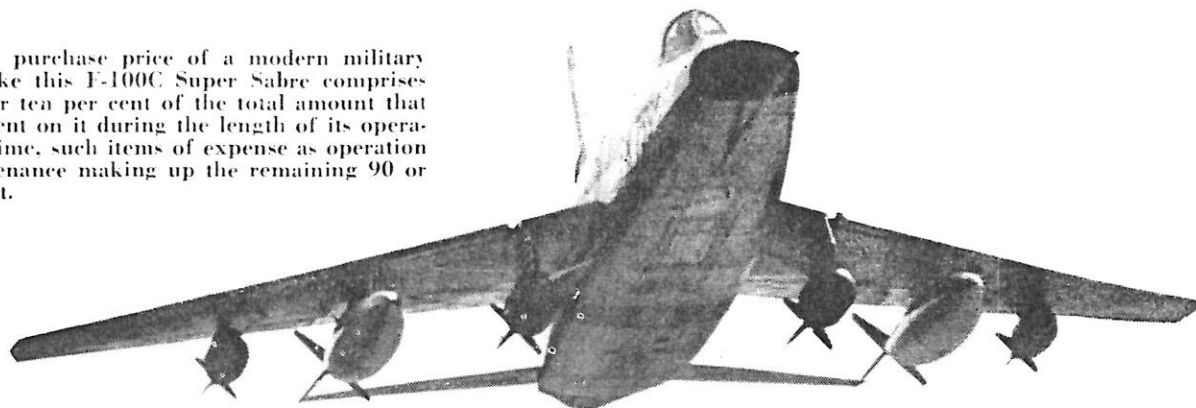


The initial purchase price of a modern military airplane like this F-100C Super Sabre comprises only five or ten per cent of the total amount that may be spent on it during the length of its operational lifetime, such items of expense as operation and maintenance making up the remaining 90 or 95 per cent.



# The Dollar Decision

By GROUP CAPTAIN H. R. FOOTIT

*"Look beneath the surface; let not the several qualities of a thing nor its worth escape thee."*  
—*Marcus Aurelius (A.D. 121-180)*

ARMY HEADQUARTERS lay dusty and quiet in the afternoon sun. The humid wind sweeping off the Red Sea offered little relief from the stifling heat. Inside the main building a group of sweating staff officers looked over the report again. But the answer, on this summer day of 1927, was the same as it was the year before, and the year before that. The facts were there. It would take an all-out army campaign to drive back the Iman of Yemen and his hostile tribes.

The undesirable Iman and his henchmen has been a headache to the British since 1919. At that time they commenced a slow infiltration from the

south, and now they occupied a large part of the British Protectorate of Aden. To get rid of them would take a toll of thousands of English lives in sickness and casualties. And according to the official estimates, it would cost the British crown some six to ten million pounds.

**Simple Solution:** A year later, however, the solution was simple. The Royal Air Force, in the early twenties, had been experimenting with maintaining law and order on India's frontier by air control. Warring tribes that infringed the law were warned by an air drop of leaflets. If they refused to heed the word, bombers arrived and villages vanished. Now air control was established in Aden. In short order the bombers came. They zoomed over the forts of the Kataba and the Head-

quarters of the Iman. Bombs blasted the fortifications, and the Iman quickly decided to beat a retreat back to his own territory.

As one report summed it up, "These operations cost only 8,500 pounds—another example of the humane and economical advantage of air control."

This 1928 stress on the monetary cost of operations against the enemy was one of the forerunners of what we might call today, the dollar decision. For nothing, in this expensive world of civil and military air power can be decided without knowing the cost. Price tags must be attached to every program from operating a new fleet of air liners to modifying a control column. Though dollars are a vital part of every such assessment, they may not tell the total story, and they may be

misleading. Consequently, we must look below the surface, as Marcus Aurelius said, to ensure that we have all the factors affecting the figures.

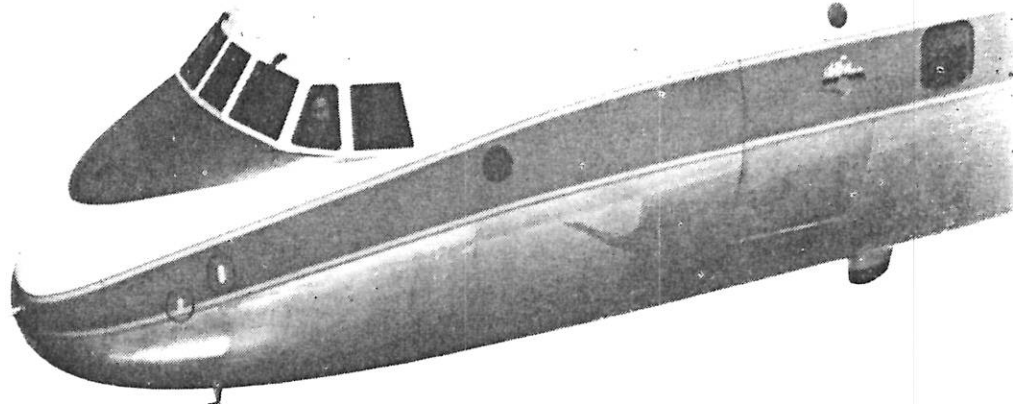
To be sure, dollars are often decisive, in peace or war, since they represent in easy numerical form, the man-hours and materials that went into a product. Any one country, at any one time, has only so many man-hours and so much material that it can expend. So when air power feeds on this national product, there is that much less for cars, refrigerators, sewing machines, and such. Thus, when war drums beat and the military begins to take a large slice of the national effort, man-hours and materials for civilian goods must be cut to a minimum. However, there is no greater fallacy than the common catch phrase, "In war, money doesn't matter." For, with survival at stake, it matters even more than in peace time. And the military's carefully assessed dollar decision in times of peace, will automatically ensure a policy that will give the same careful assessment in times of war.

**Big Day:** To appreciate the capital expenditure that goes into a military operation let us turn back the clock to February 15, 1945. This was a signal day. On this date Admiral Sherman's Task Force 58 first penetrated Japanese home waters. By this time, of course, Japan's military might was almost beaten to its knees. Her navy and air force were largely destroyed. And most of her airplanes and ships that escaped were lying motionless under camouflage netting owing to lack of oil.

Task Force 58 totalled some 16 carriers, 8 battleships, 17 cruisers, 75 destroyers, and a small armada of miscellaneous vessels. Housed in this floating arsenal were nearly 100,000 men. The Japanese scraped together everything that could fly or float to hold back the task force and managed, in three days, to knock out 10% of it. But Task Force 58 did get their bombing planes off the carriers. And hit the Japanese homeland with some 513 tons of bombs and rockets.

Air power expert Major Seversky has cast a critical eye on this whole venture. He reduced it to dollars, and came up with the startling figures that

Civil airliners, the Super Constellation among them, now have an initial cost some thirty times greater than the air transports of the 1920's.



the capital investment in Task Force 58—the bare cost—was a cool \$2,600 million. Further reducing this to a cost per ton of bombs dropped and the results show that each bomb was worth some \$5 million of the national effort.

**Add It Up:** This was just one naval task force to do one job. During World War II there were many of these forces assembled. Adding up the cost of the total forces of the army, navy and air force, the personnel and equipment, and the dollars necessary to carry out war operations stagger the imagination. In Canada alone the old Department of Munitions & Supply, established in 1940, entered into approximately two million contracts during the following five years of war, and spent some \$9,500 million in doing so. Thus Canada consumed over \$5 million a day of the taxpayers' money in the purchase of military equipment.

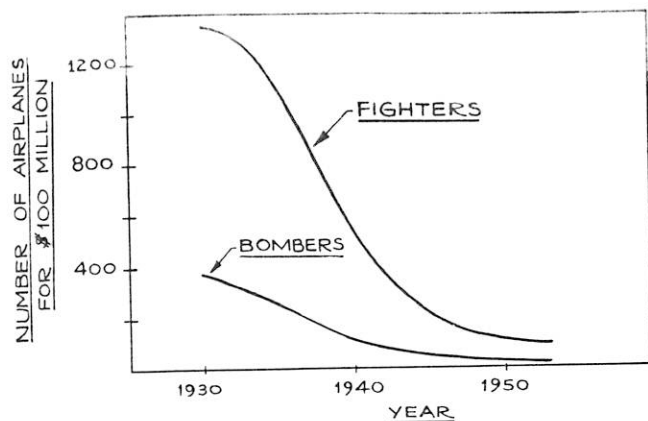
#### money does matter

**W**HILE the magnitude of these figures may seem to lend weight to the statement that money doesn't matter in war, we must appreciate that an aircraft modification costing \$2,000 per airplane (and some of them cost more than this) may easily result in a total expenditure of \$5 million over a wartime aircraft contract. Thus on one modification for one aircraft we may commit, in national effort, the equivalent of one Canadian wartime production day.

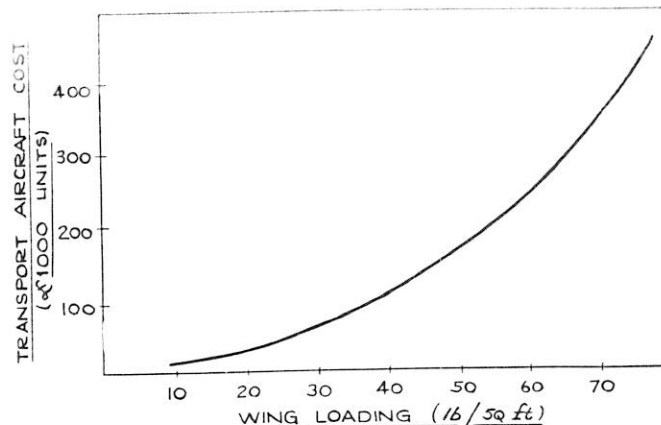
There is no question, then that dollars must form a part of every decision. However, although it is easy to turn back the pages of history and reconstruct these dollar decisions of World War II, we must be careful that we extract from them only the lessons to be learned. A comparison of the actual costs may be misleading. For the intervening years have seen a rise in the complexity and hitting force of our airpower, and an inflation of our dollars. Even correcting for inflation we can still buy fewer military airplanes for \$100 million dollars, as shown in the typical U.S. curves of Figure 1.

The same is true in the civil field. Over the years there has been a gradual increase in initial cost of airliners. The British Aviation Insurance Company looked over its statistics and came to the conclusion that the air transport of 1920 cost only about one-thirtieth of the airliner required in our era. Noting also that wing loadings were on the increase with increasing speed they plotted the value of a wide range of transports against this parameter. The results (Figure 2) show clearly that modern, high wing loading airplanes are by far the most expensive.

**Other Costs:** While these initial costs must always be investigated, we must not forget that the purchase price of an airplane is only about 5 to 10% of the total operating cost when the maintenance, spares, crew costs, fuel, oil, and all other factors are ground into



**FIGURE 1**  
**DECLINE OF MILITARY PURCHASING POWER.**



**FIGURE 2**  
**INCREASING COST OF BRITISH AIRLINERS**

the equation over the total life of the product. This is particularly true for fast military airplanes. For example, a modern jet fighter will eat up over \$100 worth of fuel alone in a single flying hour, and the fastest and most modern jet bombers will more than triple this figure.

Moreover, one dollar spent on an aircraft itself, can easily lead to another dollar for such items as publications, training aids, ground handling equipment, and a multitude of supporting necessities. The so called "weapons system", the fully operational fighting airplane, must be accompanied by a "supporting system," before the whole product can become a useable offensive or defensive system (Figure 3). This is particularly true in the field of guided missiles, where one ground-to-air missile may have as many as thirty or forty major items of equipment such as test stands, mobile transporters, and launchers, before it is fully operational and ready to be moved and fired at the enemy.

It is vital, then, that any decision based on dollars includes total dollars — not just those for the actual piece of equipment — conveniently forgetting that we may easily double our ante when all the supporting items are tabulated.

Keeping in mind that a major part of any price tag is expended for man-hours, it can be shown that we can easily waste man-hours in seemingly saving dollars. Perhaps this can be interpreted by the old saying, "Penny wise, and pound foolish." Paul Dilworth, well known former Chief Engineer of the Gas Turbine Division of Avro Canada (now Orenda Engines Limited), and presently head of a firm

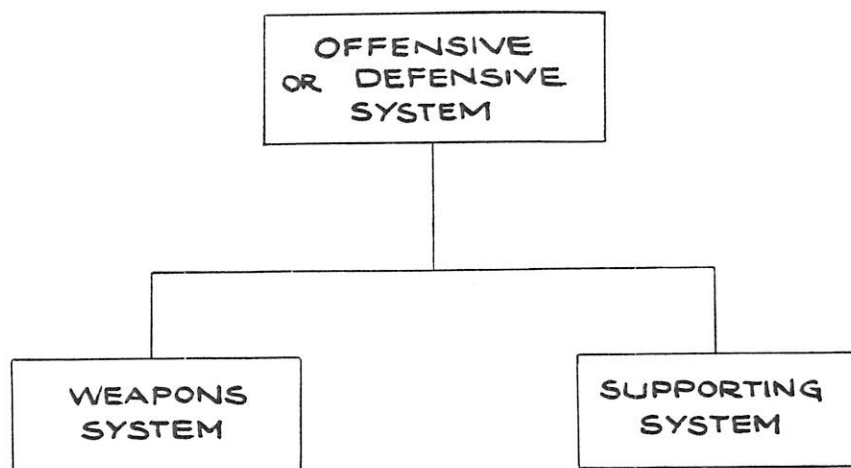
of Toronto consulting engineers which bears his name, raises an interesting example associated with our usual method of getting engineering proposals from a number of companies before committing ourselves to the purchase of a new piece of equipment.

**Waste of Time:** Says Dilworth, "If you want a good example of prodigal expenditure of engineering man-hours — which, incidentally, are in very short supply these days — take the case where a new specification is issued for a piece of complicated service equipment. It is common practice to ask each company in that line of business to make an engineering proposal on the basis of the specification. This specification may be sent to 15 different firms. Each company can easily expend

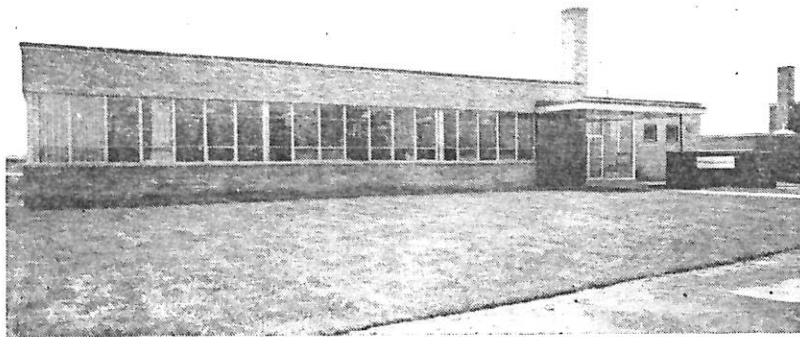
many hundred man-hours before their report and drawings are bundled up and sent to the potential customer."

If each company expends 1,000 man-hours (and this figure is not unduly high), then 15,000 man-hours of the national effort are consumed on these proposals. According to Dilworth, "This is often adequate to cover the total cost of engineering the project through its development and production phases, instead of just getting it to the proposal stage."

"Furthermore," Dilworth points out, "most of these companies are in the military business. Though the proposals are supplied on a 'free bid' basis, actually they result in increased cost for subsequent equipment supplied to the government if the company, as it



**FIGURE 3**  
**COMPONENTS OF AN AIR POWER SYSTEM.**



## New Home for Aeroquip

During June, Aeroquip (Canada) Limited of Toronto held an open house to mark officially its occupancy of a new plant in the north-west section of the Ontario provincial capital.

Aeroquip (Canada) manufactures the well-known Aeroquip line of flexible hose lines, self-sealing coupling, and re-usable fittings, and was formed in February of this year. At that time, the hose and fitting business of Prencos Progress & Engineering Corporation Limited, also of Toronto, was purchased by Aeroquip Corporation of Jackson, Michigan. Prencos had been licensee for Aeroquip products since 1940, and though it is no longer engaged in this particular activity, it continues to take an active interest in the aircraft industry, concentrating particularly on the design, development, production and distribution of aircraft and industrial hydraulic controls, clamps, precision machining of aircraft parts, light metal design, etc.

Visitors attending the open house included prominent Canadian industrialists, RCAF officers, and manufacturers' representatives. Welcoming them to the new plant were Acting General Manager Robert W. Bowman (bottom, centre), L. E. Buckwell (left), aircraft sales manager, and W. D. Heeley (right), industrial manager. Other guests, from the parent company at Jackson, were M. J. Betley, vice president &

general manager; B. A. Main, Jr., vice president; William F. Rogge, industrial sales manager, and Dorgan Arthur, aircraft sales manager.

The new Aeroquip (Canada) plant—shown in photo at top—is located on a two-acre property and is owned outright by the firm. It contains 30,000 square feet of office and manufacturing space. Occupancy of the plant actually began on April 1, being completed on April 15. In this time, machinery purchased from Prencos Progress and the Canadian government, as well as various pieces received from Jackson, were installed and set in production.

Although the building was not leased until February 22 (it was purchased later), co-operation of contractors and suppliers in installing compressed air lines and electrical power, made possible the completion of the move in such a short period, without interruption of deliveries.

Employment as of June 1 totalled 46 persons.

The volume of business at the Canadian plant is divided roughly two to one, between the aircraft field and industrial users. A substantial increase in industrial sales is anticipated, and immediate plans are to triple the capacity of the multiple spindle screw machine department to handle adequately the expected increase in business.



usually does, plans on staying in business. Consequently, in the long run, the government pays for most, if not all, of the so-called 'free man-hours', and receives very questionable value for the resultant increase in cost of its purchases."

**Going Too Far:** While such proposals have a certain competitive value, that helps to get the best, Paul Dilworth's example shows that we can carry the "free proposal" business too far, waste a lot of engineering man-hours and run up costs for a very dubious gain. One answer, of course, is to be selective and only have limited bids on any one item of equipment.

Paul Dilworth, conscious of the role of the consulting engineer, favors a different approach. He suggests that, "It is better to let a cost-plus development contract to a reputable firm that is competent to engineer and develop the equipment to meet the specification. Competitive production tenders can be called for later when the original firm has proved the prototypes and has complete detail drawings and specifications. In this way the job is paid for only once, instead of several times."

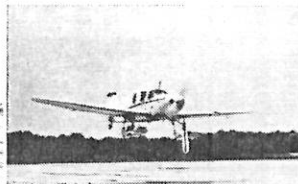
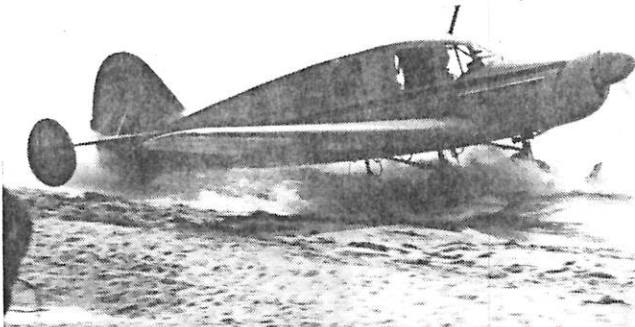
This competitive proposal procedure is carried out in a variety of ways by all our major aircraft companies, and it is the standard procedure for the government's Department of Defence Production. This fiscal year, DDP will be using this process to contract for the equipment that forms a major part of the Armed Services' appropriation of 37% (7½% of the gross national product) of the total government expenditure. For aircraft and engines alone, the RCAF has allocated almost \$300 million.

**Cross Check:** In spending these funds DDP cross checks the manufacturer's bid against any data they have on file on similar jobs. I asked Thor Stephenson, the other day, whether his Aircraft Branch of DDP also kept cost quotations on U.S. and U.K. aircraft to compare with Canadian products. He quickly pointed out that there may be as much as 35% increase in cost for an item produced in the U.S. compared to the equivalent item produced in Canada provided the man-hours are the same.

"Moreover", he said, "even in Canada there are variations in cost per man-hour depending which part of the country you are talking about. For

(Continued on page 78)





**UNIVERSAL LANDING GEAR:** This Bellanca Cruisemaster is described as being the first airplane to be equipped with retractable "hydro-lift". All American Engineering Co., Wilmington, Del., which designed and developed this type of landing gear, says that it is not to be confused with hydro-skis such as

are used on the Convair Dart, as these are for use on water only. Hydro-lift enables a landplane to operate from any surface, including water, snow, mud, ice, and runways, according to AAE. A number of landings and take-offs have already been made from water, sod, and hard-surfaced runways.

## PARACHUTES

(Continued from page 45)

during the initial inflation or opening period of the parachute, reducing the sudden flaring out of the skirt and thus preventing "explosive opening" of the canopy.

As the canopy expands, the extensions act as aerodynamic brakes against the sudden radial outward motion of the canopy skirt and provide a smooth, uniform opening with minimum opening shock. In descent, a considerable amount of air turbulence is created between the closely-spaced flow separation edges of the extensions, which increase the drag of the parachute. The guide surfaces are tilted inward 45° to the direction of descent. Any deviation of the parachute from the vertical position deflects the air flow along the guide surfaces in such a way that the canopy is directed back to the vertical position. The airman approaches the ground with the parachute in this position, enabling him to land straight down on his feet.

**Other Types:** There are several models of this type parachute, adapting the guide surface principle to a wide range of modern flying conditions. Stabilization, or guidance of bombs, mines, torpedoes and streamlined objects is accomplished with other special types of guide surface parachutes, making possible a new degree of precision in mine-laying and bombing — maximum accuracy with minimum oscillation. Aerial-launched torpedoes are stabilized in their flight paths by these parachutes, replacing

conventional fins.

The high approach and landing speeds of jet aircraft demand a method of deceleration and braking which will insure safe landings even on short runways. For bombers, large ribbon-type brake parachutes provide the drag which allows the approach to be made at a steeper angle. They effectively shorten the roll and are particularly effective when slippery runway conditions make wheel brakes inadequate. Smaller, ring-slot type parachutes are similarly used for jet fighters. In both of these heavy-duty applications the parachutes reduce landing hazards and cut down wear on tires and braking systems.

## TECHNICAL PUBLICATIONS

(Continued from page 31)

large by publishers' standards, a small multilith press can often cope with the printing requirements. The system of printing one page at a time is slow, but confers several advantages. It allows last minute changes to be made without the scrapping of large plates. It also permits individual sections of the book to be re-run as revisions at a later date without the preparation of large plates. The small plates are also easier to handle and store. However, for particularly large jobs, the services of sub-contracting printers who can print large numbers of pages at a single run are frequently employed.

Collation of a large book is a problem usually solved by the crude, tedious, but nevertheless effective

method of having a large number of people walk around a large table, picking up one sheet at a time.

## DOLLAR DECISION

(Continued from page 18)

example, plant averages in the Maritimes will total about \$1.09 per man-hour, while those in Montreal \$1.40 and Toronto \$1.70."

"Man-hours are really the best basis for assessing one proposal against another," Stephenson says. And since we are truly interested in the amount of national effort we are calling upon our aircraft industry to put out, our dollar evaluations should, if we could work it, show man-hours instead of the more familiar price tag of dollars and cents.

It is clear then, that this is just another case where dollars alone may be misleading, and it serves to stress the fact that we must "look beneath the surface" with every dollar decision to ensure that all the factors behind the price tag are carefully tabulated. When it comes to defence spending, with the taxpayers' money, this is even more important. However, with the RCAF, the Defence Research Board, the Department of Defence Production, and finally the Department of Finance's "Treasury Board," all dabbling in defending the dollar, there are few factors that escape scrutiny.

The results of this process are apparent. As Thor Stephenson sums it up, "We in Canada get as much as any country in the world for our airplane defence dollar—and in many cases we get more."