A STUDY OF HELICOPTER MANUFACTURING IN CANADA

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PREFACE

This study paper has been prepared for purposes of generating input and opinions on the feasibility of creating a helicopter manufacturing presence in Canada. To this end, the paper is being distributed to a number of Aerospace related companies as well as to other federal and provincial government departments.

The paper ends with a number of questions which will hopefully be considered in any reader response.

The paper includes input from both the Aerospace Industries Directorate and the Electrical and Electronics Branch of the Department of Industry, Trade and Commerce, and has been reviewed in draft form by appropriate personnel in the Department of National Defence. It should be noted, however, that any views and opinions expressed here are the author's and do not necessarily reflect official views or opinions of any Canadian Government department or agency.

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INTRODUCTION

"Helicopter industry growth is not only meeting the predictions of the last decade, it is exceeding them by an impressive margin. Since 1977, the world's eight major helicopter manufacturers have built 6,700 aircraft. The largest percentage of these - 63% or 4,200 helicopters - were for non-military use. Experts say production of helicopters during the next decade will top 29,000 units with 21,000 of them for civil use. There is good reason to believe that the production of civil helicopters may be the strongest growth area in the aerospace industry during the 1980's."

Aviation Week & Space Technology
January 19, 1981

PURPOSE OF STUDY

Helicopter manufacturing has not been classified as an industry in itself. As a result, this aerospace industry sub-sector, its potential, and its contribution to Canada's trade balance, have been somewhat hidden from management's view as a factor in Canada's trade balance and as a potential for new manufacturing opportunities.

The purpose of this study is to review this sub-sector as an entity in itself so as to provide an inventory and a source of information for business planning and future policy making.

METHODOLOGY

The method of study consisted of a literature review with selected visits and interviews with some corporate personnel actively engaged in this sub-sector. Detailed market studies have not been attempted.

I STUDY SYNOPSIS

A. Summary of Findings

Canada is the second largest market for non-military helicopter sales in the world and is conveniently located next door to the largest market. Although the Canadian military market is nowhere as large in numbers, or in frequency of purchase, it represents an equal potential in dollar amount and a significant future market, and may represent some leverage in creating a Canadian helicopter manufacturing presence. Estimates of future sales of new equipment and parts into this market are that they could exceed $2 billion in the next 10 years.

Canada does not manufacture any helicopters at this time. Furthermore, because of the very high technology factor in this sub-sector, coupled with high start up costs and risks, Canada will not likely obtain this capability without some degree of federal initiative and/or participation.

B. General Observations

Failure to create an aggressive Canadian participation in this industry will have a significant, negative impact on Canada's future manufacturing trade balance. This lost opportunity would also be in the area of high technology.

Opportunities appear to exist for Canadian involvement in licensed manufacture of established helicopters and for participation in research and development for future product lines, with established manufacturers.

The missing link for Canada to benefit from this market situation is the absence of a substantial Canadian entity, dedicated to the helicopter manufacturing field, desirous of pursuing proprietory products or proprietory participation, and which has access to adequate future research and development capital.

II HELICOPTER MANUFACTURING IN CANADA

A. History

Although Canada currently does not manufacture helicopters, there have been attempts in the past to gain entry into this field. The first published attempt was the SZNYCER, named after its designer, which was built and flown in Montreal in 1946. This was a three seat aircraft and, with the exception of the engine and rotor, every component was Canadian made with 42 Canadian firms acting as sub-contractors. The project was shelved in 1948 because of poor economic conditions but restarted again in 1951 when it received its certification. However, lack of private or government financial support forced the project to permanently shut down, and the designer moved to the U.S.

Another attempt was the DOMAN-FLEET LZ-5 which was a joint U.S./Canadian attempt. One aircraft was built and flown at Fleet Industries in 1956 but the project was dropped by Fleet as not being economically viable.

The third Canadian attempt was by AVIAN AIRCRAFT LTD. between 1959 and 1972. Although the product line was a gyroplane, as opposed to a helicopter, 6 prototypes were built and a $540,000 federal R&D grant was made. Although certified in 1968, this certification lapsed in 1970 and the assets were sold in bankruptcy in early 1972. Insufficient development capital has been stated as the cause.

Another closely related project was the development by Canadair of the CL-84. This aircraft was not too dissimilar from the Bell Tilt rotor project discussed later in this paper. It was a sixteen passenger sized, experimental aircraft which converted from V/STOL take-off and landing mode to cruise mode by rotating its two engines and wing from a near vertical position to a near horizontal position. Although abandoned in 1974 as a project, the development provided Canadair Ltd. with a good deal of VTOL/VSTOL technology as well as composite blade technology from the development of glass-fibre bound, Kevlar propellors.

Actual assembly, with some manufacture, did take place as a result of the DND purchase of Sea King (S61) helicopters in 1963. Pratt and Whitney Canada created a subsidiary in order to introduce Canadian content to the purchase of 41 machines. A facility was established at the St. Hubert Airport to assemble kits supplied by Sikorsky in the U.S. The initial kits were 100% U.S. but the Division soon started manufacture of the wire harnesses and then tail cones, doors, and cockpit windscreens.

As a result of acquiring the sheet metal and airframe capabilities, Sikorsky supplied the Division with the necessary tooling and fittings for the manufacture and assembly of components for the CH53 program in the U.S. The peak period of activity occured during the early to mid 1970's when 250 ship sets were delivered for the CH53 program and modernization and R&O on the Sea King fleet was going on. An average 500,000 man hours of work per year and 150,000 sq. ft. of plant space was being

utilized. In addition to the helicopter activities, this division was also made responsible for R&O, and modification work on the Turbo Train program.

With completion of the CH53 program activities significantly decreased and at present time: the division's activities centre around R&O work on the Sea King Fleet's transmissions and rotor-heads, as well as on the turbo train. Some airframe manufacturing activity continues but is limited to sheet metal fabrication for Sikorsky.

On a NEAR MISS basis, the closest that Canada has probably come to having a major helicopter manufacturing presence was the purchase of PICTON Airport by PIASECKI AIRCRAFT for the planned redeployment of their U.S. manufacturing operations to Canada in 1969. This redeployment was contingent on a DND purchase of 70+ single engine, Hiller designed helicopters for which PIASECKI appeared to be a major contender. However, a last minute decision to purchase from Bell Helicopters effectively killed this possibility. It is worth noting the Bell purchase was made through the U.S. Army and no visible off-set benefits were attained.

B. Helicopter related component manufacture in Canada

Although Canada has not achieved a helicopter manufacturing capability, it has had some success in the manufacture of sub components. Both Menasco and Dowty have had development programs for helicopter landing gear while Spar Aerospace and Haley Industries have been involved in the development of helicopter gear boxes, transmissions and rotor heads.

In addition, some accessories and specialty products are being manufactured in Canada. DAF Indal Ltd. of Mississauga, Ontario has been producing a "Helicopter Hauldown and Rapid Securing Device" (HHRSD) for the Canadian navy and has developed a "Light Recovery Assist and Secure System" to facilitate operation of small helicopters from small ships. Leigh Instruments, of Ottawa, Ontario, produces and markets an ice detector for helicopters which provides the pilot with a very precise indication of the presence and severity of icing conditions. And Bristol Aerospace Limited of Winnipeg produces a "Wire Strike Protection System" (WSPS) which is a cutting device for inadvertent helicopter contact with cables such as power lines.

Because sales figures for helicopter work and other aviation work are not differentiated in most companies' accounting procedures, it is difficult to obtain accurate dollar amounts on the volume of such business. However, this business is likely less than $1 million per year per company and consequently quite insignificant. Similarly, a limited amount of Sikorsky airframe sub-contracting, is being performed by Pratt and Whitney's helicopter division. Although the amount of this business is slightly over $1 million in the last year, it is conventional airframe construction which will disappear as Sikorsky converts to all-composite manufacture.

The one pleasant exception to Canada's low level participation in helicopter manufacture is the success of Pratt and Whitney Canada's "TWIN PAK" program in conjunction with Bell Textron. Developed with significant DIP Program support, this very efficient twin engine drive

system utilizing the PT6 engine facilitated the design of Bell's 10/14 seat 212 helicopter. Bell has sold in excess of 2000 of these machines internationally and are now modifying this aircraft to a 412 model having 4 composite blades as opposed to 2 standard. P&WC sales from this product line now exceed $400 million.

One unfortunate side effect from this success lies in Bell Textron's apparent attitude to placing new subcontract work in Canada. Although the program was joint and mutually productive, Bell tends to refer to its purchases from P&WC as offsets for the sales of their over-all product mix into Canada (which are very significant).

C. Repair, Overhaul and Research in Canada

The vast majority of repair and overhaul activities on Canada's light weight helicopters (under 12,500 lbs.) are performed by Canada's normal General Aviation maintenance facilities such as Field Aviation and Innotech. In commercial operations such as Okanagan Helicopters and Viking Helicopters, where fleet sizes warrant it, the majority of repair and overhaul is carried out within the company. A similar situation exists within the military where most ongoing repair and overhaul is performed by DND personnel. In all cases, parts come from the helicopter manufacturer.

There are, however, a few Canadian organizations that are unique to helicopter operations and exist because of special capabilities for major repair, or major airframe modification and overhaul. These firms are:

1. Helicopter Welders of Canada Ltd.

This Vancouver Company has been in operation for over 20 years and has built a solid reputation for the repair of damaged helicopter airframes. Because this type of work requires the use of precision made airframe jigs, which are expensive, it can normally only be performed in the manufacturer's own facilities. However, this Canadian firm has gradually acquired jigs for different helicopter models and has established itself as one of only a few companies worldwide, other than the manufacturers, to be able to perform government certified work.

The business is primarily with North and South America and with Bell and Aerospatiale products.

Although it would appear to present a good base for a helicopter manufacturing facility, the existing owner's desire to maintain full ownership and control would likely limit this Company's potential in this area.

2. Boeing Canada Ltd. (Arnprior)

The division was established in 1954 as Piasecki Helicopter Corporation and became Boeing of Canada Limited when purchased by the Boeing Aircraft Corporation in 1961.

In 1972, the division concluded a two year support effort on a research and development program on the CH47 Helicopter (Chinook). The "State-of-the Art"

concept, was in the research of a tactical air guidance system (T.A.G.S.). In 1974, they undertook the manufacture of Lag Dampers for the CH113/CH113A/107/CH46 Aircraft under a licence agreement with Delco. The first production run went to the operators in June 1975.

The present staffing at the Arnprior Division stands at 337 of which 90 are office staff and management and 247 are production and maintenance employees.

The division currently occupies 103,000 sq. ft. of space of which 30,000 is new building. This consists of administration offices and hangar space to accommodate 4 Chinook size helicopters along with a new aircraft paint spray booth. The remaining building, housing the machine and sheet metal shop area as well as a stores building, are old WWII hangars which the company hopes to replace within 5 years.

Orders for a substantial additional quantity of damper kits are currently in process of being authorized by the U.S. Navy. Annual business for damper kits and parts is approximately $400,000 and sales are made to the U.S. Navy, Canada, Sweden, and Columbia Helicopters, a commercial operator in the U.S.

The company was recently awarded a modification contract with DND for 11 Boeing Vertol helicopters at a price of $20.4 million.

Although this operation appears to represent an ideal nucleus for a manufacturing operation, it is currently a branch-plant type of operation and the apparent lack of autonomy does not seem to lend itself to the manufacture of a proprietary product.

3. Pratt & Whitney Aircraft of Canada Ltd.

As mentioned earlier, a manufacturing presence was established in 1963 to assemble Canada's purchase of 41 Sea King helicopters and thereby add some Canadian content. 150,000 sq. ft. of St-Hubert plant space was being utilized at the company's peak period in the mid 1979's, but this has now dwindled to a 50,000 sq, ft. portion of the P&WC Plant #2 in Longueuil, Quebec.

Although there is a heliport at this facility, the location and limited working space do not appear suitable for an expanded operation in an airframe or manufacturing scope of operations. However, a core of helicopter expertise still exists and would likely be very capable of developing an expanded operation at a new location.

4. IMP Group Limited (Halifax)

This Company involvement in the helicopter field involves performing most of the repair and overhaul work on the DND fleet of Sea King helicopters. Although another of their plants manufactures wire harnesses, this is the only component capability at this time.

5. Canadian Marconi Co.

The avionics section of Canadian Marconi Co. is developing a capability in the area of total avionics system integration. The Company also would likely have an interest in supplying Doppler or Omega navigation systems and engine instrument packages. They are already onboard a number of helicopters with such systems.

6. Computing Devices Company

Computing Devices Company is in the Projected Map Display business and has developed a small version of their highly successful fixed wing aircraft unit specifically for helicopter application. They are also in the ASW signal processing field in a very strong way, and will be interested in providing sub-systems for ASW helicopter applications.

7. CAE Electronics Limited

CAE Electronics Limited has already designed and produced flight simulators for the CH-47, UH-1D, CH-53, SeaKing Mk. 41, AB-205 and AB-212 helicopters and has the capability for producing simulators over the entire helicopter spectrum. They are also in the Magnetic Anomaly Detector field, which also has helicopter applications.

8. Other Sensors

A number of other sensors of interest to helicopter application are available; i.e. Leigh Instruments has capability in Crash Position Indicators, Mechanical Strain Recorders for structural members monitoring, as well as Ice Detectors. DG Instruments is currently working on a Velocity Sensor System for helicopter application, but is not yet in a position to supply the system.

9. Other Capabilities

Although not a manufacturer of parts or accessories, the National Research Council has helicopter related capability that forms part of a Canadian inventory.

The National Aeronautical Laboratory located at Uplands Airport in Ottawa has an ongoing research programme using the only successful variable stability helicopter in the Western World. NASA, the FAA and various other foreign research authorities use this unique facility in evaluating helicopter handling qualities, requirements under IFR conditions, helicopter fly-by-wire controls, and even the handling qualities of airships.

In addition, this NRC facility has the only helicopter icing rig in the Western World. This rig generates man made icing conditions for helicopter testing in actual flight, and is used by manufactures from both the U.S. and Europe.

D. Major Helicopter Manufacturers

Most, if not all, major western helicopter manufacturers are either state owned or receive heavy government funding through military contracts. This is due primarily to the dominant position of the military and state in the use of helicopters in the recent past, along with the relatively high research and development costs in producing a new model. By far, the dominant country in this field has been the United States but with increasing competition from Europe and anticipated from Japan.

1. The United States

There are four major helicopter manufacturers in the U.S. that have evolved through heavy military investment in design and procurement. In addition, there are smaller companies that are showing some success in designing for the light civilian market.

(a) Bell Textron

By far the largest helicopter manufacturer in the Western world, Bell employs approximately 9,000 people and has produced more than 23,500 helicopters. They produce helicopters in the range from the the 3,200 lb. take-off weight of the Jet Ranger to the 16,500 lb. take-off weight of the Bell 214. As of December 31, 1980, there were 1,081 Bell helicopters in Canada, out of a total of 1,571 machines (see Appendix D). The current replacement value of these machines is estimated at $309 million.

Although there has been no production, under license, of Bell equipment in Canada, current

license arrangements exist with Augusta in Italy and Mitsui and Fuji in Japan. In addition, licensing agreements have been made with the People's Republic of China and Australia.

(b) Boeing Vertol Company

This subsidiary of the Boeing Company was established in 1960 and has produced and delivered 2,500 tandem-rotor helicopters to the U.S. military as well as to foreign nations. The CH-47 Chinook (46,000 lbs. max. take-off weight) is the Company's current production helicopter and is in service with most NATO nations. A civilian version of this machine, to carry forty-four passengers, is currently in the process of certification.

Boeing Vertol has made licensing arrangements with Japan and Augusta in Italy for production of its CH-47 models and has itself produced the BO 105 under license from MBB. There are 22 Boeing helicopters in DND with an estimated replacement value of $144 million. (See Appendix "D").

(c) Sikorsky Aircraft (Division of United Technologies Corp).

In business since 1923, this Connecticut company has specialized in large military helicopters, with its S61 (Sea King) the main production aircraft in the last 20 years. Although they ceased production of this helicopter last year, it is still being produced under license by Westland in the U.K. and

has been licensed out also to Augusta of Italy, Aerospatiale of France, VFW-Fokker in Germany, Mitsubishi of Japan, and Pratt & Whitney in Canada.

The Company has recently introduced a long range, commercial, 12 passenger helicopter called the S-76 Spirit which utilizes extensive use of composite materials, and is attaining good civil success. Okanagan Helicopters in B.C. has ordered 21 of these machines and a similar number have been ordered by other Canadian firms at about $1.4 million each.

As at December 31, 1980 there were 78 Sikorsky machines in Canada with an estimated replacement value of slightly over $200 million not counting the systems value of the DND "Sea Kings".

(d) Hughes Helicopters

The last of major U.S. companies with a significant sales presence in Canada, this Company has developed primarily along the light weight civil market field although they are the current winner of a U.S. military contract to purchase 536 attack helicopters. Their best selling model is the Hughes 500 series while their older 300 series models are also achieving continued sales success. Of the net increase of 156 helicopters in Canada in 1980, 41 were Hughes machines. This brought their total up to 254 helicopters, all civil, with an estimated replacement value of $55 million.

Partially because of the current success of the Company's product line, coupled with an influx of

military orders, Hughes has allowed license manufacture of the 500 series by RACA in Argentina, Kawasaki in Japan, Breda Hardi in Italy and Korean Airlines in Korea.

(e) Other U.S. Companies

There are various other small U.S. firms producing light weight helicopters, three of which have machines in Canada. These are HILLER, with 42 machines, ENSTROM, with 19 machines and BRANTLY, with 3 machines; all as at December 31, 1980. One other U.S. company, KAMAN, appears to receive a portion of U.S. military R&D money but this company has no presence in Canada. A new company called Robinson has developed a new light weight, low cost helicopter that also may have some success in Canada, particularly for training.

2. Europe

There are many companies producing helicopters in one way or another in Europe, but only 4 which have, or may be expected to have, some impact in the Canadian market.

(a). Westland, U.K.

A privately owned British company, Westland entered the helicopter industry in 1947 by acquiring the license to build the Sikorsky S-51. It subsequently acquired another Sikorsky license to build the S-61 (Sea King) which it still produces, and has co-production arrangements with Aerospatiale on the Gazelle, Lynx and Puma models.

In 1959, Westland acquired Saunders-Roe Ltd. and in 1960 it acquired the Helicopter Division of Bristol Aircraft Ltd. and Fairey Aviation Ltd., and is now the only major helicopter design and manufacturing organization in the U.K.

The Company has entered into a joint development program with Augusta of Italy to develop a replacement aircraft for the Sea King. Other participation is apparently welcome and MBB of Germany and Aerospatiale of France are both thought to be showing some interest.

Although there are currently no Westland helicopters being marketed in North America, there is a corporate desire to gain entry to this market as well as a possible interest in joint ventures.

(b) Aerospatiale, Helicopter Division, France

A division of France's state owned aerospace corporation, this organization has grown into the position of being one of the world leaders in helicopter production. Their initial impetus comes from its joint development, with Westland, of the Puma, Gazelle and Lynx models. As the initial helicopter manufacturer to develop the use of composite material in rotor blade and airframe construction, the Company now stands as possibly the world leader in the use of advanced technology in this field. Their current production mix includes aircraft up to the "Super Felon" with a maximum take-off weight of 28,000 lbs.

At this time, this is the only off-shore helicopter manufacturer to gain significant entry into the North American market and they have just last year opened a $16.8 million, 270,000 sq. ft. facility in Grande Prairie, Texas to manufacture and assemble sales for North America. The North American backlog was stated at $320 million in July, 1980.

As at December 31, 1980, there were 90 Aerospatiale helicopters in Canada with an estimated replacement value of around $22 million.

(c) Augusta, Italy

In 1952, Augusta acquired a license to manufacture the Bell Model 47 helicopter and has subsequently made licensing arrangement to cover all its military purchases. These other models manufactured under license are the Bell 205, 206 and 212, the Sikorsky SH-D and S-61R (Sea King), as well as the Boeing Vertol CH-47C Chinook. As a result of the expertise gained from this license work, Augusta has been able to design and manufacture its own AUGUSTA 109 general purpose helicopter as well as the AUGUSTA 129 military attack helicopter.

The Company has entered into agreement with Westland to co-develop a Sea King replacement and has just formed a new subsidiary in the U.S. to market its 109 model in the U.S., Mexico and Canada.

As of December 31, 1980, there were no helicopters registered in Canada but the 109 will likely make an inroad in the country in the near future.

(d) MBB, Germany

Formed in 1969 from a merger of smaller German Aerospace companies, the Company is Germany's agent in the Airbus and Toronado programs. MBB's BO 105 was the first twin-turbine lightweight utility helicopter to enter series production, and it is now working in partnership with Kawasaki Heavy Industries of Japan on a new helicopter known as the BK 117.

North American sales of the BO 105 were initially to be handled by Boeing Vertol but this arrangement has been dropped. A new subsidiary, MBB Helicopter Corp., of West Chester, PA, has been established to handle BO 105 and BK 117 sales and may perform some limited assembly.

3. Japan

The one other offshore country that appears may turn into a major factor in the helicopter manufacturing field is Japan. Like Italy, they have had a general policy of building under license as opposed to straight purchase and have manufactured the Bell 204 and 205 through Fuji Heavy Industries Ltd., and the Boeing Vertol 107 and Hughes 500 series through Kawasaki.

Mitsubishi has built the Sikorsky 55,62 and Sea King.

Kawasaki is currently producing the BK 117 jointly with MBB and could be expected to develop its own proprietary product in the near future.

In October, 1980, Bell Helicopter Textron and Mitsui & Co. Ltd. have agreed to co-produce the Bell 2145T in Japan, with Mitsui beginning fabrication of

empennage units immediately and ultimately producing the entire helicopter.

E. The Canadian Market Profile

1. Fleet size and breakdown

As of December 31, 1980, there were 1,571 helicopters in Canada of which 1,118, or 71% were commercial, 260, or 17% were privately registered, and 193, or 12% were military (Appendices A, B, C & D). The military mix, although only 12% in numbers, is made up with a large percentage of expensive equipment and represents just under 50% in terms of equipment value (Appendix D). The private figure includes all state-owned helicopters, other than military, as well as utility companies and large corporations not commercially licensed.

In terms of the non-military fleet, piston powered machines continue to be deleted from the aircraft register and are being replaced by new turbine equipment. As a result, figures for net increase in fleet size are not truly indicative of new purchases. For example, the net increase of non-military helicopters between 1977 and 1979 amounts to 18.2% while new helicopter registrations in that period represent a 25.7% change over the 1977 figure. In 1980, there was a 11% net increase in helicopter registrations while new registrations represented a 15% change. Military numbers tend to remain relatively constant for long periods of time, even shrinking slightly as aircraft are lost. However, as purchases are made in program fashion and involve expensive equipment, dollar amounts tend to be quite significant.

Current military equipment replacement plans suggest that replacement purchases exceeding $600 million could be anticipated by the turn of this decade. This estimate is in 1980 dollars and is not made on the basis of an increased helicopter role, which is the case with the rest of NATO's military.

2. Non-military helicopter uses

Helicopters are used in a variety of tasks generally involving the movement of crews and their equipment in remote or otherwise inaccessible areas.

Hydro-electric companies often employ helicopters in aerial construction, line stringing and line patrols. The principal use of helicopters on the part of mining companies is in the support of prospecting and diamond drilling. Oil companies, who generally are large consumers of helicopter services, employ helicopters in exploration and production activities, particularly the movement of crews and equipment to and from offshore oil well drilling stations. The helicopter is also used for seismic operations, surface geology and at times rig movement. A number of the larger Canadian oil companies have mineral subsidiaries active in mineral exploration and development, and as with strictly mining companies, helicopters are used in support of these activities. The principal use of helicopters in forestry is related to forest fire suppression, although logging is a growing activity, as is survey and mapping work.

One of the more interesting applications of helicopters in Canada is a year-round activity in support of railway and communications system maintenance in Northern Quebec. Government departments, in particular the federal government, are large users. Energy, Mines and Resources' Polar Shelf Project has consumed literally millions of dollars of helicopter services over the last several years in its Arctic activities.

3. Possible future civilian uses

In 1978/79, in a Ministry of Transport survey of commercial operators, both large and small carriers identified the same new market areas for future exploitation. The most often mentioned prospects were the urban corporate or executive transportation market and IFR operations in support of domestic and international offshore oil exploration and production. Other areas mentioned were heavy lift and utility roles related to future northern pipeline development, and increasing logging applications. For the most part, these expectations will depend on the economic efficiency of current helicopter developments.

4. Canada's Military Situation

As mentioned earlier, Canada's armed services had 193 helicopters as of December 31, 1980 with an estimated replacement value in the area of $350 million (see note Appendix "D"). These numbers are down slightly from original purchases as a

result of losses and attrition. However, in October 1980, a purchase of 14 Jet Rangers has increased the KIOWA class helicopter by this number.

Partially because of extremely tight budgets in recent years, programs to replace portions of this aging fleet have been pre-empted by decisions for life-extension by means of major overhaul. A $20 million contract was awarded to Boeing Arnprior in June of last year for major overhaul on 11 Boeing helicopters and a similar decision is expected for the fleet of "Sea King" helicopters. However, the decision on the Sea King is a presumption at this time and no contracts have been awarded.

The result is that most of the DND fleet is probably having its service life extended to the late 1980's or mid 1990's when replacement will likely be forced to occur. As an indication the eventual replacement amounts, there were 41 Sea King helicopters originally purchased and these have since fallen to 35 in number. Military personnel have stated that an appropriate replacement number in 1980 would be 40-55 machines with a possible higher number by 1990. The current replacement would represent a $600 million purchase in 1980 dollars.

Another development that may have a significant impact on future helicopters purchases is the Advanced Attack Helicopter being introduced in the U.S. The aircraft is a tandem two seat helicopter which is heavily powered, armored and armed for tank support, anti-tank combat, and low level ground

support operations. The U.S. has purchased 536 of these aircraft which are being built by Hughes, with delivery starting in 1981. Augusta is developing a similar model, the A129 for introduction in Europe.

Although there have been no announced plans for DND purchase of this class of helicopter, its acceptance by other NATO countries would tend to create a similar requirement in Canada.

5. Future Market Predictions

No record of projected growth rates for non-military helicopters has been located for Canada. However, both industry and FAA projections have been made for the U.S. The manufacturing industry in the U.S. presented congressional testimony this year which indicated the U.S. Airspace currently has 7,000 helicopters and will have more than 20,000 by 1990. This represents a compounded growth rate of over 11% per year.

The FAA has recently published a report which suggests the 1980 fleet size to be only 5,800 helicopters with a projected growth to 11,100 by 1992. However, in this same report, the FAA estimates the helicopter growth rate will be slightly better than the 12% rate expected for the overall general aviation mix. Extending the FAA's 1980 fleet estimate by 12% yields slightly over 18,000 helicopters by 1990, or quite close to the industry estimate. It should be noted that these estimates are for net fleet additions and do not include fleet replacement.

If a similar rate of growth, which is identical to Canada's current rate of growth, is applied to this Country's non-military fleet, the 1,378 number at the end of 1980 would grow to 4,314 by the end of 1990. Using the same fleet mix, and 1980 replacement values, this would represent approximately $850 million worth of civilian purchases over the next 10 years in 1980 dollars. This figure may well turn out to be ultra conservative as it does not include aircraft replacement and does not take into account the possibility of an accelerated growth rate resulting from off-shore oil exploration.

6. DATA Discrepancies

In the U.S., as in Canada, statistics on helicopters are usually difficult to get as the industry has not been treated as a special entity. In some FAA compilations, helicopters are lumped in with dirigibles, balloons and gliders and thus a detailed breakdown cannot be done. Although there is a separate category in Canada's aircraft register for helicopters, trade movements of parts and equipment are not separated from general aviation in any known publications.

F. New Technology and Product Development

There are various reasons why helicopters haven't taken over the whole role of aviation, but in final analysis, these narrow down to two factors.

The first is the relative high operating costs, brought about by a large cost factor for parts and maintenance. In comparison to fixed wing aircraft, there are far more moving parts which are in turn subjected to very high levels of vibration and sonic resonants. The useful life of these parts and components is therefore reduced significantly because of accelerated risk of metal fatigue and parts failure. The bottom line being that costs for parts and maintenance are significantly higher than for equivalent valued fixed winged aircraft.

The second factor is one of speed. In normal forward flight in a standard helicopter, the amount of lift from the side of the rotor that is travelling forward, is far greater than from the side that is retreating. The balance is maintained by increasing the blade angle on the retreating blade to achieve an equal amount of lift. After this blade angle has been increased to a certain point, to balance for the increased forward speed of the machine, the blade hits a point where it begins to aerodynamically stall. This is the forward speed limit of the machine, unless an alternate procedure can be used to balance the lift on both sides. On most conventional helicopters, this speed limit is in the vicinity of a 150 MPH.

There are two general areas of new technology and product development that are countering these limitations:

1. Composite Materials

   Usage of composite materials in aircraft manufacture is relatively recent with most of the benefit

resulting from weight reduction. Although this is also a factor with helicopters, a far greater benefit in the form of structural integrity is being achieved. Up until quite recently helicopter rotors where constructed like other airframe parts, with metal fabrication the prime ingredient. With the development of the MBB-BO105, a rotor was developed (by Aerospatiale) utilizing total composite methodology. Extensive testing has shown that these blades are not only not prone to material decay, as were conventional blades, but the manufacturing procedure allows blade design that is aerodynamically superior. The net result is more efficient blades that have a far greater service life, resulting in greatly reduced repair and overhaul costs.

Composites are now being used also for helicopter airframes (Sikorski & Aerospatiale) where weight reduction is the prime benefit, and extensive research and development is proceeding to adapt these materials to "rotor head" and "gear box housing" fabrication. Adaptation of these materials for these parts will again contribute significantly to lower maintenance costs.

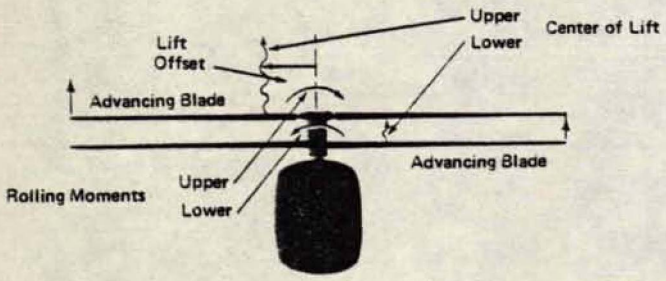
2. High Speed VTOL Developments

There are two current research projects underway which offer the potential high cruise speeds (300 knots plus) while still retaining the benefits of VTOL (Verticle Take Off & Landing) capability. Both are currently being funded by NASA in the U.S.

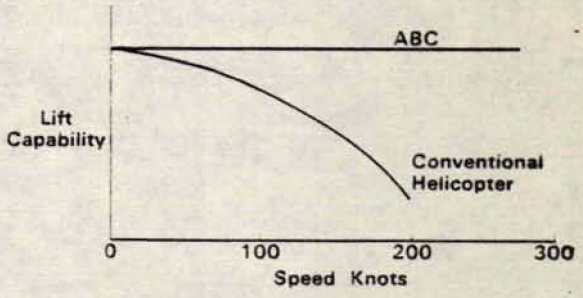
(a) Sikorsky's "Advancing Blade Concept"

Flight research on this concept has been underway for slightly over 5 years at this time. A solution to the unequal lift from the advancing and retreating sides of a conventional rotor is being developed and consists of using two, counter rotating, stiff rotors instead of the normal one. The result being that at any one given time, each side of the helicopter has both one advancing blade and one retreating blade.

ABC – RIGID ROTORS CARRY
BALANCED, STEADY ROLLING MOMENTS



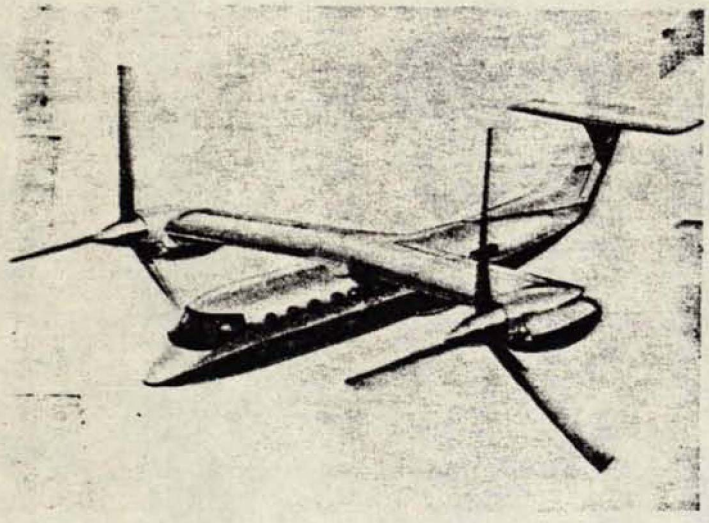
ABC MAINTAINS LIFT CAPABILITY
AS SPEED INCREASES

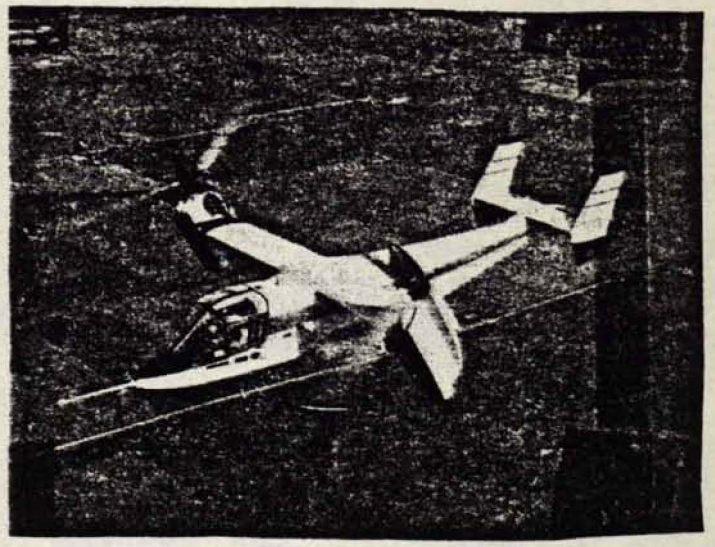


This coaxial rotor arrangement eliminates the need for a tail rotor and thereby eliminates the power demands of the tail rotor while reducing complexity, maintenance burdens and noise.

Testing is continuing and data to date has been very encouraging. Operational developments using these principles are expected.

(b) Bell Textron's "Tilt Rotor Project"





With the same design objectives of the ABC project, the approach here uses two large rotors, or propellors, one on each side of the fuselage, which rotate from a vertical position to a near horizontal position to go from straight lift to horizontal thrust.

This concept has been under development and testing, in one form or another, since 1960 and has now been proven out with a variety of test aircraft.

NASA and Bell Textron are currently doing operator surveys to ascertain the design criteria of a large (30-35 passenger) utility version of this concept and the chances seem very good that this product will be on the market in the next 5 to 8 years.

c) General

These two projects along with off-shoot projects will likely have an impact on not only the VTOL market but likely the STOL markets as well.

G. Financial Project Summary

1. Military

As already mentioned, the military fleet is in the process of major overhaul for an extension of useful life to the end of this decade and shortly beyond. At that time, most, if not all, will have to be replaced. In 1980 dollars, the current fleet value $352,800,000 (Appendix D) will likely exceed $1 billion at present replacement estimates.

2. Non Military

In using a 12% growth rate to cover both fleet additions, as well as fleet replacements, $850 million of civilian purchases can be anticipated by the end of 1990.

3. Spares and Parts

In operating cost projections published by Sikorsky Aircraft, new aircraft purchases usually require an initial additional investment of around 12½% for

spare parts and support equipment. Ministry of Transport officials have estimated that annual expenditures for replacement parts would amount to an additional 5%.

Translating these extra purchases to both military and non military projections, yields another $231 million for initial spare parts and support and annual parts purchases increasing from our 1980 estimate of $37.7 million to $110 million in 1990. Using an average annual expenditure of $73.8 for the next ten years, would suggest purchases of around $738 million in spare parts over this period.

4. Summary

Summarizing these amounts suggests that Canada could be exposed to $2.819 billion worth of Helicopter related purchases by the end of 1990 or shortly thereafter.

5. General Comment

These forecasts could turn out to be high for this ten year period, particularly if Canada experiences a prolonged economic slow-down. However, the opposite would be true if either East Coast oil exploration is successful, or an expanded military requirement for helicopters develops, and both of these possibilities seem quite likely at this time. Irrespective of the above, these growth rates are exponential and represent a missed opportunity in one time frame or another.

H. Canadian Manufacturing Opportunities

1. Unanswered Questions

The extent of the future Canadian Helicopter market appears to present considerable opportunity for creation of new manufacturing industry. And yet, many questions remain to be answered:

- Are start up costs and problems prohibitive?
- Would the vehicle best be state owned or privately owned? If privately owned; one vehicle or many, and with federal assistance or without?
- If one vehicle was to be created, where would the best location be?
- Could access to future Federal purchases be made a factor, even if only to manufacture the requirements under license?
- Is the recent elimination of tariff barriers on this class of equipment a major factor in preventing a Canadian capacity?
- Would there be any interest on the part of Canada's established aerospace companies in developing this product area?
- Is the existence of a relatively large Canadian market, in itself an advantage to a Canadian manufacturing entity?
- Would there be any Provincial Government interest, and financial support, for the establishment of a major facility?

2. Possible Avenues of Entry

Although answers to the above questions would have to be found before any official national policy could be established, certain observations should be made.

First, most established helicopter manufacturers seem to be still receptive to arrangements where their designs are manufactured under license. This method of market entry has been used successfully in Europe and is being used now in Japan. If pursued in Canada, it would likely significantly reduce start-up costs and problems.

Secondly, most manufacturers, especially outside the U.S., appear to be receptive to joint-venture, development projects as a method of reducing risk. The ability for a Canadian entity to take part in research and development would be essential for the ultimate achievement of significant proprietory product lines.

APPENDIX "A"

CANADA'S NON MILITARY HELICOPTER FLEET
DEC. 30, 1977 - DEC. 31, 1980

	Model	Dec. 31 1977	Dec. 31 1978	Dec. 31 1979	Dec. 30 1980	Net Change Dec. 31/ 77-79	Net Change Dec. 31/ 79/80
AERO-SPATIALE	330	2	1	2	2	-	-
	350	-	2	15	42	+15	+27
	341G	17	19	16	15	-1	-1
	Alouette	40	36	32	23	-8	-9
	Alouette III	7	10	10	8	+3	-2
BELL	204B	13	13	19	23	+6	+4
	205A	16	16	19	23	+3	+4
	206A	68	52	42	43	-26	+1
	206B	363	411	492	539	+129	+47
	206L	20	31	54	84	+34	+30
	212	17	16	17	26	-	+9
	214B	1	2	4	5	+3	+1
	47(G, G2 & G2A)	85	77	73	65	-12	-8
	47(G3, 4 and 5)	132	116	109	95	-23	-14
	47(J and J2)	30	27	27	22	-3	-5
BRANTLY	(B2 and 30S)	4	3	3	3	-1	-
ENSTROM	F28 (A, C & C2)	3	7	12	13	+9	+1
	280	1	1	4	6	+3	+2
HILLER	FH 1100	9	12	14	16	+5	+2
	UH 12E	31	27	27	26	-4	-1
HUGHES	300's	38	36	38	54	-	+16
	500's	119	141	175	200	+56	+25
ROBINSON	R22	-	-	-	2	-	+2
SIKORSKY	S51	1	1	1	1	-	-
	S55	13	11	12	14	-1	+2
	S58	7	5	7	7	-	-
	S61	9	7	10	12	+1	+2
	S76	-	-	2	9	+2	+7
	TOTALS	1,046	1,080	1,236	1,378	+190	+142
	Commercial Reg.	848	903	1,022	1,125		
	% of Total	81%	84%	83%	82%		

Source: Canadian Civil Aircraft Register - Transport Canada

APPENDIX "B"

NUMBER OF HELICOPTERS BY TYPE OF PROPULSION AND GROUP(1)

COMMERCIAL ONLY

TURBINE-POWERED	1975	1976	1977	1978	1979	% Change 1979-78
Group A	394	428	487	521	599	15
Group B	12	10	11	11	9	-18
Group C	48	46	46	47	63	34
Group D	6	6	9	7	15	114
Group E	1	-	1	-	1	-
Sub-total	460	490	553	586	686	17
PISTON-POWERED						
Group A	177	176	156	138	127	-8
Group B	3	3	3	2	1	-50
Group C	3	3	1	-	1	-
Sub-Total	183	182	159	140	129	-8
Total	643	672	712	726	815	12

(1) Group A 00- 4,409 pounds maximum gross take-off weight
Group B 4,410- 7,500 pounds maximum gross take-off weight
Group C 7,501-18,000 pounds maximum gross take-off weight
Group D 18,001-35,000 pounds maximum gross take-off weight
Group E 35,001-75,000 pounds maximum gross take-off weight

Source: Canadian Transport Commission

APPENDIX "C"

NUMBER OF HELICOPTERS BY MAKE AND MODEL

COMMERCIAL ONLY

MAKE	MODEL	GROUP	1975	1976	1977	1978	1979
Aerospatiale	Alouette II	A	39	37	25	20	17
	Alouette III	B	2	1	3	3	3
	AStar	A	-	-	-	1	8
	Gazelle	A	13	13	13	13	13
	Lama	A	-	1	1	3	4
	Puma	C	-	1	1	1	2
Bell	47	A	156	154	132	108	98
	204	C	17	12	11	13	17
	205	C	9	14	15	14	18
	206	A	277	295	327	345	383
	206L	A	-	-	12	17	31
	212	C	11	13	13	11	13
	214	C	-	-	1	2	4
Boeing	BO 105	B	1	-	-	-	-
	Vertol 107	D	-	-	1	-	-
Enstrom		A	-	-	1	5	7
Hiller	UH-12	A	11	13	14	14	7
	UH-12T(Soloy)	A	-	-	-	-	2
	FH-1100	A	5	6	5	7	9
Hughes	269	A	10	9	9	11	15
	369	A	60	77	104	79	67
	369D	A	-	-	-	36	65
Sikorsky	S-55	B	3	3	3	2	1
	S-55T	B	9	9	8	8	6
	S-58	C	3	3	1	-	1
	S-58T	C	8	7	5	6	6
	S-61	D	6	6	8	7	15
	S-62	C	3	1	-	-	-
	S-64	E	1	-	1	-	1
	S-76	C	-	-	-	-	3
Total			643	672	712	726	815
Change from Previous Year			7%	5%	6%	2%	12%
Number of Types Reported			21	20	24	23	27

Source: Canadian Transport Commission

CANADA'S MILITARY HELICOPTER FLEET
AUGUST 1980

Company	Military Model	Civilian Equivalent	Number	Approximate Replacement Values
BELL	CUH-IN Iroquois	212	46	$ 21,600,000
	OH-58A(CH-136) Kiowa	206	67	26,200,000
	206	206(new 1980)	14	6,000,000
	UH-1H Iroquois	205	9	8,100,000
BOEING VERTOL	CH-47C(CH-147 Chinook)	114/234	8	88,000,000
	107 Sea Knight	107	14	56,000,000
SIKORSKY	HSS-2 (Sea King)	S61	35	147,000,000
			193	$352,800,000
		Combined Total		$754,607,000

Source: Military fleet size as published by INTERAVIA in Spring of 1980. Values based on civilian equivalent.

Note: The use of civilian prices for DND procurement creates an extremely conservative estimate. This is due to both a more stringent quality requirement, e.g. armore, and the relative high cost of on board military systems. As an example, a reasonable estimate for the cost of the "Sea King" replacement alone would be in the area of $600 million in 1980 dollars with up to 70% of that total being for on board systems.

APPENDIX "D"

CANADA'S NON MILITARY HELICOPTER FLEET
DECEMBER 31, 1980

	Model	Number	Approximate 1979 Replacement Values
AEROSPATIALE	350	42	
	341G	15	
	Alouette II	23	
	Alouette III	8	$ 22,314,000
BELL	204B	23	
	205A	23	
	206A	43	
	206B	539	
	206L	84	
	212	26	
	214B	5	
	47 (G, G2 & C2A)	65	
	47 (G3, 4 & 5)	95	
	47 (J & J2)	22	247,750,000
BRANTLY	(B2 & 305)	3	225,000
ENSTROM	F28, (A, C & C2)	13	
	280	6	2,052,000
HILLER	FH1100	16	
	UH 12E	26	6,392,000
HUGHES	300's	54	
	500's	200	54,644,000
ROBINSON	R22	2	100,000
SIKORSKY	S51	1	
	S55	14	
	S58	7	
	S61	12	
	S76	9	68,330,000
		1,378	$401,807,000

Source: Fleet size - Canadian Civil Aircraft Register
Values - The latest published aircraft prices were used (1979) on an average price basis where aircraft are still being manufactured, and an average price for used helicopters based on a published list by the Helicopter Association of America (Jan 1, 1980) in all other cases.