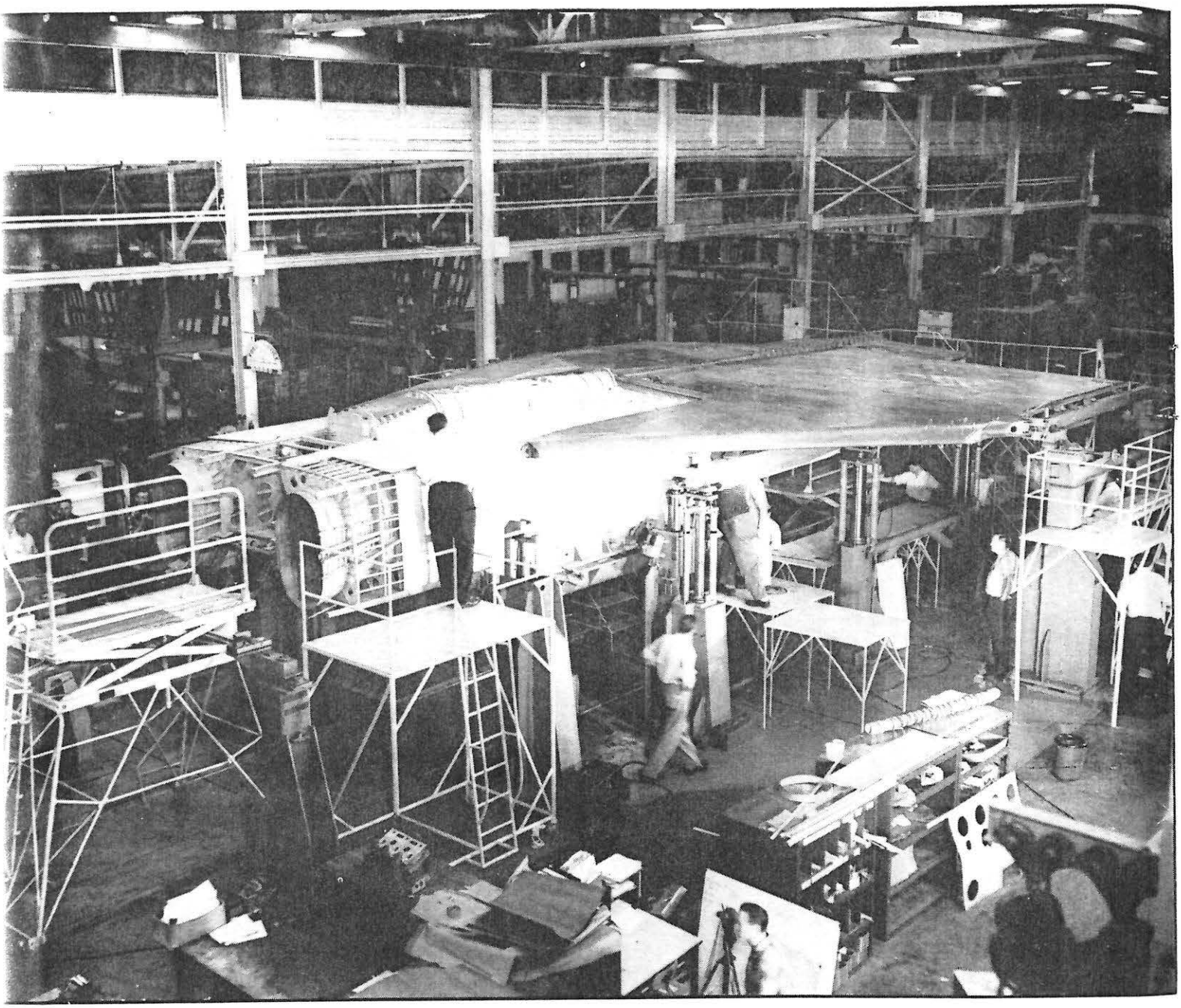


Since last November, the Avro CF-105 Arrow weapon system has been under the management of a Project Office.

THE SEARCH FOR MANAGEMENT

By GROUP CAPTAIN H. R. FOOTTIT

"The military needs and demands the highest calibre of management."
—*General C. S. Irvine, USAF*

THE HOUSE was in an uproar. On all sides the Prime Minister was being blasted with a barrage of harsh and bitter words. This was May 7, 1940, and the British forces had just been thrown back into the Norwegian seas by the victorious German Army.

Prime Minister Neville Chamberlain —whose appearance and rolled umbrella had become the very symbol of

appeasement—tried hard to stem the tide. When a "Want of Confidence" in the Government was called, Chamberlain's Conservative Party barely scraped by with a majority. Fifty of their own members voted against the Government. Three days later Hitler's Army burst over the Belgian border and the rape of the Lowlands had begun. This was the end. With a sad and weary face Neville Chamberlain submitted his resignation to the King. And Winston Churchill was immediately called to Buckingham Palace and asked to form a new government.

Old Campaigner: Though he had never been Prime Minister before, most of Churchill's life had been spent in politics. He had also been trained as a military man and had campaigned with the army in India, Egypt and South Africa. With this checkerboard of experience he had a firm belief in the efficacy of air power, and he had long made up his mind on how the British should start to achieve it. "I had resolved as a result of my experiences in the last war," he wrote in his book *Their Finest Hour*, "to remove the Supply and Design of Aircraft from the Air Ministry." So with the help of that able Canadian, Lord Beaverbrook, he set up the Ministry of Aircraft Production. Henceforth the MAP would call the tune on design requirements and production schedules. And the RAF's Air Ministry could get on with fighting the air war and specifying, in broad terms, what weapons they needed to fight it with.

Churchill's organizational change, whereby the MAP would manage new aircraft programs instead of the Air Ministry, was the beginning of a chain reaction that is still going on today. All over the Western World we are searching desperately for efficient management techniques to smooth out and speed up the design, development, and production of today's complex aircraft and air weapons. For nearly twenty years we have been wrestling with this problem. Although we have made considerable progress with the weapons system concept and its management philosophies, the road ahead is still fogbound and uncertain. An evaluation of the evidence indicates that our channels of communication and our decision-making machinery are the major causes of friction in the management mill. So until we smooth out these processes our search for efficient management will go endlessly on and on.

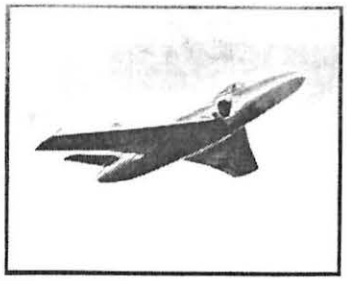
A typical incident where charges of mismanagement were hurled at the government's design authority, is the case of the Supermarine fighter, the "Swift". At the end of the last war the responsibility for supervising British aeronautical programs was passed from the Ministry of Aircraft Production to the Ministry of Supply. In the latter 1940's the RAF sent the MOS a broad operational requirement for a new jet fighter. In keeping with the Ministry's management role, they rewrote the requirement into a specification and asked the aircraft industry to tender design proposals. In the end the RAF dropped the project and the Royal Navy took it up. The result was the Supermarine naval fighter, the Attacker, and two squadrons were flying from the fleet by 1952.

Improving the Attacker: The Attacker is a straight wing, jet aircraft. In the early prototype days the Supermarine company saw possibilities of improving the fighter's performance by sweeping the wings. Several swept wing prototype models were built and flown. About the same time Supermarine's designers sent the Ministry of Supply a preliminary proposal for an RAF fighter version. It was this proposal that ultimately became the Swift.

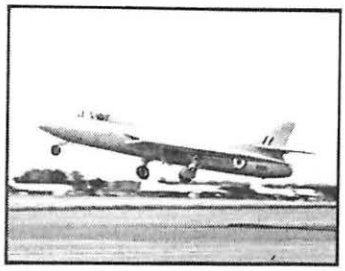
In the early '50s through the medium of the British press and the Farnborough Air Show, the Swift was widely advertised as the latest in interceptors that was being "put into production for the RAF." However, the MOS had carefully backed the Swift program with another jet fighter development, the Hawker Hunter. With the shadow of the Korean war over the world both fighters were ordered into production, and on the surface, both programs were proceeding without undue concern.

However, there was an undercurrent of rumors that aerodynamic difficulties were plaguing the Swift's progress. Then production orders were cut back. By 1956 it was clear to everyone that the Hunter had definitely won the Hunter-Swift competition, and questions were being asked by indignant Britishers: "How much have we spent on the Swift program and why?"

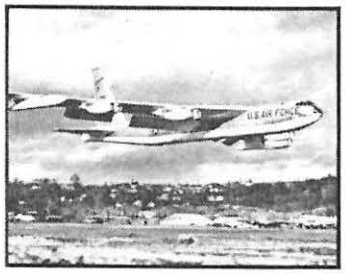
The first public probing of the problem started with the House of Common's "Select Committee on Estimates" late in 1956. This group tagged the Swift as a failure that had cost the taxpayers over $92 million.



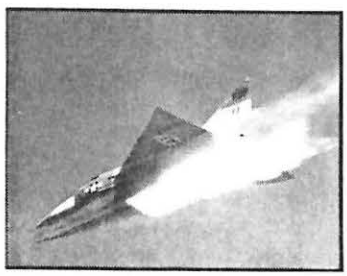
This is the Nene-powered Supermarine 535, a forerunner of the costly Swift, which never lived up to its early promise. Production Swifts had Avons.



The Hawker Hunter (F.Mk.1 shown) was insurance that paid off. When the Swift's snags proved insurmountable, the Hunter was available to fill the gap.



B-52 is in production under the direction of a Weapon System Project Office, which concerns itself with all needs for B-52 construction and operation.



Convair F-102 production is also guided by a WSPO. Here a F-102A fires a salvo of rockets, which are carried in the missile bay doors.

Last year a further committee, the Committee of Public Accounts, went through the Swift ledger. Now the cost had risen to $112 million, which the Committee said was "largely abortive."

In groping through the records the group found that some of the Swift's troubles had been forecast long ago. When the preliminary design proposals were handed to the Ministry of Supply in December, 1950, the U.K. research organization, the Royal Aircraft Establishment, had sifted through the technical data. They predicted some of the aerodynamic troubles that eventually killed the Swift. The RAE also recommended some changes and a few of these were finally incorporated. But in spite of all this the Swift was put on a schedule for RAF operational use in 1953, and the MOS signed a contract for 492 airplanes.

When the first three aircraft were delivered they had such bad pitch-up characteristics that they were branded as unsafe for high altitude flying. When a modified Swift was tested in 1954 the maneuverability was so poor that the Ministry promptly cut the contract to 170 airplanes, exclusive of prototypes.

Mismanaged

THE COMMITTEE of Public Accounts took note of all this and essentially accused the Ministry of Supply of mismanaging the Swift program. The Committee doubted, for example, that MOS had kept sufficient technical and financial control during the Swift's design and development years. So in the final reckoning the Government had paid out over $112 million for relatively nothing.

Although not referring to the Swift, Air Commodore F. R. Banks, a director of The Bristol Aeroplane Co. Ltd., indirectly struck the keynote to the U.K.'s troubles when he said last year, "Aviation has grown into a big and serious business that cannot be run by a few people with ideas. It needs considerable foresight, first class organization, and elaborate facilities to get anywhere at all." Although the British have talked about weapon system concepts, weapon system organizations, and weapon system management techniques, there are many in the U.K. who feel that they have never really implemented them. So such cases as the Swift are almost bound to result.

Although I have used the Swift as an example, there are other projects in the Western World where even competent technical and financial managers are chained to outdated management systems. The net result is an end product that is often too little and too late. The basic difficulties, of course, are the tightening of our defence budgets, the increasing cost and complexity of our modern weapon systems, and the urgent demands to get them into operational use in minimum time. All these requirements are obviously not compatable. So financial managers ride herd on technical managers who are pressed by operational personnel—and the squalls and storms finally blow up to key government and industry personnel for decision. But this is a long, slow channel of communication and many vital decisions are unwittingly delayed. So the program suffers.

Credit to U.S.: To the U.S., I believe, goes the credit for first realizing the situation and trying to devise management modes to skirt around it. In 1949 the U.S. Air Force found that their development programs, under the Air Research & Development Command, were not flowing smoothly into their production programs, under their Air Materiel Command. Moreover, industry was dealing with a wide swath of technical specialists in the USAF who were not coordinated under a single head. To provide a focal point for all these activities the Air Force established Joint Project Offices for each major project, and staffed them with ARDC and AMC personnel.

Several years later the impact of systems thinking drove home the idea that an aircraft such as a fighter, is only a part of a large air defence system. The fighter must have its own ground support equipment, test stands, maintenance skills, and other such items, or it is relatively useless operationally. So the USAF established Weapon System Project Offices (WSPO's) to replace the Joint Project Offices. Thus WSPO's are in being for such major weapons as the Boeing Bomarc, ground to air missile, the Convair F-102, supersonic fighter, and the Boeing B-52, strategic bomber. The USAF regulation that set up the WSPO's states that their job is to "manage the program", and "achieve the proper phasing of actions pertaining to development, procurement, production, maintenance, and supply, in order that the weapon system can be delivered and supported in a timely manner." At the same time management techniques with prime contractors and associate contractors were worked out so there was a clear chain of command from the military, through the Project Office, to the various contractors.

Arrow Project Office

FOLLOWING this USAF procedure the RCAF last November instituted a project office for the CF-105 "Arrow", the supersonic interceptor now in Avro Aircraft's flight test hangar. This Arrow office brings together all the various engineering functions of the RCAF and has, or will have, personnel from the Department of Defence Production, the Defence Research Board, the RCAF's Air Materiel Command, and technical talent, working for the group, from the various contractors associated with the Arrow program. It also includes officers drawn from the financial and logistics directorates of RCAF Headquarters.

For some time the RCAF, DRB, and DDP have recognized that it takes more than a government group to manage such a complex weapon system as the Arrow. As the USAF's General Clarence S. Irvine put it recently, "The infinite complexity of modern aircraft or weapon systems precludes detail supervision from the military." Consequently plans are going forward for establishing a "Coordinating Contractor" for the Arrow. This contractor will be responsible for knitting together the detailed efforts of the other companies that hold government contracts for major portions of the Arrow system—such as Orenda Engines Ltd., with the Iroquois engine, and the Radio Corporation of America with the integrated electronic system. In this way the coordinating contractor, with all the associate contractors, can demonstrate and deliver to the RCAF an operationally functional Arrow weapon system, with all the direct support equipment that is vital to keeping the airplane flying.

Slow Starter: With this Arrow Weapon System Project Office just

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azine, the "Experimenter", which has received strong support and the praise of all homebuilding enthusiasts for its quality and content.

FOOTTIT

(Continued from page 12)

starting, it might be said that Canada is four years behind the U.S. attempt to devise management methods to eliminate weapon system bottlenecks. The U.K., I believe, is even further behind. With this backlog of U.S. experience to draw on our search for management might seem ended. But such is not the case. In fact, cracks in the U.S. weapon system management structure, which we have essentially copied, are already beginning to appear.

Some time ago, for example, the U.S. Department of Defence set up a special study group headed by a Deputy Secretary, Reuben B. Robertson, Jr. The group's job was to study the weapon system cycle from concept to operational use. When the committee tabled its report over a year ago they strongly supported the weapon system project office idea. However, they found that the WSPO was often stalled over vital decisions. Since the Project Office did not have the authority to make these decisions it could only circulate memoranda and reports at high military levels and wait for the decision to be handed down. This delaying tactic, the study group found, tended to negate a large portion of the management skills that the USAF had hired from the prime contractor in the first place. The way over this hurdle, the group felt, was to raise the status of the WSPO and give it the right to make its own decisions.

This decision-making process is all part of the overall problem of management communication channels. Group Captain F. R. Sharp, the RCAF's Director of Management Engineering, told me recently that "Management—or the lack of it—is primarily a problem in proper communications." His words are certainly reinforced by statements that have been made during the last year by key men involved in the USAF turmoil. For example, Sherwood C. Frey of the Lockheed Aircraft Corporation pointed out that "Studies have indicated that some Soviet weapon systems have been developed in approximately half the time it takes [the U.S.], and that our long delays are primarily due to our decision processes. It has only recently been recognized that the slow decision process is that all three groups [government, military, and industry] are involved, and that the process of intercommunication is exceedingly slow." Frey and Phillip R. Carlson illustrated this point by noting that there is usually a three to four year delay in the implementation of new, major weapon systems. Captain D. J. Welsh of the U.S. Navy's Bureau of Aeronautics put it much simpler when he said at the same session, "There are a lot of masters to clear with before the military can make a major decision."

"Oxley here is Captain of the local Ground Observer Corps."

Other Culprits: Faulty communications, however, are not all confined to the government's camp. USAF General H. M. Estes made it clear some time ago that USAF Project Offices suffered from lack of information due to negligence on the part of many contractors. He pointed out that a company will run into a difficult technical problem that is going to take some time to solve. Instead of notifying the WSPO immediately, the company holds back. Then the schedule slips and the Project Office is caught short in its planning. The RCAF has had some trouble along this line with some Canadian contractors.

From all this it is readily apparent that communications are vital to proper management. Yet aviation is an extremely complex business. And as management experts will tell you, the ratio of managers to employees increases rapidly with the complexity of the job. Lord Heyworth, Chairman of the vast corporation, Unilever Limited, gave some statistics along this line in his 1956 report on the company's operations. On the corporation's plantations in Nigeria and the Cameroons, where

the operations are relatively simple, only 3% of the employees are classed as managers. In their small processing plants in Indonesia, where they produce only detergents and edible fats, the management ratio is 6%. In their large plants in the U.K. and Holland where foods, toilet preparations, and other items are also processed, the ratio is up to 11%. And in their largest operation in the U.S. where all manner of goods are turned out, the ratio jumps to 15%.

I don't know what these ratios are in the aeronautical world, but they are undoubtedly very high. Consequently with so many managers in the system, aviation has a real communications problem. In other words, we have to devise a method for managing the managers.

Although we have come a long way with many of these mangement techniques, the search for more efficient management must go on and on. As General Irvine said, the military alone must have the highest calibre of management for its projects, since our very life may depend on it. From the U.S. experience, however, it appears that we're not going to get the ultimate until we clear out our channels of communications and overhaul our decision-making machinery. How long must we wait before we tackle these tasks?

AVON 200

(Continued from page 24)

packed closely round the lower half of the compressor casing, from which they deliver to a double gallery round the delivery duct and thence through eight duple burners to the flame tubes. A common drain tank is mounted under the turbine casing.

Ignition and Starting: The ignition system is of the high-energy type, with two HE units mounted under the compressor casing and a surface-discharge igniter plug in two of the flame tubes. There are several alternative starting methods: a 25 hp 120 volt motor in the nose bullet; a 350 hp IPN (Isopropyl Nitrate) turbostarter; or a 350 hp kerosene/LP air turbostarter—the latter can be supplied from an air-storage bottle or an external supply, such as the B & G A Palouste truck, the fuel being drawn from the aircraft tanks.

Airline R.A.29

THE MILITARY and prototype civil experience gained with the R.A.14 family has led to fairly-extensive revision in the R.A.29 for airline use. Unfortunately, despite its fairly imminent introduction to foreign civilian personnel, the engine remains "Restricted" by Security. With the same diameter of 41.50 in., and a net dry weight of 3,326 lb., the initial rating is 10,500 lb. static thrust for a sfc of only 0.775. External examination suggests the addition of a "0-stage" to the front of the compressor and the turbine appears to have three stages. These modifications would give higher thrust at lower operating temperatures, with a consequent gain in specific.

Modifications to the compressor casing are indicative of the high temperatures attainable with the aid of supersonic ram intake air. While the first part of the compressor casing is still magnesium alloy, split horizontally, the last six stages are encased in a fabricated steel drum that is integral with the delivery duct. A short split portion of aluminum-alloy is interposed, presumably to absorb the differential in the thermal expansion coefficients of magnesium and steel. These modifications are scarcely required for present airliner speeds, so one could assume that it is a variant of the R.A.29 which is used in such new fighters as the Royal Navy's Vickers Scimitar and D. H. Sea Vixen as well as the RAF's English Electric P.1B.