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FUTURE PROSPECTS FOR SCHEDULED HELICOPTER OPERATIONS

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1. Introduction

Todate, experience in scheduled helicopter operations throughout the world has been very limited. In the 1950's a number of operations using single engine helicopters were set up both in America and Europe.

Three major operators in America were New York Airways, Chicago Helicopter Airways and Los Angeles Airways and these were joined later by San Francisco and Oakland Airways. Their services were mainly inter airport links and between airport and downtown areas. In Europe Sabena operated a number of services from provincial cities in Belgium and Holland which acted as feeders for their main line international fixed wing services from Brussels while in Britain BEA set up the worlds first scheduled passenger service during 1950 between Liverpool, Wrexham and Cardiff. This service was superceeded in 1951 by one operating between Birmingham and London Airports at Heathrow and Northolt. Other services were operated by BEA for limited periods between London Airport and Southampton, Central London and London Airport and Birmingham, Leicester and Nottingham.

All of the above services were operated by small single engine helicopters and all operated at a loss. In Britain it was decided to suspend scheduled operations until such times as multi engine helicopters became available and in Belgium, Sabena decided to withdraw all helicopter operations and disband the section which operated them.

In America the three original companies NYA., CHA, and LAA were kept in existence by subsidies from the U.S. Government and San Francisco and Oakland Airways made a profit for a while but later ran into financial difficulties and ceased scheduled operations. However after a while these were resumed and are still in operation today in the Bay Area.

In the early 1960's, two types of helicopters each driven by 2 gas turbine engines became available. These were the Boeing Vertol 107 and the Sikorsky S61. The BV107 was bought by New York Airways and the S61 was selected by Los Angeles Airways and Chicago Helicopter Airways. The BV107 ran into severe mechanical problems and NYA subsequently disposed of these helicopters and re equipped with Sikorsky S61. Both Los Angeles Airways and Chicago Helicopter Airways ran into financial difficulties and both subsequently withdrew from scheduled operations. In Britain 2 Sikorsky S61N's were purchased by BEA who then formed a subsidary company known as BEA Helicopters Ltd to operate same. This company came into being on 1st January 1964 and scheduled operations between Penzance and the Isles of Scillies commenced on 2 April of that year. This service is still operating today and it is interesting to note that this service is operated by one aircraft with no standby, achieves an overall regularity of about 97.5% with an engineering regularity of about 99%. Traffic has increased from some 28,000 in 1964 to a current level of some 75,000. Up to 12 return services are operated daily at peak periods and the operation now makes an overall profit. Last years profit was about £12,000. New York Airways is still in operation and provides services between the 3 major New York Airports and downtown New York. Mention should also be made of a very successful operation in Australia by Ansett Airlines. This is a service to a holiday island off the East Coast of Australia and this again is operated by one aircraft with no standby and achieves a very high annual utilisation. Services have also been in operation within Greenland for some years.

Helicopter services have been set up in other parts of the world, notably in the Mediterranean area, but for one reason or another have now ceased operations. It is known that a fairly extensive helicopter operation exists in the USSR but little is known about the details of such operations.

Therefore although the experience in scheduled helicopter operations is very limited and there have also been failures, never the less those operations which survive today have shown that a viable operation is possible. With modern technology and the vast amount of operating experience being gained from other types of operations i.e. off shore oil rig support, the scene is now set for the introduction of more extensive scheduled helicopter operations.

2. Why Scheduled Helicopter Operations ?

It is well known that short range operations by fixed wing aircraft tend to be uneconomic. Costs arising from the take-off and landing cycle are considerable and on short range operations form a very much larger proportion of the total costs than on long range operations. Likewise the 'dead' time associated with the take-off and landing cycle form a large part of the total time thereby reducing the effective point to point block speed. Such factors give rise to a very much higher DOC for an aircraft on short range operations compared to the same aircraft used on long range operations.

The demand for more speed, more payload, more power etc has in the past usually been at the expense of take-off distance. Airports have had their runways extended to meet this demand until large areas of land are now sterilised, not only to provide runway and taxyway requirements but to provide adequate noise free areas around the airports. There are many instances around the world were these land requirements have necessitated the original airports to be closed and a new airport built in a rural area, far from the community it serves. This has meant that the passenger has a much greater distance to travel to catch his flight and effectively he has his total travelling time increased.

With the growing demand for travel there is a need to diversify transportation methods for short range operations. Recent years have seen the construction of a vast network of rural and urban motorways and the Advanced Passenger Train (APT) is now taking its place for high speed inter-city transportation. Although both of these systems have their place in short range transport both involve a large capital outlay and also the motorway network sterelises vast areas of land. However, there are areas where it is not practical or economical to lay down either of these systems. For example where there is a water crossing or other geographical obstacles. It is in such cases where consideration should be given to the helicopter for it offers both a practical and economic solution to the problem.

3. Possible Trends in Transport Helicopter Development.

Recent years have seen considerable advances in helicopter technology and any transport helicopter of the future is likely to incorporate some if not all of a number of these advances discussed below.

i. New Blade Contours and Tip Design
The need for higher cruising speeds has led to much research on blade profiles and new blade contours are now coming into service which permit normal cruising speeds of anything up to 180 Kts. Much research has also

gone into blade tip design with the aim of cutting down external noise levels.

ii. New Blade Materials and Methods of Construction

Associated with the development of blade profiles has been the development of new materials and new methods of construction. Titanium is now used for main blade spar construction and there is also at least one type which utilises a main spar fabricated from stainless steel. The use of honeycomb and glass fibre sheet for the trailing edge on such blades eliminates much of the former trouble experienced with trailing edge pockets. The use of such materials has led to blades with virtually indefinate life, there by considerably reducing the overall operating costs.

Blades are now also being made utilising Carbon or Boron fibres. These also give virtually indefinite life. All of these blades have a very high quality surface finish thereby making best use of the new blade profiles.

iii. Development of Gear Box Design

The integrity of helicopter gear boxes must be of the highest possible standard. To meet this requirement, it has, in the past been necessary to remove the gear boxes from helicopters at fairly frequent intervals, strip, inspect, replace worn parts and reassemble. This has of course been at considerable cost. Gearbox life over the last few years has been under steady development and much know how has been aquired. However radical changes in gear box design have recently been taking place and the gearbox in the helicopter of the future is likely to be a very much different piece of mechanism to that we have seen in the past. The use of conformal gears has shown that the stress level in the teeth can be very much reduced. The number of gears required to reduce the engine r.p.m. to the rotor r.p.m. at a given power is reduced leading to a lighter and more reliable overall transmission system.

A problem area in the past has been the transmission oil cooling system. This has usually involved external pipes and oil cooler and the danger of a failure in this system leading to a failure in the gear box has always been present. It is now the practice in the latest helicopter designs to duplicate the systems in such a manner that in the event of a failure in one system the other system can successfully lubricate the box by itself. An alternative solution is to design the gearbox with a complete internal oil cooling system.

Another system being introduced mainly on tail and intermediate gear boxes is to completely seal the box and lubricate with a solid lubricant.

Extensive use has been made in recent years of magnetic plugs and spectrographic oil analysis to pick up impending failures within gear boxes. Although not yet in general use, warnings of impending failure in gear boxes of the future are likely to be given by some form of sonic analysis. This method gives warning much earlier than other methods and is able to identify the particular gear or bearing which is showing signs of failure. With such systems "on condition" gear box overhaul shows every possibility of becoming a reality.

iv. New Head Design

In a complete transmission system the main rotor head is the most costly component to maintain, taking some 40% of the total transmission costs. Therefore, as would be expected, this component has had a considerable amount of design effort put into it in recent years in an effort to simplify its basic design and thereby reduce maintenance costs.

The elastomeric head is now coming into use for fully articulated rotor systems. The elastomeric head employs spherical elastomeric bearings, bearings made of a 'sandwich' of thin rubber and metal laminates which replace the three hinges which permit the rotor blade to perform its motions in the normal articulated rotor systems. These motions are changes in blade pitch, blade lead and lag and blade flap. As one elastomeric bearing replaces all three hinges, each of which normally contains a bearing system of its own, the number of parts is greatly reduced. A further added advantage is that this type of bearing needs no lubrication.

Another rotor system now in use on a number of helicopters today is the rigid rotor. Advances in material technology has lead to the design of the head in which the flapping and lead/lag motions are taken within the material of the head itself. Such a system offers considerable reduction in head maintenance costs.

v. Engines

Mention must also be made of the recent development in engines designed more specifically for use in helicopters. Experience over the last decade with gas turbines in helicopters has enabled the overhaul lives to be developed to more economical periods. The use of the various contingency ratings has now been established and there is a much better understanding of these requirements between the engine and airframe manufacturers. Two and even three spool engines giving good s.f.c's are now accepted fact and modular construction greatly assists maintenance.

vi. Stage 1 Development of the Future Transport Helicopter

With the advances in helicopter technology discussed above the first stage in the development of a transport helicopter suitable for regular scheduled operations could be carried out in a reasonably short period of time say two to three years. A basic military helicopter such as a Sikorsky S65 (CH53) equipped with new blades, new head etc would be a very suitable helicopter for this stage of development. It could carry some 44 to 48 passengers over a 200 NM stage length at a cruising speed of 160 Kts. It would give a comfortable ride to the passengers and its external noise characteristics should be acceptable in the urban areas to which it would operate. It would of course operate to Group A performance requirements and its take-off and landing requirements would not demand extensive areas of land.

It can be shown that such an operation using this type of helicopter could become economically viable after about 3 or 4 years operation, it would establish the helicopter as an acceptable means of transportation and would pave the way for more larger and more advanced types in the next decade.

vii. Stage II Development

The next decade should see the development of much larger helicopters than that referred to above, seating at least 100 passengers and cruising at a speed of some 260 Knots with a still air range of 550 NM. Powered by 3 or 4 engines such a helicopter would be compounded with the rotors off loaded in cruising flight. Forward propulsion would be derived from ducted fans in the wings driven from the main engines. Proposals for such a helicopter airliner have been made by Sikorsky Aircraft using many dynamic components from military projects. This type is known as the S200.

Although in the experimental stage, use of the ABC rotor could lead to a cruising speed of 350 Knots. This would put the block time of the helicopter higher than fixed wing block times on short sectors, as although the actual cruise speed would still be some 150 Knots less than the cruise speed of a short range jet airliner, taxy times would be reduced to a minimal amount. (It is interesting to note that on a short sector such as London Paris some 15 to 20 minutes is spent taxying).

4. The Heliport and Some Operational Aspects.

A feature of a scheduled helicopter operation is the very small size of the heliport required even to carry out a fairly intensive service. The small size of the heliport is not only reflected in the modest capital required to construct but economy of operation in service. Maintenance costs are kept minimal and the small size of area involved means that dual function duties may be performed by the operating staff. It is interesting to note that in 1964, the Heliport at Penzance was constructed for a cost of only £88,000. This included the purchase of the land, the consolidation of the strip 1200 ft. long x 150 ft. wide, a 100 ft. square pad, offices and passenger terminal, hangar, workshops, access road, services, fencing, a car park for 250 cars and operating equipment. Yet this small heliport has the capacity to handle some 250,000 passengers annually.

Obviously the size of the heliport will depend on the scale of operations but the actual operating area will be similar for most cases, that is a pad some 100 to 150 ft. sqaure surrounded by an area of consolodated ground about 500 to 600 ft. square. Approach paths should be free of obstructions. The greatest area will be that for the number of stands required to meet the demands of the service, the passenger buildings and car parking facilities.

Therefore the capital cost of setting up a heliport under present conditions could vary from say £100,000 in the Highlands of Scotland where traffic density would be very low and required facilities minimal, to some £5 to 6 million in a city centre - a far cry from the hundreds of millions required for the construction of fixed wing airfields.

Great emphasis is being placed on the question of external noise, for the helicopter has to operate into the centres of communities and it must be a good neighbour. Today it is comparable to many other noises encountered in city centres. In over 11 years of operations at Penzance only 5 or 6 complaints have been received and recently over 200 operations were made to a site in the centre of London during a 28 day period without one complaint being received.

Much operational experience has been gained over the last few years on operations over the North Sea in connection support for the off shore gas and oil industry. Helicopters are now equipped with all aids necessary for flight in IFR and approval has been given for at least one helicopter to be operated in light icing conditions. An approach aid under development, has recently been undergoing civil evaluation and the initial trials have indicated that it is an accurate and reliable piece of equipment.

5.
Economics

When expressed in terms of Direct Operating Cost, the helicopter does not compare very favourably with fixed wing aircraft. In order to obtain a true appreciation of the economics of the helicopter relative to its fixed wing counterpart, it is required to consider all the back up facilities required for both. That is, the capital cost of the airport/heliport, all the necessary ground equipment in each case and the differences in man power required to support each operation.

As mentioned earlier, a feature of helicopter operations is the relatively small area required from which to operate. Although the land for a heliport in a city centre is likely to cost more per acre than that required for a comparable airport, the total land cost is but a small fraction of that for an airport. Likewise construction costs of a heliport are but a small fraction of an airport cost. A mere 100 or 150 ft. pad is all that is required for a heliport compared to some 6000' to 10000' length of runway, probably in at least two directions for an airport. Impact loads with a helicopter are less therefore the pad need not be so heavily stressed. Taxying requirements are likewise but a fraction of comparable airport requirements.

The fact that heliport operations are confined to a small area means that operating staff can be reduced to a minimum and dual function working is possible. For instance baggage handlers can double up as firemen for their fire fighting equipment is but a few yards away from their normal working area and any possible emergency requiring their services as firemen is likely to be but a short distance away. With such a system there's much to be said for the operating company to also own and control the heliport for it is then able to directly control all functions and delegate dual duty functions of staff.

Very detailed studies have been made on the viability of helicopter operations between London, Paris, Brussels and Amsterdam using a Sikorsky S65C type helicopter. With 6 return services per day between London and Paris, 3 per day between London and Brussels and 4 per day between London and Amsterdam it has been estimated that the return on capital would be about 12% for the first year of operation rising to about 30% in the fourth year. This takes into account all the capital and operating costs of running the heliport as well as the aircraft costs. Fares are based at first class fixed wing levels and it is felt that this assumption is justified on the grounds of convenience with the elimination of the city to airport journey. In the longer term, using a 100 seat helicopter such as the Sikorsky S200 it is felt that fare levels could be reduced to tourist class levels and still maintain a similar level of return on capital. Revenue estimates made due allowances for reduced rate travel i.e. party rates, excursion and so on.

Consider now a very different type of scheduled operation such as could be set up in the Highlands and Islands in Scotland. In this area, by nature of the terrain, existing communications are poor. There is a very limited rail network and the road system has to make many detours around lochs and mountains. The steamer services to the various island communities are slow and infrequent. The present fixed wing services are likewise limited and involve a considerable loss annually. Also the operating costs of the airfields used are a further drain on the finicial resources of the authorities

These airfields are mainly ex wartime military airfields, and are badly sited for the areas which they serve which involves considerable surface transport at each end.

There is at present a great need to improve the communications system within Scotland for there is much growth in certain areas in connection with the North Sea Oil exploration. It's also an area of great natural beauty and a great tourist attraction. The helicopter offers the best and most economic solution to improving the Scottish communication system.

Traffic demands are not particularly high and consequently the heliports required would not require extensive traffic buildings. Capital costs for each heliport would be in the region of £100,000 to £150,000 and some 18 would be required to provide an adequate service incorporating most of the current air routes with some new destinations such as Fort William, Aviemore, Oban etc. Therefore all ground facilities could be provided for a total of about £2.5 m.

It would be possible to provide an adequate service utilising 2 x S61N helicopters seating 30 passengers each and 8 x S65C helicopters seating 44/48 passengers each. The current capital cost of such a fleet would be in the order of £23m. This would mean a toal capital outlay of about £25m.

Writing off the capital cost of the ground facilities over 25 years and the aircraft over 15 years would mean an annual depreciation of about £1.8m. It is interesting to note that proposals have been made for improving and modernising the airfields and facilities in Scotland for fixed wing operations which involve a toal expenditure of £100m. over 10 years and this does'nt include the cost of aircraft re equipment.

Traffic on many of the proposed routes is very low and many cases are pure social services, with the result that total revenue is not likely to meet total operating expenses, at least not in the early years of operation. Current fixed wing services run at a loss and have been doing so for years, and it was recently proposed that at least some of the existing services should be subsidised. The setting up of heliports would enable many of the existing airfields in Scotland to be closed and it is suggested that the saving in their operating cost could form the basis of the subsidy for helicopter operations. Studies have shown that with a subsidy based on the current running costs of the affected airfields in Scotland a fairly extensive helicopter network could be provided which should at least break even over the first year or so of operation and there after show a small profit.

6. Conclusions

The prospects of scheduled helicopter operations as reviewed in this paper are realistic. All matters discussed are within the known state of the art and are backed by considerable research and practical experience. No basic unknown technical ideas are envisaged. As discussed in this paper scheduled helicopter operations could be successfully applied to short range international services across the Channel and within regional areas such as in Scotland. What is I feel most important in these days of high costs is that helicopter services can be set up with a modest capital outlay. In fact this is probably the helicopters greatest drawback, for there is always plenty of lobbying for schemes designed to cost thousands of millions i.e. Maplin Airport, Channel Tunnel and so on, but precious little support for schemes costing but a few million. Is it because politically they're just not worth bothering about ? Personally I have no doubts about the technical or operational capability of the helicopter to fulfill the role of a scheduled transport vehicle, I have no doubts about its ability to be acceptable environmentally, but I do have concern for the backing necessary to promote its introduction, particularly the all important political backing. I feel a real bold political backing, something very lacking in the past is vital. Perhaps the high rate of inflation will force the issue, and maybe we will see the vehicle which for so long has carried the "HIGH COST" label on it's back, a means of econimically solving many short range transportation problems.