, flight performance, flight characteristics, stress, vibrations, and simulation.

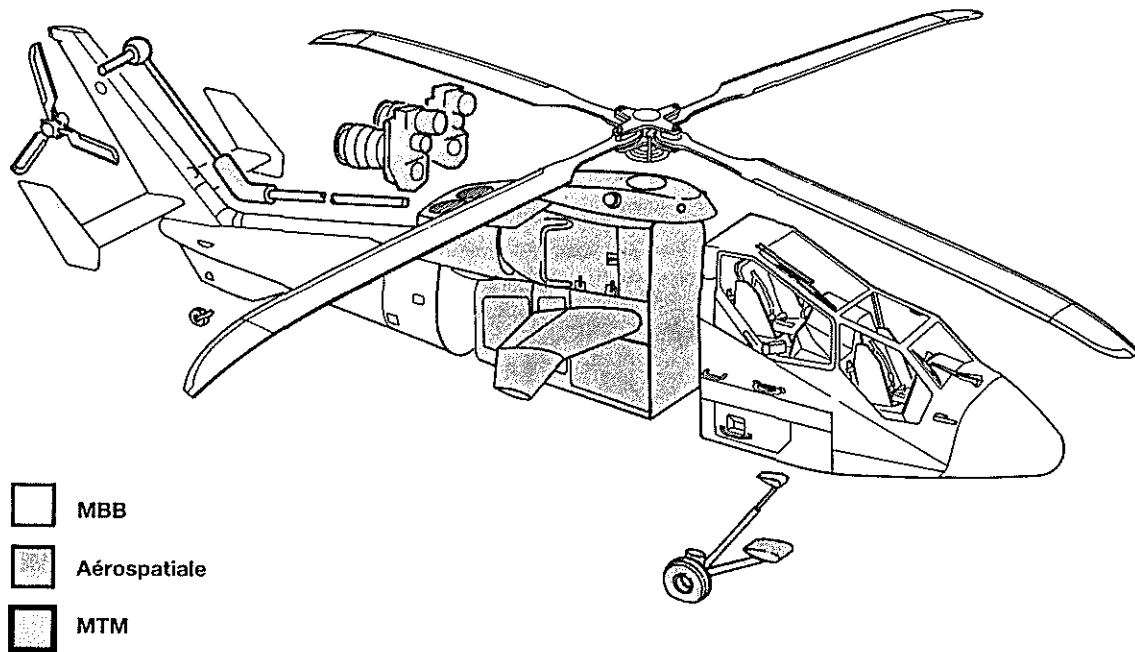


Fig. 3 Work Sharing

- The French partner company is fully responsible for the tail rotor, center fuselage section including engine installation, transmission, fuel and electric systems, aerodynamics, weights, maintainability, reliability and survivability.

4.2 EUROMEP

The work sharing/responsibilities for the development of EUROMEP are depicted in Fig. 4.

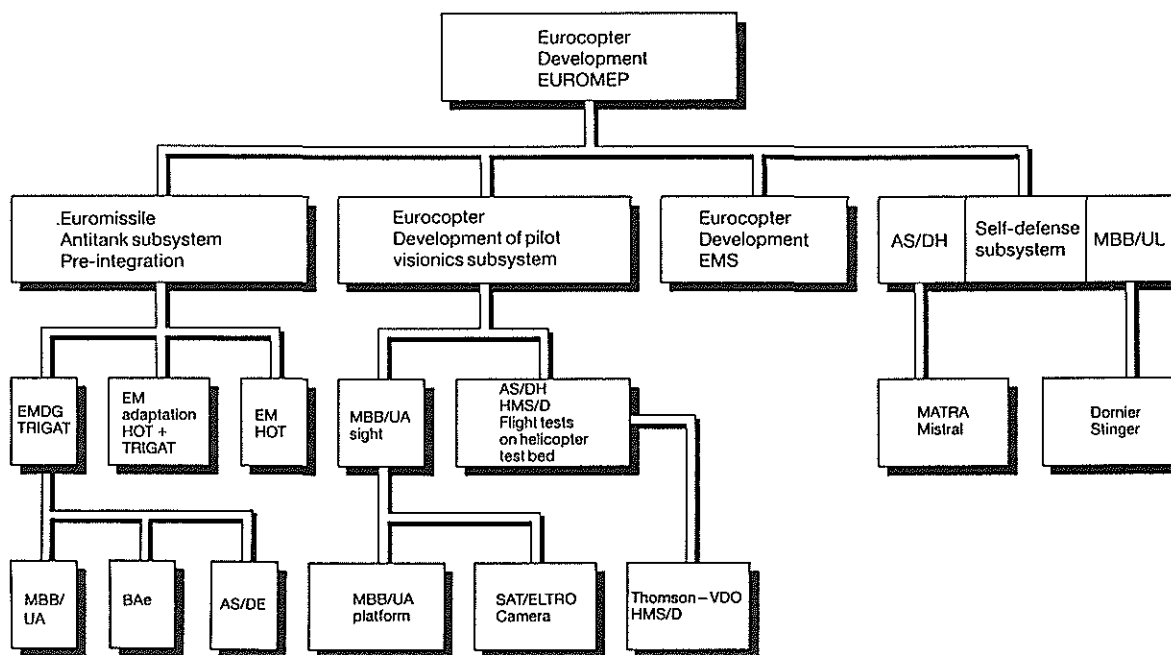


Fig. 4 Work Sharing/Responsibilities for EUROMEP

4.3 Integration

The integration of MEP into HAP is AS work share, whereas the integration of EUROMEP into the PAH-2/HAC is shared among AS and MBB.

5. Integrated Teams

A number of work packages involving decisive new technological development requires the participation of both companies. Integrated teams consisting of engineers from both companies were set up in order to handle these packages. These teams will work with the development departments of the two companies. In general terms, the activities of the teams cover the following items:

- System engineering: analysis of system requirements, analysis of functions, system layout as well as system and hardware architecture, interfaces
- Development of the subsystems including all sensors related to piloting, navigation, communication, countermeasures, fire control, instruments, displays and processors/devices for processing/displaying information coming from the above sensors
- Development of operational software
- Testing and integration of the system

Four integrated teams have been established:

- Basic Avionics (primary rig): responsible for the basic avionics system; located at MBB/Ottobrunn
- EUROMEP: responsible for the EUROMEP system (under the management of Eurocopter); located at MBB/Ottobrunn
- PAH-2/HAC Integration: responsible for overall system compatibility; located at MBB/Ottobrunn
- Basic Avionics (secondary rig): responsible for avionics rig support of basic helicopter flight test; located at AS/Marignane

In addition, there will be two other integrated teams:

- Flight Test I: responsible for flight testing of basic helicopter and of HAP; located at AS/Marignane
- Flight Test II: responsible for flight testing of PAH-2/HAC; located at MBB/Ottobrunn

It is probably worth mentioning that in particular cases integrated flight tests with mixed crews (Industry/Officials) are foreseen in order to save time and money.

6. Programme Organisation

6.1 Governments' Programme Organisation

For HAP, PAH-2/HAC as well as for the engine, the government programme organisation is headed by a Steering Committee which represents the French and the German Ministries of Defense (MoD). The Steering Committee is chaired equally by two presidents who have to decide unanimously. The Steering Committee decides on major programme matters.

Specific problems are handled within a Harmonization Committee and a Military Committee reporting to the Steering Committee. Meetings will be arranged ad hoc, the members are nominated according to the problems to be tackled.

The Executive Agency (EA) manages the programme on a day to day basis on behalf of the Steering Committee and is the contractual partner to industry. The EA is part of the German BWB at Koblenz. While managing the programme on behalf of both governments, the EA cooperates very closely with the STPA/ Paris. Representatives of STPA are seconded to the EA at Koblenz.

Both governments agreed in the MoU in 1987 to establish a bilateral "Programme Office" (NATO Agency) which will replace the EA and which will be located in Munich close to EUROCOPTER premises. The task of this "Programme Office" will be to manage the programme at governmental level as a contracting agency under the guidance of the Steering Committee.

As already mentioned, the basic TRIGAT development is carried out under a separate contract with a separate organisation. The same situation applies to the HOT2 standard programme.

The TRIGAT governmental organisation is headed by a trilateral Steering Committee representing the MoD's of France, Germany and Great Britain.

Both Steering Committees cooperate to harmonize the helicopter and the TRIGAT programmes.

6.2 Industry Organisation

The prime contractor for the helicopter programme is EUROCOPTER GmbH, Munich, a joint subsidiary of AS and MBB set up with the aim of cooperating in the helicopter field. As the general manager of the helicopter programme, EC negotiates the development contracts with the EA (Fig. 5). Once the contracts are signed, EC contracts the development of the basic helicopter and the integration of mission equipment packages to the helicopter divisions of AS and MBB. In turn, these divisions subcontract the development of the subsystems to the equipment industry.

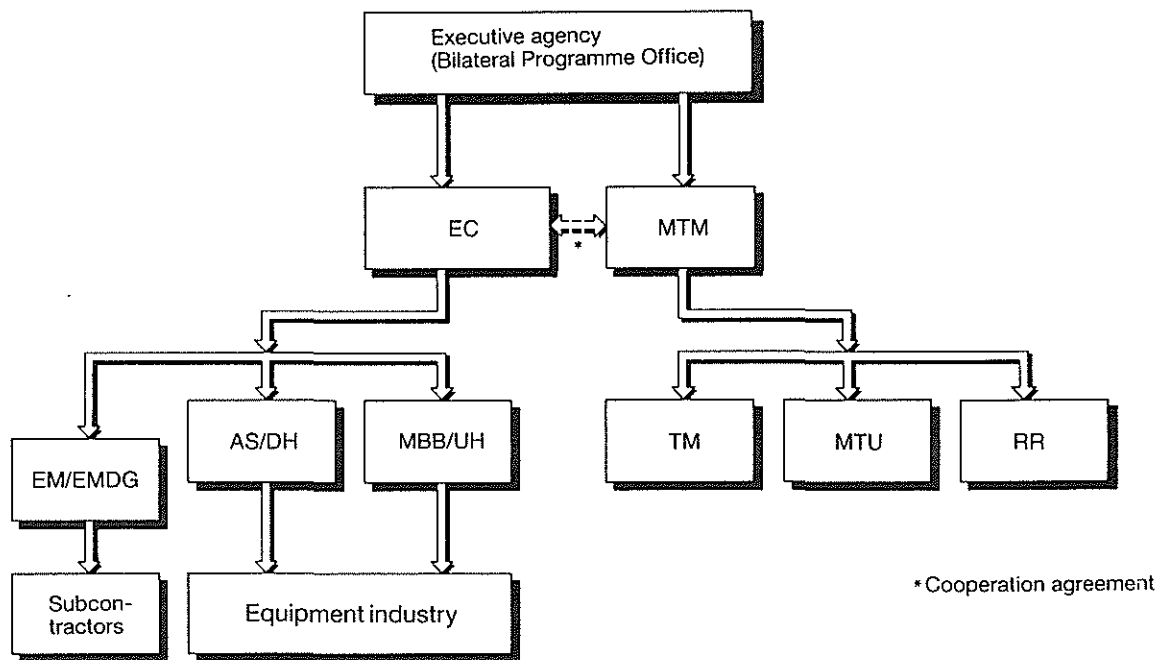


Fig. 5 Organisation

The development work for EUROMEP is (as already shown in Fig. 4) partly subcontracted to AS and MBB and to EM, a joint subsidiary of the missile divisions of AS and MBB. The procurement of the TRIGAT prototypes in "standard configuration" is subcontracted through EM to EMDG, a joint company formed by AS, MBB and BAe.

As already mentioned, the programme organisation on the industrial level is headed by Eurocopter. Eurocopter manages and integrates the efforts of the helicopter divisions of the two parent companies. In order to assure close interaction between Eurocopter and its parent companies, the programme managers of the two helicopter divisions participate in the management meetings of EC, and the managing directors of the helicopter divisions, together with the Eurocopter directors, form the Management Board of Eurocopter.

As far as EUROMEP is concerned, the programme managers of EM participate in the management meetings of EC, and the Management Board of Eurocopter is enlarged by the two managing directors of the missile divisions of AS and MBB.

MTM is the prime contractor for the development of the MTR 390 engine. It is a joint development of MTU and Turbomeca with the participation of Rolls Royce.

A cooperation agreement between EC and MTM was signed in order to coordinate the engine and the helicopter programme at industry level.

7. Cost

The basic contractual and financial terms for the development phase have been agreed with the two nations. The programme is based on the concept of a target price (Fig. 6) versus defined weapon system specifications with an incentive, or rather, penalty scheme. If the agreed target cost is exceeded, the contractors and the customer will share the additional costs 50 : 50 up to an agreed ceiling price. Beyond the limit of this ceiling price the risk is borne fully by the industry. The total costs of the helicopter development in the scope of the EC contract are about 2,325 billion DM as per 12/86 economic conditions including the above mentioned contingencies.

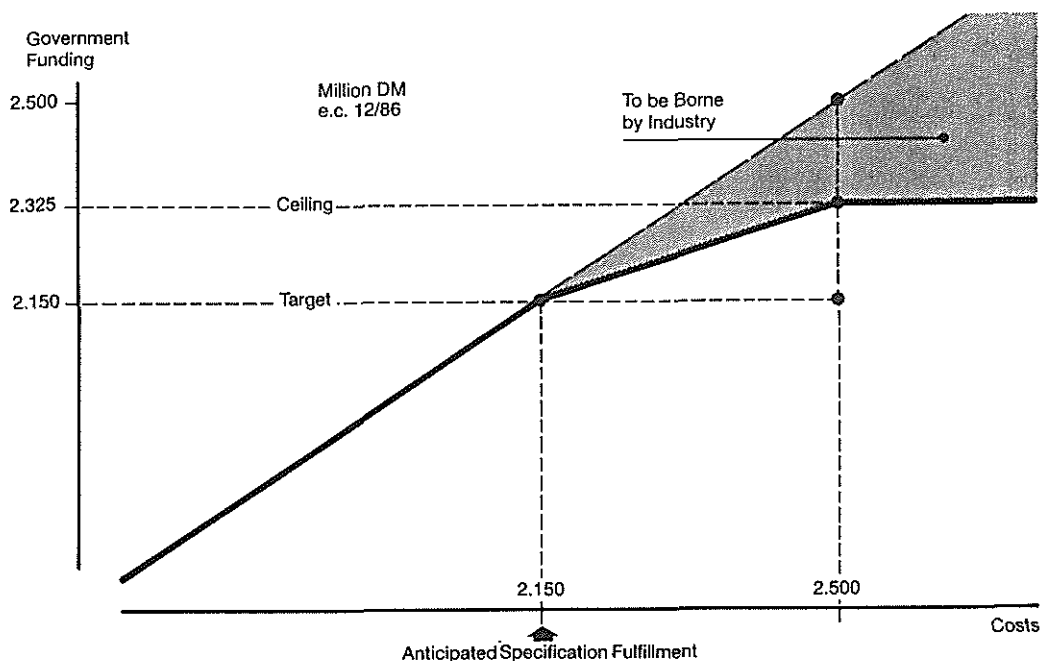


Fig. 6 Programme Cost/Government Funding

The overall programme costs, including the engine development, the HAP mission equipment package and miscellaneous cost items, amount to approximately 3,5 Billion DM.

8. Payment of Development Cost

In order to assure appropriate payment to the industry, a payment schedule was established according to scheduled work progress.

The industry will receive quarterly payments throughout the development phase to cover the development costs. The payment will reflect the work performed in the quarter. However, the release of governmental payments depends on the achievement of agreed work progress milestones (so-called "payment milestones") by Industry.

When selecting these "payment milestones", it was taken into account that:

- They are shared almost equally by the partner companies.
- Over a longer period of time, each major development section (levels 3 and 4 of the WBS which is mainly a hardware breakdown) will have been "controlled" by at least one "payment milestone".

In case a "payment milestone" is not met, payment will be reduced by the governments, the balance to be paid when the milestone has been achieved.

9. Production Unit Price

The production unit price (including engines) is in the order of 16 to 20 million DM (e. c. 12/1986), depending on the configuration (HAP, HAC, PAH-2). Hereby it is assumed that orders will be placed for 212 PAH-2 for the German army, 75 HAP and 140 HAC for the French army.

GFE, other than the engines, and "systems" costs (e. g. GSE, spares) are not included.

10. Schedules

The Master Time Schedule is depicted in Fig. 7.

There will be five prototypes for certification and qualification flight tests.

The first, PT1 (without the basic avionics system), which will complete its maiden flight in 1991, will serve as a test vehicle for engine integration and for evaluating basic helicopter performances and flight characteristics.

The second, PT2, will have the basic avionics system and is scheduled to fly in 1992. PT3 will follow six months later, again with basic avionics. Both prototypes are to be used for evaluating vibrations, flight performances, flight characteristics and handling qualities of the weapon systems (WS). The MEP's of the WS will be represented by mock-ups.

PT4 will be the HAP prototype and will complete its first flight in 1993.

PT5 is the prototype of the WS PAH-2/HAC. Its first flight with HOT 2 is scheduled to take place in 1993. Flight tests with TRIGAT will follow in 1996.

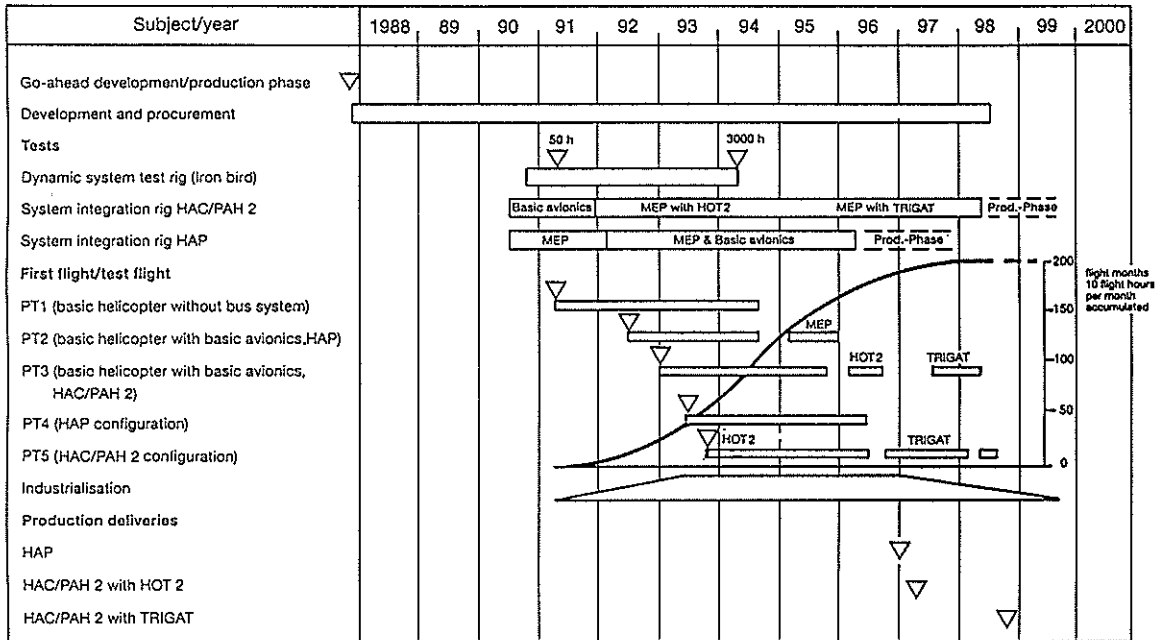


Fig. 7 Master Time Schedule

At a later point in time, PT2 and PT3 will be fitted with the HAP and PAH-2/HAC mission equipment package, respectively, for further flight testing of the fully equipped helicopter weapon system.

All in all, about 200 flight months are scheduled for the certification and qualification flight tests on all five prototypes.

Production delivery is to commence in 1997 with the French army's HAP.

The scheduled annual production rate is shown in Fig. 8.

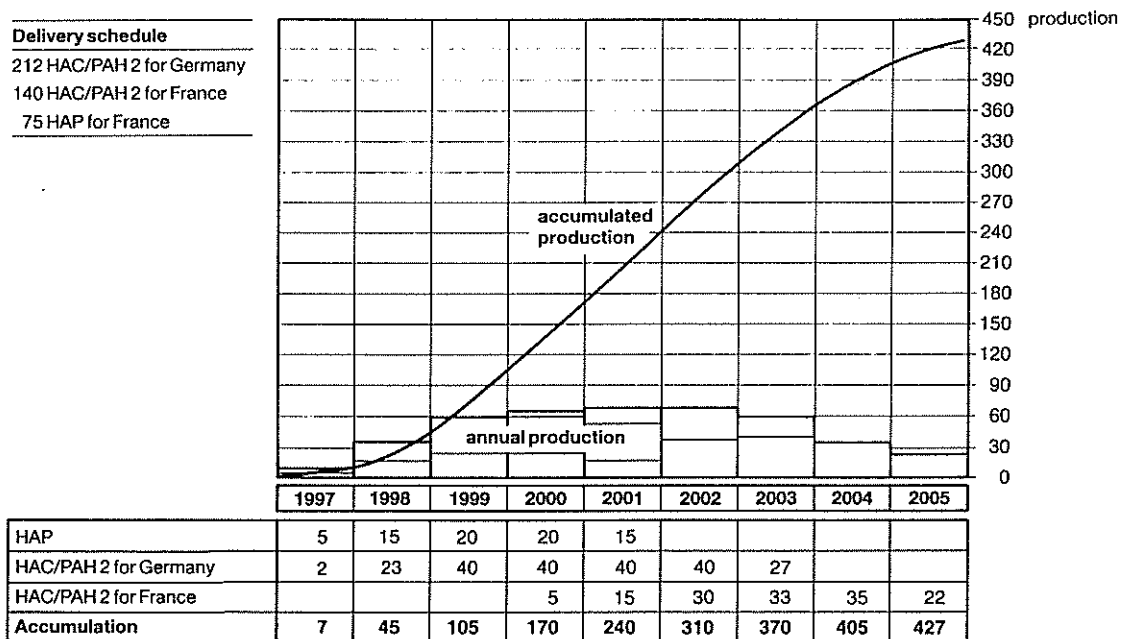


Fig. 8 Annual Production Rate

11. Programme Status as of August 1988

11.1 Contractual Situation

- The two governments endorsed the start of full-scale development on December 8th, 1987.
- A preparatory work contract was signed in June 1988 and will be executed by the end of this year.
- An Initial Development Contract (IDC) for the first 18 months of the development phase representing roughly 10 percent of the total development price is scheduled to be signed in September 1988.
- The IDC will last until mid 1989 and will be absorbed by the main development contract, which is scheduled to be signed at that time.
- The development of the MTR 390 engine was also launched by both governments in December 1987. The contract negotiations have a status comparable to the negotiations on the helicopter programme.
- TRIGAT development was launched in May 1988 (prefinanced by Industry). The development contract is scheduled to be signed in September this year.

11.2 Development Work

30 main specifications have been signed bilaterally. In addition, there are about 100 further specifications, most of them harmonized between Industry and EA.

Full-scale development is under way on the basis of all these specifications.

At AS and MBB, detailed design work on the subsystems of the basic helicopter and for the test benches (e. g. iron bird, integration rigs) is under way.

The following items will highlight the status of the development work as of August 1988:

- Basic helicopter
 - The tender phase for the major avionics and functional equipment subsystems has been started.
The first equipment should be selected early next year.
 - Adaptation of the whirl tower to perform main rotor tests has been accomplished (Fig. 9).
 - The development simulator for the investigations of e. g.
 - handling qualities
 - flight controls and AFCSis in full operation at MBB (Fig. 10).

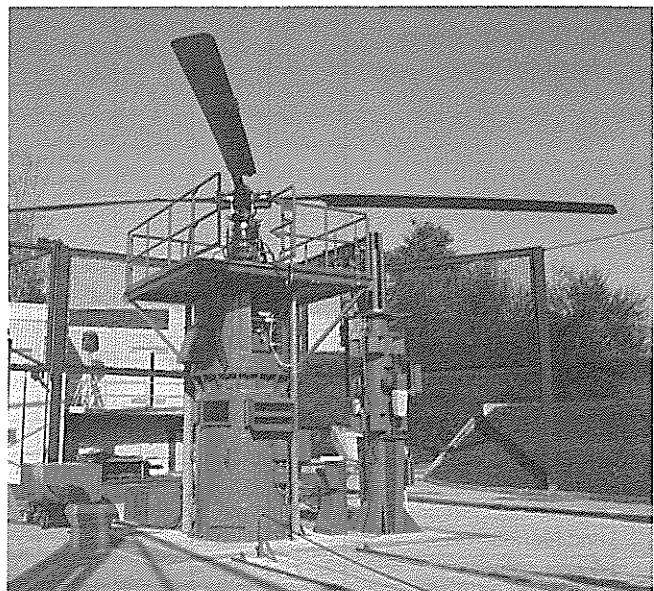


Fig. 9 Whirl Tower

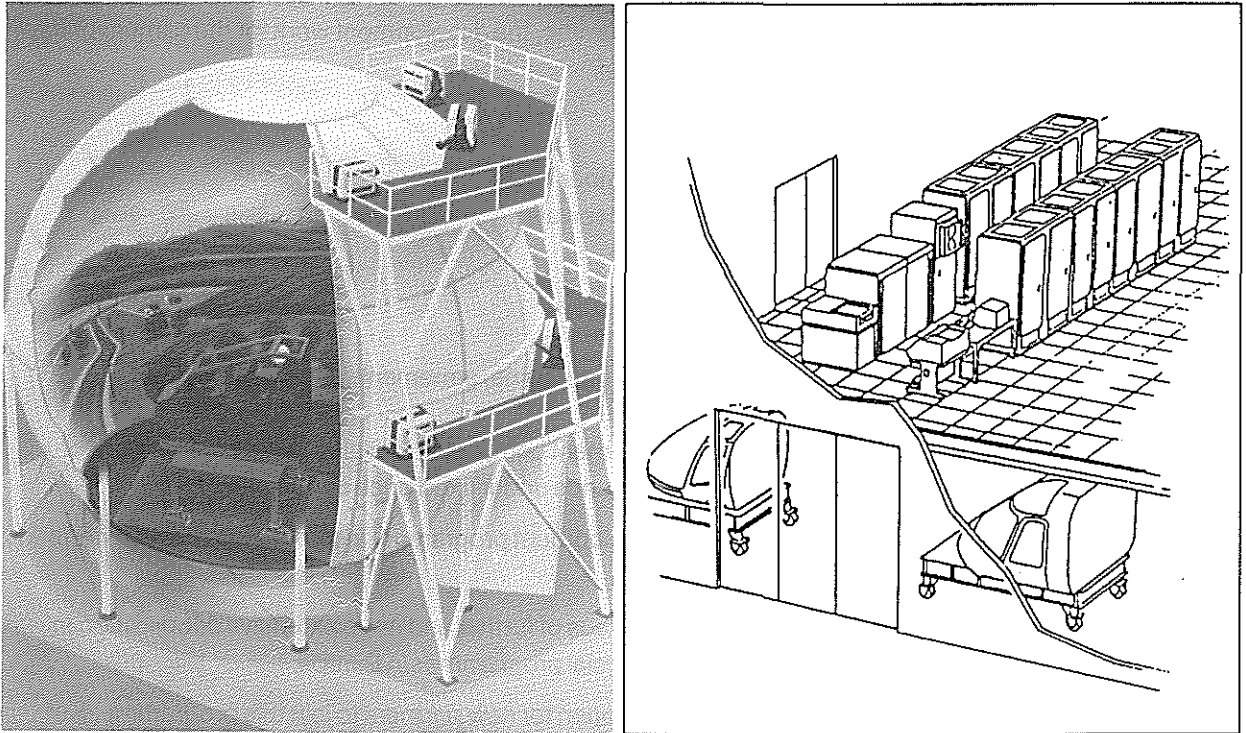


Fig. 10 Development Simulator

- MEP HAP

- The turret-mounted gun, part of the mission equipment for the HAP, was successfully tested by AS on a PUMA in various flight conditions in summer this year (Fig. 11).



Fig. 11 Gun of MEP-HAP on PUMA

- EUROMEP
 - In addition to the TRIGAT development programme, the development work for the camera of the PVS has been started at SAT/ELTRO.
- Engine
 - Full scale development work started in December 1987.
 - Detailed design and component trials are under way.

12. Concluding Remarks

- The development of this weapon system (including engine, armament, visionics) is a great challenge.
This is not only due to the technical and management complexity, but also to the commitment of industry on guaranteed weapon system performance under fixed price conditions.
- This programme is at present the only joint development programme in the western world for armed helicopters for the year 2000 and beyond.
- EC believes that this programme will be the nucleus of further and more extensive cooperation in the helicopter field for both military and commercial programmes in Europe.
- EC and the parent companies AS and MBB are open for new partners to join this programme. Not much time is left, however, since development is already under way.

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Abbreviation list

| | | | |
|---------|--|-----------|--|
| AFCS | Automatic Flight Control System | IDC | Initial Development Contract |
| BAe | British Aerospace | MEP | Mission Equipment Package |
| BWB | Bundesamt für Wehrtechnik und Beschaffung, Koblenz | MoD | Ministry of Defense |
| EA | Executive Agency | MoU | Memorandum of Understanding |
| e. c. | economical conditions | MTM | MTU/Turbomeca |
| EM | Euromissile | MTR | MTU/Turbomeca/Rolls Royce |
| EMDG | Euromissile Dynamics Group | PAH | Panzerabwehrhubschrauber |
| EMS | EUROMEP Management System | PT | Prototype |
| EUROMEP | European Mission Equipment Package | RR | Rolls Royce |
| GFE | Government-Furnished Equipment | STPA | Service Technique des Programmes Aéronautiques |
| GSE | Ground Support Equipment | TADS/PNVS | Target Acquisition Designation Sight/Pilot Night Vision System |
| HAC-3G | Hélicoptère Anti-Char 3ème Génération | TRIGAT | Trinational Guided Antitank System |
| HAP | Hélicoptère d'Appui-Protection | WBS | Work Breakdown Structure |
| HMS/D | Helmet-Mounted Sight/Display | WS | Weapon System |
| HOT2 | Hoher Unterschall Optisch Telegesteuert, 2. Generation | | |