DECADE OF THE SIXTIES

In late May 1961, the late President John F. Kennedy, in a special message to Congress, stated: ". . . I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to earth. No single space project in this period will be more impressive to mankind or more important for the long-range exploration of space. And none will be so difficult or expensive to accomplish."

At exactly 10:56 p.m., EDT, July 20, 1969, Astronaut Neil A. Armstrong stepped from the lunar module. *The Eagle,* and became the first man to set foot on the moon. A pioneering nation's commitment was fulfilled.

The flight of the Apollo 11 was a dramatic capstone to the Decade of the Sixties. The feat, which was duplicated four months later with the Apollo 12 mission, was unquestionably man's greatest melding of technical and managerial talents.

Virtually the entire story of space exploration is told in the Decade of the Sixties. There were, of course, space efforts in the late Fifties. The U.S. had a few unmanned satellites in orbit, and in 1959 there were 11 successes and 8 failures in our space launches. In 1969, through September 30, there were 34 successes and 1 failure.

Equally dramatic has been the impact of the large scale introduction of turbine-powered transports to the nation's — and the world's — airline fleet. In 1959, U.S. scheduled airlines alone carried 56 million passengers and flew 847 cargo ton-miles. In 1969 the same airlines carried *162 million* passengers and flew *4,400 million* cargo ton-miles.

Perhaps the deeper significance of progress in air transportation is in the fact that the manufacturer of a wide-bodied, high-capacity, third generation airliner was able to say to a customer: we will deliver this aircraft to you in three and a half years. Such a promise, to deliver a revolutionary aircraft, bound by schedule penalties, could not have been possible with the capabilities of the airframe industry that existed at the beginning of the Sixties.

In an oversimplified sense the Sixties represented for the aerospace industry a change from a production-oriented defense industry to a research and development-oriented industry.

Karl G. Harr, Jr., president of the Aerospace Industries Association, summed up the industry's outlook in a recent speech.

He said: "The (aerospace) industry matured in certain areas during the Sixties and there was a corresponding increase in the public demand and the public expectation based on our industry's demonstrated capability for additional performance in the Seventies.

"This will be a guiding factor as to what happens in the Seventies. Certainly as far as air travel is concerned, the U.S. public — perhaps more than any other in the world — expects some of the promise shown during the Sixties to be fulfilled in the Seventies. They are not going to be happy with anything less. In a different framework, but along the same lines, the same kind of expectations exist for our space program through the decade of the Seventies. There will also be either explicit or implicit pressure at all times on this technologically-advanced industry to help meet all national needs. There is going to be pressure on us to produce and apply our technological talents and skills to the solution of a wide range of nondefense space and national needs. I believe we can look for that as a hallmark of the Seventies." — The Editor

AIA

aerospace

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ECONOMIST • Gerson N. Chanowitz
ART DIRECTOR • James J. Fisher

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The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems;

Foster understanding of the aerospace industry's responsibilities in the space exploration program;

Foster understanding of civil aviation as a prime factor in domestic and international travel and trade;

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

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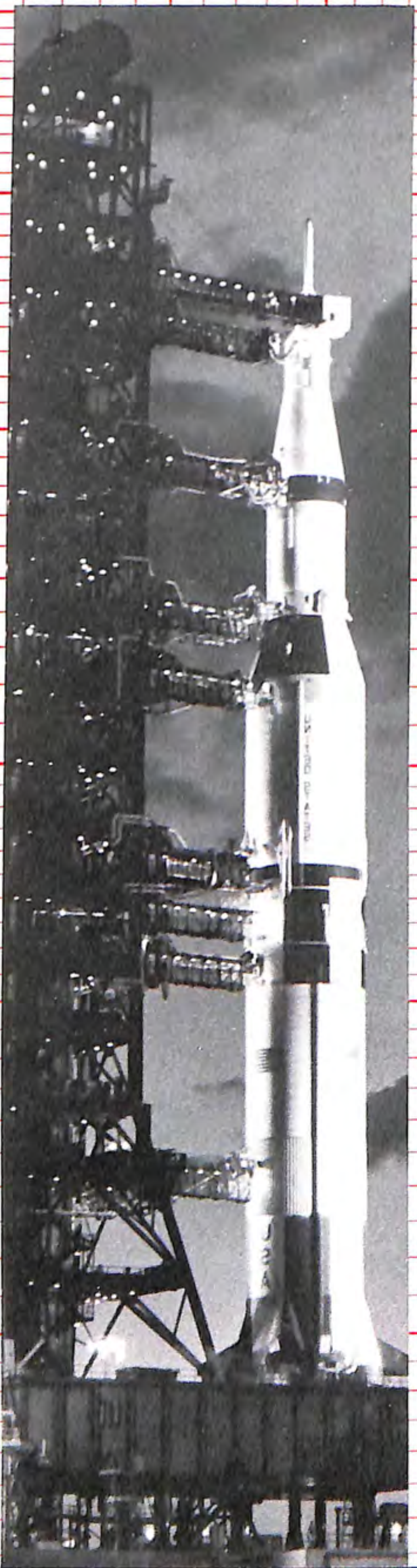
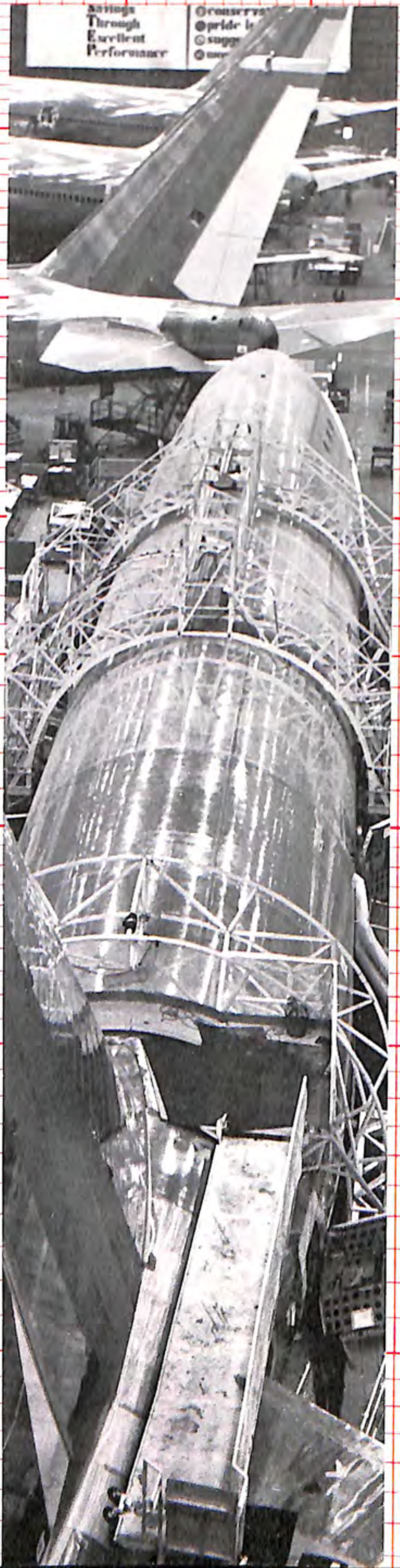




Savings
Through
Excellent
Performance

AEROSPACE INDUSTRY: 1969 REVIEW AND FORECAST

Aerospace industry sales of $28.3 billion in 1969 were the second highest in the industry's history despite the anticipated decline of 4.1 percent from the record $29.5 billion achieved in 1968, Karl G. Harr, Jr., president of the Aerospace Industries Association, announced.

All areas of aerospace endeavor leveled off from the record activity in 1968 with the exception of an increase in nonaerospace sales by aerospace companies.

Commercial aerospace sales, principally jet transports, amounted to $5,800 million in 1969 compared with $6,429 million in 1968. This trend is temporary and results from a phasing out of current transport models while production of the new wide-bodied jet transports is just beginning. Other areas of commercial aerospace sales — executive and utility fixed wing aircraft and helicopters — showed sales increases.

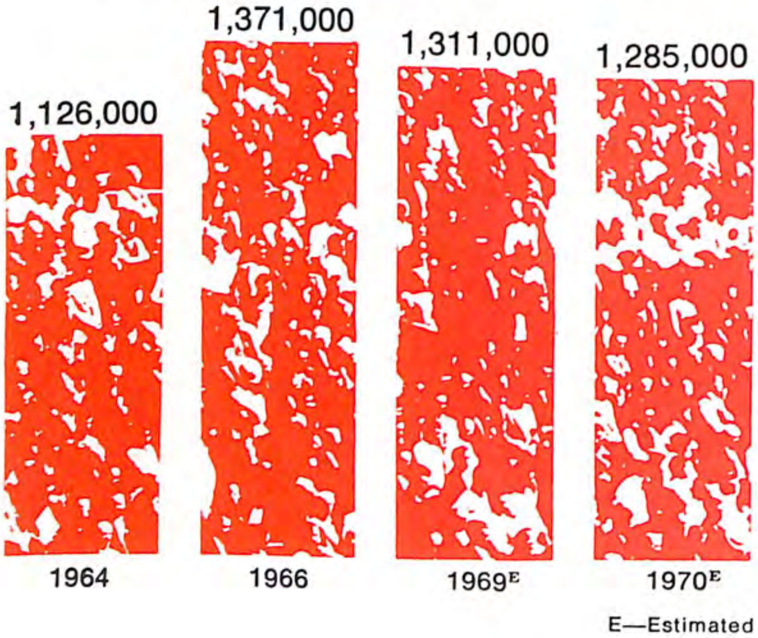
Dollar value of utility and executive aircraft shipped increased from $421 million in 1968 to $478 million in 1969 although units delivered declined from 13,698 in 1968 to 12,948 in 1969. The increase in dollar value was due to the production of a greater number of twin-engine planes and other larger utility and executive aircraft.

Civilian helicopter production increased from 522 units to 550 units between 1968 and 1969, and dollar value of this production rose from $57 million to $66 million. Civil helicopters are used primarily for business purposes although increasing numbers are being used for traffic and crime control and as air ambulances.

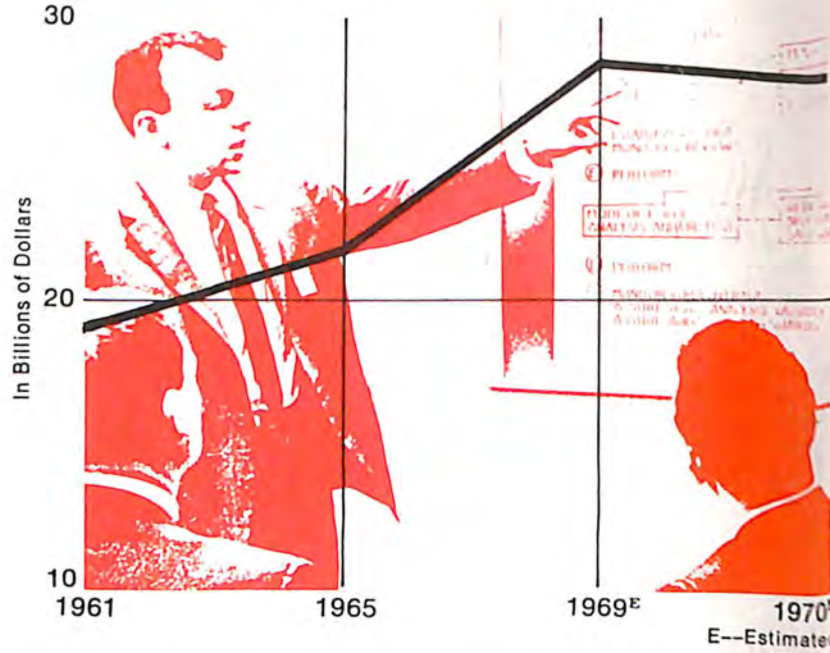
Other major sales highlights between 1968 and 1969 include:

- Sales by the aerospace industry to the Department of Defense in 1969 were $16.2 billion compared with $16.6 billion in 1968.
- Military aircraft sales amounted to $10.0 billion in 1969 compared with $10.7 billion in 1968.
- Missile sales in the same period rose from $4,719 million to $5,034 million, an increase of 6.7 percent.
- Space sales dropped to $4,499 million in 1969 from $5,108 million in 1968 as a result of the approaching completion of the hardware phase of the Apollo pro-

AEROSPACE EMPLOYMENT



AEROSPACE SALES



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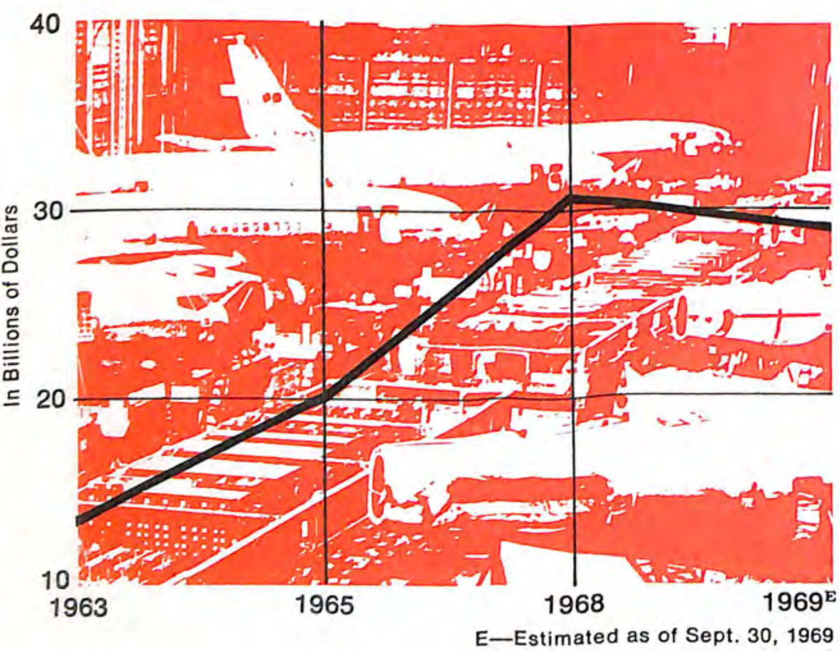
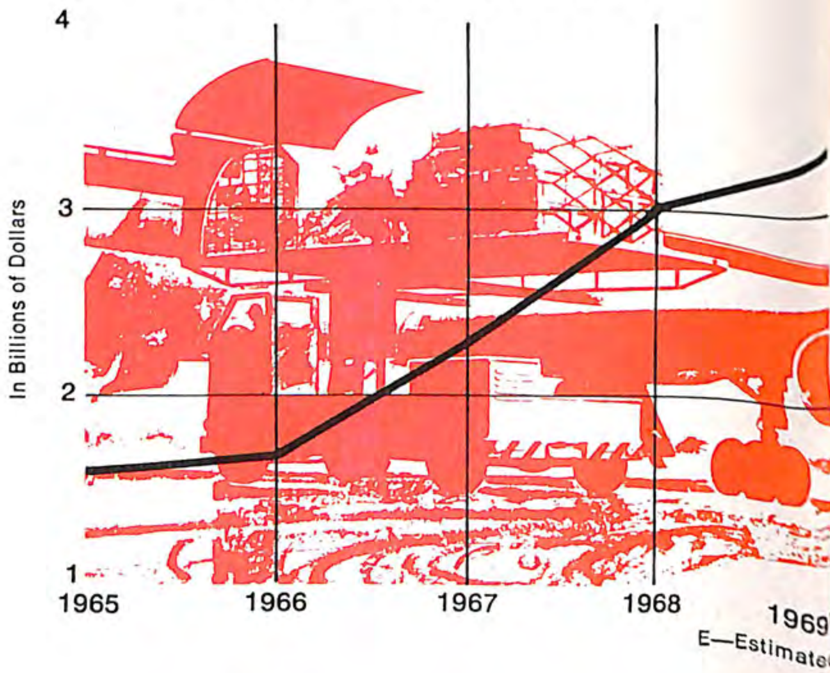


AEROSPACE EXPORTS



gram, as well as cancellation of the Manned Orbiting Laboratory.

Sales of nonaerospace products and services are expected to increase substantially between 1968 and 1969 from $2,567 million to $2,880 million. These sales represent work by aerospace firms utilizing aerospace technology in such areas as marine sciences, water desalination, crime control, urban transportation and pollution control.

FORECAST FOR 1970

Aerospace industry sales in 1970 are anticipated to be $27.7 billion from $28.3 billion in 1969. This will result primarily from lower sales of military aircraft.

Commercial aerospace sales are expected to increase during the 1969-1970 period from $5,800 million to $6,100 million or 5.2 percent. This will result from an increase in the dollar value of civil transports from $2,895 million to $3,162 million, or 9.2 percent, largely due to deliveries of the first production units of a wide-bodied jet transport model.

Utility and executive aircraft production is expected to increase from 12,948 units in 1969 to 13,781 in 1970. The dollar value of these aircraft will gain from $478 million to $532 million.

Helicopter production is expected to decrease from 550 units to 500 units with a corresponding lower dollar value of $61 million in 1970.

Department of Defense sales are estimated to be $15,400 million in 1970, due primarily to lower aircraft sales while missile and military space programs are expected to remain approximately the same between 1969 and 1970.

Nonaerospace sales are expected to increase slightly over 1969 levels to $2.9 billion.

BACKLOG

At the end of the third quarter of 1969, total aerospace backlog was approximately $28.8 billion compared with $31.5 billion in the same quarter of 1968.

The backlog of transport aircraft declined from $10.1 billion to $9.0 billion between June 30, 1968 and the same date in 1969. However, in the same period the backlog of foreign orders for commercial transports rose from $2.8 billion to $2.9 billion.

EXPORTS

Aerospace shipments abroad continued to increase as they have since 1964. Between 1968 and 1969 they rose from $2,994 million to $3,296 million, or 10.1 percent.

Principally responsible for the increase were military shipments which rose from $820 million to $1,293 million, up almost 58 percent. The major portion of the increase was for fighter-bombers.

Civilian exports declined slightly from records set in 1968. These shipments fell from $2,174 million to $2,003 million, or 7.9 percent.

EMPLOYMENT

The aerospace industry remains the nation's largest manufacturing employer with over 1.3 million workers. Employment in the aerospace industry declined from 1,430,000 to 1,311,000 between December 1968 and December 1969.

Declining aerospace program levels for aircraft, missiles and space have caused lower levels of employment. However, aerospace employment still remains higher than for any previous year with the exception of 1967 and 1968.

Production workers in the aerospace industry dropped in the period from 774,000 to 665,000 or 14 percent. The major drop was in work on aircraft programs.

In 1969 production workers made up 50 percent of total employment, scientists and engineers accounted for about 16 percent, technicians, 6 percent, with the remainder in white collar categories.

It is anticipated that aerospace employment will decline by 2 percent between 1969 and 1970 from 1,311,000 to 1,285,000 workers.

PROFITS

Profits in the aerospace industry are expected to decline from 3.2 percent in 1968 to 2.8 percent in 1969. This decline is the result of rising financing, labor and material costs which have in turn adversely affected the levels of net income. Declining sales levels have also been a factor.

PLANT AND EQUIPMENT

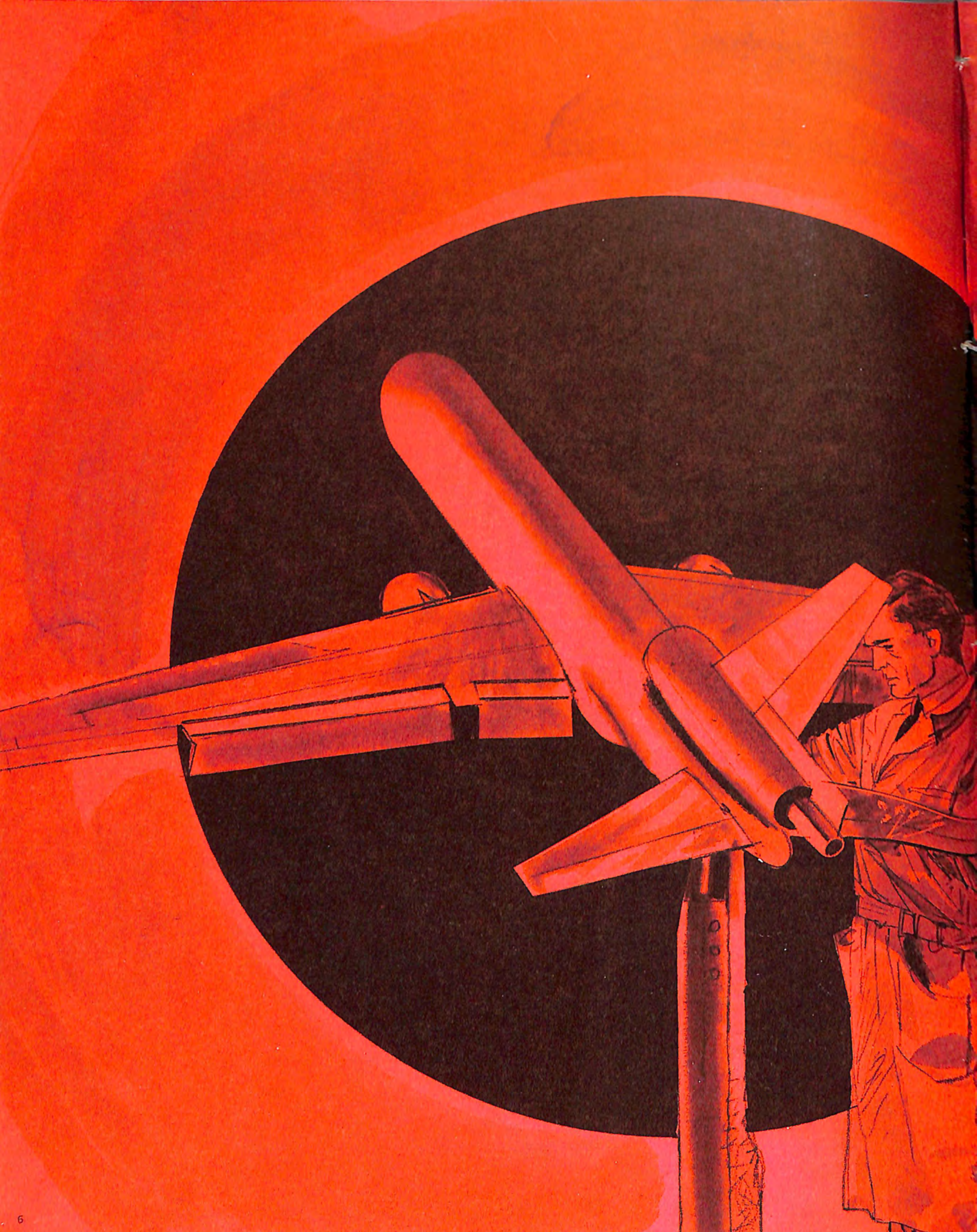
Approximately 3 percent of total sales are invested by aerospace firms annually for the expansion, replacement and modernization of plant and equipment, and between 1968 and 1969 company expenditures on plant and equipment are expected to rise by 12.3 percent from $730 million to $820 million. Between 1969 and 1970 these expenditures are expected to level off at $820 million.

HOURS

Between 1968 and 1969 average weekly hours in the aerospace industry declined slightly from 41.8 to 41.7. Overtime dropped substantially from 3.6 to 2.7 hours in the period coinciding with a decline in employment.

PAYROLL

Between 1968 and 1969 average production worker earnings in the aerospace industry rose from $153.53 to $161.18. The industry payroll rose from $13.7 billion to $14.0 billion.



The Subcommittee on Advanced Research and Technology of the House Committee on Science and Astronautics held hearings in December on aeronautical research and development. The major purposes were to evaluate recent progress and determine the future extent to which the National Aeronautics and Space Administration can support activities in aeronautics to alleviate problems in the field of aviation. Subcommittee Chairman is Congressman Ken Hechler of West Virginia.

Two witnesses appearing for the Aerospace Industries Association were Kendall Perkins, Corporate Vice President, Engineering and Research, McDonnell Douglas Corp., and Mark E. Kirchner, Manager, V STOL Transport Branch, The Boeing Company's Vertol Division. Both spokesmen stressed the need for an increased effort in aeronautical R & D. Excerpts from their testimony follow.

AERONAUTICAL KEY: R&D

Mr. Perkins:

As long as the U.S. holds a clear technological lead (in advanced aeronautical research and development) over the opposition we can proceed under this assumption with reasonable deliberation and with reasonable safety. In recent years, however, there is increasing evidence that we do not lead other countries as much as we once did. In some areas we may not lead at all. This reduces our margin of safety. How far we let this go is, of course, a matter of opinion.

Faced with the necessity of matching requirements and the long time span for development, it seems obvious that more prototype starts have the potential of uncovering needed research areas and providing more options for full development as requirements become clearer.

This two-way interaction between aeronautical research on one hand and development of flying hardware by industry on the other begins with research such as we look to NASA for which supplies concepts, techniques, and data. On the basis of such data contractors make design studies to bring out what can be practically done to meet future military requirements. The military services in turn have the difficult problem of matching expected needs with expected capabilities and, when the timing and other factors seem right, initiating the development of a new model and specifying its required characteristics. Competitors for the development contract must then pitch in and do their best to meet these requirements without committing to do things they can't be reasonably sure of doing. At this point they often find that there are gaps in the background data and the need to fill these gaps is urgent. To the extent that they have the time and the facilities they may undertake a crash research program themselves. This situation could be improved by expanding the leading edge of aeronautical research done by NASA.

There is also a chicken-and-egg relation between research and hardware development. There are a number of areas where the need for research is only disclosed by attempts to build flying hardware and by encountering the unforeseen problems which inevitably emerge during the course of developing, producing, and operating complex equipment in which the state of the art is being advanced. These problems have come to be called unknown-unknowns and the greatest source of technical risk in the aerospace business. They are also a major contributor to cost growth of aircraft development programs.

The number of new aircraft models sponsored by DoD in recent years has been reduced drastically as compared with previous periods in the U.S. and as compared currently with the USSR. This applies particularly to development test articles and experimental prototype aircraft programs. The result has been that while most of the foreseeable research requirements have been reasonably met there has been a real lag in the rate at which unpredictable problems have been brought to light and hence the rate at which research applied to such problems has been carried out. We feel that the only solution for this is for DoD to sponsor more programs in which testing of experimental hardware and research go hand in hand.

With respect to civil aircraft, the situation is different. New commercial transports, for example, are initiated when the manufacturers and airlines reach the conclusion that a new model will have sufficient economic advantage over current models, as a result of significant advances in performance, comfort and safety, to justify the high development and startup costs. The introduction of new transport models is also influenced by such factors as market growth rate and size considerations. However, the ability of U.S. transports to successfully compete with foreign transports in the world market depends to a large degree on relative technical sophistication. The lead which the U.S. once held over the rest of the world seems to have been retained in the areas having little dependence on research, such as reliability and maintainability, but in areas depending more on research, such as aerodynamic and structural sophistication, our lead seems to have narrowed.

The most severe future limitations on commercial aircraft utilization in the U.S. have to do with operating problems — factors such as traffic control, airport facilities and noise. These were discussed at length in a report by the Aeronautics and Space Engineering Board of the National Academy of Engineering which I understand has been submitted to your Subcommittee. We concur with the recommendations in that report. I do want to emphasize, however, that the aircraft industry is vitally concerned that solutions for these problems be found since failure to resolve them can have profound effects on limiting the growth of civil aviation. Recognizing that the operating problems are especially difficult, we feel there is urgent need for clear allocation of responsibilities nationwide and that the organization with this responsibility must have adequate resources and must manage its efforts in a thorough and systematic way if it is to be successful. Procurement of complex hardware such as aircraft by the military services and of spacecraft by NASA has presented problems of hardware acquisitions which, over a period of years, they have organized for and learned how to handle. Civil aircraft operating problems may be even more challenging because of need for interaction with the public and many local governments. There will also be related technical problems. We believe NASA is the most logical agency to work on those for which it has or can be given the appropriate resources. Industry can and should be used to solve such problems through studies and R&D under contract with the government.

With regard to noise, our industry, working with NASA, is engaged in reducing engine noise as its source, in treating the installation in such a way as to reduce noise produced by engines, and in providing flying characteristics which permit climbing as promptly as feasible to altitudes where noise is no longer unduly objectionable. NASA has and can help further to improve techniques for doing these things. We specifically urge the construction of the proposed noise facility at Langley.

In general we believe NASA should do: aeronautical research requiring facilities which individual members of the industry cannot afford; provide appropriate access to industry for use of facilities on a non-interference basis; broad investigations of particular technical areas to provide uniform and consistent background data from which industry can create optimum aircraft design characteristics; and other research in the national interest.

The future position of the U.S. in relation to the rest of the world in military and civil aviation depends on aeronautical research by NASA and the aerospace industry. To retain a satisfactory competitive position in future, it is essential that NASA have the personnel and facilities to carry out an accelerated program of advanced aeronautical research. For the same reason it is essential that the aerospace industry be given more opportunities to develop and test actual hardware.

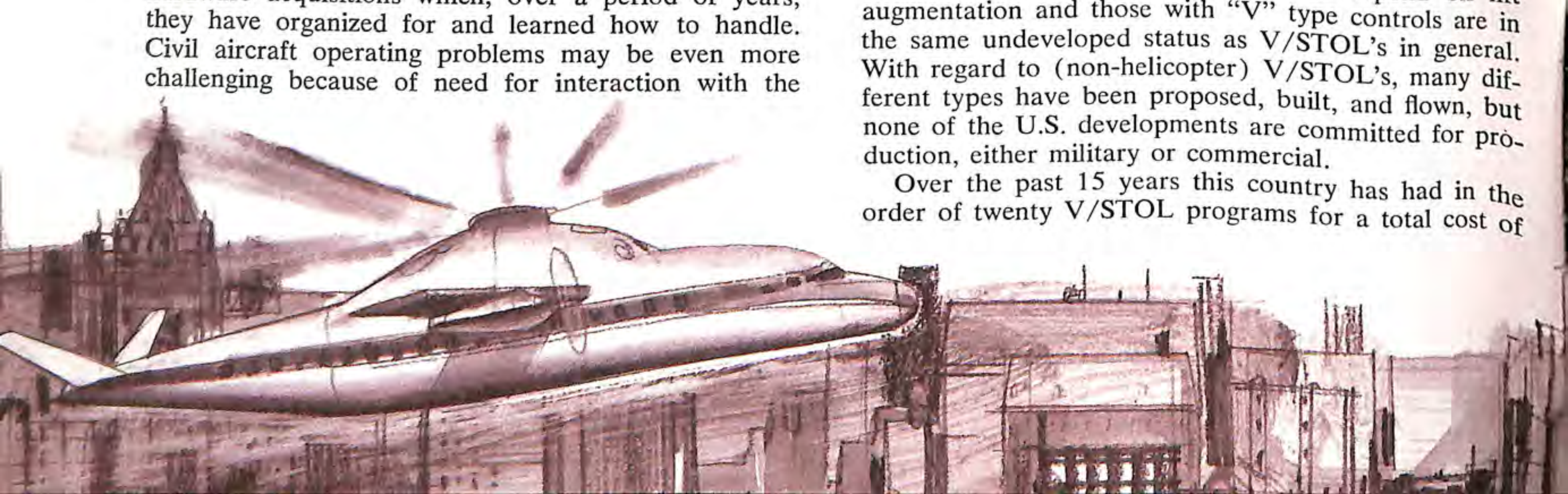
Mr. Kirchner:

Helicopters have been refined to a relatively high degree during the last 20-year period and are familiar to us all. Important derivatives of helicopters, such as the winged helicopter and the compound helicopter, are presently in the developmental stage.

STOL aircraft can generally be typified as belonging to one of three categories; first, very low wing loading fixed wing aircraft; second, winged aircraft with vertical lift augmentation that depend on forward speed for control; third, aircraft with vertical lift augmentation that have controls which are independent of forward speed.

Although there are STOL types operating that depend on low wing loading, STOL's which depend on lift augmentation and those with "V" type controls are in the same undeveloped status as V/STOL's in general. With regard to (non-helicopter) V/STOL's, many different types have been proposed, built, and flown, but none of the U.S. developments are committed for production, either military or commercial.

Over the past 15 years this country has had in the order of twenty V/STOL programs for a total cost of



several hundred million dollars, and the question is often asked "Why don't we have a product in production?" I have two observations with respect to this question: the proliferation of configurations, and the research rather than prototype nature of the aircraft built.

First, the proliferation of configurations. We have studied and built several types using rotors or propellers or turbofans and jets. So many configurations have survived so much study because there is no "best" configuration for all considered missions and because in many cases, the differences between configurations are small. The logical selection of an optimum configuration and the simultaneous requirement to define and develop the rest of the total system have resulted in a virtual deadlock of V/STOL developmental progress in the U.S.

The second observation deals with the nature of the V/STOL programs which have been conducted to date. Most, if not all of them, have been research aircraft and were not prototypes for production and were not configured to be competitive with other transport systems. There are many reasons why these aircraft were not competitive: lack of the optimum power plants, no program objective to achieve a competitive payload, low funding level, insufficient technical homework prior to aircraft manufacture.

We have a paradox: as recent system studies have shown there is on one hand increasing pressure to develop short haul V/STOL air transport systems to solve an increasing need. On the other hand there is frustration over the apparent aimlessness of our V/STOL program and the absence of any emerging operational vehicle.

We are aware of the ever increasing difficulties that are being encountered in travelling, especially for relatively short distances. Surface congestion is frequently bumper to bumper — and for the short distance air traveler, the trip to and from the airport in many cases is more time consuming than the flight itself. Fifty-five percent of the total intercity business travel is under 200 miles. Of this, fixed wing scheduled airline penetration is less than 3 percent. However, an airline system that could compete effectively with the automobile and train would find a very lucrative market. If a V/STOL airline system were sufficiently attractive to capture 10 percent of the total business 0-200-mile market, the resulting demand would be 2½ times the revenue passenger miles generated by the local airlines in 1969 and would require about 275 vehicles of 100-passenger capacity.

The government since 1964 has spent $1.5 million in studies that examined 15 different V/STOL, STOL and VTOL configurations for the short haul market. Three studies were sponsored by NASA, three by the FAA, one by the Department of Commerce, and one by the Presidential Science Advisory Committee. Although each study had its own unique objectives, such as "northeast corridor," or a "national short haul system," the general results common to most of them follows:

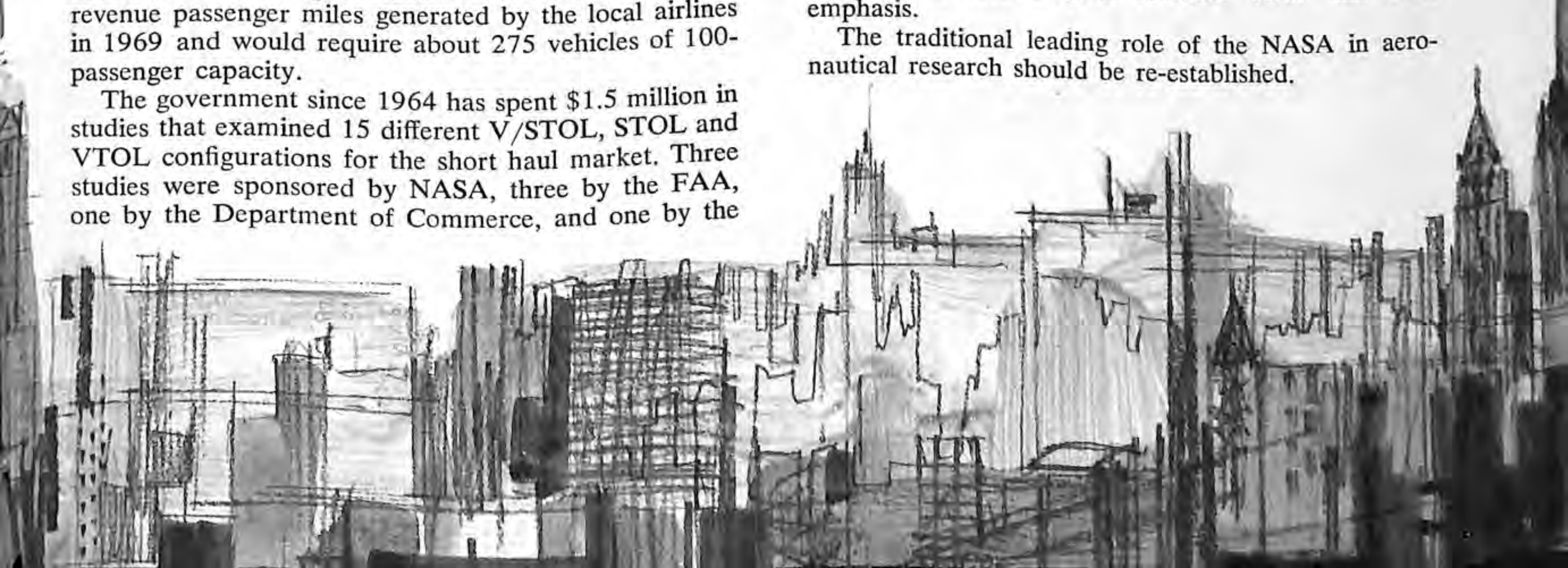
- It was shown by these studies that efficient STOL's, V/STOL's and VTOL's operating from VTOL or STOL sites could compete economically in the proper total system environment with other transportation systems in the short haul market and offered economic and time savings advantages to the users.
- The size of the short haul traffic is large and therefore a small shift of this ground traffic to air would be large by air traffic standards.
- In addition there are 3 major environmental problems in establishing a viable short haul air transport system: Noise; air traffic control; and terminal and support facilities.

All of this results in a major quandry. The traffic appears to be available, but the size of the vehicle to be economically viable approaches 100 passengers and therefore represents a major developmental cost. Finally, the traffic, ground facility, and community acceptance problems are so complex that any airframe development alone is doomed to economic failure unless these problems are simultaneously solved.

In the case of the V/STOL and STOL fields there are many configuration options so that the process of selecting the correct ones to optimize for production is a formidable task. Germany and England recognize this problem and have programs to select a single configuration for the development of prototype vehicles and related technology.

In order to focus technology research and vehicle development in this complex V/STOL field, it is recommended that NASA continue to contribute to the system studies being directed by the Department of Transportation with respect to the technological aspects. The airlines in their role as ultimate user must be active participants in developing the system requirements including vehicle technical requirements. The adherents of various concepts should participate in the studies to insure that the good decisions are reached. Funded industry participation with sufficient depth will allow technical consistency and provide substantiation in areas such as structures, weights, propulsions, control, etc. The results from these studies will be valuable in highlighting the technological research areas that need emphasis.

The traditional leading role of the NASA in aeronautical research should be re-established.



The Military-

Industrial Complex: A Perspective

Excerpted from a speech before the Defense and Contract Procurement Administration Conference, Detroit, Michigan.

BY EUGENE M. ZUCKERT
Former Secretary of the Air Force

For twenty-five years I worked in a variety of capacities to help build a proper and productive relationship between government and industry — a relationship necessary to meet the needs of our national defense. Today I am saddened. That relationship has been misunderstood, has been criticized, has been denigrated, and the term "military-industrial complex" has been used as a mark of opprobrium. This has been true even though it took the same skills and the same resources of the very same complex to produce the much-applauded Apollo 11!

How and why has this come about?

What I hope to do is to give some views, based on my own experience, what I believe lies behind the public controversy which now pours more heat than light on the problems of our national defense and defense establishment.

I am proud of the defense establishment of today, that I have had some share in building it to its present level of effectiveness. But, at the same time, I am not blind to the faults, the failings and the built-in inefficiencies that one can find in the defense establishment or in any huge organization, particularly one which does not have to sell its products to the public to stay in business.

I have spent a good part of a lifetime looking for those faults and for ways to correct them. I only wish that the current critics of the defense establishment were looking sincerely for genuine faults and positive corrections. But basically, that is not at all what the most vocal of the critics are after.

What is the thread of the allegations against the military and its supporting industry? It goes far beyond a concern for the proper level of military expenditures. There is an underlying charge that a conspiracy exists among our military and the defense industry that results in wasteful spending for arms with consequent profits to industry and an inordinately swollen military posture. From that running start, the charges fan out and derive nourishment from sensationalized treatment of a variety of examples of mistakes and inefficiencies, whether real or alleged.

At the same time, a whole host of newly qualified military experts spring up on all sides; there is a startling discovery that the military has run wild because of perfunctory scrutiny of the defense budget. That is particularly ironical to me because I recall the vigorous McNamara budget process. The fashionable criticism in those days was that our military suffered an excess of civilian control with a resulting downgrading of experienced military judgment.

It is my considered judgment that the current furor over the military industrial complex is really an attack on an unpopular war. Wasn't it Arnold Toynbee, the great historian, who said that war weariness is a most useful tool for dictators and demagogues? The critics of the Vietnam war have been raging on the Potomac since 1965, and they are not likely to subside soon. The professors, politicians and pundits who are already in the fray are enjoying it immensely, and they have friends who also are bound to claim "a piece of the action."

There is a long list of things which the storm over the military-industrial complex is NOT:

- It is *not* — as advertised — a Great Debate over American Defense and Foreign Policy. A Great Debate, in my opinion, is desperately needed. But this isn't it.
- It is *not* — as some claim — a popular uprising against militarism and procurement hanky-panky in the Pentagon. Waste there is and always will be. But these critics are opposed to the Defense Establishment no matter how well run.
- Nor is it — as claimed — a "concerned dialogue" over national priorities. How can you have a "dialogue" on whether we should have obsolete weapons systems or higher vertical slums? The two serious problems deserve serious attention, not rhetorical flim-flam.
- What we're experiencing is not even a rational discussion of the weapons systems our current national defense posture requires. One cannot find in all the arguments an effort to define our needs and then measure the defense establishment against the requirements.

Superficially, the controversy over the military-industrial complex might seem to arise from any or all of these issues, depending on what syndicated column or Washington newsletter you read.

But don't you believe it. All the sloganeering just doesn't add up: How we must reassess our national priorities by cutting back our defense expenditures; how we have to get the military under civilian control; how we are headed down the road to militarism and fascism.

The controversy over the military industrial complex is the same tired old combination of *unilateral disarmament* and pious hopes that we have seen played on the Washington circuit off and on for well over a quarter of a century! The young ones don't know it, and the old ones too often have forgotten, but we've seen and heard it all before.

To be sure the format has been updated. Now it's a kind of ideological Western. The military-industrial complex is cast in the role of the bad guys. Forty years ago it was the "Merchants of Death" — but the plot was the same.

All reasonable persons can applaud conscientious dispassionate inquiry into and search for evidence of stupidity, incompetence, favoritism and waste in military procurement. Responding to such inquiries is a legitimate part of the job for the uniformed and civilian Defense leaders who must defend their management before Congress. . . .

But what I regard as dangerous and illegitimate is the highly organized and furiously pressed propaganda assault on our defense institutions disguised as a selfless effort by "concerned" intellectuals to save the nation from takeover by an alleged combination of defense industry profiteers and a war-minded military.

Some there are who may say this merely is symptomatic of the malaise of our times — part of the current attack on so many of our established traditions and institutions. Some there are who will insist that a better-educated and more enlightened populace has finally risen in righteous wrath and indignation against a longtime evil.

Actually, however, the scenario is old hat.

It was first staged in the early '30s by a curious combination of far-out Liberal intellectuals and a group of Republican isolationist Senators of that era. The isolationist Senators just did not want the United States in any more European wars. Some of the involved intellectuals believed that the French and British were about to join with Hitler in common cause against Russian communism. But whatever the motivations, and they were mixed, everybody in the combination wanted to make sure that Wall Street and the munitions-makers of World War I were blamed for whatever past, present or future problems could be claimed.

So what played the Washington circuit then was a truly memorable extravaganza. A Senate Committee (to become famous as the Nye Committee) set out to investigate the relationship between Wall Street and American war profiteers and munitions-makers who stood accused of having dragged the United States into World War I. The production played to standing room only. It received tremendous publicity and developed a new "devil image" for Wall Street and American Big Business, the evil.

Congress rushed to pass the Neutrality Act of 1935. Free from the machination of the Merchants of Death we were all, presumably, safe.

Sure we were — until the roof caved in on us at Pearl Harbor.

Today, many of the players are different. But the arch-villain is the same — something called this time the military-industrial complex.

But what the nation could endure in the peaceful, non-nuclear '30s becomes an irrational luxury in the nuclear, cold war '60s. We can see the danger now that a colossal demonstration of pacifist sentiment may well lead to hasty and ill-advised actions designed to fetter our defense establishment and impair our defense posture. This, in turn, could be misread as a sign of our weakness, and it could trigger the very confrontation that the anti-military group presumably wants to avoid.

Does this sound far-fetched? I don't think so. Let's look at what happened in the '40s, the '50s, as a result of so-called "popular demand":

- Remember the frantic demobilization of our fighting forces and the defense industry we had built to meet the needs of World War II? We paid heavily for that spasmodic reflex to strident, fomented hysteria. I had a ringside seat at the anti-military fights that went on before, during and after that struggle. (I was then Special Assistant to Stuart Symington, Assistant Secretary of War for Air.) The critics hastily cut the armed forces and just as hastily rebuilt them for Korea.
- In 1949 I watched the late Defense Secretary, Louis Johnson, — acting under Presidential orders to economize — cut the military budget to the bone. That was the year when Russia developed her own A-bomb, on which *we* were supposed to have a monopoly for at least twenty years!

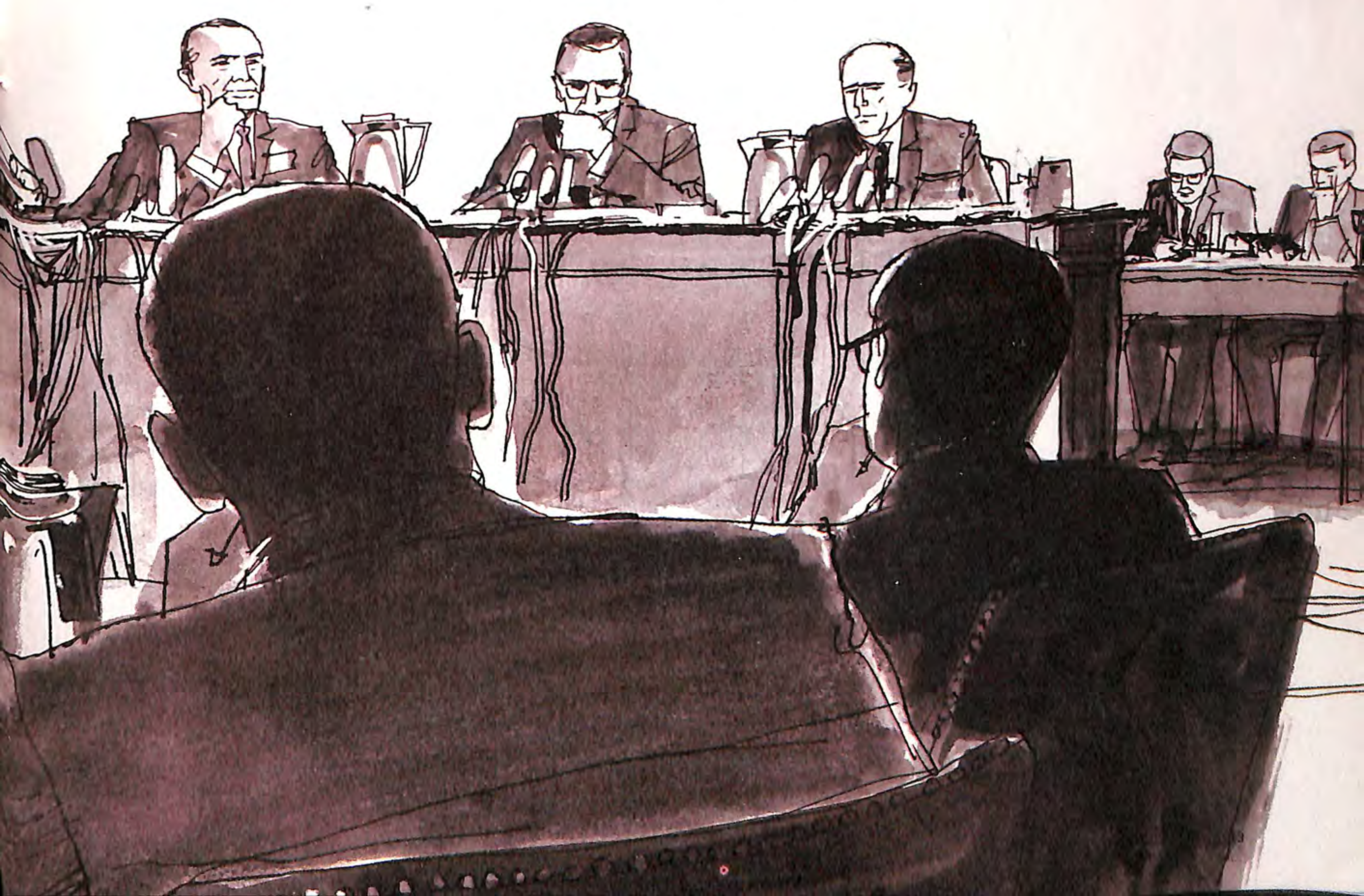
It took the communist invasion of Korea in 1950 to teach us the hard way that the ill-considered demobilization and disarmament after World War II was a disaster never again to be invited.

That's when we started, painfully and expensively, to rebuild the defense establishment we had deliberately and ruthlessly wrecked.

The furious controversy over our development of nuclear and thermonuclear weapons compounded the difficulties of recapturing and rebuilding our initiative in nuclear technology. This was brought home to me when I served as an Atomic Energy Commission member from 1952 to 1954.

These are strange times indeed. The Democratic Party seems to be abandoning the Truman Doctrine. The stance of many of its leaders in the fight against deployment of an ABM carried overtones of a reversion to the Dulles policy of "massive retaliation." Some of the Liberal intellectual rhetoric sounds like an echo of the old arch-conservative rallying cry of "Fortress America."

I don't get it.



One thing I do get. Inevitably and unavoidably, in the absence of clearly defined policies or clairvoyance of the future, the military establishment must plan to fight almost every kind of war that could be thrust upon us.

Another anomaly. So many ardent supporters of the late President Kennedy are now enthusiastic participants in the campaign against the Vietnam War and the off-shoot crusade against the military-industrial complex. Have they forgotten the words of President Kennedy in his Inaugural Address? He said:

> "We dare not tempt them with weakness. For only when our arms are sufficient beyond doubt can we be certain beyond doubt that they will never be employed."

I haven't forgotten. . . .

Let me emphasize that I believe that the military establishment does need change and improvement. And let me also offer some specific areas in which truly concerned people can carry on fruitful discussion. I don't have instant answers to the issues which I will list here, but I can assure all of you that there will be profit to our nation and to our freedom if we address these issues in a responsible way.

1. *Our Foreign Policy Philosophy and Posture.* If our international role is to be one of *pacifism in isolation* the people of the United States should know that fact from their elected representatives. They should not have to rely on contrived consensus. If it is to be *isolationism* in *Fortress America* they should know the implications from their elected representatives.

If our elected representatives believe that our true course lies in a responsible *international role,* then a rational dialogue should include such questions as these: What values — material, moral, spiritual — are we prepared to fight for? . . . Real estate? Access to vital resources? The values of the Judeo-Christian civilization? National honor?

This question — what are we prepared to fight for? — arises in many forms. In the Middle East. Israel. West Berlin. Africa. Latin America.

Rational dialogue would develop a viable and credible foreign policy, a realistic defense strategy and a stable defense planning and funding policy.

2. *Can we, in this day and age, develop a bipartisan policy matrix?* The creation of West Germany, the Berlin Airlift, the Marshall Plan, the Japanese Peace Treaty are milestones of bipartisan cooperation. I believe it could work for us again. Perhaps a Special Commission, consisting of members appointed by the President, the President of the Senate and the Speaker of the House might be able to develop such a matrix by 1972.

3. *How do we avoid undermining the homefront in a real albeit undeclared shooting war?* The Founding Fathers just never had to consider the possibility of limited and undeclared wars in which the propaganda front is as vital as the military front. But these struggles constitute a fact of life in our times. Perhaps (when American Forces are actively engaged in some undeclared conflict) it might be possible to have, say, a "State of Belligerency" proclaimed. When our men are asked to risk their lives on a foreign field of battle, can the rules at home be the same as in peacetime?

4. *Should there be a ceiling on the Defense Budget?* There may be ways of stabilizing the Defense budget. There is merit in the idea that the President place his prestige behind a determination that there be allocated a certain percentage of the Gross National Product to national defense under conditions of "normalcy." In conditions short of formally declared war or a Special State (such as Belligerency) the percentage of GNP could then more likely be held firm, regardless of what political party may be in office.

5. *Why not periodic review of our Commitments and Contingency Plans?* Some steps are already being undertaken by a subcommittee of the Senate Foreign Relations Committee under Senator Stuart Symington. It is a highly constructive idea, long overdue, and it can produce reasoned, dispassionate conclusions. After all, the level of our Defense expenditures is based primarily on the number and nature of our foreign commitments — not on the pie-in-the-sky desires of the generals and admirals.

6. *Why should not concerted effort be made to improve the military reality and thereby the Military Image?* Technology has changed the face of war. Propaganda has created a new dimension of war in a clash between our open society and a closed system. Our Armed Services should be encouraged to modernize their philosophy, doctrine and education curricula.

Perhaps impartial civilian review of procurement policies and practices on a periodic basis under any Administration would be a step forward in this direction. But, more important, starting with the Service Academies, the military services must make concerted effort to build leaders with an understanding of the separate and combined roles of *all* the Armed Services. The ability to communicate modern military values to men under their command should be encouraged and nurtured as an essential of military leadership.

7. *Rapport between the Business Community and the Intellectual Community.* In what remains of the century there will be a reengineering of the nation's social, economic, educational, military and political institutions. Industry — the productive core of the "complex" we've been talking about — *must* help solve the problem of achieving equitable distribution of abundance while preserving basic free institutions.

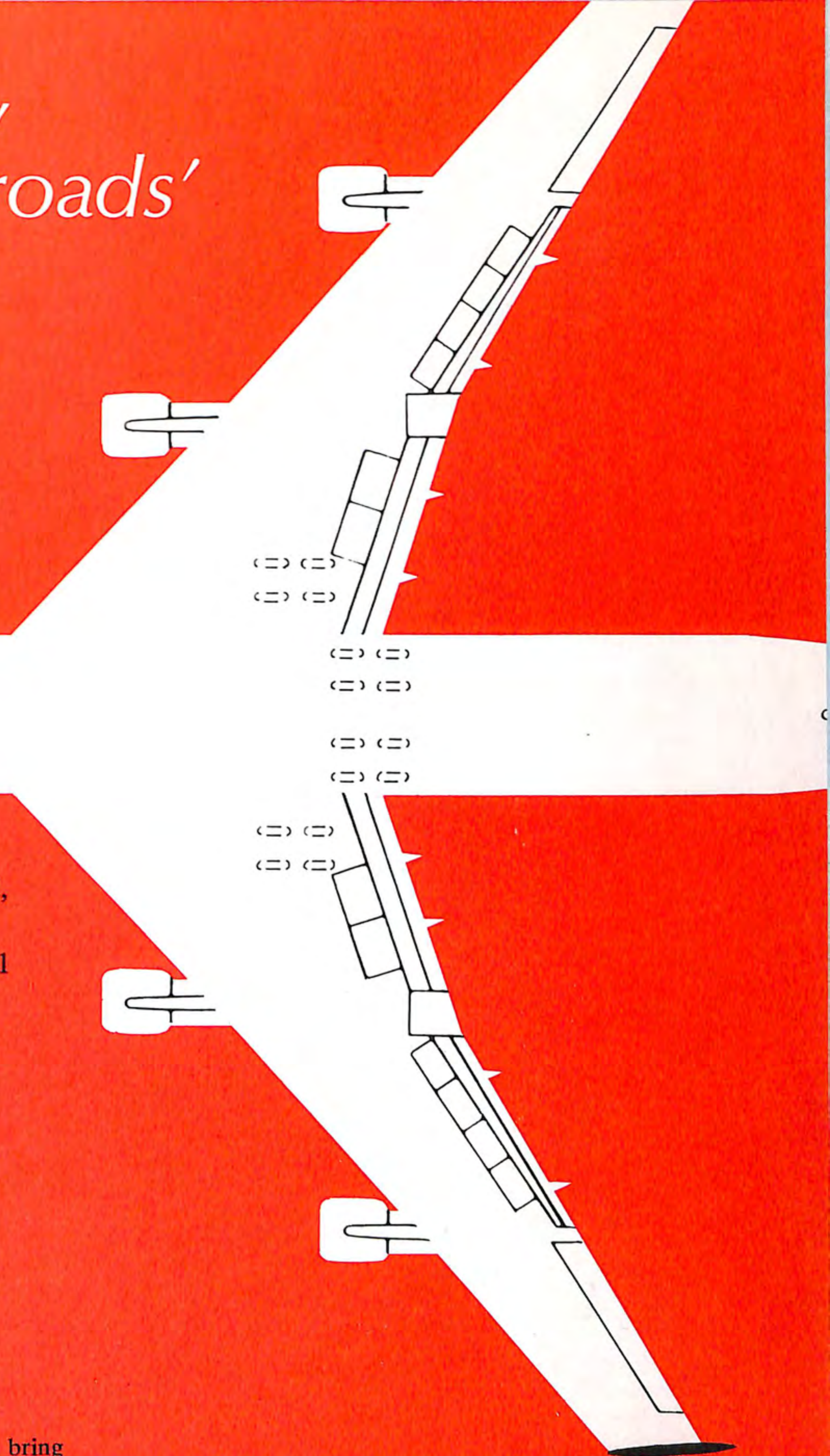
Like industry, our intellectual community is indispensable to this effort. There ought to be a cease-fire in the cold war between the intellectuals and business which has been going on for much too long. Each needs the other in the common cause. . . .

Because this is a world where widespread unrest and conflict are manifest against the background of the unsolved and growing problems of nuclear weapons, I close with a note of warning sounded by the late President Kennedy in his first State of the Union Message. Listen:

> "I speak today in an hour of national peril and national opportunity. Before my term has ended we shall have to test anew whether a nation organized and governed such as ours can endure. The outcome is by no means certain."

That test of our survival is now upon us.

'. . . Let us hurry and open the roads'



William M. Allen, Chairman of the Board, The Boeing Company, was the 1969 recipient of the Wright Brothers Memorial Award. At the Award Dinner in Washington, D.C., Mr. Allen mentioned the efforts of the Wright Brothers who made the first powered flight on December 17, 1903. Their first flight covered a distance of 120 feet and today could be made in the *fuselage* of the Boeing 747, first of a new generation of wide-bodied, high-capacity turbine transports. Mr. Allen's remarks follow:

This occasion has prompted me to endeavor to bring my thinking up to date on what has happened and what is happening in the aerospace industry. In doing so, I re-read the pages from Orville Wright's diary of December 17, 1903, and a comment made by Wilbur Wright five years later. It is apparent from Wilbur's comment that the Wright Brothers had, in the five year period, gained sufficient experience to look to the future with considerable confidence. Said Wilbur on November 5, 1908, "It is not really necessary to look too far into the future; we see enough already to be certain

that it will be magnificent. Only let us hurry and open the roads."

I asked myself: How was it that the roads were opened for the truly magnificent accomplishments of the six decades that followed, from experiencing the shaky vibrations of a machine that barely lifted itself from the ground, to reaching out and setting foot on the moon?

First, it was the Wright Brothers doing original work. Later, it was a government contract under which an airplane was built for the Signal Corps, and ultimately more airplanes under government contract that helped enable the Wrights and others to mature the development.

It seems to me there is something to consider here. There was an acknowledged relationship between government and private industry to work toward something which appeared to have merit and future usefulness. The private industry, if you could call it that — certainly a private industriousness — didn't need to be prodded. Its incentive was its own desire to accomplish, and the government helped make this possible. Very soon a certain commercial utility of the machine appeared, and again, private incentive sought to develop this to a point where it could serve a larger purpose.

Much of the progress in the aerospace industry since the days of the Wrights has been the product of this government-industry relationship. In many instances the government has been the enabler. On the commercial side, it was with airmail, with airway aids, with licensing and safety enforcement functions, and the work of NACA and NASA laboratories. On the national defense side, the inventiveness that was native to the private industry approach became crucially important at times, when the life and death situation of war called for the best that anyone could bring forth, to meet dire threats to our country.

I think we all have some sense of the private industry contributions, and, hopefully, some justifiable pride in them. It seems to me that they stem primarily from the basic ingredients of our free enterprise system, namely, competition and reward. The government has harnessed these to serve a national purpose — to fill the needs of national security and advancement, as these needs have changed through the years with changes in the world situation and the advance of technology.

As we look back we can see some of the elements that have been present in this government-industry relationship that have brought outstanding results. They include a constructive attitude on the part of both parties, a willingness to work together, a willingness to acknowledge that the task was not always easy — that it was fraught with problems — but a determination to see it through. There has been the requirement for mutual confidence and faith.

These are the oil in the machinery that gets things done, and the fuel is the competitive urge on the part of members of both industry and government and the opportunity to come out on top of the job.

If we view the results that have been obtained by these means, we must conclude that these ingredients of the free enterprise system, and these characteristics of the government-industry relationship, must be encouraged. This is not to say that there should not be criticism where criticism is due. But sustained unjust attacks on the process can cause a deterioration of this government-industry relationship and its product. If, for example, it were to force all the risks to be borne by industry and none by government — if it were to depress the possibility of earnings to a point far below that in other lines of endeavor — then these factors that have been working to produce the kind of results we have seen in the past would no longer have force. The incentive of reward would tend to disappear; the amount of competition would lessen.

I feel that this is something that we must not let happen — in the interest of our national security, the growth of our economy, the continued advancement of our technology and the competitive capability of our country among the nations of the world.

I believe the results achieved through the system under which we have been operating in this country speak for themselves. We have the examples in the military field of what industry was able to do in arming our forces in two world wars. In space, I need hardly elaborate on the accomplishments to date. In the commercial aircraft field, we have established a world leadership through the efforts of private industry undertaken on a basis of risk and reward.

There is much to be done. Serious problems of national security confront us. We have barely begun to see the possibilities in space. In air transport, the growth trends give rise to forecasts of world traffic by 1990 six times what it is today. For the long-distance over-ocean routes, we will have the supersonic transport coming along to further shrink the world by two-thirds. This latter effort again shows the product and the economic gain that can derive from a sound working relationship between government and industry.

The needs of both security and progress make this a time for developing and encouraging the process we have proved, as contrasted with an effort to tear down. We have seen results in the overall that have been not only good, but excellent. Let us recognize this fact and determine to nourish and foster the basic ingredients of success that we have found. I repeat, these ingredients include the basic principles of competition, incentive and reward and mutuality of interest in our government-industry relationship.

To paraphrase Wilbur Wright—we have seen enough by now to be certain that the future can be still more magnificent. "Only let us hurry to open the roads."

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A strong aeronautical research and development program is required to realize the transportation potential of V/STOL aircraft (see *Aeronautical Key: R & D*, page 6).

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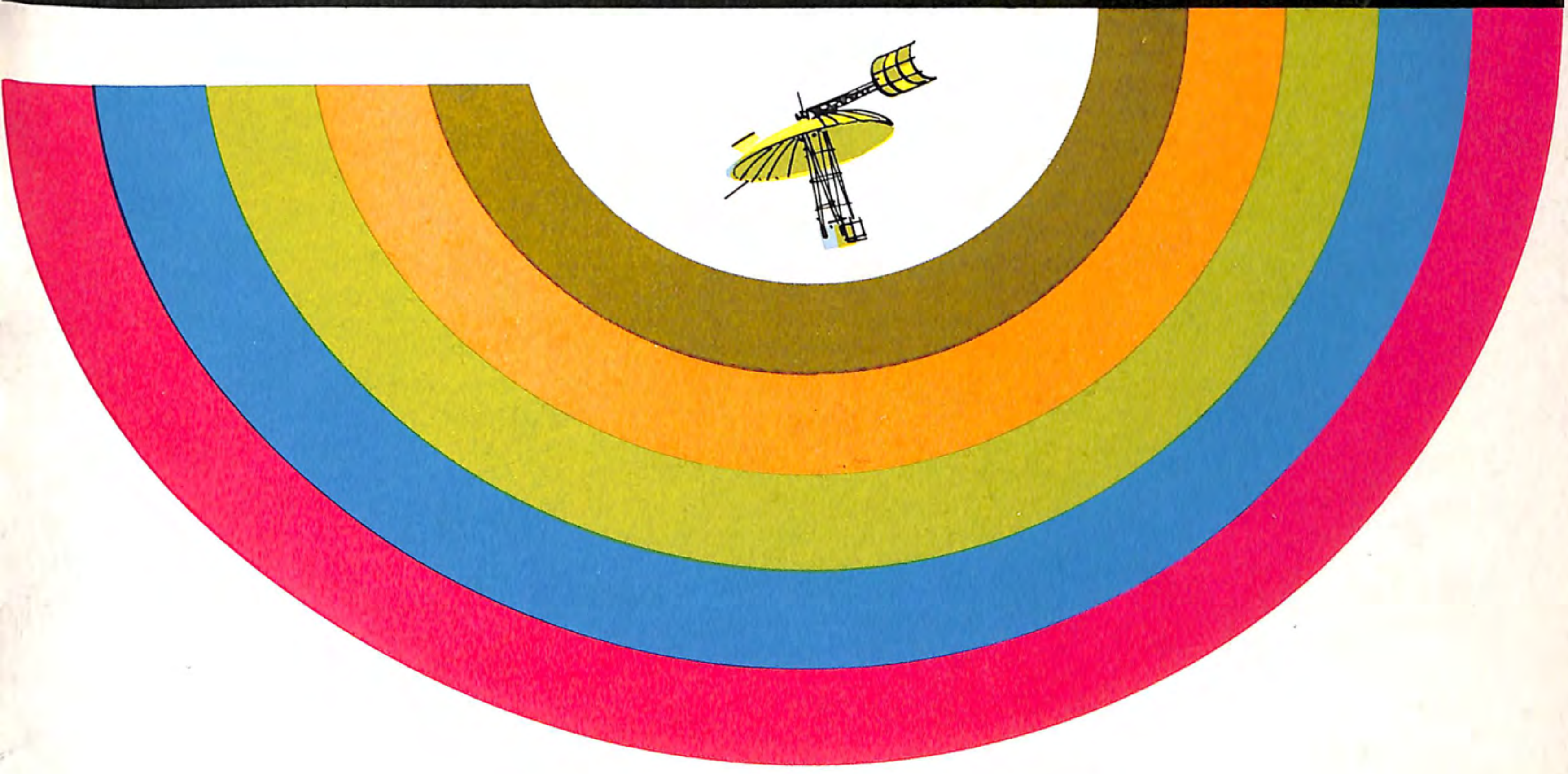
OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION • MARCH 1970

SPACE AND THE NATIONAL ECONOMY

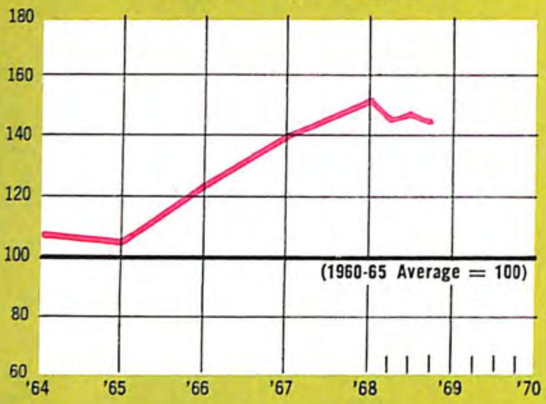
By KARL G. HARR, JR.
President, Aerospace Industries Association



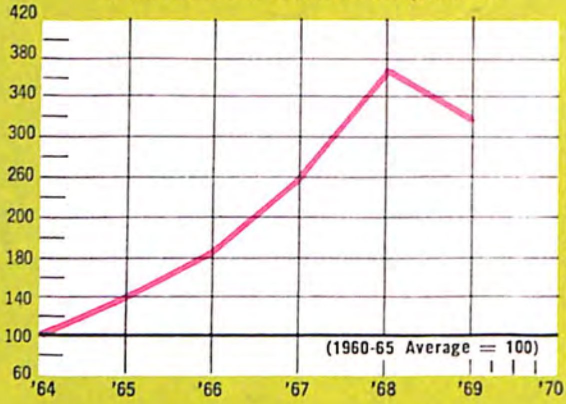
AEROSPACE ECONOMIC INDICATORS

CURRENT

Total Aerospace Sales

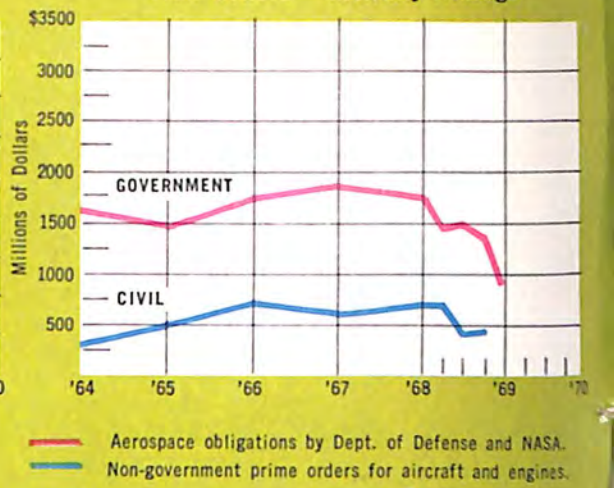


Value of Civil Aircraft Shipments



OUTLOOK

New Orders — Monthly Average



ITEM	UNIT	PERIOD	AVERAGE 1960-65 *	LATEST PERIOD SHOWN	SAME PERIOD YEAR AGO	PRECEDING PERIOD †	LATEST PERIOD
AEROSPACE SALES: Total	Billion $	Annual Rate	19.4	Quarter Ending Sept. 30 1969	29.4	28.1	27.1[R]
	Billion $	Quarterly	4.8		7.0	7.1	6.2
DEPARTMENT OF DEFENSE							
Aerospace obligations: Total	Million $	Monthly	1,151	Nov. 1969	1,056	1,263	819
Aircraft	Million $	Monthly	601	Nov. 1969	646	523	401
Missiles & Space	Million $	Monthly	550	Nov. 1969	410	740	418
Aerospace expenditures: Total	Million $	Monthly	1,067	Nov. 1969	1,398	1,336	1,255
Aircraft	Million $	Monthly	561	Nov. 1969	890	755	819
Missiles & Space	Million $	Monthly	506	Nov. 1969	508	581	436
Aerospace Military Prime Contract Awards: TOTAL	Million $	Monthly	920✠	Dec. 1969	1,360	726	999
Aircraft	Million $	Monthly	447	Dec. 1969	898	511	526
Missiles & Space	Million $	Monthly	473	Dec. 1969	462	215	473
NASA RESEARCH AND DEVELOPMENT							
Obligations	Million $	Monthly	215	Jan. 1970	273	257	313
Expenditures	Million $	Monthly	130	Jan. 1970	286	231	222
UTILITY AIRCRAFT SALES							
Units	Number	Monthly	692	Dec. 1969	985	722	779
Value	Million $	Monthly	15	Dec. 1969	37	31	33
BACKLOG (60 Aerospace Mfrs.): Total	Billion $	Quarterly	15.3#	Quarter Ending Sept. 30 1969	31.5	29.4	29.1
U.S. Government	Billion $	Quarterly	11.6		17.3	15.0	15.0
Nongoverment	Billion $	Quarterly	3.7		14.2	14.4	14.1
EXPORTS							
Total (Including military)	Million $	Monthly	110	Dec. 1969	276	240	298
New Commercial Transports	Million $	Monthly	24	Dec. 1969	111	50	116
New Utility Aircraft	Million $	Monthly	2	Dec. 1969	8	10	11
PROFITS							
Aerospace — Based on Sales	Percent	Quarterly	2.3	Quarter Ending Sept. 30 1969	3.4	3.0	3.0
All Manufacturing — Based on Sales	Percent	Quarterly	4.8		4.9	5.1	4.6
EMPLOYMENT: Total	Thousands	Monthly	1,132	Nov. 1969	1,403	1,335	1,311[E]
Aircraft	Thousands	Monthly	469	Nov. 1969	622	591	574
Missiles & Space	Thousands	Monthly	496	Nov. 1969	603	570	563
AVERAGE HOURLY EARNINGS, PRODUCTION WORKERS	Dollars	Monthly	2.92	Nov. 1969	3.79	4.02	4.05[E]

R Revised
E Estimate
* 1960-65 average is computed by dividing total year data by 12 or 4 to yield monthly or quarterly averages.
† Preceding period refers to month or quarter preceding latest period shown.
# Averages for 1961-65.
✠ Averages for fiscal years 1960-1965.

IR&D—INVESTMENT IN CAPABILITY

Independent Research and Development (IR&D) is the composite of activities chosen by corporate management as being the most promising to advance its technological capabilities to serve the future market for its goods and services. No company, whether commercially or governmentally oriented, could long survive without it.

The cumulative IR&D done by American companies, particularly those engaged in advanced technology such as the aerospace industry, constitutes the primary means by which this nation ensures its continued capability to compete successfully with the rest of the world.

Despite this recognized vital contribution to the economic growth and technological competitiveness of the nation, the role and nature of IR&D are often misunderstood, particularly as applied to the nation's defense programs. Upon invitation, Karl G. Harr, Jr., president of the Aerospace Industries Association, recently appeared before the Research and Development Subcommittee of the Senate Armed Services Committee to testify on the bill S. 3003 and clarify the misunderstanding.

The testimony pointed out that IR&D is basic to the efforts of any company to employ its resources usefully, profitably and continuously to meet its responsibilities to its customers, its employees, and its owners. The cost must be recovered in the price of its goods and services. A customer, whether commercial or governmental, does not buy IR&D as a commodity. He pays for it as an element of the product cost. Moreover, when the government is the customer it carefully scrutinizes overhead costs, including IR&D, and costs not reasonably or equitably distributed to all customers are disallowed.

In negotiated government contracts, competitive restraints prevail, and the customer is the beneficiary. A company attempting to burden a negotiated contract with excessive overhead costs would quickly find itself at a competitive disadvantage. To the extent that a contractor's commercial or fixed price contract business is bearing part of the IR&D overhead, the government customer is better off than if it had contracted directly for and paid for such activity. Far more important, from the government's point of view, is the retention of competition. This is the real value that accrues to the government from IR&D.

The aerospace industry, by virtue of its high technology products, relies most heavily on and competes most effectively through pushing back the technological frontiers on as broad and as rapid a basis as can be done efficiently. The preservation of our national security as well as the accomplishment of national space objectives are related to this fact. In this process IR&D leads the way.

Mr. Harr's testimony underscored the fact that IR&D is an investment in future capability and that S. 3003, if enacted into law, would legislate against competition, against the search for knowledge, against technical competence, against national security, against hopes to solve critical environment and social problems at home and against national leadership.

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Official Publication of the
Aerospace Industries Association of America, Inc.

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CONTENTS

The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems;

Foster understanding of the aerospace industry's responsibilities in the space exploration program;

Foster understanding of civil aviation as a prime factor in domestic and international travel and trade;

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

AEROSPACE is published by the Aerospace Industries Association of America, Inc., the national trade association of the designers, developers and manufacturers of aircraft, missiles, spacecraft, their propulsion, navigation and guidance systems and other aeronautical systems and their components.

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SPACE AND THE NATIONAL ECONOMY

By Karl G. Harr, Jr., President
Aerospace Industries Association

Following are the remarks by Mr. Harr before the "Miracles of America" Leadership Conference of The Center Of American Living in New York City.

So much has happened in the very short period of time that comprises our space age, and so much has been said and written about what has happened as we have moved along, that some major elements of the forest have been obscured by the trees.

One of these elements has been the interplay between our national space effort and our overall national economy. Fully to understand this interplay it is necessary to review the past, particularly the way in which our space effort began, 13 years ago, and how it has evolved.

In the beginning economic considerations played virtually no part at all. Scientists of many nations, including the United States and the Soviet Union, in the course of programming for the International Geophysical Year, declared that the orbiting of artificial satellites was possible, and these two nations undertook the accomplishment of this novel and interesting, but relatively small scale, scientific feat.

Both the amounts budgeted and the objectives of the program were so modest as to involve no real economic considerations, either in terms of resources allocated or returns expected.

Once the Soviet Union preceded the United States in the successful launching of such a satellite, however, things escalated very fast. Implications which had been only dimly seen in advance within both societies became crystal clear with the event. And the Soviet achievement was exploited to its fullest by those who found it in their interest to do so, not only in the international political arena, but also in domestic politics, as a presidential year approached.

From almost every important point of view, it soon became apparent that our national interest dictated the initiation of a meaningful space effort.

Economic considerations of both the obvious and the not so obvious kind became an important part.

Obviously, as a first step, the processes of the government of the United States had to make a quantum judgment, in general terms at least, as to the size of our national effort. At a time when there was wide disagreement as to the shape any national space program should take, and when there was only a vague idea as to the applicable scientific and industrial resources available to us, i.e., how fast we could usefully proceed no matter how much money was available, a rough cut evaluation of the priority that should be accorded our national space effort had to be made.

Gradually in the late 50s as scientist, politician, foreign policy expert and comptroller argued, refined and reargued this case, such an evaluation emerged as a working hypothesis for starting our national program.

As we moved from consideration of a wide and varied range of competing programs to primary focus on a manned landing on the moon, this evaluation was refined, became much more valid and could become firm.

We had committed ourselves to a national space effort; we had undertaken the logical major first step; we had supplemented this with a balance of other lesser space programs to help us develop a comprehensive space capability. We were underway.

It was now, really, as we moved into the early 1960s that the fundamental economic effects began to appear. The obvious ones, such as the many thousands of jobs involved in the establishment, operation and management of the communities that became our national space base and the many thousands of jobs created by the tooling up of industry, were accompanied by indirect economic effects, such as the growing pressure to effect the wide range of scientific and technological breakthroughs necessary to achievement of our space objectives.

This latter pressure had its impact everywhere — in universities, research labs and industry, at all levels. It permeated virtually every scientific and technological discipline and its impact ranged from pure scientific research to the most mundane manufacturing technique. Everything that became a part of our space program had to be viewed anew and against different standards.

Here too, as in the case of employment, tangible economic effects began to be felt early. Industry, for example, had to upgrade itself to meet the cruel requirements of space. Manufacturing tolerances were reduced by orders of magnitude just as reliability requirements were commensurately upgraded. Standards described as "man rated" and "zero defects" began to creep into industry language and practice. New alloys, materials and processes had to be developed, discovered or invented to meet the design requirements for space. This is the point at which industry, in response to the national decisions about space, began to generate the myriad new practices, products and procedures which comprised our space effort's second economic legacy. And with the growth of our national investment in space came a corresponding growth in this economic return.

Mercury and Gemini placed man and then men in space, and as we moved into the middle 1960s the cumulative effects of this effort on all sides began to be felt throughout our economy. It was clear that American universities, industry and goverment were fully embarked on an organized technological reach of unprecedented scope. More important it was becoming clear that they were solving the managerial problems of integrating this massive effort into a system comprehending unprecedented complexities and unprecedented numbers of people.

The process, of course, was not entirely smooth. Multiple teams of highly skilled people representing different perspectives engaged in an effort wholly unprecedented both as to size and nature, require some shaking down before they can operate in optimum fashion. But this process too was accomplished without affecting the achievement of our space objectives. Vast new ground was broken in the techniques of systems management. And that was our space effort's third economic legacy.

All this could be done because the American people had seen the necessity to support such a national effort. That support in turn resulted in the creation of a national asset in the form of technological and managerial capabilities (for whatever application desired) unlike anything ever known before.

A fourth important economic legacy from our space effort was the direct economic benefits of the programs themselves such as improved communications, navigation, weather prognostication, earth resources control and inventory.

By the time we were able to land men on the moon and return them, American industry had come just about as far in that short time span as had the space program itself. Technological capability and managerial capability had made quantum jumps in step with space attainments. They had had to. And in so doing they had upgraded our total national economic capability. Technological advance is largely inseparable. You either opt for it or you don't. The junkyard of history is full of nations who rejected the major challenge of their times. And there is no question that space is the major challenge of our times. As Sir Bernard Lovell, director of Britain's Jodrell Bank Observatory, has stated: "You will find that only those communities that had been prepared to struggle with the nearly insoluble problems at the limits of their technical capacities — those are the only communities, the only times, that civilization has advanced.

"The Roman Empire decayed when it ceased to be progressive in this sense, and there are other examples. To a certain extent, you see the beginnings of it in the United Kingdom today, but fortunately not in the United States and certainly not in the Soviet Union."

Now you do not spend billions on a space program merely to give jobs to people in Huntsville or Houston or Southern California or anywhere else. You do not do it either to produce a better frying pan for the housewife, or a new way to cure cancer or heart disease. Nor do you do it to make quantum technological jumps, per se.

Fundamentally you do it to explore space — the universe in which we live. If you are partially goaded

into action by international competition for prestige, if you are partially motivated by national security implications and the like, these are secondary to the true justification.

But whatever the motivation or combination of motivations, the economic impact is the same. By reaching to the utmost you forge new muscle and sinew throughout your society and reap the whole range of benefits accruing to a people who, given a chance to opt for the future, has chosen to do so. Nothing even compares to our space effort in terms of offering so great a challenge to so great a segment of our society.

Here is where we come to the most significant conclusion about space and our national economy today. All of us recognize that both the economic and social environment are different from what they were in say 1961 or even 1966. In purely economic terms the ravages and dangers of inflation and the heightened competition of other compelling national needs require accommodation.

The point however is this: We cannot afford to sell the day to profit the hour. Our national space effort has for a decade stood so far out in front as the pacesetter of our national technological advance as to be virtually alone. It has given us in a decade new capabilities to address to all our problems that otherwise would have taken many times as long to develop. It has been a primary factor in keeping this nation with its tiny percentage of the world's population in a technological position to remain both free and prosperous at a time when both are becoming increasingly difficult.

Above all it has given us a new way of doing things. In joining to accomplish the most difficult feat ever undertaken by man, government and industry have forged a new problem-solving capability adapted to our present huge and complex society and all its problems.

'RODUCT GROWTH

This is the final and most important legacy. The need for this capability has never been more acute.

In terms both of our economy and our ability to meet pressing social needs, we must acknowledge one lesson that the sixties have taught us: Over the long run to have a healthy growing economy we need a vigorous space effort just as having a vigorous space effort depends on a healthy growing economy.

Should our people and our government fail to realize this special relationship between space and technological advance on the one hand, and technological advance and national well being on the other, we will have not only deprived ourselves of one of our greatest national assets, we will also have heavily mortgaged our ability to solve our other problems.

We cannot opt out now. We have come too far along the road to the future to make that mistake. Those nations whose resources or inclination have prevented them from partaking of this adventure bear the most convincing witness to the wisdom of our course. Without exception, they attribute the "technology gap" and the "brain drain" to our space effort and acknowledge that we have never made a better investment. Even a few years ago, one foreign finance minister judged that each dollar spent by us on space would return four-fold within ten years.

We have forged in this short span a national economic asset unrivaled in any other place or at any other time in the history of mankind. It is, of course, the base from which we can explore the universe. But it also is a principal driving force in our overall economic advance here at home.

In a free society there are no sacred cows. Our national space effort cannot and should not stand immune from the pragmatic judgments involved in ordering national priorities.

But to be properly judged it must be seen for what it is. It must be seen as a source of national advance on all fronts. It must be understood to be an ally rather than an adversary in the campaign to solve other national problems.

The world has never seen a greater single challenge than that offered by the opportunity to explore the universe. The United States has been in no way more blessed than in having been in a position to accept the challenge. We have made the hard choice — we have paid the full price—and we have reaped all the rewards.

Now we must look to the future.

Suppose, in 1960, we had been able to assume the vantage point of today, 1970, to help us arrive at the hard decisions we then had to make. Would we have opted for the Mercury, Gemini and the Apollo manned program culminating in landings on the moon? Would we have undertaken the Ranger, Surveyor, Mariner and other unmanned probes that have so developed our knowledge of the universe? Would we have launched the series of orbiting earth resources satellites, or the communications, navigation and meteorological satellites that were pressed directly into man's service in that decade? Had we been afforded such hindsight there never would have been any question.

Involved was not only the total recoupment of national prestige and spirit, not only the total removal of apprehensions about threats to our national security from this quarter. General James Ferguson, Commander of the Air Force Systems Command, points up the real possibility that "the technical capability demonstrated by the United States in landing a man on the moon may have been the final step necessary to convince the leaders of the Soviet Union that they cannot win the arms race." Clearly involved also was the radical upgrading of our overall national technological capability and hence our entire economic base.

As, in 1970, we look back at the previous decade we can answer for the decisions made with pride and conviction. They were worthy of both the opportunity and the nation.

No one need apologize to anyone for our national will and vision in that decade.

Let's suppose that now, in 1970, we were able to assume the vantage point of 1980 to help us make today's and tomorrow's decisions. Will we in 1980 be able to look back to a decade in which we continued our advance? Or will we look back on one in which we faltered, and in so doing dissipated everything we worked so hard to accomplish?

This question is so big, is so vital to our national future, is so complex and has been so rapidly thrust upon us that it must be a subject of continuing national debate. Important as the experts are in guiding us through these complexities, the basic decisions are too vital to our national future to be left entirely in their hands. A democratic society must manage its own future, and we can all recognize that space is an important key to that future.

It is essential that our society as a whole participate in these decisions — and that means that the matter be discussed and debated as widely and as continuously as possible.

AEROSPACE NOTES

Kangaroo Rocket to Test Space Travel Hazards

A rocket which carries its second stage and payload within its own core is being developed by United Technology Center of United Aircraft as an important tool for future manned space flights.

Dubbed the Kangaroo rocket, because of its ingenious design, it is scheduled to be used to probe earth's atmosphere for hazardous conditions prior to launching of manned space flights. The new missiles carry their instrument-laden payloads on the final leg of their journey to the fringes of space in pencil-like darts which are safely protected inside the rocket's casing.

At a predetermined altitude, they are ejected from the motor rocket into the atmosphere. Kangaroo is being developed for the U.S. Navy's Pacific Missile Range.

Such a probe would serve as a flying scientific testing laboratory to gather data that can best be evaluated by instruments exposed directly to the hazards of unfiltered cosmic rays and solar radiation, high concentrations of charged particles, or heavy meteoroid bombardment.

Kangaroo is capable of placing its instrument package to altitudes of more than 400,000 feet, a distance well beyond the range of comparable meteorological rockets in use today.

Computer-Created Images Help Design Gas Turbines

Gas turbine components for jet engines are now being designed at Allison Division of General Motors by computer-created images. Engineers communicate design decisions to the computer through lighted areas of the cathode ray tube terminal with a photoelectric light pen. This procedure cuts blade design time to one-tenth that of conventional methods.

Stored programs then display design information on the screen of the terminal. The information desired may, for example, be the drawn image of a compressor or turbine blade geometry.

The system required to provide this design capability is called Remote Access Procedure for Interactive Design. This company-developed system allows the engineers to enlist assistance from a network of many complex computer programs. These programs, involving more than 45 million instructions, are stored in the remotely-located computer

Hamilton Standard Designs New Propeller for V/STOL

Hamilton Standard Division of United Aircraft is developing an advanced technology propeller for vertical and short takeoff and landing (V/STOL) aircraft which will be the largest ever designed by that company. Twenty-six feet in diameter, the propeller will be made of lightweight metal and have a cyclic pitch mechanism for changing blade angles to control aircraft attitude.

The cyclic pitch blades are designed to give pilots direct control of the pitching movements of V/STOL airplanes during vertical flight and transition to forward flight. This would eliminate the need for adding a tail rotor to V/STOLs for attitude control.

The demonstrator prop is designed for medium-sized tilt-wing V/STOL transports powered by four gas turbine engines to be built for the U. S. Air Force. This will be the first time that the cyclic-pitch concept, commonly used in helicopter rotors, has been applied to a full-scale propeller.

The lightweight blades will be made of titanium covered by a fiberglass shell. Other composite materials will also be investigated for propeller application.

Tiny Rocket Destined For Interplanetary Use

A rocket engine tiny enough to dangle from this girl's earring has been developed by North American Rockwell's Rocketdyne Division. The same company built the world's mightiest rocket engine.

The miniscule engine has 1/100th of a pound of thrust and is destined for use as an attitude control rocket on spacecraft during long interplanetary voyages. Such engines would be installed on a spacecraft in couples to fire simultaneously.

The engine burns a Rocketdyne-invented product which employs a gaseous monopropellant and produces twice the performance of normal cold gas attitude control systems with virtually no increase in system complexity.

Device Gives Machines 'Eyes' for Computer 'Brains'

A remote oculometer invented by a scientist at Honeywell's Radiation Center at Lexington, Mass., is seen as a means of giving machines "eyes" to aid computer "brains" to make decisions and solve problems. Applications are expected for industry, education, military reconnaissance and space travel.

A diamond-trading firm in London is considering the unit for sorting rough diamonds by quality, incorporating the oculometer in a microscope.

A fine beam of infrared radiation, invisible and harmless to the eye, is focused on the eye. Separate reflections bouncing off the retina and cornea inform an image dissector (electro-optic sensor) about eye movements.

Other possible applications are in air-traffic control or other places where man scans a machine or radar screen for information. A worker watching a production line could work immediately to correct a flaw by just looking at something: stopping the eye movement on a flaw would signal to a computer or machine that corrections were needed at a particular point.

Bell Demonstrates Air Cushioned Aircraft

First water takeoff by an aircraft fitted with an air cushion landing system was recently demonstrated by Bell Aerospace on Lake Erie near its Buffalo plant. Developed for the Air Force's Flight Dynamics Laboratory, the aircraft required only 650 feet of water for its takeoff. On landing its transitioning capability was demonstrated by taxiing ashore.

The air cushion concept enables an aircraft to traverse water or land as well as ice, snow, mud, marsh or any number of other intermediate surfaces. The cushion is created by a small auxiliary on-board engine which drives an axial lift fan. The fan forces air down through the fuselage into an inner-tube-like air cushion bag fitted to the bottom of the aircraft. The underside of the bag is perforated with thousands of small holes through which the bag air is allowed to escape to create the layer of air upon which the aircraft rides.

GE Employs Satellites To Fix Vehicle Locations

Using communications satellites, General Electric's Research and Development Center at Schenectady, N.Y., has been experimenting with a system for determining the positions of ships, airplanes and land vehicles.

The experiments are designed to permit a ground-based station to locate automatically, via satellite link, aircraft, ships and land vehicles equipped with automatic receiving and transmitting equipment. Results of the tests could lead to application of advanced techniques for satellite position-fixing and traffic control that could aid in the solution of the world's transportation problems.

For its experiments, GE used two NASA orbiting Applications Technology Satellites and a time-sharing computer. The satellites relayed coded signals back and forth between the tracking station and participating vehicles. The computer analyzed the signals and calculated the position of a vehicle in only a few seconds.

Precision of better than three to five nautical miles was achieved, equalling the performance of the best currently available navigational aids not using satellites. At the same time, the new system offers the advantage of covering very large areas of the globe and reporting to a ground control station rather than merely informing the vehicle's crew where they are.

Philco-Ford Radar Maps Polar Ice for Shipping

Philco-Ford's Aeronutronic Division has designed and built a sidelooking airborne radar system which was used to help direct the world's first commercial tanker-icebreaker through the Northwest Passage. Carried aboard a Lockheed C-130 ice reconnaissance aircraft, the new radar detected ice conditions in the path of the *SS Manhattan* to determine its most accessible route through the polar ice pack.

The Coast Guard aircraft flew over the areas ahead of the *Manhattan* taking photographs by radar and dropping the film by parachute to the ship for developing and analysis. With the new lightweight radar, an area 10 miles wide was scanned which generated a strip map that was recorded on film to provide a "sea road map" for the ship. The radar map indicated ice floes, pressure ridges, breaks in the ice and open water, and mapped the best course through the ice pack.

General Dynamics Designs Small Radar Altimeter

A high reliability radar altimeter so small it fits the palm of a hand has been developed by the Electronics Division of General Dynamics for use on helicopters, vertical and short takeoff and landing aircraft, and low flying aircraft.

Capable of measuring altitudes to 2,000 feet, the new altimeter uses monolithic integrated circuits or compact construction. A slot array antenna is an integral part of the unit. Total weight, including the antenna, is 21 ounces.

The altimeter enables aircraft flying at low altitudes under adverse weather conditions to determine its altitude from 20 to 2,000 feet above ground. Accuracy is within two feet and three percent of altitude. A simple modification makes possible readings to ground-zero.

DOWN WITH COSTS

Efforts by aerospace companies to reduce costs, to find innovative methods to do a job better at a lower price are motivated by the strongest possible reason: Corporate survival in an intensely competitive procurement environment.

Therefore, cost reduction efforts permeate every aspect of the aerospace industry's operations from concept to design, to development, to manufacturing and product maintenance. The efforts extend to the thousands of suppliers and vendors who furnish subsystems, materials and services as subcontractors to the prime contractors.

Sensing that the magnitude of these efforts were substantial, Dr. H. W. Ritchey, president of the Thiokol Chemical Corporation, recently asked leading aerospace and defense contractors to provide examples of "value above and beyond" that expected or provided for by contract.

In each example, Dr. Ritchey sought an estimate of the savings to the government by the accomplishments. An excellent response was achieved with 61 companies providing 102 examples. Of the examples reported, estimates of savings were supplied for 63 projects. Total savings: $11.7 billion.

The examples were classified into four categories:

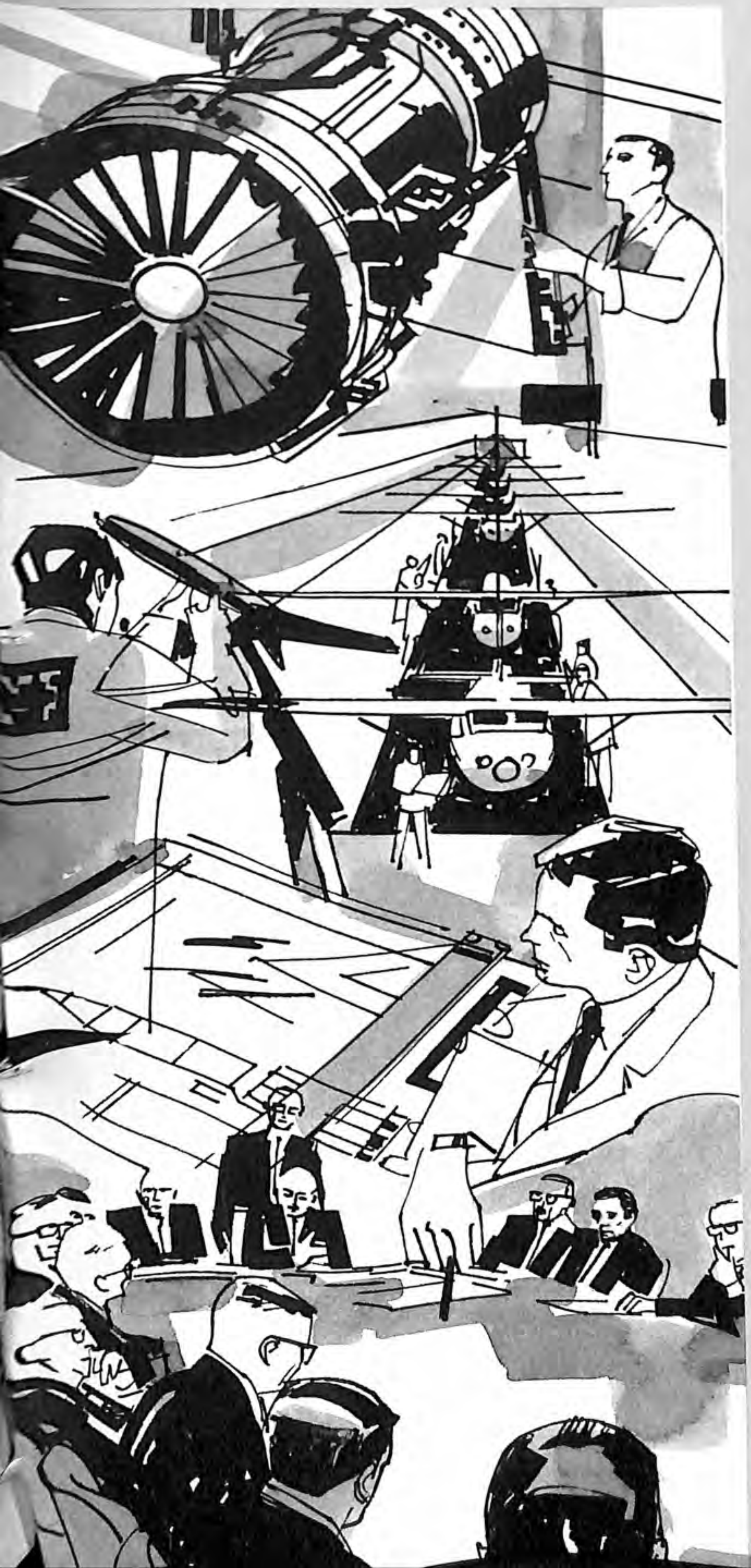
Service Life Improvement — This category included examples where the product exceeded the contract requirements for service or maintenance life. Service life improvement provided 41 examples, 24 of which reflected estimated cost savings of approximately $8.4 billion. This category accounted for more than 70 percent of the savings reported in the survey.

Development — This area involved examples where contractor initiative sparked development of a product improvement or new process. Nine such examples accrued estimated cost savings of approximately $226 million.

Learning Curve — The learning curve is a major factor in cost reduction. Over the last year defense hardware was procured at substantial savings as a direct result of learning curve effectiveness. Learning curve savings are achieved through combined engineering and quality control techniques which reduce labor and material requirements and costs. The two examples provided in this area accounted for savings of $65 million.

Other — This category included cost savings in such areas as transportation, training and testing, and amounted to $3 billion.

Typical examples from AIA member companies participating in the survey include:



Abex Corporation

Twelve years ago the Aerospace Division of Abex started producing several sizes of hydraulic pumps for use on fighter aircraft. The Time Between Overhaul on the aircraft, specified by the Air Force, was 500 hours. As a result of constant company-sponsored development, the specified TBO has been increased to over 1,000 hours.

During this period, Abex invested in capital equipment to the extent that, even with the large increase in material and labor costs, the units sell for essentially the same price as 12 years ago. The increase in TBO by a factor of 2-to-3 over the years has saved the government millions of dollars in repair and support costs.

Avco Corporation

The Minuteman weapon system specifications required that the reentry vehicle have a useful life of five years. Avco directed its research and development efforts not at merely meeting this requirement but rather toward producing the best design possible within the tight constraints of budget and schedule

The outstanding benefits to the government of such an approach have recently been demonstrated by test results from an Avco-conducted aging and surveillance program. Data from this program has made it possible for the Air Force to double the field life of the reentry vehicle from five to ten years.

The ability to extend the useful life of the reentry system represents a saving to the government of approximately $40 million to date, $40 million per year for the next three years, and a total of $160 million for the life of the system.

The Bendix Corporation

Mobile launchers and flame deflectors for the Saturn V vehicles were equipped with a special surface treatment to provide protection from atmospheric corrosion and from the high-temperature high-velocity blast of the 7,500,000-pound-thrust exhaust of the Saturn V. The surface treatment consisted of an inorganic zinc primer with intermediate and top coats of vinyl. Launch temperatures caused the vinyl coatings to partially disintegrate and fuse to the surfaces of the mobile launchers and flame deflectors which necessitated complete sandblasting and recoating with alternate zinc and vinyl after each launch.

Bendix found that the use of acrylic latex eliminated the intermediate coat that was required when vinyl was used. The acrylic latex did not fuse to the primer during launch and provided adequate protection against atmospheric corrosion at a cost much less than the vinyl systems. The total first year savings was $500,775.

The Boeing Company

As contracted for, the design service life for the ground electronic system for the Minuteman missile system was three years. Actual experience and test evaluation now indicates this service life will exceed fifteen years—and most probably twenty. Each replacement of the five-wing system would cost $350 million. This has been saved at least five times, an increase in value to the government of about $1.5 billion.

The Garrett Corporation

The Garrett Corporation won a Navy competition for a powerplant for the OV-10A counter-insurgence aircraft. With its own funds, Garrett redesigned its commercial engine to meet all military requirements. This development program included some 6,000 hours of engine running, as well as all necessary engineering, tooling, and testing. Garrett also undertook at midpoint in the program to uprate the horsepower of the engine from 665 to 715 HP, and to qualify at the higher rating.

This action resulted in the introduction of a new and versatile powerplant into the U. S. military inventory which has a number of applications beyond the OV-10A aircraft and saved the government a conservatively-estimated $30 million.

General Electric Company

In 1964, General Electric was awarded a contract for a six-barrel machine gun. Design objectives called for a life of 200,000 rounds, firing at least 20,000 rounds between stoppages at a rate of 6,000 rounds per minute. Within two years, GE was delivering guns in production quantities, one of which is still firing in Vietnam after 7,500,000 rounds. In addition, this weapon consistently exceeds 500,000 rounds between stoppages. The price of today's machine guns is now one-third the cost of the first production deliveries. The weapon has exceeded its design life by 37 times and exceeded its mean rounds-between-failures by a factor of 25.

Goodyear Aerospace Corporation

The Air Force purchased 11,326 cargo pallets from Goodyear Aerospace Corporation for air transporting defense materials and supplies.

The Goodyear pallet, although costing $499 as opposed to a second source price of $266, yielded an overall savings to the Air Force of $195,000 in Fiscal Year 1967 with savings of $8,966,000 through Fiscal Year 1969, based on the life cycle of the pallets procured. It was proven that the Goodyear pallets, though costing almost twice as much, lasted seven times as long.

A comprehensive, in-house value program was conducted during Fiscal Year 1969, resulting in the average pallet price being reduced $104.80 per pallet from the lowest Fiscal Year 1968 contract price. This price reduction yielded a net savings to the government of $2,426,015 for the Fiscal Year 1969 procurement.

Hercules, Inc.

Nineteen different rocket motors have been produced by Hercules in substantial quantities for a total delivered cost of more than $1 billion. The shelf life goal for most of these motors was five years, although only three years was the objective of several. Shelf lives of more than 15 years have already been demonstrated for some of the motors and the newer models are under a continuing surveillance program.

Kaman Aerospace Corporation

Bearings on Navy helicopters operating at sea have always been subjected to salt water corrosion, which tended to shorten their service life considerably. Kaman's UH-2 Seasprite was no exception.

Concerned with the rapid degradation and frequent replacement rate of bearings in the dynamic control system, Kaman came up with its own design, using titanium, ceramic and compacted carbon—all inert materials that are impervious to corrosive elements and require no lubrication. Bearing manufacturers told Kaman that such a bearing could not be built. Kaman however proceeded on its own to set up limited production, and convinced the Navy to try the new bearings. The initial installation on a UH-2 operating from a low-freeboard ship, the most corrosive environment in the Navy, demonstrated a life improvement of better than 20-to-1, and markedly reduced labor to troubleshoot, replace and flight test, while completely eliminating labor for lubrication.

The Navy decided to retrofit its entire fleet of 150 UH-2's with a resulting savings in bearings alone of more than $103,000—including parts and labor. In addition, the Navy received the added benefit of increased aircraft availability. The Kaman bearing is now being installed in the Army's more than 5,000 UH-1 and AH-1 helicopters and the Air Force's Huskie helicopters. The bearings demonstrate considerably longer life than the bearings they replace, and represent a savings to the Department of Defense in excess of $500,000.

Lockheed Aircraft Corporation

On a major missile system development program, the contractual requirement was to test fire every fifth motor produced for assurance of motor reliability. After performing on this basis to develop experience data, the Lockheed propulsion engineering group proposed a reduction in the test firing requirement. This proposal was supported by analysis and the evaluations of the test firing requirement. The proposal was accepted, and the number of firings were successfully reduced for the balance of the program saving the government approximately $75 million.

LTV Electrosystem, Inc.

Through company-funded efforts, LTV demonstrated the feasibility of electro-mechanical valves for

missile liquid-injection, thrust-vector control systems. Such valves reduce weight, improve reliability and decrease logistics support, as compared to other existing approaches. An electro-mechanical thrust-vector control system is now used on the third stage of Minuteman III. Cost savings to the government (based on 1,000 systems) is estimated to be $11 million.

The Marquardt Company

In 1965, Marquardt received orders for a substantial quantity of attitude-control rocket engines for use on the Apollo program. The rocket engine is the Marquardt Model R-4D, and it was developed for the North American Rockwell Space Division for use on the Apollo Service Module. The same basic rocket engine was employed by Grumman Aerospace Corporation for use on the Apollo Lunar Module.

Although the contracts from these customers were totally independent, Marquardt voluntarily initiated a common engine production program which enabled the fabrication of these units to be combined. Substantial cost savings were realized due to Marquardt's ability to combine orders for material and purchased parts with concurrent leases for larger production runs.

Further cost savings were realized from a company-instituted plan of simplification of required test and checkout procedures. These voluntary efforts produced tangible cost reductions which in turn permitted return to the government of more than $1,750,000 in contracted funding.

Martin Marietta Corporation

Early in the Titan program, Martin Marietta added a requirement for integration and launch of operational payloads on the third and fourth Titan IIIA's and the second and subsequent Titan IIIC'c using research and development vehicles. The only consideration to Martin Marietta for this additional benefit from the research and development program was a normal increase in contract price for the additional work involved. The performance incentive provisions of the contract were not altered.

This utilization of research and development vehicles for launching operational payloads eliminated the necessity for procurement and launch of 15 additional vehicles expressly for the payload program. The estimated cost to the government of this 15-vehicle program is $295 million.

McDonnell Douglas Corporation

The Dragon anti-tank weapon system is a self-contained weapon to be used by infantrymen against tanks and armored vehicles. The propellant cannister case of the launcher assembly was previously draw-formed from high strength steel plate and required extensive machining in order to meet rigid weight and safety design specifications. McDonnell Douglas Astronautics Company reduced costs by developing a thin-wall precision-forged cannister which required little machining. The change also added safety and reliability.

Based on initial estimates, costs of the Dragon to the Army will be reduced by $6.9 million over a five-year production program.

North American Rockwell

North American Rockwell Corporation's Autonetics Division has designed, developed, and is producing 99 percent of all electronics in the Minuteman ICBM excluding the reentry vehicle.

Guidance and control accuracy on Minuteman I was 67 percent better than specified. Weight of the guidance and control system was 15 percent better than specified. Minuetman I missiles stored in silos showed 25 percent better guidance reliability than specified, and a control system reliability seven times greater than required by contract.

The improvement in operational readiness substantially reduced the number of missiles needed to satisfy Air Force launch-ready requirements. The "cost avoidance" in procuring fewer missiles is estimated at $1 billion. In addition, over a seven-year lifespan, logistic savings are estimated at $135 million.

Although the Minuteman II guidance and control system was approximately three times as complex as Minuteman I, its accuracy was 41 percent greater than initially required. Guidance and control requirements were subsequently tightened by 33 percent and the tightened requirement was bettered by 51 percent. Weight of the guidance and control system was five percent less than specified.

Northrop Corporation

Since September 1961, Northrop Corporation has delivered over one thousand T-38 Talons to the Air Force Training Command as its basic training aircraft.

The original Air Force prediction of T-38 losses per 100,000 flying hours were 27 for the first three years of operation, leveling off at 12 from 1967 on. The cumulative average for the first eight years operation has, in fact, been only 2.7 aircraft lost per 100,000 flying hours and the current annual rate has been reduced to 1.6 Thus, the government has saved over $200 million in anticipated replacement aircraft.

Maintenance costs may equal half of the total 10-year program costs of an aircraft and one of the T-38 design goals was to reduce by 50 percent the maintenance requirements then attendant to supersonic aircraft. The resultant maintainability goals were 14.6 maintenance manhours per-flight-hour at 50 hours-per-month utilization with a 70 percent operational ready rate.

The current maintenance index is nine maintenance manhours per-flight-hour at an average utilization of over 51 hours per month with an operational ready rate of 84 percent. In maintenance manpower costs alone, these improvements over the original goals have saved the government $140 million.

Philco-Ford Corp., Aeronutronics Division

Dual property steel armor offers a high degree of ballistic protection for comparatively low weight. This attribute makes the armor particularly desirable for application on military aircraft and boats.

Aeronutronics has supported a continuous research effort to reduce the weight and the cost of this high quality armor. Recent improvements in a unique manufacturing process will substantially reduce the cost of producing this armor. Based on sales for 1969, cost savings to the government will exceed $3 million.

RCA

MK-93 proximity fuzes manufactured by RCA were classified as "Class C Explosives" by the Department of Transportation regulations, which required packing the fuzes in expensive shipping containers and shipping them at much higher rates.

RCA conducted a preliminary "fire" test in order to determine the explosive characteristics of the device and ascertained that the above classification should be reduced. RCA requested the Bureau of Explosives and the Association of American Railroads to perform an independent test on the fuzes. These tests confirmed that the "Class C Explosives" classification was unnecessary and that the fuzes could be shipped safely without classifying them under the DoT regulation.

This change in classification resulted in a 49 percent reduction in shipping rates. A new, simplified shipping container reduced container cost by 83 percent and container weight by 40 percent. By implementing this proposal on all future orders of this item, the government will benefit by $6 million in cost savings.

Thiokol Chemical Corporation

In the early years of the development of composite solid rocket propellants, there was much concern about possible short shelf life. Government agencies expressed a desire (not a contractual requirement) for a shelf life of at least five years.

Strenuous research and development efforts were made by Thiokol Chemical Corporation to provide as long shelf life as technologically feasible. As a result, Thiokol-produced rockets have been in inventory under aging surveillance for periods of up to thirteen years with large numbers currently in the eight- to ten-year range. To date, not one Thiokol-produced solid propellant rocket has required reloading due to expiration of propellant shelf life.

Estimates of the inventory of Thiokol-produced solid propellant rockets and replacement costs indicate increased shelf life has saved the government approximately $310 million.

TRW Inc.

Recent contracts for the Nuclear Detection Satellites (VELA) included incentives for TRW in terms of a number of performance factors, such as the length of time the satellite performed satisfactorily in orbit. Vigorous efforts by TRW resulted in such a spectacular life-length of the first orbiting satellite that the Air Force was able to reduce the total program cost by approximately 32 percent or savings of approximately $26 million.

United Aircraft Corporation

Early jet and turbine aircraft engine experience in this country and abroad indicated that a relatively larger number of spare parts and spare engines would be required than those needed for piston engines. The Time Between Overhaul was low, indicating a need for frequent changes and a large number of engines for the overhaul cycle and pipeline.

Pratt & Whitney Aircraft was able to develop a series of jet engines which provided an increase in the TBO well beyond any contract requirements. In the engines for the 100 series fighters, the B-52 bombers, and the KC-135 tankers, for example, P&WA achieved a level of reliability and durability which permitted the government to cancel procurement of more than 3,000 J57 engines, as originally planned for 1958 through 1963, with a saving to the government of approximately $500 million.

THE 'UNK-UNKS'—

Not Knowing You Don't Know

The aerospace industry, which has enriched the national lexicon with such phrases as "go juice" (rocket fuel), "pad chief" (launch director) and "glitch" (voltage change), has come up with another entry — the "unks" and "unk-unks."

"Unks" are the known-unknowns and "unk-unks" are the unknown-unknowns that inevitably crop up in the development of highly advanced weapon systems. They exist, however formlessly, at the frontiers of technology as brought out in an in-depth Aerospace Industries Association study of the procurement and development of weapon systems.

Weapon systems since World War II have become bigger, more effective, more complex and more expensive. Developing, procuring, and deploying the major weapon systems that are essential to the present and future defense of our nation is a complex task with considerable technical, cost, and schedule uncertainties.

With the evolution of large systems in the 1950s, it became necessary to assemble greater resources in men and material, and management capability by both industry and government to accomplish the job.

During the early 1960s, new factors were introduced to cope with an increasingly complex job of funding, financing, contractor selection, developing, producing and deploying major weapon systems. Some of these factors involved different and supplemental approaches to budgeting and funding. Decision making became more centralized while competition became more intense and fewer and larger systems actually reached completed development.

There were also significant changes in government

THE WEAPON PROCESS

This chart shows in greatly oversimplified form the basic processes and a few of the key decision points involved in a typical weapon system. There are literally thousands of decisions—procedural, managerial, technical and contractual—made between the conception and operational delivery of a system. The four basic processes overlap because the enormous complexity of each process requires, for example, acquisition planning in the Definition Process. At many key technical points, decisions to proceed are made on system elements that are "known-unknowns" and "unknown-unknowns." Management systems and contracting procedures to accommodate these factors are completely unique to the weapon acquisition process. The possibility of errors is implicit. Constant monitoring and review during each process permits adjustments to minimize or preempt errors. The teamwork between the government and its contractors is a prime factor in making the system successful from the viewpoints of both effectiveness and cost.

CONCEPTUAL PROCESS

- National Objectives and Strategy
- National Security Council
- Secretary of Defense
- Joint Chiefs of Staff

contracting procedures which resulted in the imposition of low-profit and high-loss potential fixed-price contracts.

The public, the government, and industry shared an appreciation of the successful progress made possible by rapid technological advances; however it was felt that the time was ripe for a careful analysis of the relationship between technical reality and procurement practices.

AIA's Aerospace Technical Council, assisted by the Procurement & Finance Council, initiated in January 1968 the study of the Essential Technical Steps & Related Uncertainties in DoD Weapon Systems Development.

Phases I & II, completed in 1968, analyzed the essential technical steps and related uncertainties and then gave consideration to and superimposed the legal, contractual and financial constraints on the basic model. Recommendations to DoD were addressed to the problem that existing contractual policies and regulations are not compatible with the inherent technical uncertainty in the weapon system development process in that they do not give appropriate or adequate recognition to the unanticipated unknowns. The inherent problem in treating technical uncertainties — the unks and the unk-unks — is not simply their conversion to certainties, but also the inability to identify and failure to provide for what is not known in a timely manner.

As a result of Phase II and its findings, and in an effort to help DoD and industry resolve this serious mutual problem, three recommendations were offered:

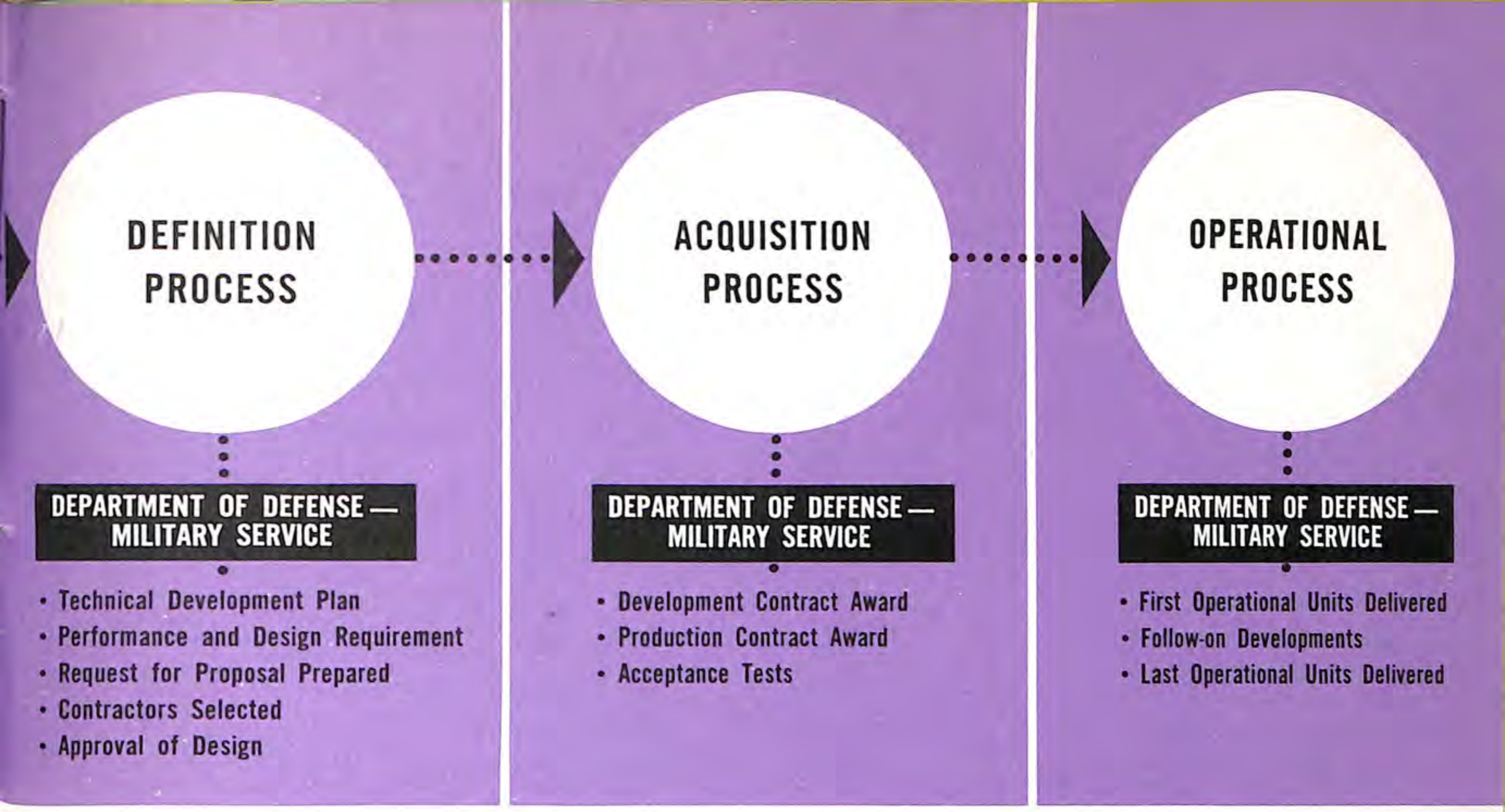
• *First,* DoD policy should be revised to recognize that technical uncertainties in weapon systems acquisitions are a major factor to be considered in determining the appropriate contract method selected for each weapon system. For example, a weapon system can be an airplane, missile, spacecraft or ship. Major systems were the consideration here, i.e., those that take $25 million to develop and/or at least $100 million to produce.

• *Second,* that the Office of the Secretary of Defense (OSD) establish a standing board for the purpose of review and final determination of the contracting method to be used on all major acquisitions which are within the scope of DoD Directive 3200.9 which initiates Engineering Development and Contract Definition.

• *Third,* OSD should establish a working interface with industry representatives to continue the study of this mutual problem with the objective of developing further guidance regarding the selection of the type of contract for systems development.

In support of these recommendations, the group developed several possible approaches which included a revision to DoD Directive 3200.9, a revision to Section 3 of the Armed Services Procurement Regulations which covers contract types, and a proposed charter for the standing contract review board.

Since these recommendations were made, DoD has been increasingly aware of risk and uncertainty considerations in the selection of a contract method. The establishment of the DoD Defense Systems Acquisition Re-



search Council accomplished the intent of the second recommendation. The last recommendation is still pertinent and communication between industry and government has improved since the recomendation was made.

Continuing its study of the problems associated with weapon systems development, the AIA embarked on a Phase III effort in January 1969 to develop specific recommendations aimed at solving the problem of long-term commitments without either the requisite technical information or without regard to the varying degree of uncertainty in the technical information available at the time of commitments. This problem led to the objective of determining what information is necessary and reliably available to make meaningful decisions in the weapon systems process and suggested DoD courses of action to implement the recommended changes.

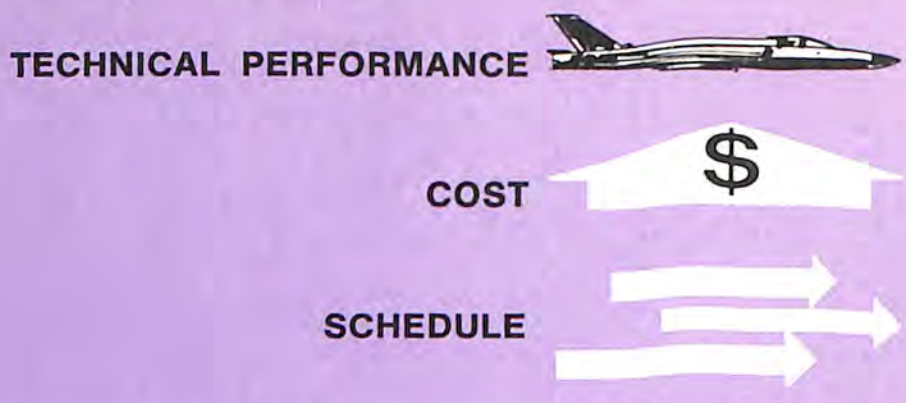
Experienced senior managers examined actual programs, analyzed the findings of the two earlier phases and developed conclusions that led to five recommendations focused on satisfying the stated objective:

• *First,* guidelines should be issued for DoD Directive 3200.9 to expand the concept of program tailoring so that greater program implementation flexibility could be more fully exploited. This flexibility covers total program scope, not just management systems and techniques. In support of this recommendation, possible guidelines and scenarios were established as sample acquisition environments to indicate various tailoring processes that should be considered for program implementation in the Concept Formulation Phase, the Contract Definition Phase and Engineering Development. This flexible multiple-option development policy is needed to accommodate each different development program in terms of each unique set of technical, strategic and economic uncertainties. Also the nature of the threat, the urgency, and the possible consequences of failure also must be considered in deciding how to tailor a particular acquisition.

• *Second,* a supplement should be issued to DoD Directive 4105.62 on Proposal Evaluation and Source Selection to encourage, in appropriate cases, the evaluation by qualified industry sources of the Request For Proposal (RFP) including statements of work desired by the procurement agency to be accomplished during Concept Formulation Phase, Contract Definition Phase and Engineering Development. It was concluded that this supplement could provide a means by which both DoD and industry could establish an optimal work package for the program. In addition to the regular source selection procedure the supplement establishes an RFP evaluation process including a technique which would permit qualified industry sources to review, analyze and comment on the proposed RFP, the Statement of Work, and related documentation prior to formal release of the RFP. This early step is intended to separate characterization of technical/program risk from contractor selection and will provide an objective critique and suggestions for the elimination of unneeded contractual data requirements.

• *Third,* more use of prototypes should be considered

PERFORMANCE, COST, SCHEDULE TRADE-OFF



Decision points during the several phases of a development program require a reconciliation of the three factors: Technical performance, cost and schedule. If technical performance is held fixed in a situation where the uncertainties involved are not fully understood, the cost will go up and the schedule will slip. Technical risk assessment is crucial, starting early in the program and continuing through succeeding phases.

early in development, as appropriate, in a flexible and simple management structure to reduce technical and program risk and uncertainty, and to aid contractor selections. This recommendation resulted from study effort directed toward development policy and technical uncertainty in terms of the use of different kinds of prototypes. The thesis here is that prototypes used early and sensibly in an evolving program tend to reduce technical and program uncertainties and make development/production commitments more effective.

• *Fourth,* a policy should be developed requiring DoD/industry application of searching, thorough and objective risk assessment during Concept Formulation and continuing through succeeding phases on major system acquisition. It was concluded that the greatest need for effective risk assessment arises during the Concept Formulation Phase where it should be incumbent, upon both the involved qualified industry sources and the government and its laboratories, and on not-for-profit supporting agencies to carry out such a risk assessment during all succeeding phases of the major system acquisition process.

• *Fifth,* changes should be made in procurement practices beneficial to the competitive environment, encouraging early identification of technical uncertainties, and the structuring of the acquisition process to deal realistically with the resolution of such uncertainties. Industry should highlight identification of and the approach to solutions of technical and cost uncertainties. The rationale supporting the recommendation is based heavily upon the demonstrated fact that significant technical uncertainties and consequent program risks generally are present in these programs at the start of development. Moreover, large uncertainties are present in projecting production costs of prime and supporting elements at this time, when formal preliminary design of the system hardware has not yet been accomplished. A suggested approach to further amplify this recommendation includes these factors:

• In applying criteria for competitive source selection, practices should be modified to reduce the dominance of the low-price bid.

• The practice of finalizing long-term development and production fixed-price commitments at the beginning of major system and sub-system programs should be discontinued.

• Cost Plus Incentive Fee contract forms generally should be utilized for development programs until the technical uncertainties and program risks have been reduced to a degree which permits fully rational application of fixed-price contracting. Cost Plus Fixed Fee or Cost Plus Award Fee contract forms could be utilized where appropriate. In the future, the development of new and different contractual forms may be required as discussed in the Phase II Report.

These weapon systems development studies should be helpful to the various government groups studying procurement problems including the DoD, the Blue Ribbon Defense Panel, the Congressional Commission to Study Governmental Procurement, the General Accounting Office and the Industry Advisory Council. The AIA studies are expected to continue.

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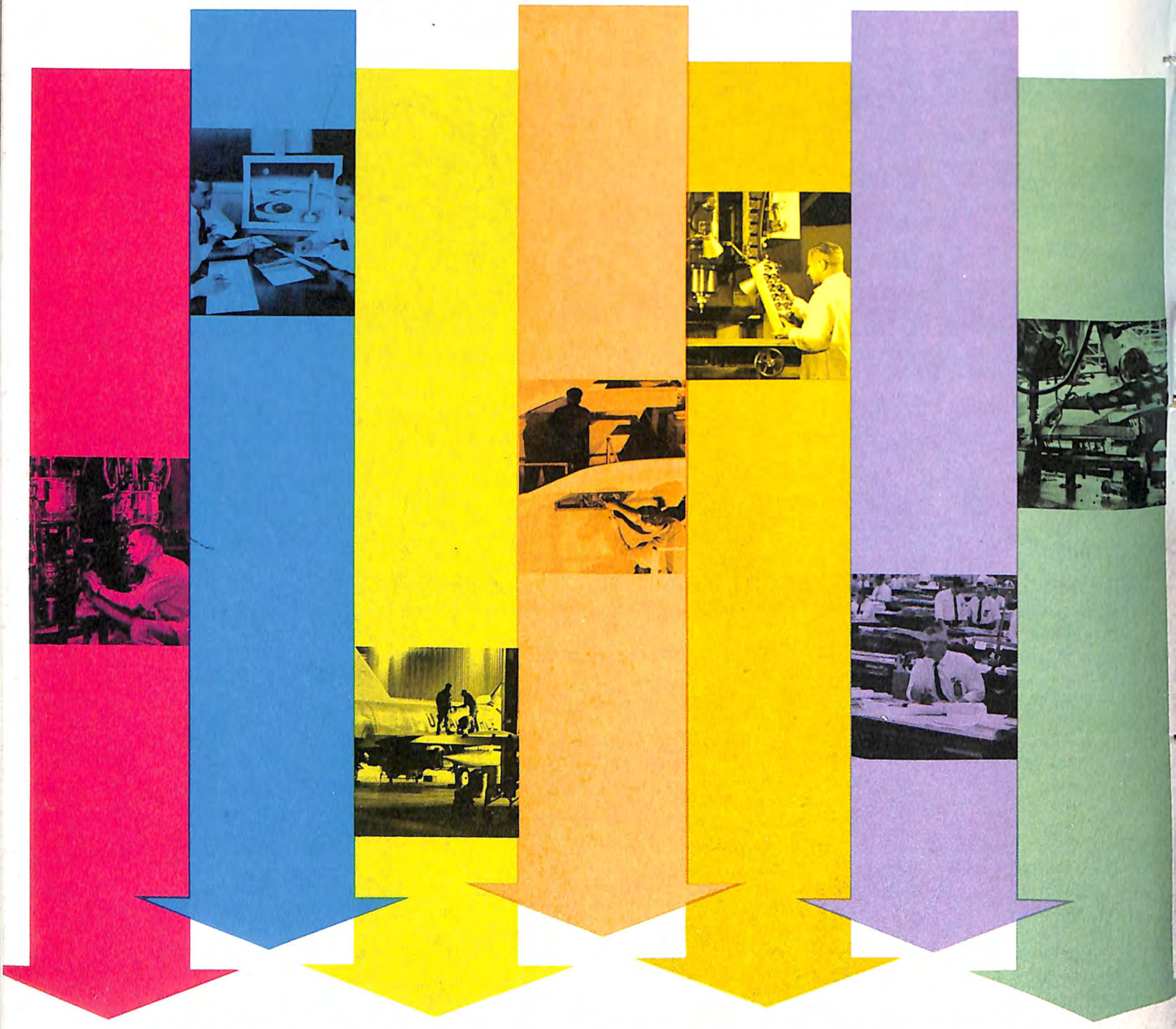
The aerospace industry has achieved dramatic cost savings to the taxpayer through innovative techniques of design, development, testing, manufacture and maintenance (see *Down With Costs*, page 8).



DOWN WITH COSTS

aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION · JUNE 1970

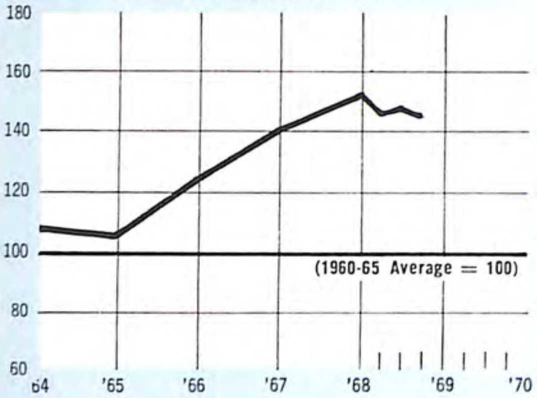
Power for Growth—
AIRPORT/AIRWAYS DEVELOPMENT

By SENATOR WARREN G. MAGNUSON
Chairman, Senate Commerce Committee

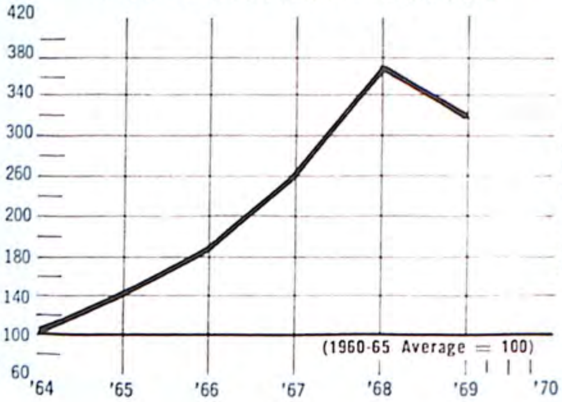
AEROSPACE ECONOMIC INDICATORS

CURRENT

Total Aerospace Sales

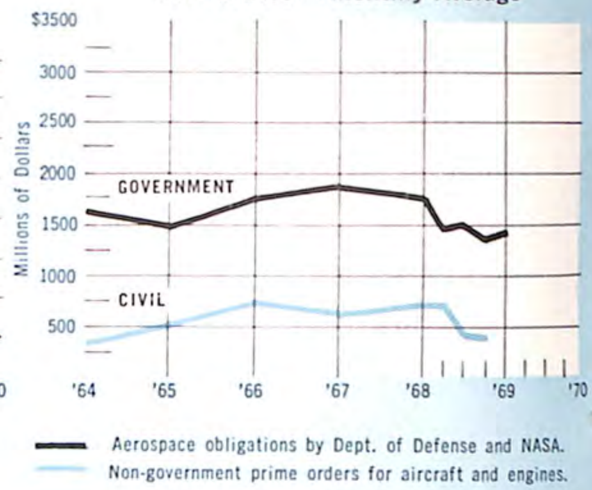


Value of Civil Aircraft Shipments



OUTLOOK

New Orders — Monthly Average



ITEM	UNIT	PERIOD	AVERAGE 1960-65 *	LATEST PERIOD SHOWN	SAME PERIOD YEAR AGO	PRECEDING PERIOD †	LATEST PERIOD
AEROSPACE SALES: Total	Billion $	Annual Rate	19.4	Quarter Ending Sept. 30 1969	29.4	28.1	27.1
	Billion $	Quarterly	4.8		7.0	7.1	6.2
DEPARTMENT OF DEFENSE							
Aerospace obligations: Total	Million $	Monthly	1,151	Feb. 1970	1,199	1,261	767
Aircraft	Million $	Monthly	601	Feb. 1970	743	907	385
Missiles & Space	Million $	Monthly	550	Feb. 1970	456	354	382
Aerospace expenditures: Total	Million $	Monthly	1,067	Feb. 1970	1,239	1,125	1,087
Aircraft	Million $	Monthly	561	Feb. 1970	786	693	609
Missiles & Space	Million $	Monthly	506	Feb. 1970	453	432	478
Aerospace Military Prime Contract Awards: TOTAL	Million $	Monthly	920✣	Feb. 1970	1,059	1,083	660
Aircraft	Million $	Monthly	447	Feb. 1970	741	595	341
Missiles & Space	Million $	Monthly	473	Feb. 1970	318	488	319
NASA RESEARCH AND DEVELOPMENT							
Obligations	Million $	Monthly	215	Mar. 1970	355	326	254
Expenditures	Million $	Monthly	130	Mar. 1970	385	297	338
BACKLOG (60 Aerospace Mfrs.): Total	Billion $	Quarterly	15.3#	Quarter Ending Sept. 1969	31.5	29.4	29.1
U.S. Government	Billion $	Quarterly	11.6		17.3	15.0	15.0
Nongovernment	Billion $	Quarterly	3.7		14.2	14.4	14.1
EXPORTS							
Total (Including military)	Million $	Monthly	110	Feb. 1970	253	302	299
New Commercial Transports	Million $	Monthly	24	Feb. 1970	137	142	143
PROFITS				Quarter Ending Dec. 1969			
Aerospace — Based on Sales	Percent	Quarterly	2.3		3.3	3.0	4.6
All Manufacturing — Based on Sales	Percent	Quarterly	4.8		5.2	4.6	4.6
EMPLOYMENT: Total	Thousands	Monthly	1,132	Feb. 1970	1,370	1,282	1,261E
Aircraft	Thousands	Monthly	469	Feb. 1970	601	562	551E
Missiles & Space	Thousands	Monthly	496	Feb. 1970	592	548	538E
AVERAGE HOURLY EARNINGS, PRODUCTION WORKERS	Dollars	Monthly	2.92	Feb.1970	3.85	4.08	4.08E

R Revised
E Estimate
* 1960-65 average is computed by dividing total year data by 12 or 4 to yield monthly or quarterly averages.
† Preceding period refers to month or quarter preceding latest period shown.
# Averages for 1961-65.
✣ Averages for fiscal years 1960-1965.

ACCOUNTING FOR COSTS

Legislation which could materially change long-established accounting policies, practices and procedures of firms selling to the government is now before the Congress. This legislation, basic to the business relationship between government and industry, involves an attempt to establish uniform cost accounting standards.

Recently the Subcommittee on Production and Stabilization of the Senate Committee on Banking and Currency held extensive hearings on the highly complex subject.

Senator Alan Cranston, in the Committee report on the proposed legislation, stated: ". . . S.3302 is being reported out of committee at a time when I believe that the government's entire procurement system should be thoroughly examined. Legislation proposing a government procurement commission sponsored by Congressman Holifield has been enacted into law. The thorough review of government procurement envisioned by the commission might well obviate the need, if any, for legislation on uniform cost accounting. Any uniform cost accounting legislation should be postponed pending the results of the Holifield Commission."

Industry witnesses testifying before the subcommittee made these key points:

Joseph G. Bacsik, appearing on behalf of the Aerospace Industries Association, provided these four reasons in opposing uniform cost accounting standards.

- There is neither a generally acceptable definition nor a common understanding of the meaning of the term "uniform cost accounting standards," and feasibility has not been demonstrated.
- The need for imposing standards has not been established or justified.
- Credible evidence has not been offered to demonstrate that the mandatory imposition of standards would accomplish anything beneficial.
- There are potential legislative conflicts and unforeseen consequences inherent in the unlimited authority granted by the proposed legislation.

Karl G. Harr, Jr., president of the Aerospace Industries Association, testified:

"We believe that existing principles and procedures modified as appropriate to changing circumstances, are adequate to accomplish the desired results. Not only is every American public corporation subject to controls of both its own and public auditors in terms of procedures and principles, but the defense segment of American industry is the most scrutinized, observed, controlled and audited business in the history of the world."

Max Lehrer, testifying on behalf of the Electronic Industries Association, said: ". . . The principal reason that uniform accounting standards are not feasible is that such standards would impose upon all defense contractors, both large and small, a requirement to classify and record the direct and indirect expenses they incurred in a 'uniform' manner. This is patently impossible because of the immense diversity of the types of business in which the suppliers to the Department of Defense are engaged."

A non-industry witness was Dr. Howard W. Wright, Professor and Chairman, Division of Accounting, University of Maryland, who stated: "In summary, this situation is much like a Greek tragedy. Circumstances seem to be inexorably moving toward an undesirable conclusion. No need for major change has been established. No major faults have been exposed. No evidence of excess costs to the government has been advanced. . . ."

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CONTENTS

The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems;

Foster understanding of the aerospace industry's responsibilities in the space exploration program;

Foster understanding of civil aviation as a prime factor in domestic and international travel and trade;

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

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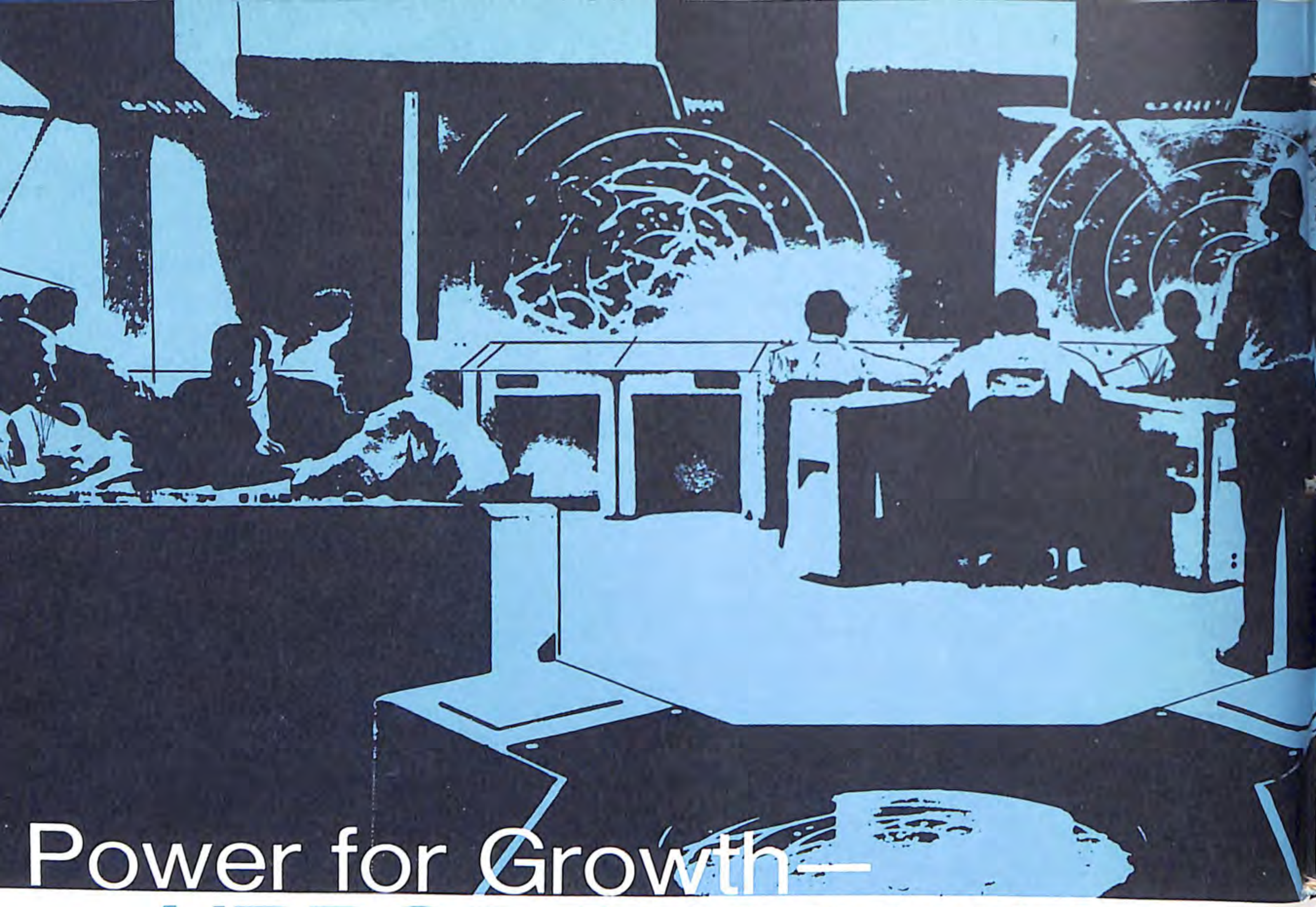


Power for Growth— AIRPORT/AIRWAYS DE

By SENATOR WARREN G. MAGNUSON
Chairman, Senate Commerce Committee

It was a few minutes after 8 p.m., Christmas Eve, 1968. The 44 passengers on board Allegheny Airlines Flight 736 were either dozing peacefully or were preoccupied with thoughts of the holiday which had already arrived. Many of the travellers were bound for Washington, D.C. to spend Christmas after boarding the flight at Detroit, or Erie, Pennsylvania. The Convair 580 turboprop was scheduled to make two more stops before arriving at Washington, the first at Bradford, Pennsylvania, the second at Harrisburg.

The short hops from Detroit and Erie had been uneventful.

Up on the flight deck, the two crew members, Captain Gary Mull and First Officer Richard Gardner, were occupied with the approach to Bradford Regional Airport. The weather was typical of western Pennsylvania in December. Erie approach control advised the crew of local weather: Ceiling 2,000 feet with broken clouds, visibility of one mile with light blowing snow, wind from the northwest from 15 to 25 miles an hour.

After passing the Bradford VOR on the outbound course for an instrument approach to runway 32, the FAA's flight service station at Bradford warned the crew that the runway was packed with snow and rough ice and braking was reported poor.

As Flight 736, on final approach, descended into the darkness enveloping the countryside around Bradford the runway lights were still not in sight as the Convair passed a point three and a half miles from the end of runway 32.

The plane continued to descend into the darkness.

Both crew members kept glancing out the window into the blowing snow searching for ground reference points which would guide them to the end of the runway.

Stewardess Rita Boylan at her station in the passenger compartment picked up her intercom microphone and advised the passengers to check their seat belts in preparation for landing at Bradford.

The landing gear, landing lights and flaps had been extended for landing.

Still the runway was not in sight.

At twelve minutes after 8 p.m. the passengers were startled by the sound of trees banging and ripping at the

AIRWAYS SYSTEM DEVELOPMENT REQUIREMENTS — 1970-80 Period
(IN MILLIONS OF DOLLARS)

CATEGORY	AMOUNT Millions
Air Traffic Control	$1,377.0
Air Navigation	285.0
Communications	216.8
Supporting Services	270.6
TOTAL	$2,149.4

Source: Federal Aviation Administration (Hearings before Subcommittee on Aviation, Sena Commerce Committee, on Airport/Airways Development)

AIRPORT DEVELOPMENT REQUIREMENTS — 1970-80 Period
(IN MILLIONS OF DOLLARS)

CATEGORY	Airfield Requests	Terminal Area Requests	TOTAL
Large Hubs	$3,375	$2,200	$5,575
Medium Hubs	570	710	1,280
Small Hubs	310	430	740
Non-Hubs	290	200	490
Other General Aviation	455		455
TOTAL	$5,000	$3,549	$8,540

Source: Federal Aviation Administration (Hearings before Subcommittee on Aviation, Sen Commerce Committee, on Airport/Airways Development)

VELOPMENT

bottom of the fuselage. Lights began flashing both inside and outside of the aircraft.

On the flight deck one of the crew members cried, "Pull up."

As the stricken airliner lurched into the outstretched trees several terrified passengers looked out the window to see the right engine, silhouetted by pounding snow, ablaze with flame.

Suddenly the right wing collided with the trunk of an outstretched tree ripping it from the fuselage and plunging the Convair over on its back hurtling to the ground, two and a half miles short of runway 32 in the wooded, snow-covered Pennsylvania hills.

18 passengers and the two-man flight crew were killed.

Incredibly, 13 days later a second Allegheny Airliner on final approach to runway 14 at Bradford Regional Airport crashed about four and a half miles from the end of the runway, plunging to earth in a snow-covered golf course. Eleven of the 28 on board, including the cockpit crew, were killed.

These two disasters, as I look back, focused renewed attention on our outdated aviation system and created the momentum for Congressional passage of the most far-reaching and significant aviation legislation since passage of the Federal Aviation Act in 1958.

Despite the fact that the probable cause of those mishaps as determined by the National Transportation Safety Board had yet to be determined, many of us in Congress were troubled with the nagging suspicion that our fine aviation system — the best in the world — was not providing the margin of safety and efficiency which we were technologically capable of providing. True, aviation safety in the United States is a fact in which we take pride and we have always been proud of the fact that flying is the safest way to travel.

But was aviation as safe as it could and should be? Were there gaps in our system that had grown as a result of insufficient funds and investment? Were there things that needed doing that could provide the greatest margin of safety possible?

In my view, which was shared by a number of my colleagues at the time, there was much we could do and we felt we must do it soon.

Ironically, my longtime friend and colleague the former Senator from Oklahoma, A. S. Mike Monroney,

Editor's Note: President Nixon on May 21, 1970 signed into law the Airport/Airways Development Act of 1970.

had been aware of the dangers of our overcrowded and antiquated airport/airways system back as early as 1966. As chairman of the Senate's Aviation Subcommittee at that time, he and Senator Howard Cannon had held extensive hearings regarding the nation's inadequate aviation facilities. Following many months of effort, the Commerce Committee reported an airport/airways development bill in the summer of 1968 designed as a start toward providing the necessary funds to upgrade the system.

Unfortunately, because of bickering between the Bureau of the Budget and the Department of Transportation and because of opposition from most of the aviation interests, the bill was stalled on the Senate calendar, never to be acted upon. Incidentally, during the summer of 1968 we witnessed the first full scale slowdown of our air traffic control system brought about, in part, by the lack of controllers and equipment needed to handle the ever increasing number of aircraft using the system.

Despite these delays which focused attention on the critical needs of the system and the persistent feeling that our system had too long been neglected, 1968 passed without any final action toward seeking a solution.

Following the two tragedies in the winter of 1968-69 my staff and I sat down with officials of the National Transportation Safety Board to review the air safety situation.

It was not a reassuring picture.

For example, I was astonished to learn that of the 565 airports in the United States served by the certified airlines, less than half are equipped with instrument landing systems, a precision approach aid. ILS, as it is known, furnishes the pilot precise and instantaneous information with respect to deviations from the approach path trajectory which permits him to make fine corrections in airspeed and rate of descent which results in a highly stabilized approach plus a very accurate trajectory to the touchdown point on the runway. Of course, the use of ILS permits operations with lower weather minimums than without and in addition it furnishes the pilot a very valuable cross check on his descent even when weather is not an important factor in landing.

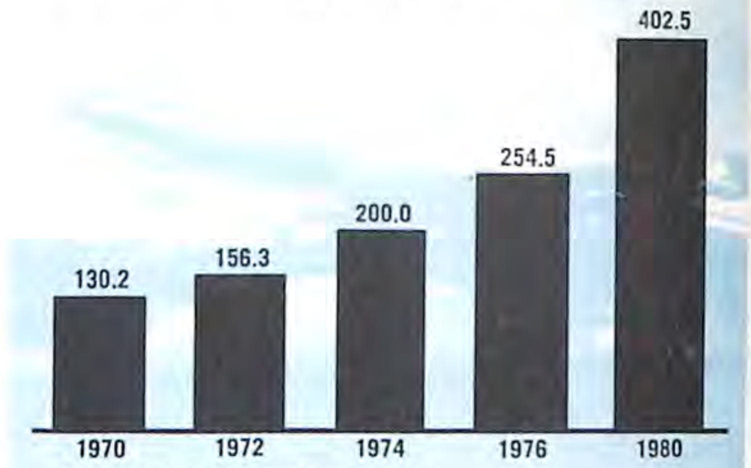
The Safety Board staff advised us that the two Bradford mishaps probably would not have occurred had ILS been available at that airport. (In the summer of 1969, despite the critical lack of funds, the FAA installed ILS at Bradford).

We further learned that control towers — the point from which controllers control the movement of traffic on and in the vicinity of the airport were lacking at more than half of the nation's air carrier airports, very greatly increasing the risk of collisions in those areas where they were lacking.

We found that another important air traffic control — surveillance radar — which permits the controller to monitor visually all traffic in his area and to quickly detect potential conflicts, is available at only 84 airports in the United States.

The fact that our air traffic control system was inadequate and obsolete was certainly borne out by the examples I have mentioned. Unfortunately, because of the severe budgetary limitations brought about by the

SCHEDULED REVENUE PASSENGER-MILES FORECAST
(IN BILLIONS)



Source: Federal Aviation Administration

conflict in Viet Nam and our other pressing domestic needs, these important improvements required in the nation's aviation system were continually being deferred because other expenditures — as viewed by the Bureau of the Budget — demanded higher priority.

Of course our air navigation system is only one component of the entire picture. Also of major importance, and up until 1969, the matter receiving the most attention was the fact that the nation's system of airports was seriously falling behind in accommodating the tremendous growth of air travel in the United States. By 1969 frustrating and costly delays were becoming commonplace for travelers destined for our great cities.

New York, Chicago, and Los Angeles were suffering severe strains because of the lack of capacity of their runways, taxiways and ramps to accommodate quickly the traffic that was increasing daily. It became routine to have 15 to 20 airplanes circling over these great cities sometimes for an hour or more, waiting to land, simply because there was no more room on the ground for airplanes. Passengers were often forced to sit for long hours aboard their planes as they waited in endless lines for clearance to take off.

Since 1946 the Federal government has been assisting local airports in meeting their development needs. Airport aid grants have helped more than 2,000 local communities in building, expanding and modernizing their airports.

While this program of Federal assistance has been very helpful, it became obvious in the mid-1960's that the meager Federal funds available were completely inadequate to meet the tremendous expansion required in our airports. For example, in 1969 only $30 million was available for grants. In that year the Federal Aviation Administration received requests for more than $400 million in assistance. Obviously Federal aid was severely inadequate in light of these needs.

With that background in mind it was clear to Senator Cannon and me that we could no longer be delayed by discussion and petty disagreements on how to proceed. We were convinced that a vast new Federal program, funded by sufficient revenues, was necessary immediately if we were to begin to meet the needs of the aviation system and preserve the level of safety expected by a nation grown accustomed to flying.

It was also clear that any legislative program designed to assure necessary funding for our needs must include two objectives. That program had to include funds for both airport development and airways facilities and must make sure that an adequate amount for each was guaranteed each year for a relatively long period of time.

I recall that early in the spring of 1969 I heatedly disagreed with some in the aviation community who were urging Congress to approve a program calling for new and increased user charges to fund an airport aid program only.

Those advocating this position contended that our woefully inadequate airways system could continue to be financed through the regular annual appropriations process in which Congress approves money for FAA facilities. It was my view, after serving on the Appropriations Committee for many years, that the Administration would simply not ask Congress for large new expenditures to upgrade the airways system because of the press of other competing priorities.

I was convinced that unless we set aside user charge derived revenues for both airport and airways airways facilities would continue to be neglected.

With Senator Monroney's proposal of 1968 and the Administration's recommendation of 1969, the Committee went to work in earnest in the summer of 1969 to develop new legislation. Five months later, after countless hearings, executive meetings of the Committee and conferences with industry, the Senate bill emerged from Committee in December. I am pleased that in large measure the provisions we designed in our program were accepted by the Conferees from the House with whom we met this spring to resolve the differences in the two programs approved by the two Houses.

Our most important objective was to establish a long-term program, financed both through user charges and from general revenues, to begin developing the total system required in the 1970's.

While the major burden of the cost of this program will be borne by the airline passenger and shipper who will pay new and increased user taxes, the major benefits, both in terms of safety and efficiency, will be well worth the modest expense to those who use and rely upon our air transport system.

Basically, the new legislation establishes a ten-year program and an aviation trust fund to provide for the development of airports and airways. User charges will bring in revenues of over $9 billion over the ten year period with over $5 billion of this amount earmarked for airport development grants and for the acquisition of air navigation facilities so vital to the continued safety and efficiency of our system.

For example, the legislation sets aside at least $250 million per year for air navigation facilities. This will enable the Federal Aviation Administration to equip every air carrier airport in the United States with an instrument landing system and with a control tower. In addition, it will provide the funds to completely revamp the en-route and terminal air traffic control system with automated equipment and computer tracking of IFR flight plans filed by all air carrier aircraft.

Not only will this annual investment provide a far greater margin of safety to the traveling public; it will also greatly streamline the air traffic control system and its procedures, greatly reducing the workload of our air traffic controllers while providing greater system capacity for more aircraft.

In addition, the legislation sets aside at least $280 million per year for airport development grants to allow the nation's 3,200 publicly owned airports to modernize and expand their runways, taxiways, ramps and related safety equipment.

Compared to the Federal investment in airport facilities over the past ten years, which has been less than $700 million, the $2.5 billion to be spent on airport grants during the 1970's will allow us to make tremendous strides toward making our airports capable of meeting the air travel needs for years to come.

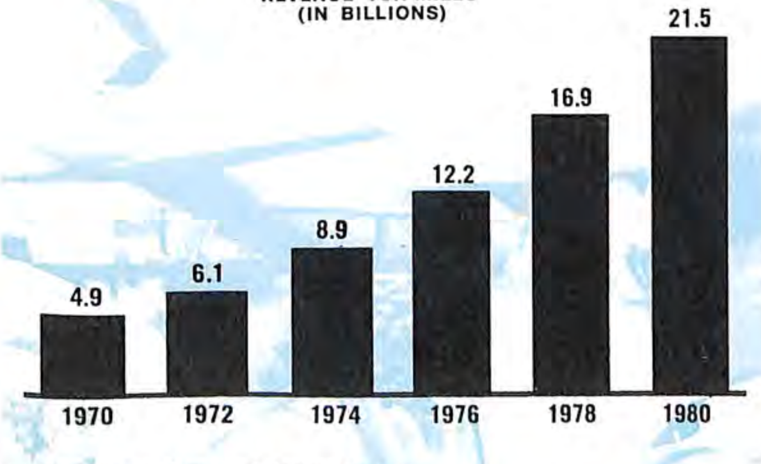
I am disappointed that the final legislation does not permit funds to be spent for those facilities in the terminal building directly related to the movement of passengers and their baggage. While this provision was a key part of the Senate bill, the House conferees would not agree to its inclusion, claiming that the Federal government had no responsibility or interest in improving terminal facilities. I have argued strongly that because the air line passenger will pay for nearly 90 percent of the development needs through the 8 percent passenger excise tax, he is entitled to a total system program that meets his entire needs. Certainly the lack of adequate ramp space, boarding areas, and baggage claiming facilities is the greatest bottleneck in many of our nation's airports.

Next year I will sponsor an amendment which will allow the inclusion of such development under terms of the program and am hopeful that, after reexamination, Congress will approve it.

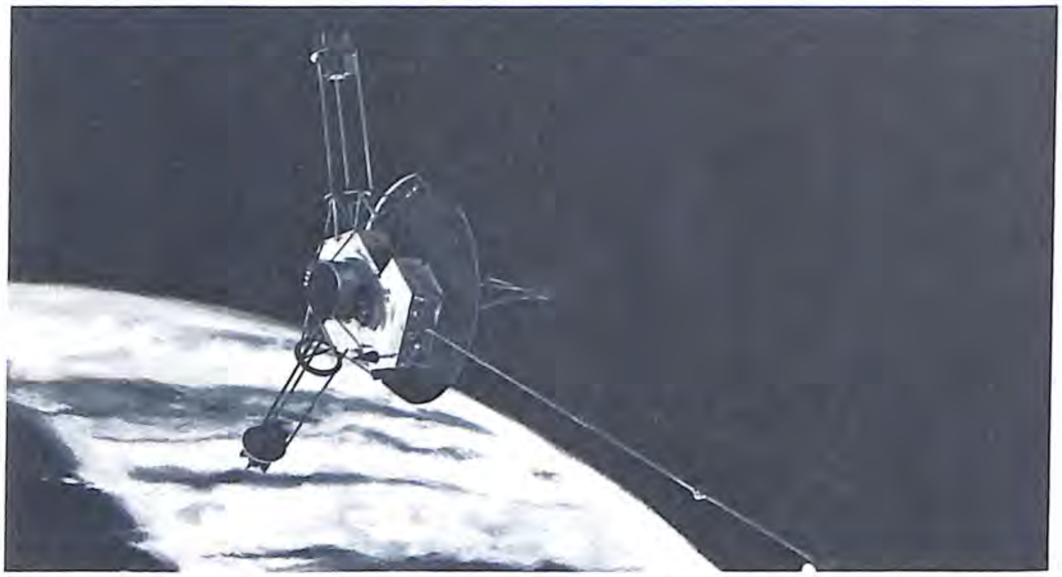
Despite that, our program as now passed is a good one. Like the Federal Highway Trust fund, financed from highway user taxes, the aviation trust fund will assure a continuous source of financing for our vitally needed facilities. The trust fund will assure that these needs will be met on an orderly and timely schedule without suffering the vicissitudes caused by other national spending which in the past has placed aviation development low on the list of national priorities.

While all users of the system will shoulder the burden through increased taxes all will share the benefits of a modern efficient, safe air transportation system for many years to come.

SCHEDULED AIR CARGO FORECAST
REVENUE TON-MILES
(IN BILLIONS)



Source: Air Transport Association



Jupiter Navigation Sensor To Be Built by Honeywell

Honeywell Radiation Center is building a key navigational sensor on the experimental space probes of Pioneer F and G spacecraft to Jupiter.

One goal of the F and G probes in 1972 and 1973 is to determine requirements for the proposed "grand tours" of spacecraft to the outer planets of our solar system in the late 1970s.

"The sun sensor we will provide for the Pioneer spacecraft has the potential capability needed for the grand tours in both range and accuracy," said John L. Wilson, Jr., general manager of the electro-optics facility.

The Pioneer spacecraft is built by TRW Systems Group, prime contractor to the Ames Research Center of the National Aeronautics and Space Administration.

The sensor has an accuracy of better than a half-degree and a range of from zero to 170 degrees.

Radioactive Device Used To Check Wear Metal in Oil

A device using radioactivity to measure extremely small quantities of wear metal in the oil of an operating jet engine is being developed by United Aircraft Research Laboratories.

By analyzing the oil in the engine, such a device would monitor the metal content of oil flushed from wearing parts and serve as an indicator of possible failures before they occur.

Measurements have been taken with a sensitivity as low as five parts per million iron in laboratory oil samples by using a radioisotope-excited X-ray source and a semiconductor detector.

Packer said this was the first known measurement of iron-in-oil performed with a radioactive source that has the potential of being applied to an engine monitoring system.

Currently, the engine operators monitor the oil-wetted parts of gas turbine engines by periodically measuring the presence of wear metals in oil samples taken from the engines. However, there are drawbacks to this system, including the problems of actually taking samples, the failure to obtain uniformly representative samples of the lubricant, and the delay in obtaining results from laboratory tests.

Ultimately, the United Aircraft method could be used aboard the aircraft as another instrument to monitor the engine constantly and determine its condition.

General Dynamics Develops 21-ounce Radar Altimeter

A radar altimeter weighing 21 ounces has been developed by General Dynamics for use on helicopters, vertical and short takeoff and landing aircraft, and low flying aircraft.

Capable of measuring altitudes to 2,000 feet, the new altimeter uses monolithic integrated circuits for compact construction.

The altimeter, designed for high reliability, enables aircraft flying at low altitudes under adverse weather conditions to determine its altitude from 20 to 2,000 feet above ground. Accuracy is within 2 feet and 3 percent of altitude. A simple modification makes possible readings to ground-zero.

Graphite Fuselage Section Meets Target Design Load

A cylindrical shell assembly, representative of a sub-scale aircraft fuselage section and believed to be the largest and most complex graphite composite structure yet fabricated and structurally tested, achieved 110 per cent of its target design load requirement at the completion of a series of structural response tests.

Conducted at the Bell Aerospace Division of Textron, the tests also involved the work of Union Carbide Corporation's Carbon Products Division, which fabricated the composite fuselage section, and Case Western Reserve University, both of Cleveland, Ohio. The three participants comprise the industry/university team that analyzed, designed and fabricated the fuselage section, established test procedures, conducted the test and analyzed the resulting data.

The Union Carbide/Case/Bell research program is being sponsored by the Defense Department's Advanced Research Projects Agency and administered by the U. S. Air Force Materials Laboratory.

Although the activities connected with the fuselage component comprised by far the largest single program effort, research was and is being conducted in several other areas of graphite fiber composites.

Included in these are studies on characterization of the graphite-fiber, resin-matrix interface, development of new and improved resin and metal matrix composites, application of advanced theories and computer programs to the structural analysis and synthesis of composites, testing and mechanical characterization of composites, and the design and testing of reinforced cutouts in composite structures.

Mockup of Space Shuttle Used for Visibility Studies

An engineering mockup aimed at a space shuttle of the late 1970s, has been designed at Lockheed Missiles & Space Co.

Because the shuttle will be a do-anything system — and both an airplane and a spacecraft — its crewmen will need a broad range of visibility, possibly including both windows and instrumented viewing. The system has prompted a wedding of aviation and space technologies.

"The shuttle will perform its missions like a conventional spacecraft," says James K. Gerrie, an expert in human factors. "But then it must re-enter the earth's atmosphere at orbital speed (about 17,500 miles an hour) and maneuver to a horizontal landing like an airliner."

The Lockheed mockup looks much like the cockpit of a jetliner, with dummy instruments, controls, information displays and seats for the pilot and co-pilot. In addition, there are waste management and food-water management stations typical of spacecraft cabins.

The cockpit's engineering subtleties are in the size, design and composition of the windows and in the finely controlled adjustability of the seats, as well as the precise arrangement of the instruments.

"We're most concerned with the eyepoint — the exact spot within the cockpit from which the pilot views everything around him," Gerrie says. "Our aim is to design a cockpit in which almost any adult, by adjusting his seat, could fit a pre-determined eyepoint.

"This is because the space shuttle must be adaptable to a very wide range of people. NASA doesn't want to have to eliminate small or large men from the available pool of pilots."

Once a pilot takes his seat and aligns himself with the desired eyepoint, he will be able to reach all his instruments comfortably — and, more important, will have the best possible visibility, whether windows or other viewing devices are used.

Final Vela Satellite Launch Made from Cape Kennedy

Final launch in one of the Air Force's oldest space programs was recently accomplished. A USAF Titan III-C placed two Vela nuclear test detection satellites into an existing constellation of ten Velas orbiting the earth.

From their vantage point 60,000 to 70,000 miles above the earth, the Velas are monitoring earth and deep space for signs of nuclear weapons testing in violation of the intent of the Nuclear Test Ban Treaty.

The satellites are sponsored by the Advanced Research Projects Agency and are under the direction of the Air Force Space and Missile Systems Organization. The spacecraft were designed and developed by TRW Inc. and the payload was designed and developed by the Atomic Energy Commission. The program has been credited with:

- The longest continually operating spacecraft.
- Saving the government $26 million.
- The first spacecraft incentive contract.
- Achieving 100 percent of its objectives.

Aerospace Facts and Figures for 1970 Available Soon

The 1970 edition of *Aerospace Facts and Figures*, which contains current and historical statistics on all major aerospace activities, will be off the press in June.

The book contains complete statistical as well as textual information on such industry programs as aircraft production, missile and space programs, foreign trade, research and development, manpower, finance and air transportation. A complete listing of the public relations officials of AIA manufacturing members is also included.

The 1970 *Aerospace Facts and Figures* is the 18th annual edition of this publication. The book provides management in both government and industry, writers and editors, analysts and students with complete historical trends of the aerospace industry's activities.

Copies may be obtained from: Office of the Publisher, *Aviation Week & Space Technology*, 330 West 42nd Street, New York, N. Y. 10036. Price is $3.95.

Pacific Airmotive Unveils Huge Jet Engine Test Cell

A mammoth new 100,000-pound-thrust jet engine test facility has been constructed by Pacific Airmotive Corporation.

No other commercial test facility exists which will handle all of the new generation, high thrust jet engines, including those for the Boeing 747, Lockheed L-1011, McDonnell Douglas DC-10, and the SST. The new test cell represents an investment by PAC in excess of $1.5 million.

The cell's credentials were fully established in an acceptance test featuring a maximum thrust run of a Pratt & Whitney JT9D jet engine.

The JT9D test was the first in a series of engine tests in preparation for the total maintenance and support of American Airlines' 747 engines. The cell made possible another PAC "first" — a major contract with a major airline for large jet engine repair, overhaul, and spares support services.

DEFENSE PROFIT PICTURE DECLINE

CONTINUES

The Logistics Management Institute of Washington is a private, nonprofit fact-finding and research organization which was incorporated in October 1961. Until this spring it contracted exclusively with the Office of the Secretary of Defense; it has now broadened its activities to include work for other Federal agencies such as the National Aeronautics and Space Administration.

Defense industry profits declined in 1968 both in relation to total sales and in comparison with commercial business profits, the Logistics Management Institute reported in its latest survey.

Trends that developed in 1958-1967, and were reported by LMI in a study published in March 1969, continued during 1968, according to the latest study made by LMI at the request of the Department of Defense. Over the eleven-year period, profits after taxes dropped by about one-third. Profits on sales before taxes had several ups and downs but declined steadily from 1966 through 1968 to a point matching the previous low in 1963.

The authoritative survey clearly rebuts the isolated but persistent charges that defense contractors enjoy unreasonable profits. In fact, it demonstrates that defense business may well be burdensome in the sense that much greater profits can be made in commercial activity.

(Dovetailing with LMI's report is another compilation recently published by the First National City Bank of New York. It shows that average net (*after* taxes) income on *total* business of the aerospace industry declined to 2.5 percent of sales in 1969, compared with a profit-to-sales ratio of 5.4 percent for the manufacturing industry as a whole. Aerospace profit percentage was 2.8 percent in 1968, it said, compared with 5.7 percent for the manufacturing industry average that year.)

Specific LMI findings included:

Average defense business profit after taxes as a percent of total capital investment declined by nearly one-third (32.7 percent) over the 11-year period, from 10.1 percent in 1958 to 6.8 percent in 1968.

Profit averages of commercial business activity of the defense companies surveyed and of durable goods manufacturers in the Federal Trade Commission-Securities Exchange Commission (FTC-SEC) index (which had a substantial upward trend through the middle years of the study period) were lower than defense business profit in the first four years but higher in each of the last seven years.

The gap, which narrowed in 1967, widened in 1968. Commercial business profit after taxes of the surveyed defense firms rose from 7.0 percent in 1958 to a peak of 11.6 percent in 1965, declined to 7.4 percent by 1967, and rose to 8.3 percent in 1968. In the broader FTC-SEC index, company profits after taxes rose from 7.1 percent in 1958 to a high of 12.6 percent in 1965, dipped to 10.1 percent by 1967, and rose slightly to 10.2 percent in 1968.

Defense profits on sales before taxes decreased from 5.4 percent in 1958 to 3.9 in 1963, rose to 4.8 percent by 1965 and declined steadily to 3.9 percent by 1968.

Commercial profits on sales before taxes of defense companies surveyed rose from 6.6 percent in 1958 to 10.1 percent by 1965, dropped to 9.2 percent in 1966 and 6.4 percent in 1967, then rose to 7.6 percent in 1968. FTC-SEC index companies' profits on sales before taxes rose gradually from 7.1 percent in 1958 to 10.4 percent by 1965, tapered off to 10.0 percent in 1966, dropped to 8.7 percent in 1967, then rose to 9.4 percent in 1968.

The commercial market of defense industry companies, as well as that of the durable goods industry in general, has expanded much more rapidly than has the defense market.

LMI found that while defense sales of the companies surveyed increased about 50 percent in the study period, commercial sales of the same companies rose about 200 percent. FTC-SEC index companies' sales increased more than 115 percent. In fact, LMI said, the commercial expansion was greater than it would appear to have been, based on the commercial data submitted, since some of the sample companies involved in mergers and acquisitions continued to submit data for only their original reporting organizations.

High-profit defense business has been less profitable than high-profit commercial business. Low-profit defense business was more profitable than low-profit commercial business during the period 1958-61, but has been less profitable than low-profit commercial business during the years 1962-68.

In its 1969 report LMI concluded that low-profit defense and commercial business were about the same in profitability in 1962-67. That finding was based on a comparison of defense Profit/Total Capital Investment ranges with the Profit/TCI ranges on the commercial business of the defense companies; at that time, FTC-SEC ranges were considered more appropriate for comparison purposes, but no such ranges were available.

For the latest report, LMI developed a random sample, consisting of 258 companies, which it considers representative of the FTC-SEC industrial comparison group companies. The resulting Profit/TCI yearly ranges were generally higher than the ranges on the commercial business of the defense companies shown in the previous report.

The most recent LMI study finds that the conclusions published in the earlier report are still valid and require no change. They include:

Increased use of competition (more high-risk contracts) in DoD procurement has been the major cause of the decline of 24 percent in profit-to-sales ratios of defense business before taxes over the 11-year period.

LMI found that the decrease in defense profits on sales resulted because defense sales included a much larger proportion of higher-risk fixed-price business in the latter years of the survey period. A new development during 1968 was that profit on sales under cost-plus type fees, which had risen steadily in the preceding several years, declined markedly: cost-plus-fixed-fee from 5.0 percent in 1967 to 4.2 percent in 1968, and cost-plus-incentive fee from 5.7 percent in 1967 to 5.0 percent in 1968.

Profit on sales under fixed-price-incentive contracts, which had declined sharply in 1967, rose slightly from 3.9 percent to 4.1 percent; in the firm-fixed-price category, which had risen from 2.9 percent in 1966 to 3.7 percent in 1967, there was a drop to 3.3 percent. Profit on price-competitive sales (which are also included in the totals for FPI and FFP contracts) rose from 0.9 percent in 1967 to 2.0 percent in 1968.

The survey found that price-competitive defense business showed a sharp decline in profit on sales in the first five years and yielded a result around zero on that ratio from 1963 through 1967. Separating price-competitive and non-competitive business within the area of firm-fixed-price contracting, LMI found that the non-competitive, firm-fixed-price profit-to-sales ratio on contracts negotiated under the weighted guidelines method during the past several years has been around 10 percent. For the overall firm-fixed-price profit-to-sales ratio to be as low as it is, LMI concluded, profit on sales on price-competitive firm-fixed-price business must have averaged approximately zero.

LMI also attributed the declining profits to the accelerated inflation in the last several years. Contractors underestimated inflation-related cost increases which were to occur during the performance of contracts.

In price-competitive sales, the report noted that the gain in the profit/sales average of 1.1 percent (from 0.9 percent to 2.0 percent) reflects only price-competitive *prime* contract sales, since the competitive contracts were identified by DoD and furnished to the companies. LMI said the 1968 ratio is considerably lower than it would have been except for the impact of a few large companies. For example, if the competitive sales and profits of two companies were omitted from the group, the 1968 profit/sales ratio on competitive contracts would have been 4.9 percent rather than 2.0 percent. This may indicate that some of the other companies have completed write-offs of high-risk contract losses which impacted on their profits in 1967 and prior years.

Increased company investment in facilities has been primarily responsible for reduced total capital turnover on defense business.

LMI found that the ratio of facilities (at net book value) to sales for those companies examined rose more than 45 percent from 1958 through 1967, while the same ratio increased less than 4 percent for the average of the FTC-SEC index companies. The ratio of company investment in defense facilities to sales decreased slightly from 1967 through 1968 because sales volumes rose substantially. The fact that DoD resistance to providing facilities started in 1961 appears significant, LMI reports.

Increased use of fixed-price contracts has been partially responsible for reduced total capital turnover on defense business.

Because of DoD's decreased use of cost-reimbursable contracts in the 1960s, companies had to provide more of the working capital required for defense business, LMI points out. The ratio of net working capital to sales for the companies surveyed rose about one percent over the study period. LMI further noted that the same ratio declined more than 12 percent for the FTC-SEC companies.

The change in the mix of commercial and defense business has resulted in more competition for resources and for new capital within the defense industry.

Because of the shift of defense firms toward more commercial business, LMI noted there is more competition for existing resources such as personnel, facilities and money. Commercial business is competing with defense for both quantity and quality of those resources in companies where commercial business was a relatively unimportant sideline a few years ago.

LMI urged that DoD study whether major defense contractors are likely to be drawn away from the defense market by more attractive commercial profit opportunities.

The Institute is also concerned that fixed-price type contracts may have been used injudiciously in some cases.

As a result of its review, LMI also feels that there is a need for re-surveying DoD policy in the non-competitive defense business area. The weighted guidelines method of arriving at profit rates should be revised to give much greater emphasis to contractor capital required, both fixed assets and working capital, according to LMI.

Return on total investment is the most logically sound and widely accepted indicator of overall company performance, says LMI, and company capital requirements differ substantially for reasons largely beyond the control of company management. Therefore, return on such investment cannot be equitable and motivate decisions in the interest of the customer unless companies with the largest capital requirements can earn higher profits on sales than do those with light capital requirements.

LMI Profit Study Background

Results of an initial LMI survey made for the Department of Defense were released early in 1968. They were based upon financial data voluntarily supplied by 65 defense contractors for the period 1958-1966. The survey was continued to include data for 1967, and the consolidated results were released on April 14, 1969. In June 1969 the Department requested LMI to update the review by securing data for the year 1968.

The companies surveyed in the updating were medium- and high-volume firms having annual defense sales ranging between $25 million and $200 million and those beyond $200 million for which defense sales represented at least 10 percent of total company business. Defense profit figures were compared with the commercial business of each company surveyed, and with profits of 3,500 industrial companies selected by the Federal Trade Commission and the Securities Exchange Commission (FTC-SEC) to provide economic reports on manufacturing corporations.

In its latest report, LMI noted that it had developed new material as the result of questions raised after publication of the 1969 review. For example, there was some speculation that the statistical validity of LMI's findings and conclusions might have been affected by the failure of some solicited companies to participate in the study.

For the 1958-67 profit review, information had been solicited from a total of 55 high- and medium-volume companies, drawn at random. Fifteen of the 55 declined to participate on grounds that they were unable to meet LMI's data requirements. Thus it became necessary to establish whether the profit experience of non-participating companies was likely to be different from that of participating companies. It was logical to ask whether the 15 declined to participate because they did not wish to reveal high profit on defense business.

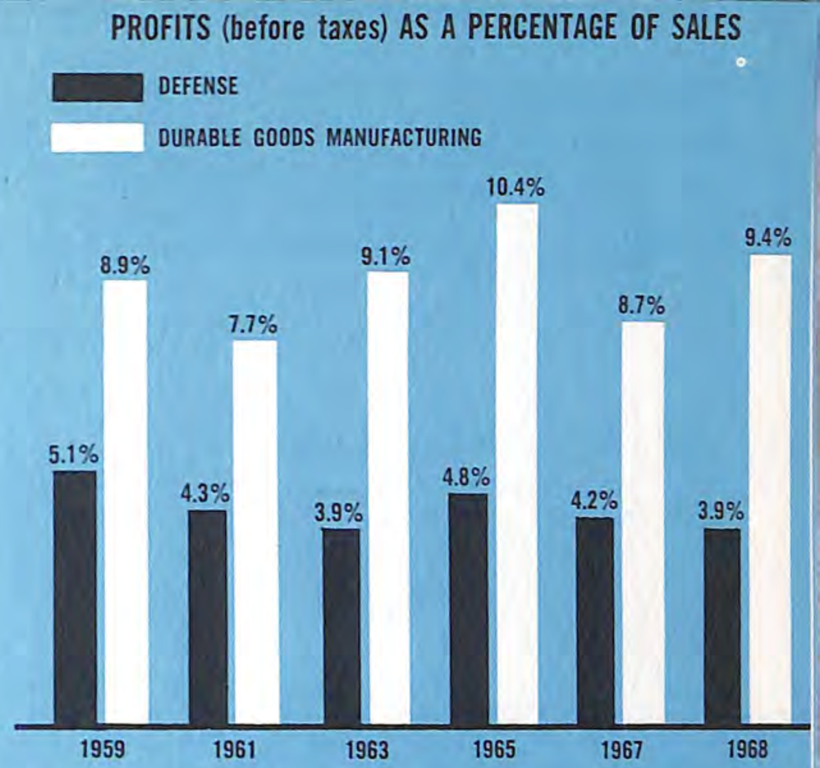
As noted in its 1969 report, LMI was granted permission by the companies involved to review the Renegotiation Board records of some non-participating firms. As a result, it concluded that their failure to participate did not create any bias in the sample.

DoD has now secured profit data from *all* of the solicited non-participating companies. A new LMI analysis incorporating these data shows that the previous average profit rates of the 40 companies and those of the non-participating companies are statistically the same, and that the latter firms did not prove to be "high profit" companies.

Critics had also asked whether company capital was allocated properly between defense and commercial business; whether defense profits should not be compared with an industrial sample which did not include any of the major defense companies shown in the LMI sample; and whether total profits of defense-oriented companies should not be compared with total company profits of commercially-oriented companies.

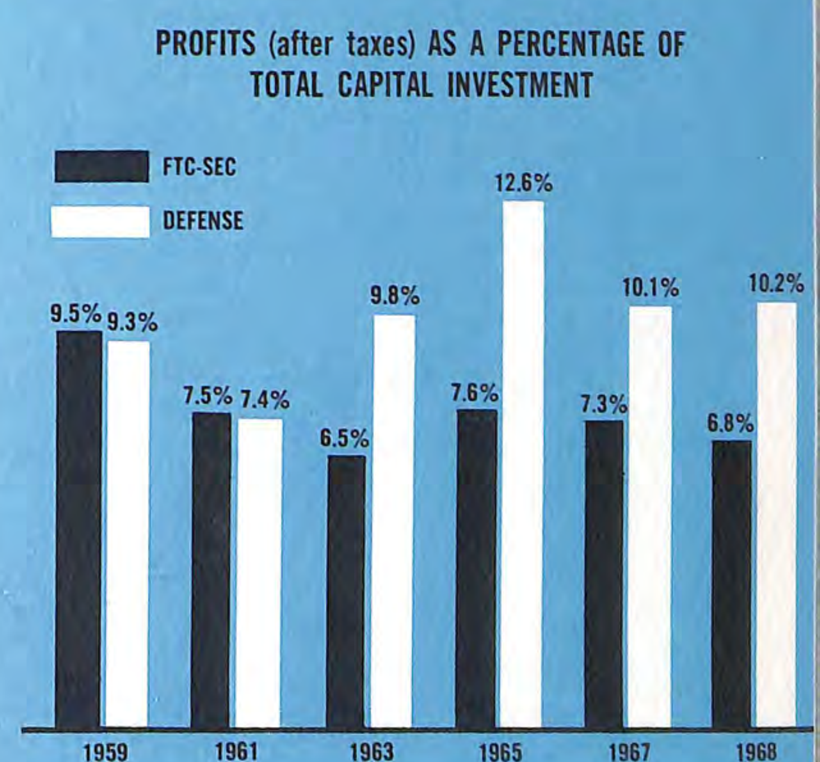
New tests and analyses were conducted by LMI to meet all of these questions. The new study determined that:

- The absence of any inconsistencies in any year throughout the 11-year period can lead to no other conclusion than that the capital allocations are completely adequate to support the findings of its study.
- Removal of the major defense companies from the FTC-SEC industrial comparison group would generally increase the difference between defense Profit/Total Capital Investment (TCI) ratios and those of the FTC-SEC sample.
- It appears that lower profit on defense business of the defense-oriented companies could account for their overall profit rate being lower than that of companies whose business is commercially oriented.



Defense contract profits, based on a percentage of sales (before taxes), declined in 1968 for the second consecutive year, matching the decade's previous low point in 1963 of 3.9%, according to the latest survey by the authoritative Logistics Management Institute. During the same year, profits on durable goods manufacturing in general rose to 9.4%, widening the gap which had narrowed slightly in the previous year. Historically, percentage earnings of durable goods manufacturing as a whole are about twice those of defense.

Source: Logistics Management Institute



Defense profits after taxes, in relation to total capital investment, were higher from 1958 through 1961 than either the profits of the defense companies' commercial business or those of the FTC-SEC index companies. This soon changed, however, and from 1962 through 1968 defense profits were lower than those in the other two categories. From 1958 through 1968 they declined nearly one-third, or 32.7%.

Source: Logistics Management Institute

The following is excerpted from testimony by Dr. John S. Foster, Jr., Director of Defense Research and Engineering, before the Joint Committee on Armed Services and Defense Subcommittee, Senate Appropriations Committee.

R&D

Our life as a free and independent nation derives in large measure from the effectiveness of our defense establishment. At least since World War II, that effectiveness has derived fully as much from vigor of our national technology as from the numerical level of our forces. In fact, even when our forces were or could have been outnumbered in the past, they have been effective as a deterrent because of their technical quality. The quality of our advanced technology derives from:

- University research and teaching
- Industrial research and development
- DoD support of defense-related R&D, including in-house laboratories
- Discussion of national security issues among informed, experienced and independent individuals.

Our valuable technological superiority is today being challenged strongly from abroad. The most serious challenge comes from the Soviet Union, whose annual defense-related R&D investment caught up with ours a year or so ago and now substantially exceeds it. The effort of our national technical base is, in fact, declining while their effort continues to grow at a steady rate. I am deeply concerned about this trend.

We know that the two essential elements of our national security are adequate force levels today and vigorous technological advances to ensure our future capability. The two essentials compete with each other, and with other national needs, for scarce funds. They can easily be confused by persons considering disarmament agreements in which it would be relatively easy to monitor force levels but almost impossible to regulate technology, especially where secrecy dominates a society. If force levels were to be controlled, we then would become especially sensitive to technological surprise. But advances in technology are essential if we are to limit, safely limit, force levels. Otherwise, we would not remain relatively secure against both surprise and possible nonadherence to an arms-limitation agreement.

My conclusion is that to provide adequately for the common defense, we must ensure the continued vigor of our technology. To do this, we must ensure that the foundations of our technical strength — in universities, industry, and Defense R&D labs and centers — are not weakened or separated from our technological drive.

Some people today seem to think that Defense R&D does more harm than good. They ask: Aren't you building weapons that do not increase security but rather decrease security and increase the taxpayer's burden? Others have a "gut feeling" that new technology, all new technology, causes more problems than it solves, and that because scientists seem oblivious to the terrible

THE SOVIET CHALLENGE

social and economic costs of their triumphs, their work must be controlled by curtailing their financial support.

Most Americans do not agree, of course, but this controversy can threaten the nation's entire research and development base. It has the most profound implications for our future national security. We must talk soberly about it. There are three related areas:

First, the continuing need for Defense R&D in a changing military environment.

Second, the national and international significance of having strong Defense R&D and a strong overall national R&D activity.

Third, issues surrounding Defense R&D.

It seems reasonably clear that the decade of the 60s and particularly the late 60s, was a turning point for the military establishment in the United States. We have been through a quarter-century of war and near-war, and during most of this period our Defense needs have been awarded essentially an overriding priority. But today, as a writer in the January issue of *Foreign Affairs* put it: "Not since World War II have Americans been so uncertain about the proper role of the United States in the world."

Much of the change in the last few years has been directly concerned with the broader implications of the Vietnamese war and America's other involvements abroad. Many persons are skeptical, even hostile, about the competence, judgment, and goals of the Defense establishment and foreign policy. They see no serious near-term military threat.

There is another tendency in public discussions of the Defense Department today: blaming the industrial sector for wars. This outlook characterizes the United States as inherently imperialistic and exploitative, and pins the responsibility for this defect on the "military-industrial complex" and on the political establishment as the agents of the repressive forces inherent in our structure.

Whatever weight we may assign to these beliefs, and whatever we believe individually about their validity, they do contribute to a changing political climate in this country. Thus a new series of issues is raised. The new climate and these new issues will affect our future national security, in part by affecting the resources assigned to Defense R&D, and in part by affecting the flexibility of Defense management in general. That is why I believe we must examine them.

The most fundamental issue rests upon the judgments we must make about the relationship between our capabilities and probability of serious aggression or threats hurting the United States' interest or the interests of our friends and allies.

Consider the tension in Europe of the late 40s, the Korean War, the Russian interventions in Eastern Europe in the late 50s, the Cuban missile crisis, the invasion of Czechoslovakia, and the current Soviet activity in the Mediterranean. All of these threats and potential threats to American interests are impressive evidence that the Soviet leaders remain prepared to act or threaten to act militarily, with major international consequences, whenever their perception of the political-military situation suggests to them that such action is in their interest and feasible. How many more such threats and actions might we have seen had we not possessed techno-

U.S. AND U.S.S.R. R&D FUNDING MILITARY-SPACE-ATOMIC ENERGY

(IN BILLIONS)

1970

During the 1960s, Soviet military R&D increased about 60 percent while the U.S. military R&D increased by roughly 30 percent. Current funding is shown above. The U.S.S.R. has shown concern in the past two years over the technological level of its civil industrial base and appears to be adding resources to this sector, but not at the expense of continued growth in their military-space-atomic energy efforts.

logically advanced capabilities? Clearly, although we are moving into an "era of negotiation," trying to shore up and broaden the emerging detente, we must remain prepared for possible confrontations.

Because of the overriding significance of strategic stability during this nuclear era, past and future, the United States has emphasized strategic nuclear deterrence. Successful deterrence requires advanced technology to ensure that our retaliatory threat continues to be credible. Further, we have required general-purpose forces for those missions necessary to support our security commitments and our allies. These missions also require in some cases sophisticated technology for a variety of combat and support functions.

There seem to me to be two central lessons in the history of national defense needs and threats since World War II. First, as the Durants said in reviewing *The Lessons of History:* "Peace is an unstable equilibrium, which can be preserved only by acknowledged supremacy or equal power." While we must take certain risks to achieve secure and lasting peace, too many risks taken in the interest of peace can at some point become in themselves the threat to peace.

Secondly, we see even greater evidence today that research and development are essential to a prudent national security effort. The reasons for this are essentially the same as in the past, but they require special emphasis today. Let me reiterate these reasons as you consider the budget request.

First of all, research and development provide a qualitative advantage required to compensate for any numerical inferiority which the United States has or might suffer in troops or equipment and for any temporary disadvantage we might suffer should a numerically superior force take the initiative. If we maintain our technical leadership, we can achieve our goals — sometimes at lower operating costs — without necessarily competing with the Soviet Union in total numbers of missiles or bombers or troops. Thus, the quality of our deterrent may be more critical than the quantity of our deterrent — and without R&D you cannot have this quality: You would not have it now, and you will not have it in the future.

The second general argument for Defense research and development is that knowledge creates options which the President *may* need during a period of tension, or during planning, or during negotiations. It is much safer to know what might be feasible in weapons than to have to guess about what a potential enemy is capable of doing. This "option-creating" function is important also because it permits the Defense Department to respond more rapidly and effectively to large changes in national security policy where such changes are caused by increased tension or decreased tension. We can be prepared to substitute new equipment for old if this improves the effectiveness of our forces, or would improve the effectiveness of an arms control agreement.

The third general justification for Defense research and development is that the nation needs as broad as possible a conceptual basis for arms control negotiations, for war, or for a provoked, renewed arms race. We need to act intelligently on national security, including arms control, by considering the broadest possible range of technological possibilities.

My point here is a direct one. To cut the R&D program today is, in effect, to claim great precision in a prediction of the nature of the world in 5 to 20 years and to foreclose on the option of our future leaders who will have the responsibility for our national security at that time. Certainly, let us try hard to cut the costs of the overall defense burden and to negotiate acceptable treaties limiting weapons. But let us not mortgage the future by dismissing or misjudging the critical — and growing — need for defense R&D.

Let me raise one final point regarding the overall U.S. technical base. Recent analyses by the Commerce Department staff have suggested that an important reason for our country's balance of payments problems and for our industry's competitive marketing difficulties abroad is that the U.S. no longer has a predominant position in "technically intensive products."

Many foreign countries are driving hard toward "technological parity" with the U.S. and, in some important cases, have already surpassed us. Japan, for example, relying upon a labor force one-half as large and not quite as well educated as that of the U.S., is advancing almost spectacularly across almost the whole spectrum of advanced technology. Japan's growth rate in technologically intensive manufactured products was 22.5 percent per year during 1955-65, compared with the U.S. at 3.9 percent per year and West Germany at 8.4 percent per year.

The latter data and perspectives are largely concerned with civilian high-technology activity rather than with exclusively military activity. Nevertheless, it would be superficial and perhaps hazardous not to assume that, when other nations' capabilities for advanced technology are already strong and growing rapidly, this has some significance for our long-term national security.

The U.S. must move toward a much more vigorous commitment to national research and development, both military and civilian-oriented, upon which our long-term national technological position can be strengthened.

There are two other points I want to touch on briefly regarding the way in which Defense R&D fits into the national technical activity.

First, some observers have asked: Why does every agency support its own R&D activity? Doesn't this lead to overlapping and duplicating work? The answer is straightforward.

For an agency to improve its effectiveness in fulfilling its mission, it must experiment with new approaches and evaluate them against existing methods. R&D provides tools used to achieve our objectives. R&D thus cannot be conducted effectively unless it is coupled as tightly as practical to the organization responsible for attaining the objective. In the last few years, this has proved again and again as the newer civilian agencies have discovered the needs for — and the power of — serious R&D efforts. Further, for the national R&D base to be healthy in the long term, each agency's R&D program should include some relatively basic research — to deepen our understanding of fundamental problems. In addition, an organization such as the National Science Foundation must assess the national scientific base and support many key projects itself, including some designed to fill in the gaps left by the mission agencies' technical priorities, so that the country has an adequate and balanced total scientific effort. This overall Federal pattern — "pluralistic" support of research — includes little or no unnecessary duplication — and the crucial reason is that no scientist or engineer wants to duplicate another investigator's work unless he has a very good purpose.

A second issue raised by many in Congress is: Why aren't there better measures to gauge the need for R&D and better measures of the quality and the payoffs of the R&D being supported? Frankly, we share this impatience, but no one can know what fruits our labor will produce — that's why we labor.

Our past national position of technological leadership is being eroded and is being challenged seriously by both our friends and our potential enemies. I am deeply concerned about this trend for national security. Second, the Federal R&D management is strongly aware of its responsibilities to avoid any unnecessary work during this period of tight national budgets and fierce international technological competition. We believe we are making every R&D investment count to our advantage.

Two current criticisms of all R&D — insufficient concern with the consequences of using new technology, and excessive Federal support of research and development — have, of course, been focused on the Defense Department. I think we should discuss them forthrightly.

Some have argued that, because other national needs should be assigned a higher priority in the future, Defense R&D has therefore become less important than the R&D related to other national needs. Some critics add that the Defense Department has dominated university research for too long and this situation should be changed. Let me give you the facts.

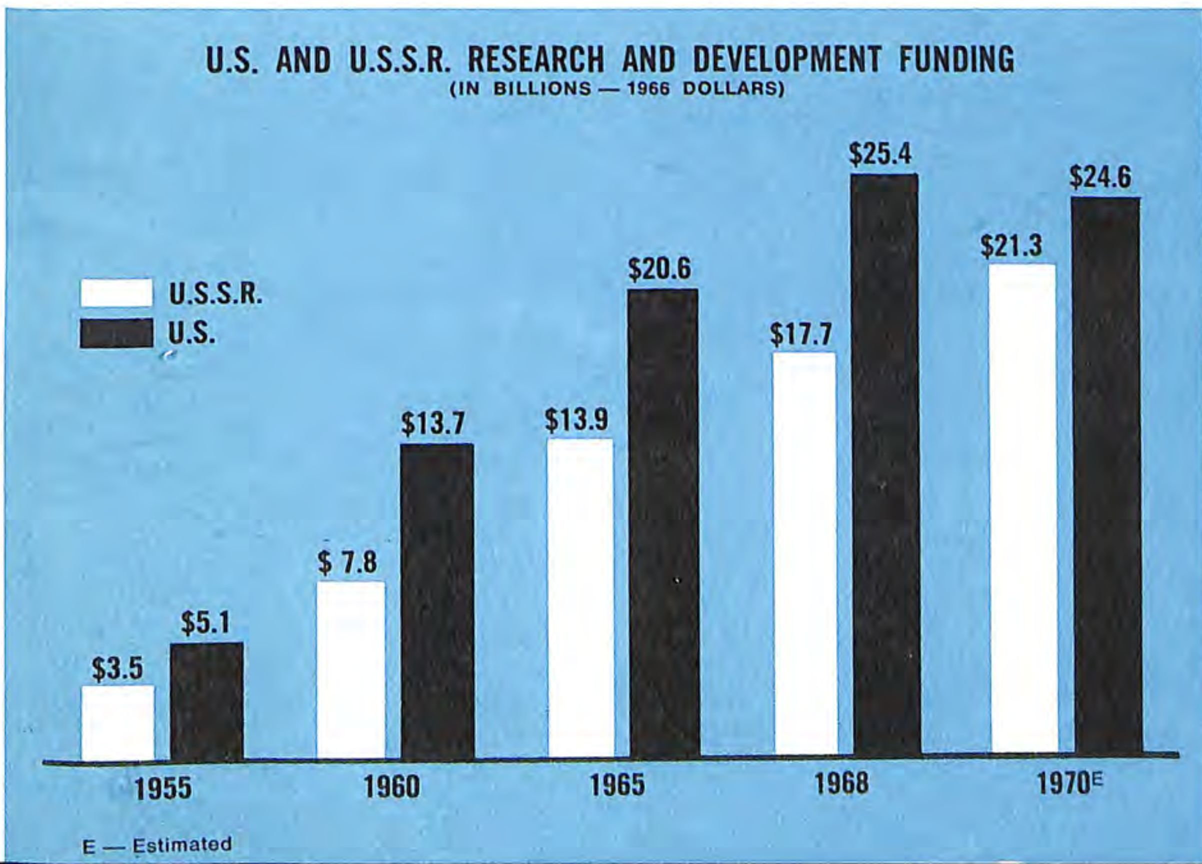
To begin with, over the last 30 years the Defense Department's share of the national research and development activity has declined significantly. In the late 1940s, most of the Federal support of the nation's research and development was provided through the Defense Department. Today, the situation is quite different:

- More than half of the total Federal expenditures for research and development (about $8.2 billion out of $16 billion) is provided by civilian agencies.[1]
- Almost 75 percent of the total national expenditures for research and development (about $20 billion out of $27 billion) is provided by civilian Federal agencies and independent (e.g., industrial) organizations.[2]
- More than 85 percent of the Federal support for academic R&D (about $1.3 billion out of about $1.5 billion) is provided by civilian agencies.[3]

[1] Reference; Special Analysis Q; "Federal Research, Development, and Related Programs," Bureau of the Budget, February 1970, p. 266.

[2] Reference; Same as 1 above, and "National Patterns of R&D Resources, 1953-70," NSF 69-30, p. 14.

[3] Reference; Same as 1 above, p. 257.



Total Soviet research and development has been growing faster during the past decade than total U.S. R&D. U.S. total funding was almost twice that of the U.S.S.R. in 1960, but by 1970 the U.S. total was only about 15 percent greater. During the last few years, Soviet R&D has been growing by approximately 10 percent a year while the U.S. effort has leveled off.

These facts squelch the popular assertion of "Defense Department dominance." And they make it clear that the nation's many growing needs for civilian technology are already reflected in the changing national pattern of research and development. Although I am concerned that the level of Defense R&D may be too low, I support the further growth of civilian R&D.

Another often discussed criticism of defense R&D is that it inevitably and uncontrollably feeds the arms race. The notion is that technology once shown feasible will inevitably be developed into full-scale hardware, that the hardware once demonstrated will be bought in quantity, and that the hardware once deployed will lead to counterdeployments by our potential enemies . . . and thus that arms procurement accelerates while real national security deteriorates.

This is a gross caricature of fact. There is no social institution or human activity which cannot be used for good or evil, peace or war, for attack or for defense. Technology may be used in either arms race or arms control. It is much less the state of technology and much more the state of world politics which determines the use of technology in international affairs. Yet whatever the political-military environment, the modern nation which turns its back on technology is doomed to a second-class existence. I can specifically relate military technology to the arms race by two threads of rational argument.

First, first-class defense-relevant science and technology slows the arms race. For example, it preserves our security by decreasing the possibility of a technological surprise which could destabilize world security balances. No one wishes to have a "Sputnik" — and a 10-year catch-up period — in national security. Further, Defense R&D helps to make arms control agreements possible by decreasing the risks should such arms control treaties be broken. No one wishes to have a Pearl Harbor after a major arms control agreement. And by providing options for qualitative improvements, R&D often enables us to avoid the need for large increases in the size of our forces. Finally, Defense R&D serves as a general "safety device" and "insurance" in that it permits technical experts to understand and apply facts and judgments to Defense decisions. Just as no one wishes to have our troops, if and when called to combat, equipped inadequately, no one wishes to have the technological aspects of an actual or potential threat analyzed by persons who do not have access to first-class technical knowledge.

Second, it is a combination of civilian leadership and public control that makes the decisions about the application of available technology. Decisions about every major procurement are subject to intense reviews by the Secretary of Defense, by the President and by the Congress. In these reviews, we are deeply concerned about the possible consequences of using new technology. We do separate clearly the issues of whether-to-R&D from whether-to-deploy. We do question the need, the real and potential threat, the costs. Many possible systems are rejected for many different kinds of reasons.

Defense R&D is a "hedge" against the unknown and is a reservoir of concepts and talent required to ensure our security. There is no "mad momentum" inherent in this outlook.

Every year for many years, senior officials in the Department have explained not only the achievements of R&D but also the problems in R&D management and our efforts to solve them more efficiently. The main reason this subject has received so much high-level attention is that it is in many respects our most important and most difficult task.

Today, the need for better R&D management is even more critical. We expect to restore the confidence of the Congress and the nation in Defense management through convincing actions and thereby earn the respect necessary to forestall reductions in funds that might well threaten our future security.

All of you know that developing new systems is inherently risky. You know that even if management were perfect, unpredictable factors always emerge — such as changes in threat, changes and surprises in technology, unpredictable engineering problems, the opportunity for further improvements in capability, inflation of the economy, and changing national priorities. You also recognize that, if the country is to be prepared for a possible threat in 1975 or 1980 or 1985, we must start now. This means trying to predict the shape of a possible enemy's forces and technology — through a curtain of secrecy — and being able to cope with them for up to two decades into the future. In formulating and carrying out programs, we must make all of the difficult judgments about all these factors far in advance.

You have heard all of this before. And you have heard what I believe was sincere testimony discussing the actions intended to improve management in this complicated environment. Some significant advances in efficiency and control were made in the past. But that testimony, those actions, and those advances were not enough. Costs have continued to grow. Some programs have failed to meet or even come close to initial goals.

So the hard question today is: What have we really done in the first year of this Administration? Have we taken decisive and substantial actions to improve our R&D management? Or do we offer nothing more than additional explanations and further pleas for understanding?

The single most influential long-range goal is to eliminate a syndrome which has grown up in the last decade: incorporating the most advanced technology into every system regardless of the cost. This syndrome pervades much of the initial design thinking at the working level throughout the Department of Defense and throughout defense industry. We must get the message throughout the system that we will not stand for unnecessary complexity and that price has as much priority as any other requirement. We must move toward the technical demands of a new kind of design in which the performance-price tradeoffs are assessed in ways similar to the design of commercial equipment.

All of our new management actions have this as their unifying theme: Control and reduce costs, and control the system acquisition process within a reshaped management environment that fixes accountability more clearly and delegates greater authority to the Services.

THE LONELY WARRIORS:

Case for the Military-Industrial Complex

J. S. Baumgartner

Author John Stanley Baumgartner in the foreword to his book puts it this way: "People who have been in both the military establishment and the defense industry recognize the integrity, devotion, selflessness, and the tremendous collective abilities of people in the MIC (military-industrial complex) — the Lonely Warriors who provide the protective cover for us and much of the free world. Theirs is a lonely war, just as this is a lonely book compared to the stack of volumes and articles that would tear away this protective cover.

"This book is intended to show why much of the criticism leveled at MIC is fallacious, and to show the procurement game as it really is."

Mr. Baumgartner does just this, taking the reader through the complex process of government procurement in lively, entertaining prose. At no point does he sacrifice accuracy to make his points.

The first and final chapter titles provide the scope of the book. First chapter: The Siege of the Military-Industrial Complex. Final chapter: Why Do They Stay In This Business?

In between those two chapters, Mr. Baumgartner provides a carefully reasoned account that disposes of many fantasies concerning the MIC by reporting the hard facts.

Mr. Baumgartner is eminently qualified to write this book. He is a graduate of the U.S. Military Academy and earned a Master's degree from the Harvard School of Business Administration. He served thirteen years in the Army and during part of his service he was directly involved in procurement. After leaving the service, he worked in the defense industry. The author is a former chairman of the Aerospace Industry Subcommittee of the Los Angeles Chamber of Commerce, and a lecturer on research and development management at the University of Southern Cailfornia.

The concerned (and often confused) citizen will find this book a most readable and creditable account of the relationship between government and industry that has provided for our national defense and our leadership in space exploration.

(The Lonely Warriors *by John Stanley Baumgartner, Nash Publishing, 9255 Sunset Blvd., Los Angeles, California, 90069. 237 pp., $6.95).*

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The importance of research and development to our national security and economic progress is discussed by Dr. John S. Foster, Jr., Director of Defense Research and Engineering, Department of Defense. (See page 12).

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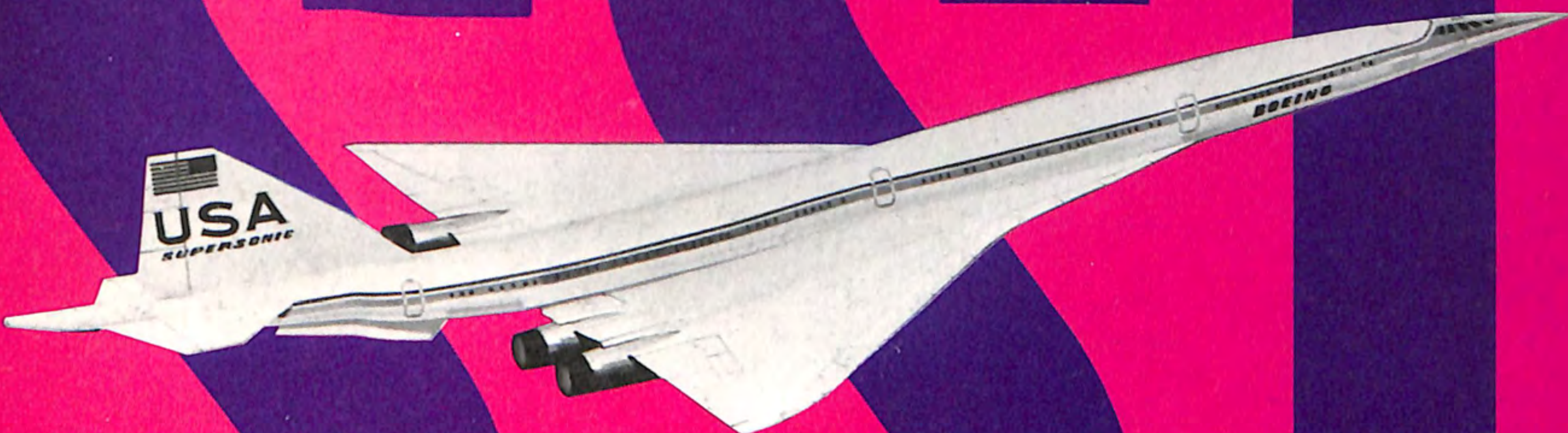
SST



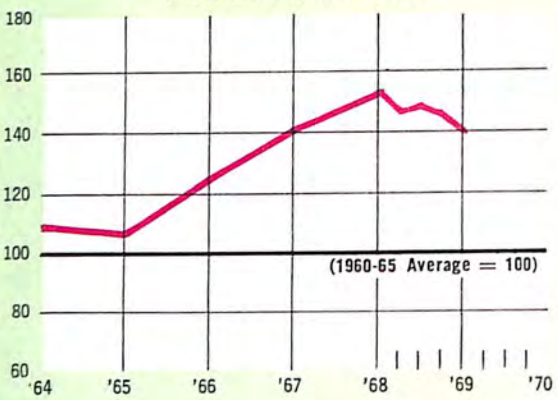
THE SUPERSONIC TRANSPORT – THE ECOLOGY AND ECONOMICS

BY SENATOR MIKE GRAVEL OF ALASKA

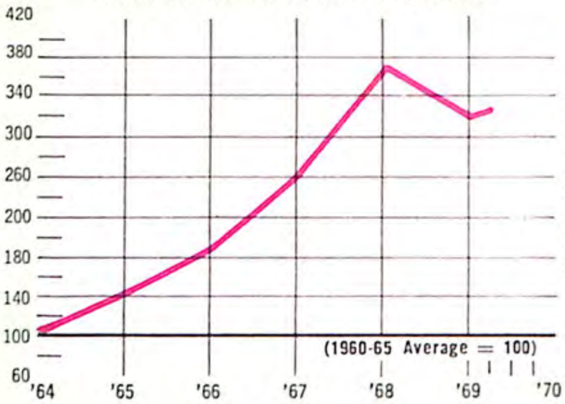
AEROSPACE ECONOMIC INDICATORS

CURRENT

Total Aerospace Sales

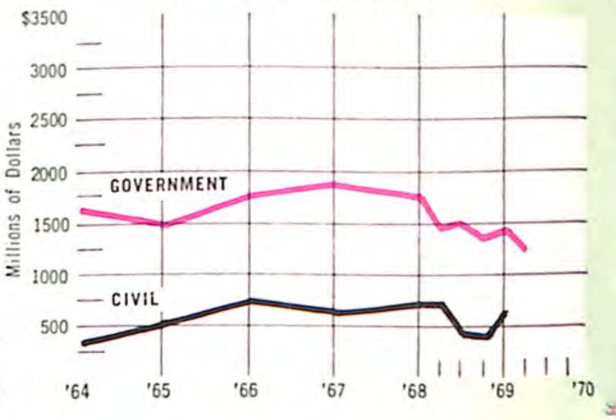


Value of Civil Aircraft Shipments



OUTLOOK

New Orders — Monthly Average



Aerospace obligations by Dept. of Defense and NASA.
Non-government prime orders for aircraft and engines.

ITEM	UNIT	PERIOD	AVERAGE 1960-65 *	LATEST PERIOD SHOWN	SAME PERIOD YEAR AGO	PRECEDING PERIOD †	LATEST PERIOD
AEROSPACE SALES: Total	Billion $	Annual Rate	19.4	Quarter Ending Dec. 31, 1969	29.8	27.1	26.9E
	Billion $	Quarterly	4.8		7.0	6.2	6.1E
DEPARTMENT OF DEFENSE							
Aerospace obligations: Total	Million $	Monthly	1,151	Apr. 1970	925	956	901
Aircraft	Million $	Monthly	601	Apr. 1970	490	638	537
Missiles & Space	Million $	Monthly	550	Apr. 1970	435	318	364
Aerospace expenditures: Total	Million $	Monthly	1,067	Apr. 1970	1,328	1,297	1,268
Aircraft	Million $	Monthly	561	Apr. 1970	813	834	777
Missiles & Space	Million $	Monthly	506	Apr. 1970	515	463	491
Aerospace Military Prime Contract Awards: TOTAL	Million $	Monthly	920✢	Apr. 1970	720	937	723
Aircraft	Million $	Monthly	447	Apr. 1970	444	701	464
Missiles & Space	Million $	Monthly	473	Apr. 1970	276	236	259
NASA RESEARCH AND DEVELOPMENT							
Obligations	Million $	Monthly	215	Apr. 1970	190	188	211
Expenditures	Million $	Monthly	130	Apr. 1970	288	273	266
BACKLOG (60 Aerospace Mfrs.): Total	Billion $	Quarterly	15.3#	Quarter Ending Dec. 31, 1969	30.7	29.3	28.3
U.S. Government	Billion $	Quarterly	11.6		16.3	15.1	14.3
Nongovernment	Billion $	Quarterly	3.7		14.4	14.2	14.0
EXPORTS							
Total (Including military)	Million $	Monthly	110	Apr. 1970	324	295	306
New Commercial Transports	Million $	Monthly	24	Apr. 1970	83	139	132
PROFITS				Quarter Ending Dec. 31, 1969			
Aerospace — Based on Sales	Percent	Quarterly	2.3		3.3	3.0	2.5
All Manufacturing — Based on Sales	Percent	Quarterly	4.8		5.2	4.6	4.6
EMPLOYMENT: Total	Thousands	Monthly	1,132	Mar. 1970	1,388	1,266	1,253E
Aircraft	Thousands	Monthly	469	Mar. 1970	614	554	547E
Missiles & Space	Thousands	Monthly	496	Mar. 1970	597	540	534E
AVERAGE HOURLY EARNINGS, PRODUCTION WORKERS	Dollars	Monthly	2.92	Mar. 1970	3.84	4.07	4.09

R Revised
E Estimate
* 1960-65 average is computed by dividing total year data by 12 or 4 to yield monthly or quarterly averages.
† Preceding period refers to month or quarter preceding latest period shown.
\# Averages for 1961-65.
✢ Averages for fiscal years 1960-1965.

Source: Aerospace Industries Association

A TRADE COMMITMENT

Aerospace exports underpin the present favorable balance of trade for the United States. Revenues from aerospace products sold abroad have exceeded $1 billion in each of the past 12 years, and reached a record $3.1 billion in 1969. This favorable trade balance (the difference between exports and imports of aerospace products) amounted to $2.8 billion in 1969.

The President's Trade Bill (H.R. 14870) is now before the Congress. Karl G. Harr, Jr., president of the Aerospace Industries Association, testifying before the House Ways and Means Committee on behalf of the aerospace industry, voiced its support of the legislation and any like proposals aimed at stimulating U. S. trade.

Mr. Harr said the industry has traditionally favored a trade policy based on equal access to world markets — on a reciprocal basis. "Our commitment to an open world trade environment continues today," he added.

"Furthermore," Mr. Harr told the Committee, "the current state of the U. S. economy underscores the need for an open and liberal trade policy. The wage-price spiral and steadily mounting inflationary pressures have necessitated vigorous monetary and fiscal policies on the part of the Administration. We have witnessed a slowdown in industrial growth, reductions in corporate earnings and higher unemployment.

"The aerospace industry has been affected as severely as any other group by these actions. Major programs have been cut and unemployment in those cities depending on the aerospace business is far above the national average. Consequently, the industry is entering a significant adjustment period. Manufacturers are looking toward new markets and, in some cases, new products to revitalize corporate earnings. In the midst of these troubled times, aerospace manufacturers reject — more adamantly than ever — protectionist measures in any form.

"We look toward increasing exports as one way of bringing stability to American industry. The current level of U. S. exports — about four percent of the Gross National Product — is well below the average for industrialized nations. We believe this level could be raised significantly by U.S. iniitiatives toward an open trade policy in foreign markets."

Mr. Harr also stated to the committee that while increased exportation is definitely one solution to the U. S. balance-of-payments problem, in many cases convenient U. S. financing is not available and this is an impediment to foreign sales. "The Export-Import Bank has done an excellent job of utilizing the resources provided by Congress, and this industry fully recognizes the very significant service the Eximbank has rendered commercial aircraft export programs," he said.

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CONTENTS

The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems;

Foster understanding of the aerospace industry's responsibilities in the space exploration program;

Foster understanding of civil aviation as a prime factor in domestic and international travel and trade;

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

AEROSPACE is published by the Aerospace Industries Association of America, Inc., the national trade association of the designers, developers and manufacturers of aircraft, missiles, spacecraft, their propulsion, navigation and guidance systems and other aeronautical systems and their components.

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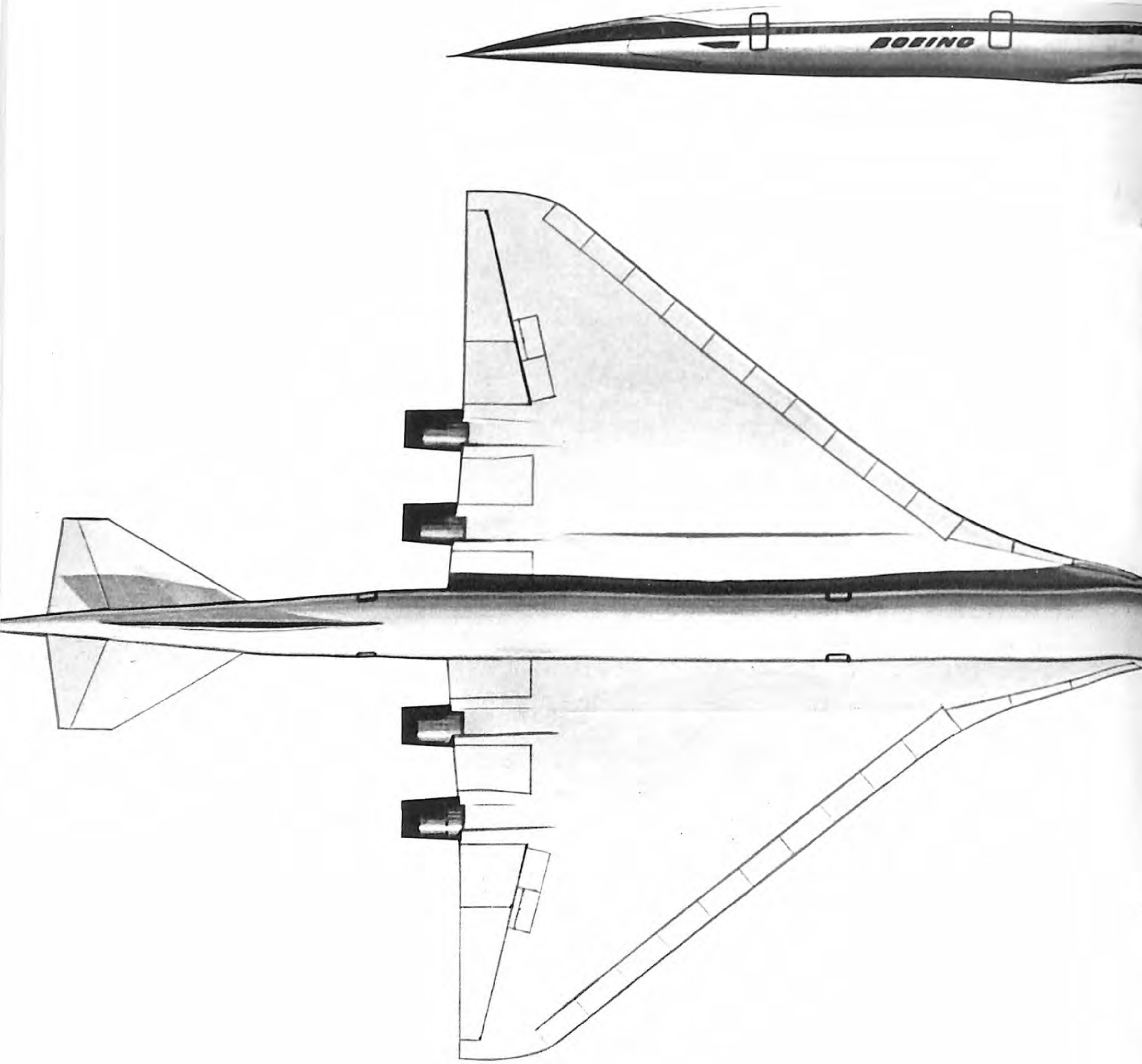

BOEING

THE SUPERSONIC TRANSPORT- THE ECOLOGY AND ECONOMICS

BY SENATOR MIKE GRAVEL
OF ALASKA

The United States Supersonic Transport will pollute the atmosphere less than any other known transportation means.

One SST carrying 300 passengers at 1,780 miles an hour will emit no more pollutants than three automobiles traveling at 60 miles an hour.

The entire contemplated fleet of SST's will put into the stratosphere in one day about the same amount of water vapor introduced by a single large thunderstorm — and there are some 3,000 to 6,000 thunderstorms active around the Earth continuously.

These and other facts established during intensive studies by both the U.S. Department of Transportation and The Boeing Company, prime contractor for the SST, have been somewhat obscured by recent criticisms of the program which claim the SST will further aggravate the nation's serious problems with the environment.

In recent months, during debate over the Federal budget and national spending priorities, a wide range of allegations has been made against the SST, by persons in and out of public life who believe that the supersonic transport will contribute heavily to air pollution, create unendurable noise, wreak havoc with its sonic boom — causing cattle to stampede, damaging structures, and so forth — and even change the weather adversely, by introducing large amounts of water vapor into the upper atmosphere.

All of these concerns, however well motivated, are the result of misinformation. Many misconceptions regarding noise and sonic boom arise because critics persistently cite some unfavorable results of military supersonic flights made several years ago. These research missions, flown at relatively low altitudes over populated areas, bear little relation to the planned utilization of the SST, which will not reach supersonic speed until it is at 60,000 feet altitude and in any case will travel supersonically only over the oceans or above the Arctic Circle. Thus, the critics in effect are begging the question.

Here are some of the most common myths, and the corresponding facts.

Myth: SST's will add greatly to air pollution through the discharge of chemical material from their engines.

Fact: Automobile engines convert 30 to 50 percent of the fuel they consume into air pollutants. Aircraft turbine engines convert less than one percent of fuel consumed into pollutants. The air transport fleet — including future SST's — emits less pollution per 1,000 seat miles than any other mode of transportation yet devised. The smoke from today's jet aircraft indicates inefficient burning of fuel. A new combustor currently is being retrofited on transports already in service. (See *No Smoking*, page 6). The new-technology jet engines do not smoke, and by the time the SST enters commercial service in the late 1970's it is expected that there will be no visible emissions.

A study by Professor R. F. Stewart of the University of California shows that carbon monoxide and hydrocarbon emissions for today's jet engines during cruise conditions are under one percent of average automobile emissions. The SST will be equipped with emission controls at least as effective as those now being implemented.

Myth: SST sonic booms over land will break windows, crack walls and stampede cattle. The boom paths will cover practically everything. Even wilderness areas will offer no escape. Booms over the oceans will cause enormous vibrations which will disperse fish concentrations.

Fact: Damage has been caused in the past by sonic booms from military aircraft flying at low altitude. However, the force created by such aircraft is 10 to 50 times more powerful than that which the SST will produce.

The SST simply is not built to fly supersonically at low altitudes. It is designed to perform around airports just like subsonic jets, and normally will require about 100 miles to achieve supersonic speed after takeoff.

Because its boom, although not destructive to property, might annoy people on the ground, the SST will fly over land (except above the Arctic Circle) at a speed of about 700 mph. This is too slow to create a boom effect.

Above the Arctic Circle, of course, there are relatively few farmlands, reservations, or national parks.

Over the oceans, the boom will be mild — about one-fourth ounce per square inch, comparable to the impact of a fisherman's spinning lure hitting the water. Marine life will not be harmed. Porthole windows on ships are designed to withstand forces 100 times stronger than the overpressure created by the SST at cruise altitude.

Myth: There is evidence that the SST will pollute the upper atmosphere in such a way as may result in terrible alterations of global weather.

Fact: This allegation apparently relates to contrails (condensation trails) from engines at high altitudes. What it overlooks is that these trails of water vapor seldom if ever form at the cruise altitude of the SST — 60,000 to 70,000 feet.

The daily stratospheric water input by the SST fleet, as mentioned earlier, will be about the same as that created by one large thunderstorm. It has been theorized that water vapor from the SST's would form a global layer of cirrus clouds, and thus alter the climate. This claim, however, was based on an estimate that water vapor would remain in the stratosphere for 10 years. Recent studies show that the circulation time is more nearly one and a half years, which rules out any significant accumulation of vapor. Two scientific groups — the National Research Council of the National Academy of Sciences, and the Office of Meteorological Research — have studied the situation and report that there will be no appreciable disturbance of the Earth's normal atmospheric balance by a fleet of SST's making 1,600 flights per day.

Myth: At takeoff, the SST would be much louder than the noisiest jet now in commercial service.

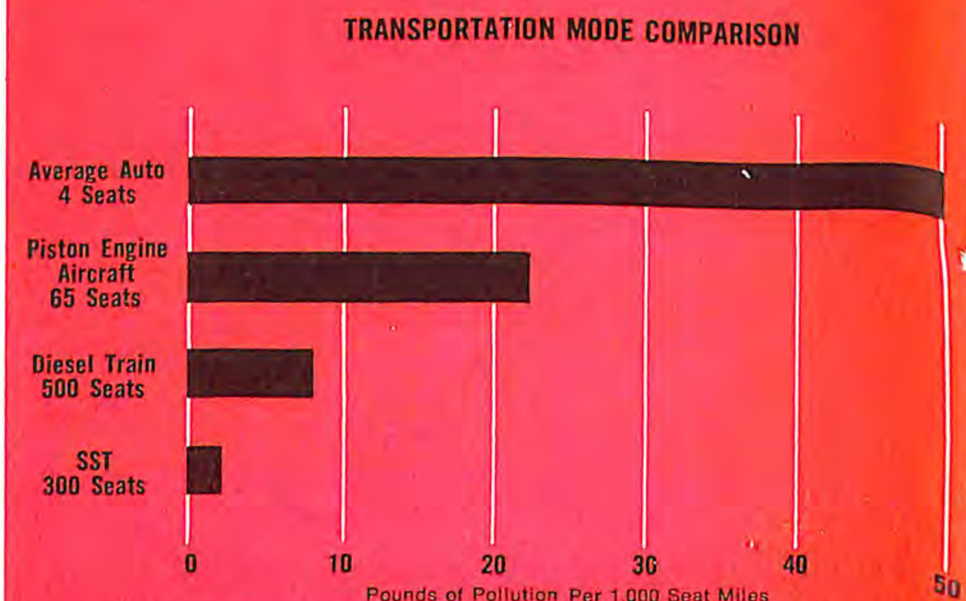
Fact: The powerful engines on the SST, with a total thrust of about 250,000 pounds, will enable the aircraft to climb quickly after takeoff. The engine sound will be less than that of today's jets at the standard measuring point from the end of the runway — usually three and a half miles after the takeoff run starts. On landing, the plane's design (wide span with separate tail and high-lift devices) will provide excellent low-speed handling characteristics allowing the pilot to cut power for landing. Also, approach noise will be reduced substantially because of the unique engine inlet required for supersonic flight.

Thus, most people living in the vicinity of airports served by the SST will be exposed to *less community noise* than they hear today.

The same engine power that provides rapid and steep climbout, cutting down on community noise, would create considerable airport (sideline) noise — if unsuppressed. With today's technology, that sideline noise would be substantially greater than that generated by jets now in commercial use. The SST airframe contractor believes that the noise level can be reduced significantly before the supersonic plane is slated to go into commercial service eight years from now. The airframe and engine contractors are working with other industry firms and the government to attain this goal.

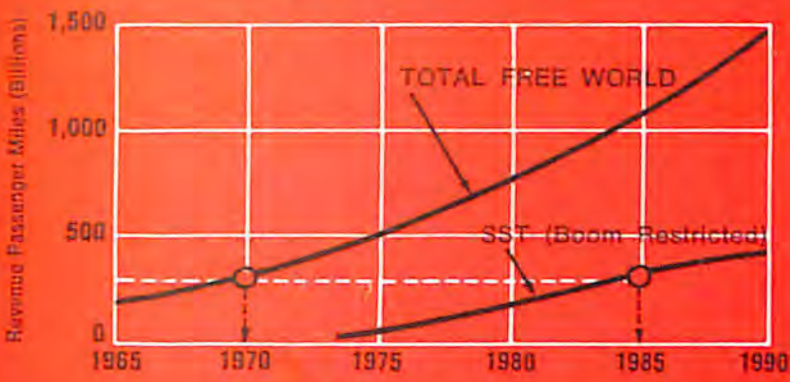
Any major new technological development, in transportation or any other activity, should be subject to careful examination to determine whether it represents real progress — that is, whether its benefits can be expected to greatly exceed any potential drawbacks from the point of view of the general welfare.

From the standpoint of ecology, results of current studies indicate that air travel in general has proven to be not only efficient in travel time and cost, but also *the most efficient* means of travel known to man in terms of *minimal impact upon the environment.* The SST should further improve upon this remarkable record.



The air transport fleet, including future SSTs, emits less pollution per 1,000 seat miles than any other transportation means. Reciprocating engines used in land transportation convert 30 to 50 percent of the fuel used into pollutants. Turbine engines used in air transportation convert *less than 1 percent* of fuel consumed into pollutants.

AIR PASSENGER FORECAST



Passenger traffic on routes to be flown by the SST is predicted by 1985 to equal that of the total free world traffic in 1970. The SST will fly predominantly international transoceanic routes at 1,780 miles per hour. This is known as boom-restricted operations. Speeds over land will be about 700 miles per hour, which does not create a sonic boom.

ECONOMICS OF THE SST

The greatest single consideration involved in America's Supersonic Transport program is technological: Whether the United States will continue to maintain its dominant position in the development and production of commercial transport aircraft for the world — with all that this means to the health of the domestic economy and the U.S. position in international markets.

Over the next two decades, the level of the world's commercial airline traffic is expected to gain by a factor of six as a result of increases in population, business activity, individual income, and leisure time. The SST is a logical and inevitable step forward to meet the demands of this new volume of air travel — regardless of who builds it.

The situation is highly competitive. Both an Anglo-French and a Soviet version of the SST have already been test-flown and are going into production. Last year, there was considerable skepticism that either of these aircraft would achieve such a degree of success; largely because of this, members of a special Presidential SST Review Committee expressed doubts in early 1969 that the U.S. SST would be beneficial to the nation's balance-of-trade position. They argued that even if the U.S.-produced aircraft were sold abroad in the numbers forecast, increasing tourism by Americans traveling abroad in SST's would more than offset the benefit derived from SST sales to other countries.

However, the Committee observed, if the foreign-made aircraft flew successfully American tourism would increase regardless. That is the prospect for the near future. Since the U.S. SST — which is expected to fly more passengers farther and faster than either of the foreign-built aircraft — will not be available before 1978, the longer-range question is whether American air carriers in the late 1970s and the 80s will be purchasing the American SST or a second-generation version of those already being produced abroad. They simply will have to have supersonic transports, from whatever source, in order to remain competitive.

Should the U.S. fail to build SST's and sell them overseas, and American carriers be forced to buy foreign-built aircraft, it is estimated that the total damage to the balance of trade by 1990 would be $22 billion. If, on the other hand, the projected U.S. program is successfully carried out and approximately 500 SST's are sold (270 of these to foreign airlines), the U.S. may expect to obtain at least $20 billion of the anticipated $25-billion world market through 1990.

(The importance of aircraft to U.S. exporting is shown by the fact that in 1969 they accounted for nearly $2 billion in foreign sales. Without these sales, the United States would have had a critical negative balance of trade.)

The potential return to the Government is about $1 billion more than its investment in the development program, and will generate an additional $5.4 billion in federal tax revenues, and state and local governments will receive an estimated $1.3 billion in taxes.

On the domestic economic front, the SST program represents employment for more than 150,000 persons. Some 50,000 of these will be on the payrolls of the prime contractors and first-level subcontractors; more than 100,000 will be employees of other subcontractors, manufacturers of ground support equipment and installation facilities, and basic industrial manufacturers.

The combined and cumulative income of the direct and supplemental labor force involved in more than 6,000 companies may well exceed $33 billion in 1990.

This employment will be distributed among virtually all of the 50 states. By its nature, it will be high in quality as well as quantity, helping to nurture higher education and skill levels. The results will add to the economic health and wealth of our society, and thereby help to finance programs to meet our urgent domestic needs for social betterment.

Less easy to assess than employment in dollar terms, but of great consequence, are the advances the SST will bring in aviation technology. These will occur in the areas of sustained higher cruising speed, improvement of existing materials and development of new materials with wide applications beyond aviation. Aircraft safety and reliability will be enhanced through advancement of instrument and flight control systems (which coincide with the increasingly critical needs created by today's air traffic congestion), and development of larger, more efficient powerplants for both subsonic and supersonic aircraft.

For the air traveler, the SST will mean flying from the U.S. to Paris in less than three hours compared with more than seven hours aboard present jets. Time advantage is commercial aviation's most important product. Shorter travel times will be all the more attractive to the traveler for whatever purpose.

Although the U.S. SST is smaller in passenger-carrying capacity than the 747 (300 passengers compared with 440 in typical configuration), it will fly three times as fast. Although it will cost less than twice as much as the 747, it will be twice as productive: during a given time period it can carry twice as many people over a specific range. In the long run, the most productive aircraft is the most economical to operate, even if its initial cost is higher.

All studies of the SST in commercial operation have assumed no increase in fares over current rates.

The SST would become a prime national asset, a generator to the entire national economy with effects far beyond its primary mission of advancing air transportation.

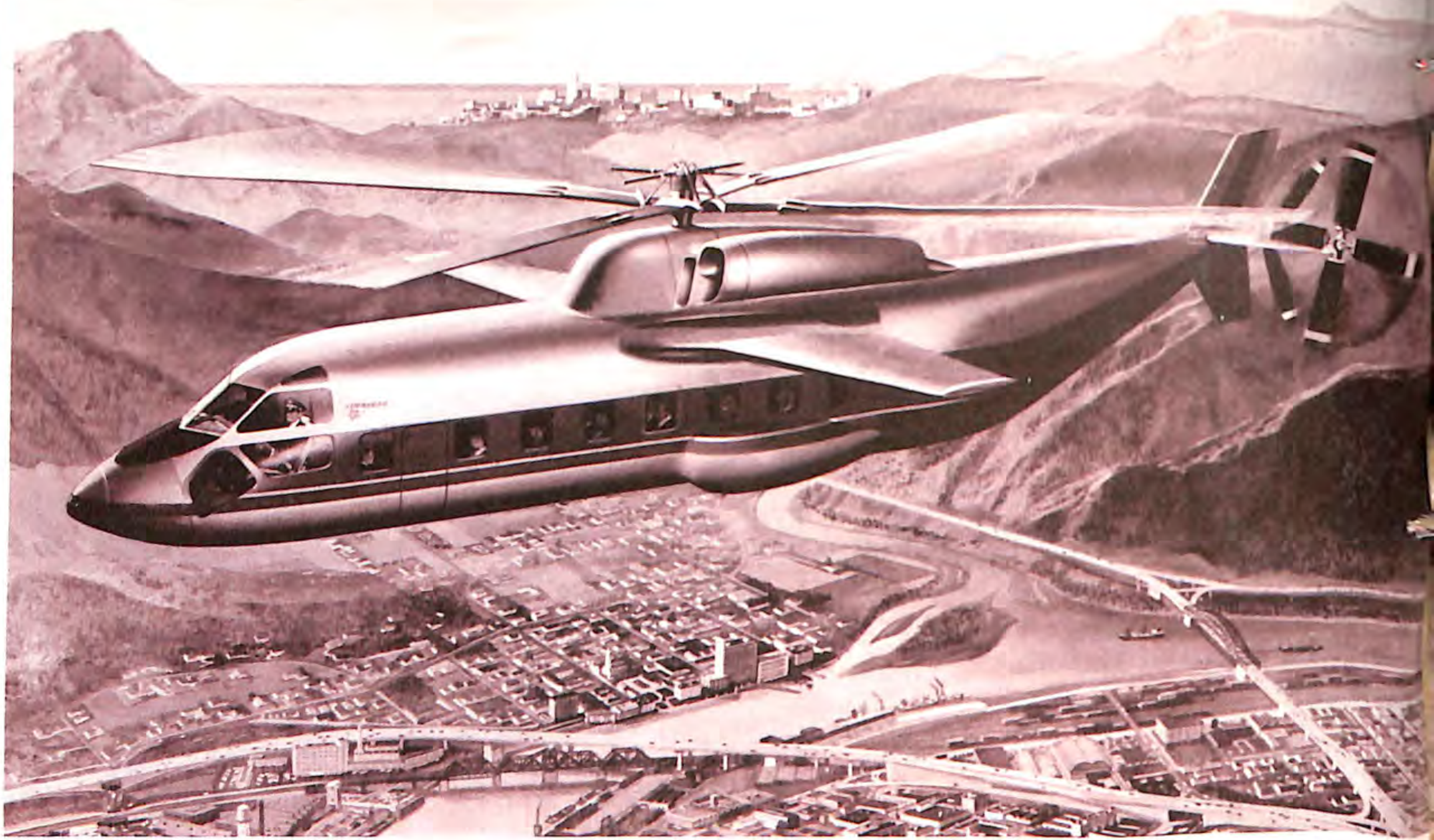
NO SMOKING!

A major airline recently received the following letter regarding aircraft engine exhaust emissions: "Couldn't you invent something to stop this? It is also causing a great deal of air pollution. It's not fair for us kids and even grownups. I don't want to die now. I am only eleven." ■ A good and concerned question, and the aerospace industry has worked with the air carriers to provide the answer: They invented something. ■ Analysis of jet engine exhaust shows that the primary contaminants are particulate matter, largely carbon and organic compounds. The non-contaminating products, which make up 99 percent of the jet exhaust gases, are carbon dioxide, water vapor, oxygen, nitrogen and excess air. These are all parts of the normal atmosphere. The concern with emissions represents only one percent of the gases and the unburned carbon which is the source of the highly visible plumes of smoke from the engine. ■ Several research approaches to reduce the smoke emissions were investigated. The one that provided the best solution was to design a combustor for the engine that would burn fuel more efficiently, thus eliminating the unburned carbon. ■ During a three-year period, a jet engine manufacturer tested over 500 different combustors. More than 200 of these were selected for further tests in engines. The combustors were then delivered to four large airlines for in-service evaluation to find out what did not work and what needed improvement. ■ A proven combustor design was selected and the airlines announced early this year that they would start installing the new combustors to complete their entire retrofit program by the end of 1972. ■ Actually, aircraft engines without the new combustors produce only a very small percentage of total pollution. Samplings of the atmosphere near airports have proven this fact. ■ While the older jet transports are being retrofitted with the new combustors, a major step has been taken in the production of the new technology engines which will power the new generation of transport aircraft — the wide-bodied jets. These engines are much larger, and two and a half times more powerful than those presently in use on four-engine transport aircraft. They will be virtually devoid of smoke. ■ In the design of future engines, methods of elimination of smoke will be made at the earliest stages of engine design. ■ The comprehensive and voluntary program by engine and aircraft manufacturers and the airlines represents a highly successful effort that has reduced and continues to reduce pollution and, as the facts above indicate, there's "a lot *less* in aircraft emissions than meets the eye," to quote one sage observer of the environmental scene.

New technology turbine engines on the 747 show no smoke emission at takeoff. The aircraft in lower photo shows emission; however, the engines are being retrofitted with a new cumbustor which eliminates smoke.

AUTOMOBILE AND AIRCRAFT CONTRIBUTION TO TOTAL ATMOSPHERIC POLLUTANTS IN LOS ANGELES COUNTY

Source: "Motor Vehicle Pollution in California"—California Department of Public Health Bureau of Air Sanitation
"Air Pollution from Aircraft in Los Angeles County"—Los Angeles County



CITY-CENTER V

Today, air travelers in some major cities around the globe (Moscow, Paris, London, Sydney, Tokyo, San Francisco, Minneapolis and New York) can board a scheduled helicopter airline, or air taxi, at a city-center heliport. From these facilities, they can either fly to the airport for a connecting jet airline flight to anywhere in the world or fly a few hundred miles to another city-center heliport. These travelers can go all the way by air and thereby enjoy the full benefit of a complete air transportation system.

In recent years, the aerospace industry has been applying the systems technique to solving sophisticated and complex problems in the manufacturing of advanced systems for national defense and space exploration.

The need now is to apply the systems approach to our present air transportation network with the federal, state and local governments working in close coordination with all segments of the air transportation industry.

We now have the technological know-how and the hardware to utilize efficiently the air space between the traffic on the ground and the airline and business airplane traffic above.

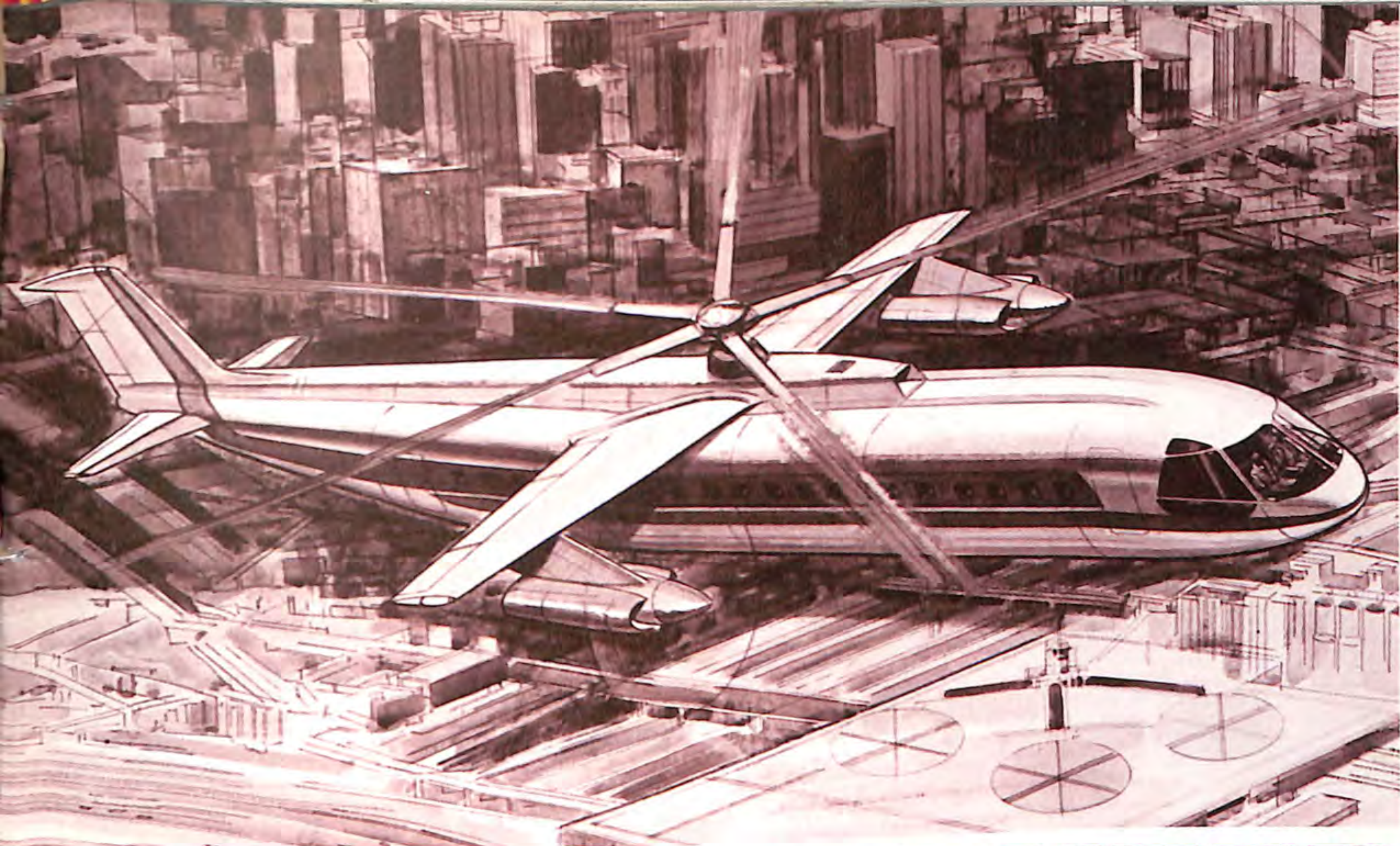
The helicopter today, as well as other vertical lift aircraft of tomorrow, can operate in this available air space and transport passengers from relatively small city-center to city-center landing areas, eliminating completely time-consuming trips to the airport.

Increased congestion on the highways and airways has focused national attention on transportation problems, and there is specific concern for pressing short-haul transportation solutions in the heavily populated Northeast and West Coast Corridors.

Recently, a helicopter was successfully tested between Paris and London and here in the Northeast Corridor as a short-haul transport.

In April, a military transport helicopter — (the commercial version is the Sikorsky S-65) flew the 213 air-miles from downtown Paris to London's Thames River-side heliport at Battersea in one hour and 22 minutes. The return trip took one hour and 29 minutes. Due to the somewhat typical inclement weather in London and over the English Channel, the helicopter flew on instruments a large part of the way on these record flights.

While both of these European capitals have city-



OL CITY-CENTER

center heliports, no such public-use facility is available in the Nation's capital. The South Lawn of the White House serves as the heliport for the Presidential helicopters, providing the Chief Executive with a complete air transportation system.

Using the available Washington Hospital Center Heliport, another record breaking city-center to city-center helicopter flight demonstration was made recently.

Pan American World Airways and Sikorsky Aircraft Division of United Aircraft Corporation co-sponsored this first demonstration in the Northeast Corridor to prove the feasibility of the helicopter as a short-haul city-center to city-center transport. Again, using a military transport model (Sikorsky civil model S-65), the flight from New York's Wall Street heliport to the Washington hospital heliport (205 miles) took one hour and 17 minutes. The helicopter flew the Washington, D. C. to Philadelphia 124-mile leg in 46 minutes and covered the 83 miles from Philadelphia to New York in 28 minutes. The trip from New York to Boston, a distance of 190 air miles, required one hour and ten minutes.

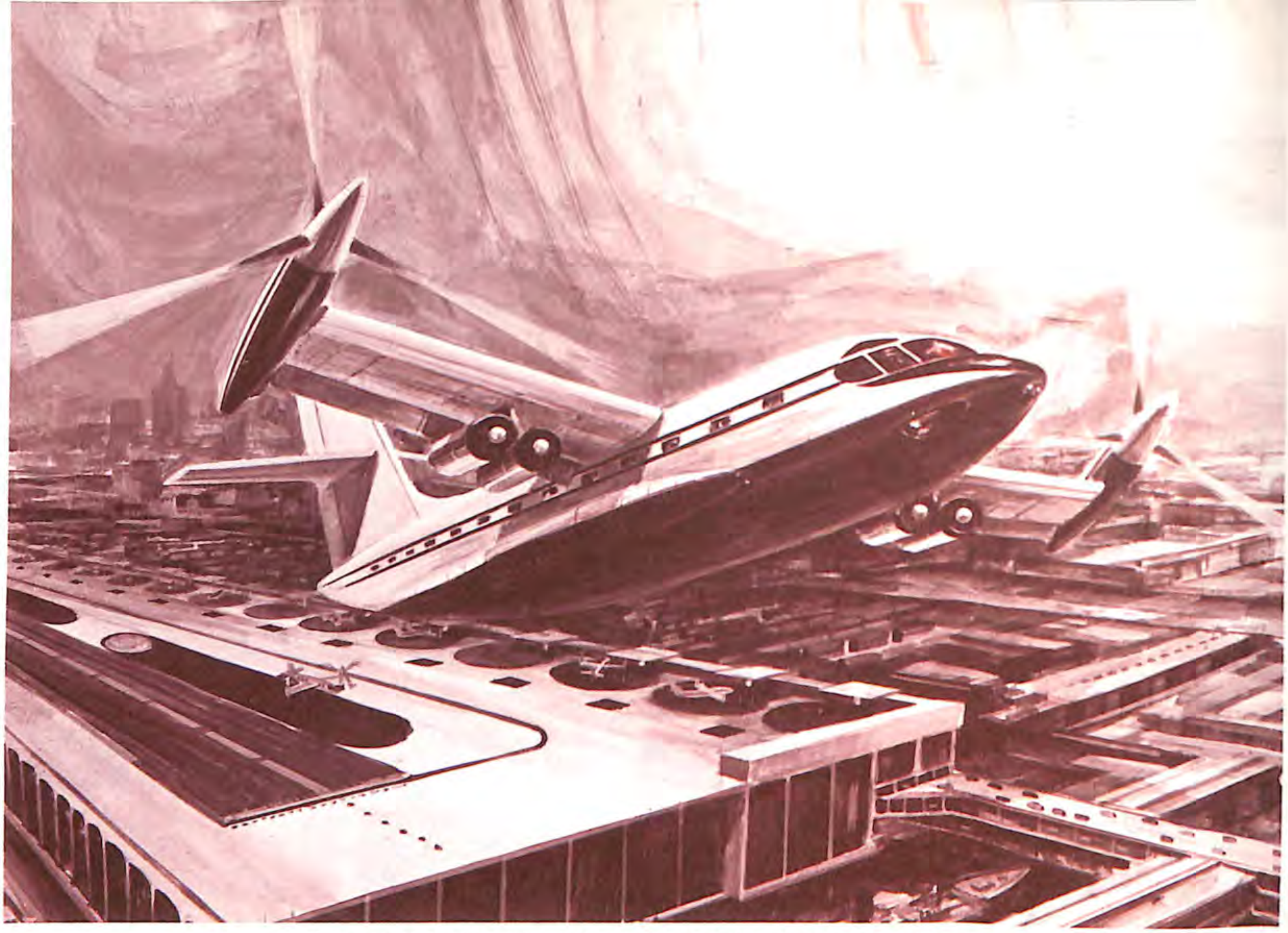
Two official records, monitored by an official from the Fédération Aéronautique Internationale, were established: Downtown New York to downtown Washington, D. C. (205 miles — one hour and 17 minutes); and from downtown New York to the Boston Common (190 miles — one hour and 10 minutes).

Other demonstration flights were made from Boston to Albany (54 minutes); Albany to New York (50 minutes); and New York to Hartford (40 minutes).

The projected New York to Washington passenger fare for a commercial helicopter flight is slightly more than $30.

In the Northeast Corridor, the West Coast Corridor and other congested airways in the United States, the helicopter overflies ground congestion and underflies air congestion. Operating beneath the commercial airlines, between city-centers, the helicopter can provide faster, closer to destination trips without the ground time needed to and from the airports and avoids traffic take-off and landing delays.

New York Airways, a scheduled helicopter airline, now offers 30 seats every 30 minutes in its inter-airport



Future application of a folding proprotor is shown in this artist's conception. This model would carry more than 100 passengers.

New York service. The airline reports a continuing passenger growth. In May, there were 23,500 passengers and in the first half of June there has been a daily average of 850 passengers.

In addition to the other three scheduled helicopter airlines — Los Angeles Airways, Inc. — Chicago Helicopter Airways — San Francisco and Oakland Helicopter Airlines, there are two notable newcomers now providing city-center to city-center helicopter service: Imperial Airways, Inc., in Minneapolis, Minnesota, and Americus Airways in Allentown, Pennsylvania. Both of these fast growing helicopter commuter airlines began service in December, 1969.

Imperial Airways, Inc. currently operates three Bell JetRangers. The four-passenger helicopters are serving the 67-mile route between Minneapolis and Mankato, and the 73-mile route between Minneapolis and St. Cloud. The fare is $16.50. In Minneapolis, with a rooftop heliport across from City Hall, Imperial can deliver its passengers downtown.

To more adequately serve the increased market, the airline has taken delivery of one of two 10-passenger Sikorsky S-62A air-conditioned helicopters ordered. Planning for future route and service expansion, Imperial has placed an order for three Gates Twinjet 12-passenger helicopters for delivery in 1973.

In addition to the passenger service, the airline is experiencing an expanding market for mail and air freight. In three months, the helicopter airline carried more freight than the local fixed-wing air carriers.

Americus Airways operates three eight-passenger Sikorsky S-55 helicopters on four scheduled daily roundtrip flights between the Allentown/Bethlehem Airport (10 minutes from downtown) and New York City's 30th Street Heliport. Commuters find the 40- to 45-minute flight, costing $21.00, more convenient, faster and more economical than other available transportation.

Americus Airways plans to add two or three three-place Bell helicopters to handle increasing requests for charter trips, and to add service to and from Easton, Pennsylvania, on its route. As with Imperial, Americus reports a continued increase in the volume of mail and parcel shipments.

It is apparent that the key to successful operation of helicopters today and future VTOL's is the city-center public use heliport or V-port.

Two examples of limited or prohibited services due to the lack of downtown public use facilities are in Washington, D. C. A local air taxi operator, Triangle Airways may operate only between the three area airports — Washington National, Dulles International, and Friendship International — which nullifies the unique capability of the helicopter to operate in and out of city-centers. Washington Airways, certificated by the Civil Aeronautics Board to provide schedule helicopter service between the same area airports and Washington,

D. C. and Baltimore, Maryland, is unable to begin service due to the lack of a downtown Washington heliport.

On July 1, 1970, the Airport Development Aid Program will become effective. Under this new program, $280 million will be authorized annually during each of the next five years for building new and expanding existing airport facilities. Public use helicopters can qualify for these matching funds. A public sponsor (a city, county, state or regional authority) is eligible to provide the needed matching funds to participate in this program.

In addition to the $280 million building fund, $15 million will be available over the next five-year period for airport system planning.

The majority of transport helicopters in civil operations are modified military machines, not designed to meet the operational and economic requirements for scheduled airline service.

The vertical lift aircraft industry has long recognized the potential of rotary-wing aircraft as a short-haul vehicle.

In 1963, the AIA's Vertical Lift Aircraft Council, in a report to the then Federal Aviation Agency regarding the potential of helicopters, recommended "a new top level government policy and plan giving the development and use of VTOL aircraft a high priority and reflecting an attitude of governmental encouragement, backing and support."

In 1966, the Council prepared a detailed report *(The Economies of VTOL Systems)* for the Governmental Task Force on Interurban Air Transportation on the requirements for VTOL aircraft as a short-haul intercity transport. The report re-emphasized the need for a national policy and support for the development of a VTOL transport and a system of city-center heliports and V-ports.

Currently, many of the manufacturers with company funding are continuing the design and testing of new rotor systems, instruments, navigational aids, and compound configurations toward the development of more efficient, economical and faster VTOL transports.

These are 50- to 100-passenger transports in design with speeds up to 400 mph, and with Direct Operating Costs of less than three cents a mile.

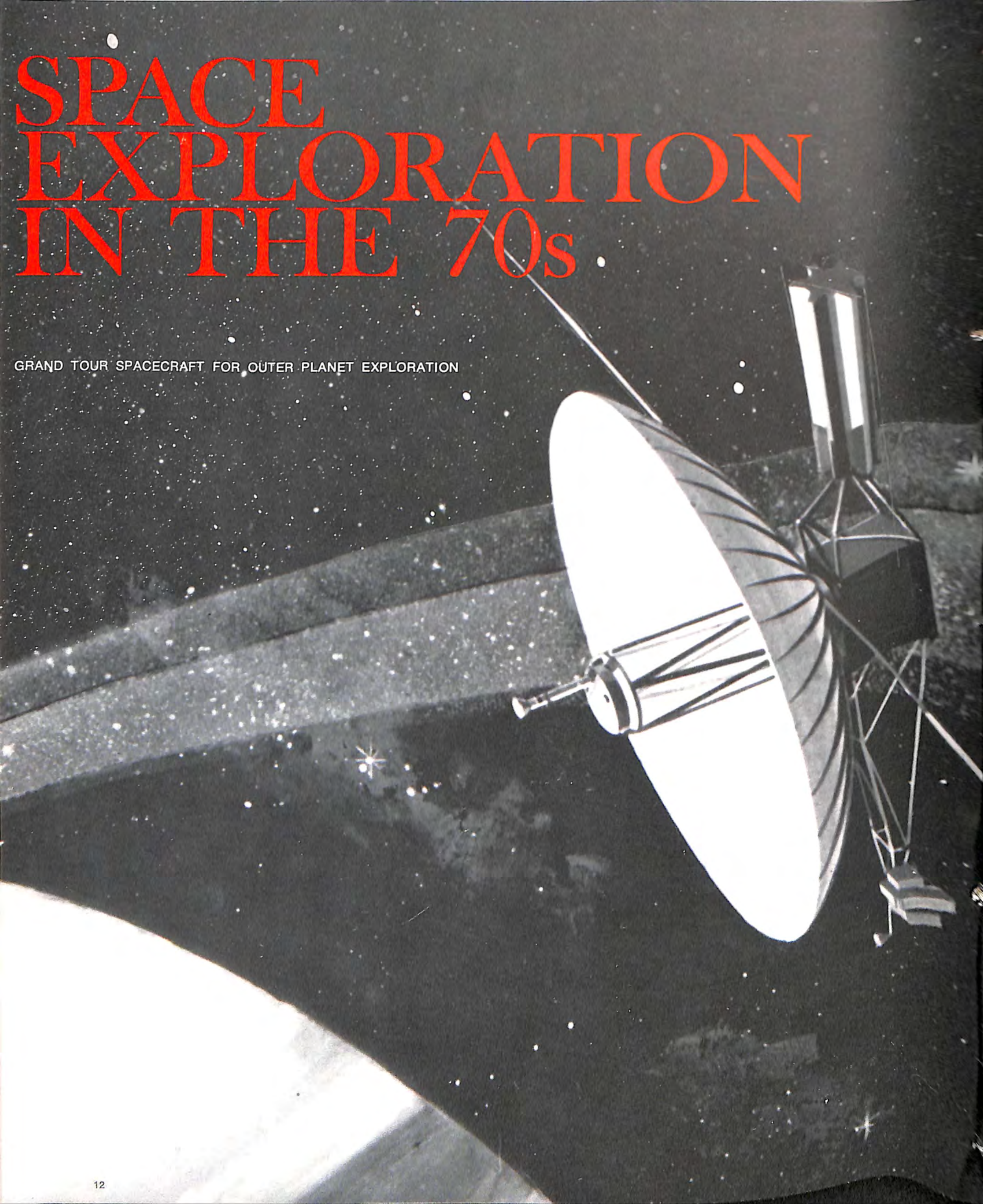
It is estimated that by 1975, 40 compound helicopters or VTOL's operating in the Northeast Corridor could carry more than 7.6 million passengers a year.

These city-center to city-center VTOL's would greatly relieve airport and airways congestion and provide one economic solution to the short-haul problem.

Karl G. Harr, Jr., president of the AIA, has stated: "Every hour of delay, every ounce of inefficiency in a transportation system is inevitably piled on to costs, to the detriment of the whole economy, available jobs, income, and competitive position."

Helicopter flight from New York City's Wall Street Heliport takes off for record run to Washington, D. C. Flight landed at Washington Hospital Center Heliport one hour and 17 minutes later (below). Flight demonstrated the feasibility of intercity helicopter operations in the Northeast Corridor.

SPACE EXPLORATION IN THE 70s



GRAND TOUR SPACECRAFT FOR OUTER PLANET EXPLORATION

No longer confined by nature to the narrow environment of his home planet, man has entered a new era of space exploration and exploitation that until today he only dimly dreamed of.

The great goal of the early Space Age — landing men on the Moon and returning them safely — has now been accomplished not once but twice. Man has demonstrated that he can cope with the fantastically complex problems of design, fabrication, assembly, propulsion, control and communications that must be surmounted for success in spaceflight. He has also shown that he can move about, work and sleep on the lunar surface with ease.

Even the Apollo 13 mission, whose lunar landing was aborted after an explosion in the Service Module, was in one important respect a step forward. It proved that astronauts can encounter serious trouble many thousands of miles from Earth and still return unharmed. While Providence may have assisted the Apollo 13 recovery, it would not have been possible without superb performance by the astronauts themselves and by ground personnel of both NASA and industry — and careful planning years earlier for just such a contingency.

Thus, although Apollo missions cannot yet be regarded as routine, our space technology has reached a level of proficiency that lends confidence to planning

for even more ambitious manned activity in space. In the area of unmanned flight, less dramatic but fully as significant, there have now been well over 600 successful launches since the tiny Explorer 1 went into orbit on January 31, 1958. In general, our satellites and space probes have become larger and heavier, more sophisticated but also more reliable, and vastly more productive of information than previous models.

How will the United States proceed in space? Which projects will be given highest priority, and at what pace will they be pursued? Detailed answers are impossible today, because the space program in the immediate future must operate with a substantially reduced budget, competing for funds with a large number of other national concerns, some of great urgency. It is certain, however, that the United States will move forward in space; to do otherwise would be contrary to the national character and wasteful of the large investment already made in our first probings of the universe.

The most definitive guidelines available were set earlier this year by President Nixon. In an official White House statement, the President outlined a "bold but balanced" space program for the 70s whose three general purposes would be further exploration, the continuing accumulation of scientific knowledge, and the practical application of the lessons learned in space to benefit life on Earth.

He listed six specific objectives:

- To continue to explore the Moon.

- To continue and extend exploration of the planets in our solar system. A key part of this effort would be "grand tours" in the late 70s of Jupiter, Saturn, Uranus and Pluto. Planning would proceed for an eventual landing of men on Mars, although this would not be scheduled for the decade.

- To reduce substantially the cost of space operations. This will rely mainly on the development of a reusable space shuttle vehicle, which would travel between Earth and space stations in Earth orbit, being launched by a booster on a rocket pad but returning to land like an aircraft. The shuttle project is now in the design definition study stage, with three prospective contractors for the engine development and two for the shuttle structure.

- To extend man's capability to live and work in space. This will initially employ the Experimental Space Station (XSS), a large orbiting workshop using systems originally developed for Apollo. Later, more flexible, longer-lived space station modules will be developed. The latter are also in the design definition stage, with two contractors involved.

- To hasten and expand practical applications of space technology. A major project approaching fruition is the Earth resources satellite program, which will provide an unprecedented capability to survey crops, locate mineral deposits, and find new sources of water. At the same time, further progress will be made with satellites devoted to weather reporting and forecasting, communications, navigation, air traffic control, geodesy and mapmaking, education by television, and surveillance for national defense.

SPACE SHUTTLE

- To encourage greater international cooperation in space.

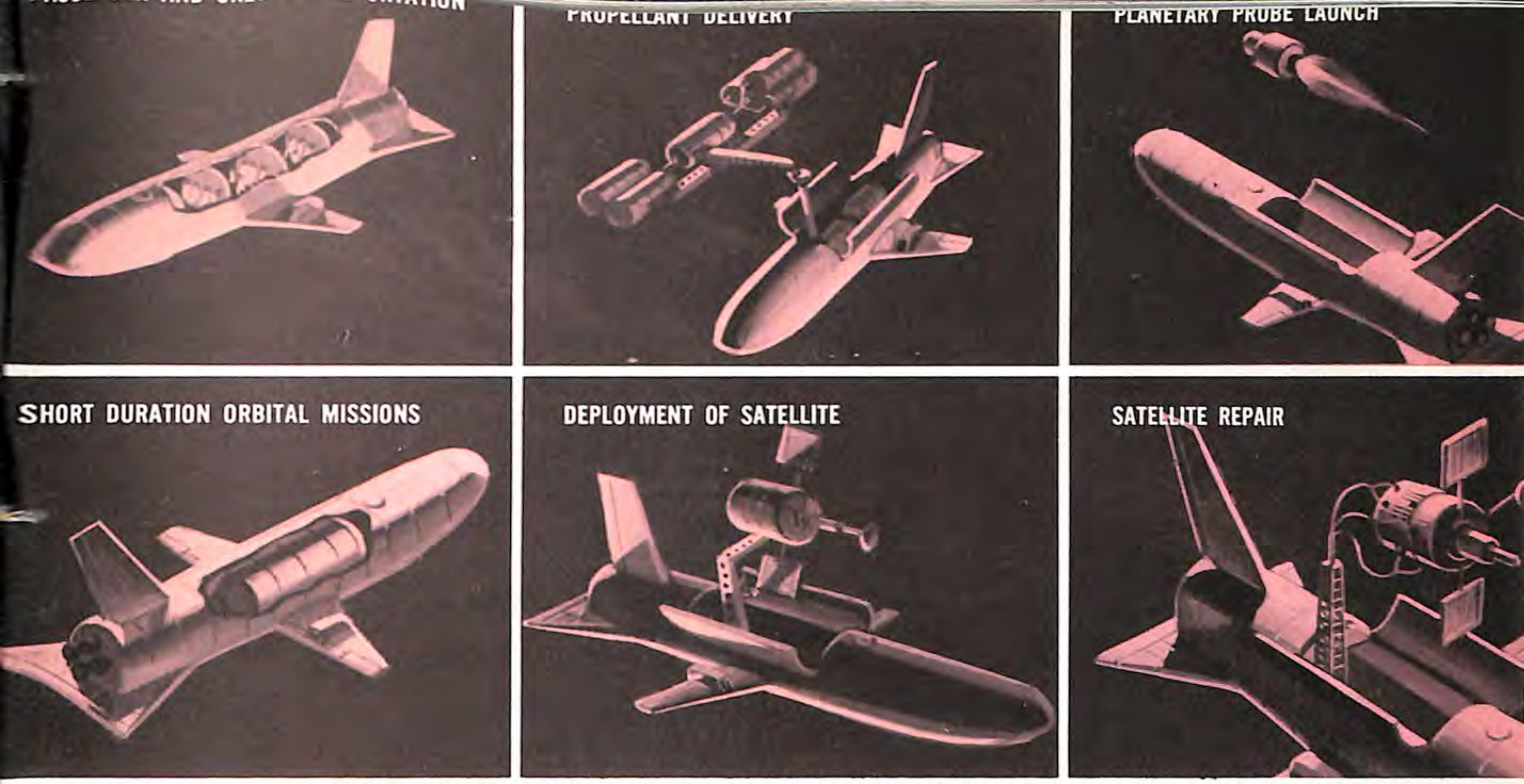
To meet these objectives, NASA has worked out detailed plans in each category of effort. Obviously, these proposals are subject to modification to meet changes in the year-to-year level of funding, and alteration of priorities within the space program itself.

Lunar Exploration Launch of the next lunar landing mission — Apollo 14 — is now scheduled for Jan. 31, 1971, although the timing is not firm. Modification of the spacecraft to eliminate the deficiencies that caused the explosion on Apollo 13 will require considerable time — just how much is uncertain.

Following Apollo 14 in the tentative NASA launch schedule are Apollo 15 in the summer of 1971, and Apollo 16 about six months later. The latter is to be the first mission to include an electric-powered Lunar Rover vehicle, in which two astronauts will be able to travel miles from their landing site to conduct experiments and collect and return with samples.

Apollo 17 is presently slated for liftoff during 1972, and the last two Moon flights in the series — Apollo 18 and 19 — in 1974. Meanwhile, late in 1972 the first Project Skylab workshop is to be sent into Earth orbit by a Saturn V vehicle.

NASA may decide to launch a second Skylab early in the decade. Because of this, some consideration is being given to deleting the Apollo 15 mission from the program, to make its Saturn V available to Skylab. A further possibility is that two Apollo flights — 15 and 18, or 18 and 19 — may be cut to release their Saturn V's for other purposes.



Artist's conceptions of the space shuttle in action. The reusable vehicle would take off like a rocket and land like an airplane. In addition to its basic role of transporting men, supplies and equipment, the shuttle would be capable of performing the other tasks indicated.

Planetary Exploration The most spectacular unmanned launches contemplated for the 70s will initiate "grand tours" of our solar system, extending well into the next decade. The first of these, to be launched in 1977, will send either one or two unmanned spacecraft toward Jupiter. On arrival in the vicinity of Jupiter after a four-year flight, the spacecraft will swing around that planet and pick up additional velocity from the strong gravitational field. Another four years will take the spacecraft to Uranus, where a second swing-around will occur. The last leg of the long journey will end at Neptune in 1988, after a total flight of 3 billion miles.

The second "grand tour" launch, in 1979, will set one or two spacecraft on a more direct route to Jupiter. The spacecraft will swing around Saturn in 1980. Five years later the spacecraft will reach Pluto, the most distant of our planets, some 3.7 billion miles from Earth.

For these missions it will be necessary to develop a computer somewhat like the one nicknamed "Hal" in the movie "2001 — A Space Odyssey." In the absence of a human crew, the computer will make repairs and alterations to keep the television system and other equipment functioning properly.

Preparations for the "grand tours" will begin in 1972. It is important that these launches be made in the 1970s. It will be nearly 200 years in the case of the first mission, and over 100 in the case of the second, before the far planets of our solar system are again in a relationship to make possible use of the swing-around effect to gain momentum and thereby to travel such great distances at relatively low cost.

Prior to these ventures to the far planets there will be a number of highly significant unmanned missions closer to home in the solar system. In 1972 the first unmanned Explorer craft will be sent to Jupiter; in 1971 two spacecraft will be flown in orbit around Mars in preparation for the landing of two unmanned craft there in 1976; in 1973 a Mariner will swing past Venus and then hurtle toward the Sun on a trajectory that will provide man with his first closeup examination of the planet Mercury.

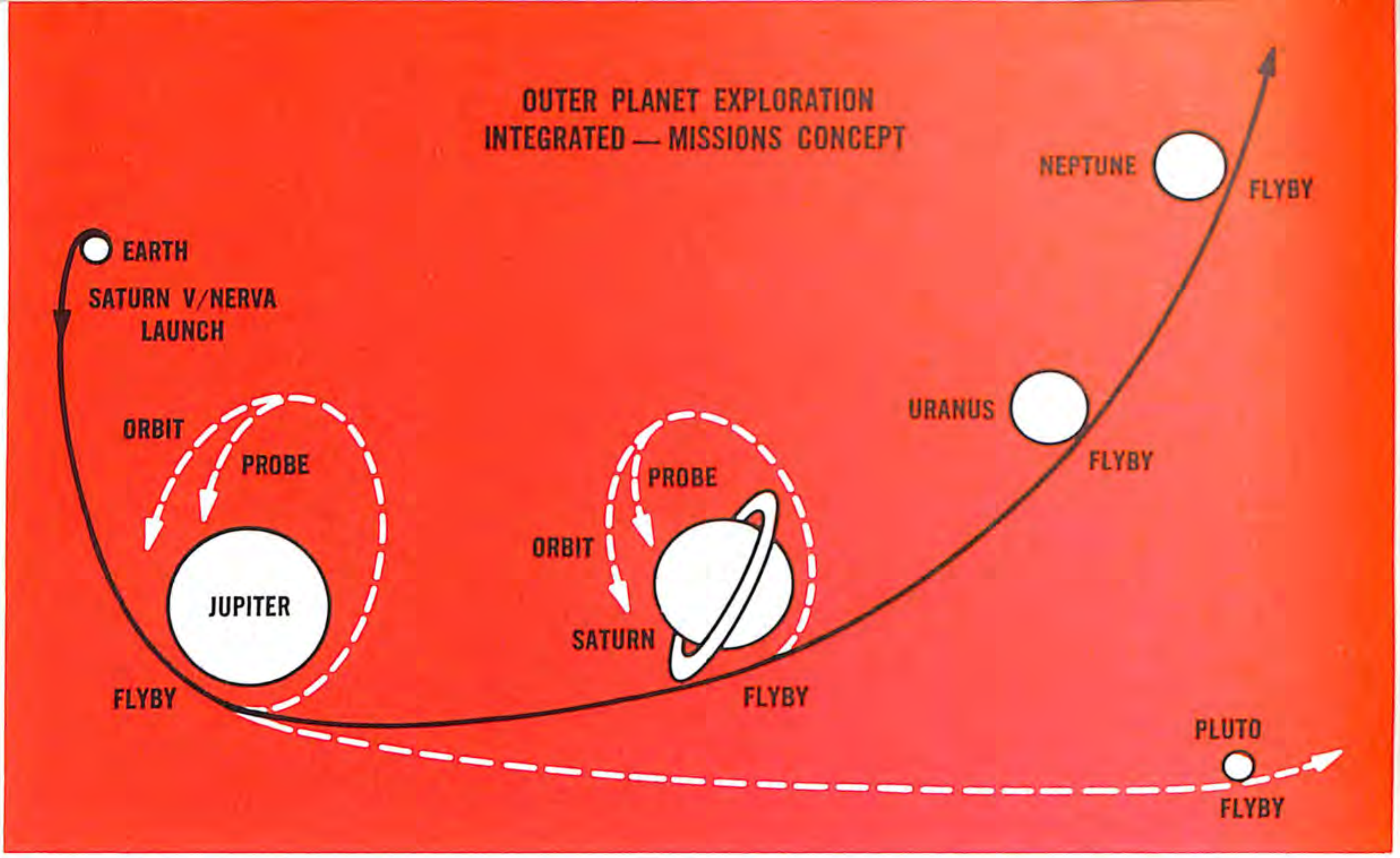
With an eye to the yet-to-be-scheduled manned flight to Mars, NASA plans to launch a nuclear-powered rocket for the first time in 1978. Nuclear propulsion is considered essential for any manned interplanetary mission.

Space Shuttle By 1976 NASA plans to make the first flights of the re-usable shuttle vehicle, a two-stage rocket plane that will take off from Earth vertically, and then separate at 40 miles altitude. The first stage will return to Earth and land horizontally like a jetliner. The second stage will carry men and supplies to rendezvous with a space station already in orbit and, after two weeks in space, also return to Earth in a conventional aircraft-type landing. Both stages will then be ready for re-use.

The shuttle will be designed to be used at least 100 times over a period of years, in contrast with the one-mission lifetime of present launch vehicles. This can reduce the present cost of $1,000 to put a pound of payload into Earth orbit to only $100 — there are some estimates that the per-pound cost may actually go as low as $50.

Several contractors are presently working to define the design for the shuttle structure and its engines. A wide variety of design approaches is being studied.

The shuttle will be used for tasks other than delivery of men and supplies. It will repair satellites, deploy



The 70s will afford a rare opportunity for "grand tour" unmanned missions. The outer planets will be in a relationship making it possible to utilize the "swing-around" phenomenon to add momentum and minimize the cost of making the first close-up study of the distant regions of the solar system.

satellites, launch planetary probes from Earth orbit, and perform short-duration orbital missions.

Space Stations—While space shuttle development continues, NASA will also be working on complementary projects to extend man's capability to live and work in space. NASA expects to launch one or two Skylabs beginning in late 1972, and follow up with "revisits" by new crews during 1973. The initial crew will be left in the Skylab for 28 days before it is replaced. The three of four replacement crews are to be aboard for stays of up to 56 days. Smaller (Saturn IB) launch vehicles will be used to deliver replacements and return crews who have completed their missions.

After examining the results of Skylab (also called the Experimental Space Station, or XSS), a decision will be made on when and how to proceed with development of a major, longer-lived space station. As mentioned earlier, contractors are already at work on designs for such an advanced module, which eventually will be enlarged to provide working and living quarters for 50 to 100 scientists and technicians.

The first of these new stations may be launched following the planned 1976 first flights of the reusable shuttle, which will service the station.

Practical Applications The schedule for unmanned activity in Earth orbit includes 1973 and 1975 launches of Applications Technology Satellites to be placed in synchronous orbits — stationary positions some 22,300 miles above specific points on the Earth's surface. These will carry large antennas with which they can broadcast TV and radio programs directly to small communities that are remote from conventional ground transmission stations. Initial plans call for transmitting TV programs to 5,000 villages in India via the 1973 satellite.

Another of the principal Earth-orbit launches will place a navigation satellite into synchronous orbit over the North Atlantic to aid in controlling the heavy volume of traffic over the main air route between North America and Europe.

Commercial communications satellites will not only provide instant worldwide TV broadcasts, but also vastly increase the number of channels available for private and business communications. Long-range weather forecasting by present and anticipated systems of meteorological satellites can, by conservative estimate, produce economic benefits at a rate of $2.5 billion a year for the United States alone by saving lives and property, increasing crop yields, and improving management of transportation and construction.

Earth resources satellites will survey our planet and send back information on oceanography, water and mineral resources, forests, crops, fisheries and pollution. This will improve our capability to manage all of our resources for more full and effective utilization by man.

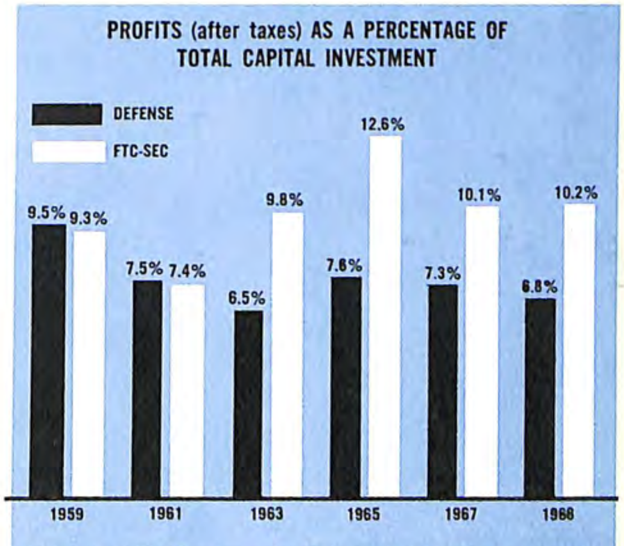
International Cooperation It has long been the policy of the United States to share with other nations, to the greatest extent feasible, the experience and the practical benefits of space exploration. On a cost-shared basis, the U.S. has already launched a number of scientific payloads designed and built abroad. Talks are being conducted with several countries, and the Soviet Union has recently indicated a growing interest in more meaningful cooperation. The U.S. is hopeful that the 70s will see an expansion of such joint effort, and perhaps even the launch of space ships manned by international crews.

'GROWTH AND DEVELOPMENT TOGETHER'

This metal sculpture was presented to employees of Aerojet-General Corporation by employees of the Watts Manufacturing Company in appreciation of help provided in establishing the minority-enterprise firm — now employee-owned — in the Los Angeles area. The sculpture symbolizes two men — one black and one white — together watering a tree whose roots intertwine into the trunk and develop into branches, representing the four branches (wood, metal, fabrics and electronics) of Watts Manufacturing Company. The tree is growing from a charred wooden base, symbolizing the Watts riots of 1965, which came from a tree burned during the rioting. Aerojet started the Watts plant in 1966 to provide employment in the area. This action by Aerojet is representative of the involvement by many aerospace firms in establishing minority enterprises.

oops!

The June issue of *Aerospace Magazine* was just off the press when telephone calls started coming in from member companies. They were interested in, and puzzled by, a chart of defense earnings as a percentage of total capital investment. They wanted to know which defense companies were making *that* profit ratio on investment; not their companies, certainly. The explanation: The legends identifying the bar lines (upper left of chart) were reversed. It made, obviously, all the difference. The corrected chart is shown below. The editors apologize.



Defense profits after taxes, in relation to total capital investment, were higher from 1958 through 1961 than either the profits of the defense companies' commercial business or those of the FTC-SEC index companies. This soon changed, however, and from 1962 through 1968 defense profits were lower than those in the other two categories. From 1958 through 1968 they declined nearly one-third, or 32.7%.

Source: Logistics Management Institute

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RETURN REQUESTED

Advanced design of a city center helibus is shown here. (See City-Center *VTOL* City-Center, page 8).

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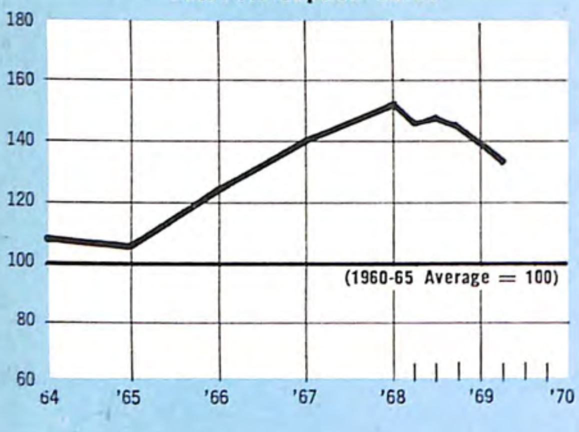
OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION • SEPTEMBER 1970

Satellites: Environmental Sentries

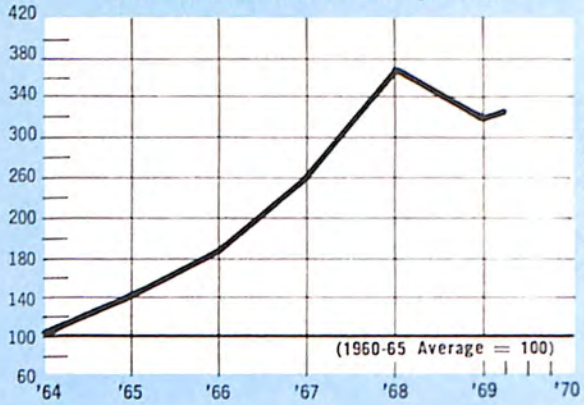
AEROSPACE ECONOMIC INDICATORS

CURRENT

Total Aerospace Sales

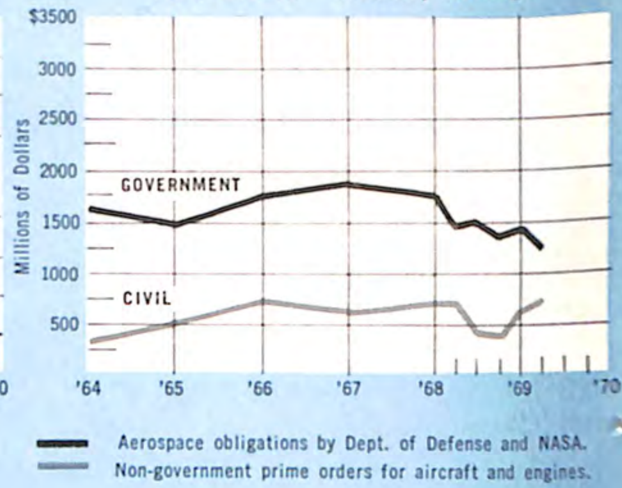


Value of Civil Aircraft Shipments



OUTLOOK

New Orders — Monthly Average



ITEM	UNIT	PERIOD	AVERAGE 1960-65 *	LATEST PERIOD SHOWN	SAME PERIOD YEAR AGO	PRECEDING PERIOD †	LATEST PERIOD
AEROSPACE SALES: Total	Billion $	Annual Rate	19.4	Quarter Ending Mar. 31, 1970	29.8	26.9	25.8
	Billion $	Quarterly	4.8		7.0	6.1	5.7
DEPARTMENT OF DEFENSE							
Aerospace obligations: Total	Million $	Monthly	1,151	May 1970	866	901	895
Aircraft	Million $	Monthly	601	May 1970	458	537	649
Missiles & Space	Million $	Monthly	550	May 1970	408	364	246
Aerospace expenditures: Total	Million $	Monthly	1,067	May 1970	1,369	1,268	1,217
Aircraft	Million $	Monthly	561	May 1970	830	777	763
Missiles & Space	Million $	Monthly	506	May 1970	539	491	454
Aerospace Military Prime Contract Awards: TOTAL	Million $	Monthly	920-+-	May 1970	684	723	797
Aircraft	Million $	Monthly	447	May 1970	386	464	591
Missiles & Space	Million $	Monthly	473	May 1970	298	259	206
NASA RESEARCH AND DEVELOPMENT							
Obligations	Million $	Monthly	215	May 1970	178	211	286
Expenditures	Million $	Monthly	130	May 1970	303	266	205
BACKLOG (60 Aerospace Mfrs.): Total	Billion $	Quarterly	15.3#	Quarter Ending Mar. 31, 1970	31.4	28.3	27.1
U.S. Government	Billion $	Quarterly	11.6		16.8	14.3	13.4
Nongovernment	Billion $	Quarterly	3.7		14.6	14.0	13.7
EXPORTS							
Total (Including military)	Million $	Monthly	110	June 1970	239	399	236
New Commercial Transports	Million $	Monthly	24	June 1970	48	218	80
PROFITS							
Aerospace — Based on Sales	Percent	Quarterly	2.3	Quarter Ending Mar. 31, 1970	3.5	2.5	2.3
All Manufacturing — Based on Sales	Percent	Quarterly	4.8		4.9	4.6	4.0
EMPLOYMENT: Total	Thousands	Monthly	1,132	May 1970	1,378	1,206	1,175[E]
Aircraft	Thousands	Monthly	469	May 1970	608	534	516[E]
Missiles & Space	Thousands	Monthly	496	May 1970	594	501	488[E]
AVERAGE HOURLY EARNINGS, PRODUCTION WORKERS	Dollars	Monthly	2.92	May 1970	3.85	4.10	4.10[E]

[R] Revised
[E] Estimate
* 1960-65 average is computed by dividing total year data by 12 or 4 to yield monthly or quarterly averages.
† Preceding period refers to month or quarter preceding latest period shown.
\# Averages for 1961-65.
-+- Averages for fiscal years 1960-1965.

Source: Aerospace Industries Association

THE SPACE LEGACY

Karl G. Harr, Jr., president of the Aerospace Industries Association, addressed the Comstock Club in Sacramento, California, on the first anniversary of man's landing on the Moon. The following, excerpted from the final portion of his remarks, is concerned with today's decisions in space exploration and their effect on the next generation.

As the citizens of tomorrow's society, it is upon our youth that the impact of current national decisions (concerning space exploration) will fall most heavily.

They must be brought to an understanding of the identification between our continued acceptance of this challenge and their ability to fulfill their own aspirations. . . .

We in America know that where major technological advance beckons, a nation such as ours, which depends heavily on such advances for its survival, its well-being, its standard of living and even the viability of its free institutions, has but one area of choice. It can opt to accept or reject the challenge; it cannot opt to accept or reject the effects of its decision. We also have learned that technological advance is essentially indivisible. You either opt for it or you don't. . . .

Our youth must fully understand these facts and do so in terms of their own aspirations. They must appreciate the relationship, again on their own intellectual, economic and social terms, between America's continued acceptance of the greatest challenge Earthmen have been privileged to assume and the range of options that will be theirs.

For when all is said and done what, in their eyes, is the single most important attribute of the society in which they will live as adults? It seems to me there emerges clearly from all their various modes of expression and assertion that they most want a society unfettered by the past. They want to be free to make their own choices, free to determine not only their own life-style but also the scope of their horizons, the range of their options. They fervently seek such freedom. Explicitly and implicitly they demand it.

How can they have any chance for such a society if today's America turns its back on the greatest challenge with which it is presented? If we were to falter now, to let ourselves fall back into a stagnant, static posture based on weakness, confusion and abdication of our responsibilities to the future, we would surely doom any and all of their efforts to achieve such freedom. They must be brought to understand this fact . . .

We don't owe our youth prescriptions for their life-style or the scope of their horizons . . . But we do owe them our best efforts to make them appreciate what is involved, and our best efforts to preserve for them the widest possible range of choice.

If when they become adults, when the world is theirs, they decide to sell the day to profit the hour, to remove their society from the mainstream of history, they will have to answer for it to future generations. If they decide to opt out, it doesn't make too much difference what we do now. But if they choose to sustain their growth, their strength and their independence of choice — and every indication is that is just what they will do — who among us will want to justify having deprived them of the chance?

AIA

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Official Publication of the
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ASSOCIATE EDITOR • Jean Ross Howard
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CONTENTS

The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems;

Foster understanding of the aerospace industry's responsibilities in the space exploration program;

Foster understanding of civil aviation as a prime factor in domestic and international travel and trade;

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

AEROSPACE is published by the Aerospace Industries Association of America, Inc., the national trade association of the designers, developers and manufacturers of aircraft, missiles, spacecraft, their propulsion, navigation and guidance systems and other aeronautical systems and their components.

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Western Office: McCulloch Building, 6151 West Century Blvd., Los Angeles, Calif. 90045

Satellites: Environmenta[l] Sentries

Surveys of the Earth from satellites may become a vital factor in maintaining human progress — and quite conceivably in maintaining human existence.

The potential of such satellites is examined in detail in a report compiled by a large group of university and government scientists which was recently published by the National Aeronautics and Space Administration.

Noting that the world's population is continuing to soar at a time when mankind is making ever more severe demands upon his planet's still vast but diminishing resources, the report quotes a graphic warning from the director of Harvard's Center for Population Studies: "The Twenty-first Century may witness a world of half-starved, depressed human masses, gasping for air, short of sweet water, struggling to avoid one another, living at a degraded subsistence level . . ."

If we are to retain a productive, habitable environment and the hope of enhancing the quality of life, we must develop much more comprehensive and current knowledge of Earth's resources than we now possess. "Fortunately," the report notes, "this now can be done both more swiftly and more economically. The whole world's surface can be surveyed as often as necessary, and in a variety of ways, with cameras and other sensing devices on orbiting satellites."

The first of a family of such satellites — the unmanned Earth Resources Technology Satellites (ERTS) — designed specifically for remotely sensing with cameras and other instruments from a near-polar orbit at about 500 miles altitude, is scheduled to be launched by NASA in the first half of 1972. In addition to NASA, the Navy and the Departments of Agriculture, Interior and Commerce are involved in the program.

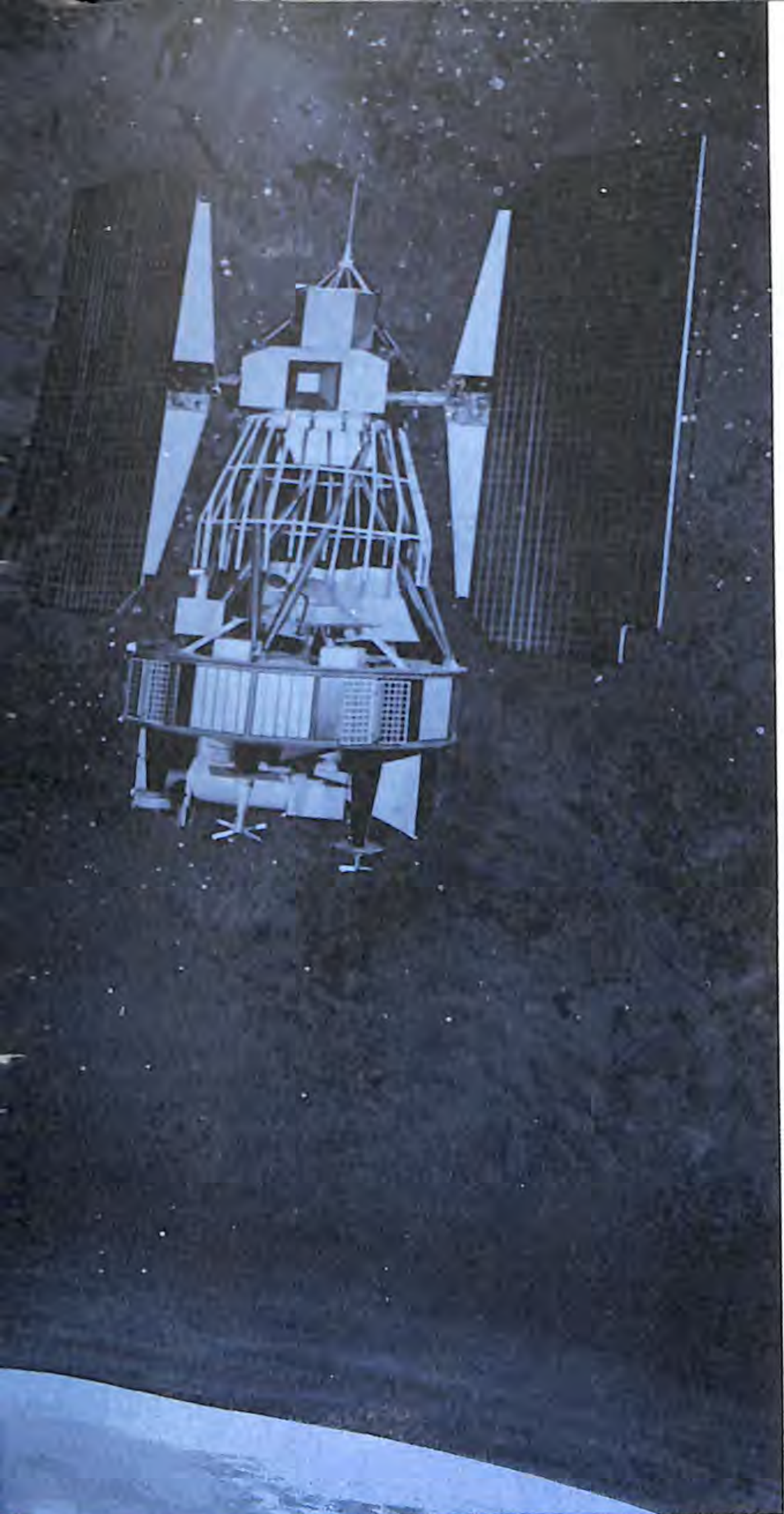
General Electric Company recently was selected to build the spacecraft, a modified version of GE's Nimbus weather satellites. The first ERTS will contain a television system built by RCA and an infrared scanning device made by Hughes Aircraft Corporation. It will also carry receiving and relay equipment to collect data from remote, automated data-gathering systems on the land and on the ocean. Information from these unattended stations will be gathered and stored on the spacecraft and then beamed back to ground stations at Fairbanks, Alaska; Corpus Christi, Texas; and Greenbelt, Maryland.

The ERTS will pass over every point in the continental United States about once every three weeks, making it possible to cover the entire contiguous states in about 2,500 separate photographic images.

Dramatic evidence of the effectiveness of photography from Earth-looking satellites was shown during several of the manned Gemini and Apollo missions of recent years. The NASA report includes numerous color photos, both conventional and infrared, taken during those flights, and points out their value to scientists in a variety of disciplines.

The Gemini terrain and weather photographs "clearly established the value of such photography in nearly all occupations concerned with the Earth," the report said. Because of the Gemini success, arrangements were made on short notice to include a photographic experiment on the Earth-orbiting flight of Apollo 9 in March 1968. This was carried out under the auspices of NASA's Earth Resources Survey Program in cooperation with the Departments of Agriculture and Interior, the Environmental Science Services Administration of the Department of Commerce, the Naval Oceanographic Office, and other agencies, firms and institutions. The undertaking, said Professor Robert N. Colwell of the University of California at Berkeley, "could easily prove to be the most important photographic experiment in history."

Already, Earth photographs taken from Gemini and Apollo are being used by mining companies to aid in their search for ore deposits. Mapping has been greatly



Artist's conception of the first Earth Resources Technology Satellite (ERTS), scheduled for launch in 1972.

advanced by the use of high-altitude cameras and new films. It is impossible to gauge the full extent of the benefits to be gained from Earth resources satellites, but it is apparent that, in addition to locating minerals and enhancing cartography, they will be highly useful in agriculture, forestry, hydrology and oceanography. They will provide us with a vastly greater knowledge of Earth's existing resources of water, minerals, trees, crops and fish, so that we can better husband these essential resources.

Aerial photography has been conducted by agricultural agencies in the United States for nearly 40 years. It is now evident that the use of cameras and other sensors aboard satellites can supplement and enhance the knowledge obtained from aircraft.

In anticipation of the first Earth Resources Technology Satellite launch two years hence, NASA crews this spring and summer have been flying a borrowed Air Force reconnaissance plane on a series of photographic missions over 26 American cities. These flights, at altitudes above 50,000 feet, carry nine cameras and take pictures of the types that will later be transmitted from the RCA Vidicon television system of the ERTS. The study is being carried out as part of the Earth Resources Observation program of the Department of the Interior, under the direction of the Department's U.S. Geological Survey. It is due to be completed this fall.

URBAN PLANNING AID

The aerial photography program will be supplanted when ERTS goes into operation. Pictures from both the aircraft and the satellites will be used to assist in measuring urban changes and planning for future city area improvement.

The photographs may make it possible to see details as small as automobiles — and to perceive almost immediately changes in land use, decay in the inner city, and expansion of residential areas into the countryside. At present, planners must rely on the U.S. Census, taken only every ten years, for comprehensive planning data.

The 26 city areas being photographed in the present aerial study are: Asheville, N.C.; Atlanta; Aurora, Ill.; Boston; Cedar Rapids, Iowa; Dallas; Denver; El Paso, Tex.; Houston-Galveston, Tex.; Lawrence, Kan.; Midland, Tex.; New Haven; New Orleans; Peoria, Ill.; Phoenix, Ariz.; Pontiac, Mich.; Riverside-San Bernardino, Calif.; Salt Lake City; San Francisco; San Juan, P.R.; Seattle; Tampa, Fla.; Tucson, Ariz.; Washington; West Palm Beach, Fla.; and Wichita Falls, Tex.

NASA's report entitled "Ecological Surveys from Space" deals with possible applications of such surveys in seven major areas of natural science — geography, agriculture, forestry, geology, hydrology, oceanography and cartography — although it remarks that "many more uses in more fields of learning are conceivable."

Following are some highlights in each of the seven areas covered.

GEOGRAPHY

Geographers serve to bring into regional and global perspective the findings of scientists in the other disciplines. Once the Earth's natural resources have been inventoried, with the participation of geographers, it will also be their responsibility to produce maps and analyses to clarify the relationships between resources and human cultures so that natural riches can be used with the greatest efficiency.

Satellite photographs might make it possible to predict the population and size of settled areas. A series of photographs over a year or several years would make it possible to analyze farming patterns, crop conditions, the impact of floods and droughts, expansion of urban areas, and changes in transportation facilities and irrigation systems.

AGRICULTURE

Managers of croplands need to know the type of crop in individual fields, the size of the field, the vigor of the crop, the identity of any damaging agents, and the probable crop yield per unit of area. Armed with this information, experts can maintain regional and global inventories and forecast yields by simple mathematics. Steps then can be taken to keep the supply of essential foods and fibers in balance with the demand for them.

Aerial photography has been used in agriculture in the United States since the early 1930s, but single aerial photographs provide very little information and it takes time to interpret them. Sequential observation of croplands from spacecraft would provide rapid information on the dramatic changes that occur. These would be detected not only through photographs but through optical scanning and radar-type imaging systems.

From the data already available from spacecraft sensing (photographs, low-resolution infrared strip maps, etc.), it appears that surveys taken from space can supplement and enhance the value of aircraft sensing.

The world has 22 principal agricultural regions totaling nearly 4 billion acres of cropland. Crop production is a year-round operation. The planting dates of certain crops in the Northern Hemisphere coincide with the harvest periods of those crops in the Southern Hemisphere. In regions of mild climate, two or three successive crops of the same species may be grown. There is every indication that modern man will try to eliminate famine as a scourge and enhance his ability to maximize world food production by increasing the efficiency of this great productive process.

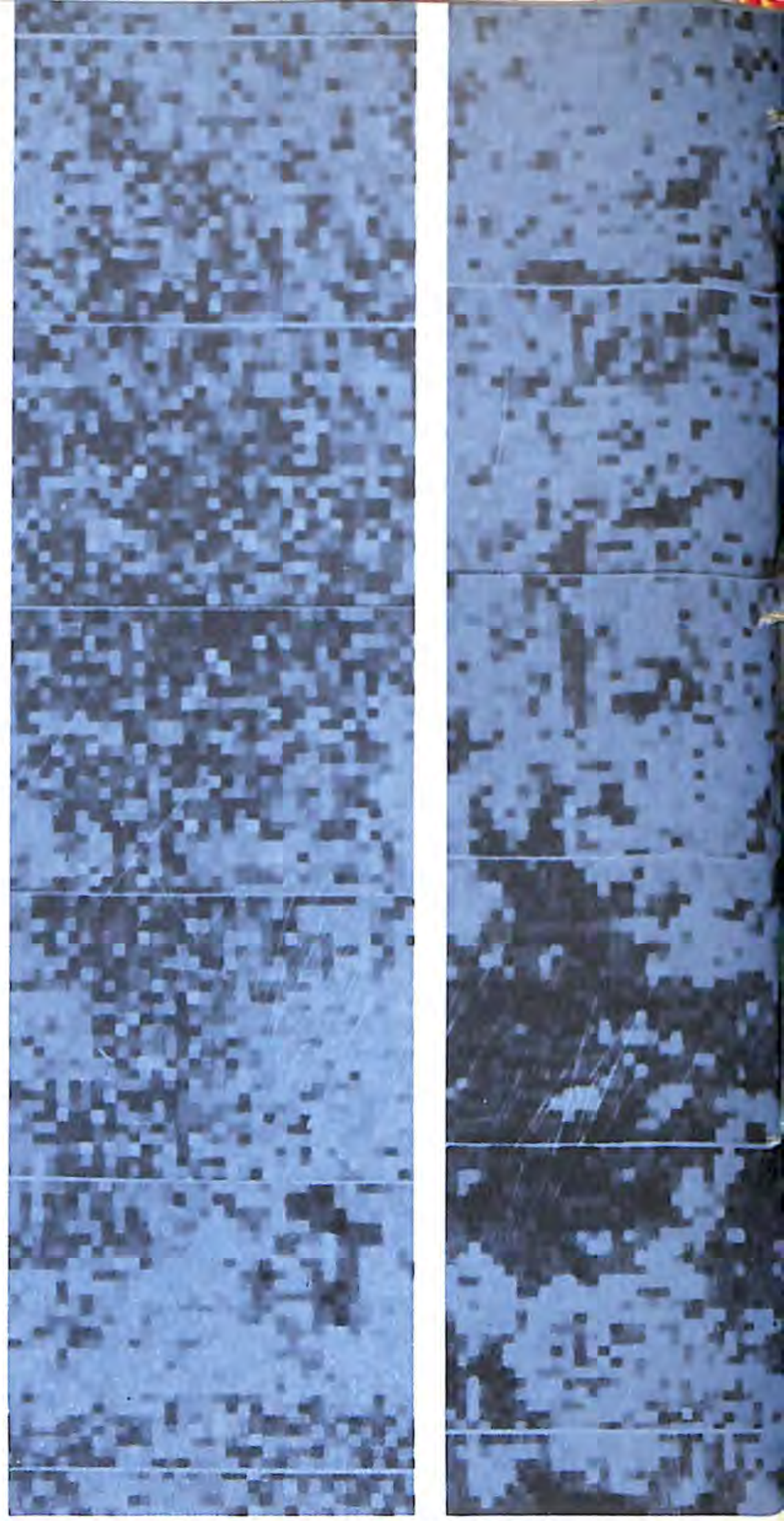
If, using satellites, extended areas of crop failure in one hemisphere were foreseen, production in the other hemisphere might be stepped up in time to reduce the danger of famine.

While the United States has evolved a rather effective crop-production control system, based on reporting and census services, this kind of information in the developing, food-deficit nations is frequently sketchy and unreliable. Access to crop-producing regions of such nations often is difficult because of terrain barriers and absence of all-weather roads. The possibilities of establishing aerospace multispectral remote-sensing systems are especially appealing as a giant step in the gathering of agricultural data on a world basis to help meet world food needs.

FORESTRY

The Forest Service of the U.S. Department of Agriculture keeps a continuing inventory of this country's vital timber resources, but some data are as much as 9 years old when reported because of the difficulties and cost of collecting information about woodlands. In many other countries, much less is known than in the United States about the current condition of forests.

Both foresters and naturalists need surveys of remote



areas that are difficult to reach on the ground but can be monitored rapidly and repetitively from orbiting satellites. Such spacecraft can serve many countries virtually simultaneously.

Photographs from infrared sensors, whose colors represent variations in the reflectance of light rather than the colors the eye sees, can be used to detect insect damage and forest fires. Studies conducted by NASA have shown that such photographs can be obtained from orbital altitudes with equipment well within the reach of existing technology.

GEOLOGY

The world's "non-renewable" resources of mineral and petroleum deposits have been depleted more during the last three decades than in all of previous civilized

Three 10-mile-wide areas of the U.S. are shown in these strips produced with an electrically scanning microwave radiometer. The left strip covers forested areas of Kentucky and West Virginia; the light area at lower right is Lexington, Ky. The center strip, near Evansville, Ind., shows a variation of hue caused by the lower emissivity of newly plowed fields (lightest areas) in comparison with vegetated sections. On the right, the area of St. Louis, Mo., shows the confluence of the Missouri and Illinois Rivers (lower left) and the Missouri and Mississippi Rivers (upper center). The area could not have been photographed by conventional means because of cloud cover.

Apollo 9 astronauts took this infrared photograph of the Imperial Valley-Salton Sea region of California. Water appears darkest; vigorous growths of alfalfa, sugar beets and barley reflect strongly in the area below the sea.

history. Because proven reserves of several such resources are liable to be exhausted within the next 20 years, there is an urgent need for more knowledge on both a regional and a global basis about the location and extent of the remaining deposits.

Global observations made year after year from spacecraft would enhance geologists' understanding of the dynamics of the Earth, and at the same time help in the search for yet-undiscovered accumulations of useful materials.

HYDROLOGY

In some parts of the world water already has become the most limiting and valuable resource. Rapidly receding water tables suggest that in many areas inadequate fresh-water supplies may soon restrict food production and even human occupancy. For more intelligent management of the Earth's water resources, more information is needed about the surface and subsurface flows of water, the locations of soil beds and strata that hold water, and the suitability of various sites for constructing dams and impounding water.

Increasing the moisture of soil decreases its reflectivity, which makes moist soils appear dark. Thus, photographs are quite sensitive indicators of relative soil moisture, even where vegetation has not been affected.

Numerous pictures taken by both the Gemini and the Apollo astronauts have indicated how photography from spacecraft could be useful to hydrologists.

OCEANOGRAPHY

The greatest and least-tapped natural resource of the Earth is the ocean. Not only is it important as a rich source of minerals and food, but its effect on the climate can govern the habitability of much of the land surfaces, and oceanographic features determine the safety with which men can travel on or near the surface of three-fourths of the globe.

Better information of many kinds is needed — for example, data on sea states, shoals, tidal waves, potassium, plankton, sardines, temperature, and turbidity.

Meteorological and other satellites, as well as Gemini and Apollo photography, have suggested many ways in which oceanography can benefit from space science and technology.

CARTOGRAPHY

The Gemini astronauts demonstrated the value of space photos for swift and accurate updating of maps.

Aerial photography and electronic surveying have increased the accuracy of many maps and charts in this century, but have not sufficed to keep them up to date. Until quite recently, mapping the whole world on a 1: 1,000,000 scale seemed to be almost as ambitious as placing a man on the Moon. Soon much of the Earth will be photographed at that scale. Men's portrayals of the condition, distribution, and depletion of a great many of the Earth's riches then can be made more precise, more vivid, more current, and more useful.

Supersonic Rotating Arm Tests Erosive Effects on Materials

An advanced supersonic rotating arm test apparatus, first ever designed for speeds of up to Mach 3.0 (2,280 mph), has been built by Bell Aerospace Division of Textron for the USAF for test and evaluation of the erosive effects of impinging rain or sand particles on aerospace materials.

The maximum velocity of the new test cell is more than twice that of the free world's only other supersonic rotating arm installations, which are limited to Mach 1.4.

Destruction of solid surfaces by high-speed particles is a phenomenon that is causing a growing concern in military as well as commercial aviation circles.

The phenomenon will occur in even the highest strength solid materials when they are subjected to high-speed bombardments of water, ice or sand particles.

Air Force operational experience has shown that rain and ice particles can cause major damage to missiles and aircraft noses, canopies, radomes, and wing and tail leading edges.

In recent years rain-caused impact erosion damage to some high-performance, all-weather military aircraft has been so severe that it has seriously affected the integrity of some of their plastic-reinforced substructures. In some cases, the damage was inflicted during flights as short as 30 seconds through heavy rain at no more than 680 mph.

Employing the test apparatus, Bell is conducting for the Air Force a materials test and evaluation program aimed at determining the erosion-resistant characteristics of some 600 material specimens at sustained speeds ranging from Mach 0.66 to Mach 3.0 at simulated altitudes of up to 60,000 feet.

Aerojet-General Building 100-ton Surface Effect Ship

The first of a new breed of ocean-going "ultra-speed" ships that will ride on air is being constructed by Aerojet-General's Surface Effects Division.

Weighing 100 tons, the "Surface Effect Ship" will move over the sea on an air cushion at speeds in excess of 90 miles per hour — up to four times faster than conventional ships.

Sea trials of the craft are expected to begin in mid-1971. Aerojet is building the new craft at the Tacoma Boatbuilding Co. under contract to the Joint Surface Effect Ships Program Office (JSESPO), a combined activity of the U. S. Navy and the Department of Commerce's Maritime Administration. The ship will help determine the feasibility of four to five thousand ton vessels with speeds of 90 miles per hour, or higher.

These new type vessels are shallow draft ships with only a few inches of their catamaran-like sidewall hulls submerged in water during their high-speed operation.

The air cushion will be supplied by axial flow lift fans. Both the propulsion system and the lift system can be powered in any combination by four Avco/Lycoming-built aircraft-type marine gas turbine engines. For navigation, safety and reliability, the craft will be equipped with advanced systems required by its high-speed operation.

Inflatable Bridge Will Give Army 'Go-Anywhere' Capability

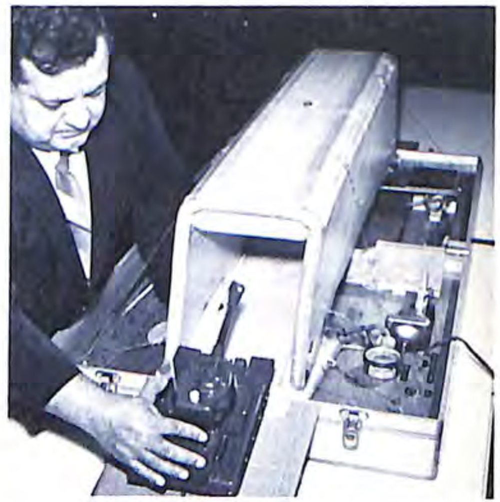
An inflatable "go-anywhere" bridge made of fabric and threads but strong enough to support a 20-ton tank has been developed by Goodyear Aerospace Corp. for the Army.

The 90-foot-long bridge can be transported on a single truck to the edge of rivers or canyons, inflated on-site and used as a crossover for entire convoys.

It can then be deflated and follow the convoy to the next canyon.

A 1/20th scale model was built to demonstrate the practical capability of the air-inflated bridge.

Key to the system is Airmat, Goodyear Aerospace's trademark for a double-walled hollow fabric comprising two layers of integrally woven coated cloth



connected by closely spaced threads. When this is sealed and inflated, the fabric layers expand to the length of the connecting threads. The unit becomes extremely rigid, even at low inflation pressures.

Honeywell Develops Long-Life Vibrating Wire Rate Sensor

A new rate sensor with a predicted life 10 times that of conventional rotating rate gyroscopes has been developed by Honeywell Inc.

The vibrating wire rate sensor will have a usable lifetime, without repair, equal to that of existing airplanes, spacecraft or missiles on which it may be installed.

The sensor produces a usable output through interaction of a vibrating wire and a pair of magnets.

Strength of the wire, yield and tension are design features that provide the basis for predicting a lifetime without repair as high as 75,000 hours for certain applications.

Some of the other features which make the device unusual are electrical isolation of the output signal; control of wire vibration to prevent signal error; relative insensitivity to temperature and aging; use of latest microcircuitry; ready time of 100 milliseconds; and constant wire frequency vibration.

The device has been in development at Honeywell about five years. The firm has built 36 for test purposes.

LTV Will Manage Training Program for Montana Indians

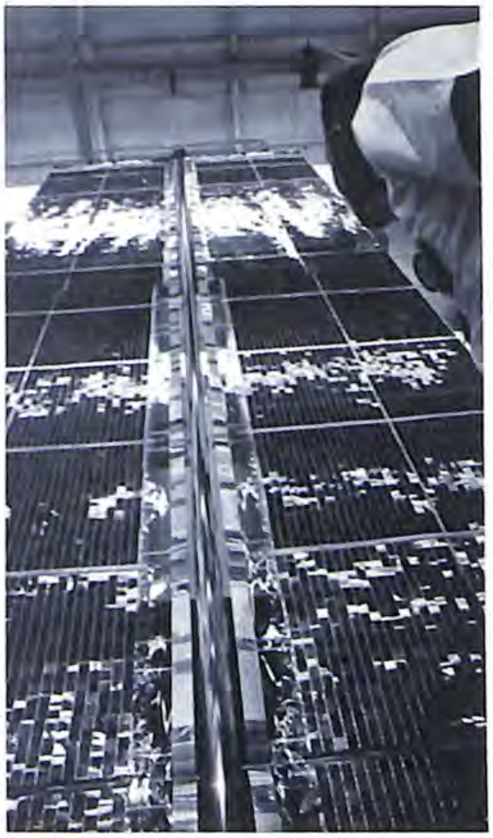
The Montana Intertribal Council has selected LTV Education Systems to manage an ongoing training program for Indian families.

The two-year-old program trains Indian workers in basic, job-entry-level vocational skills, while providing care and training for their families at the same time and at the same location.

The program has been run by the University of Montana at its Missoula campus under contracts with the Intertribal Council, which represents the state's eight Indian reservations.

One hundred families and/or individual workers will be given pre-vocational instruction and basic education over the full span of the program. Trainees and their wives and children also will be provided with services such as food, housing and health while in attendance at the center.

Recruiting of a new group of families will get under way as soon as the program is funded, and actual training probably will start in November or December. Training under the expiring contract was virtually complete.



Lockheed Studies Huge Solar Array To Harness Sun's Power

Lockheed engineers are studying a system that will harness the power of the sun to keep a large space station running for years.

The National Aeronautics and Space Administration has awarded Lockheed Missiles & Space Co. a contract to design and test the largest "solar array" in history — actually only one segment of an array four times larger still.

A solar array is a sheet of photovoltaic cells which convert solar energy into electricity. Lockheed must build and test one 30 feet wide and 90 feet long to evaluate how well it can perform in space.

The test segment will be only one-fourth the ultimate size of the array NASA hopes to install on a space station that will orbit the earth a few years from now. That total array — some 60 feet wide and nearly 200 feet long — will be 30 times as large as the biggest array flown to date and with 100 times more power.

Computer Linked With Wind Tunnel Provides Fast Results

North American Rockwell Corporation engineers are obtaining more meaningful and faster test results on proposed designs of tomorrow's aircraft by linking a computer with a supersonic wind tunnel.

An IBM 1800 data acquisition and control system now in use at NAR's Los Angeles Division engineering laboratory enables technicians to process wind tunnel test results six times faster than was possible with previous methods.

The wind tunnel, which can simulate the forces on an aircraft flying three times the speed of sound, is the largest privately owned facility of its kind in the world. With capability to operate at subsonic, transonic and supersonic speeds, the trisonic tunnel is used by North American Rockwell and other aircraft manufacturers for aerodynamic studies of products under development.

Wind in the tunnel hits the aircraft model with the force of 33 hurricanes. A test blow usually lasts 20 or 30 seconds. During that time, the test generates more than 100,000 samples of design information.

The IBM system makes test results available six times faster because it is linked directly to the tunnel's instruments. It collects and records the data at 3,600 samples every second. Test results are processed for evaluation by the engineers in less than five minutes, allowing sufficient time to plan the next test and make the necessary model modifications.

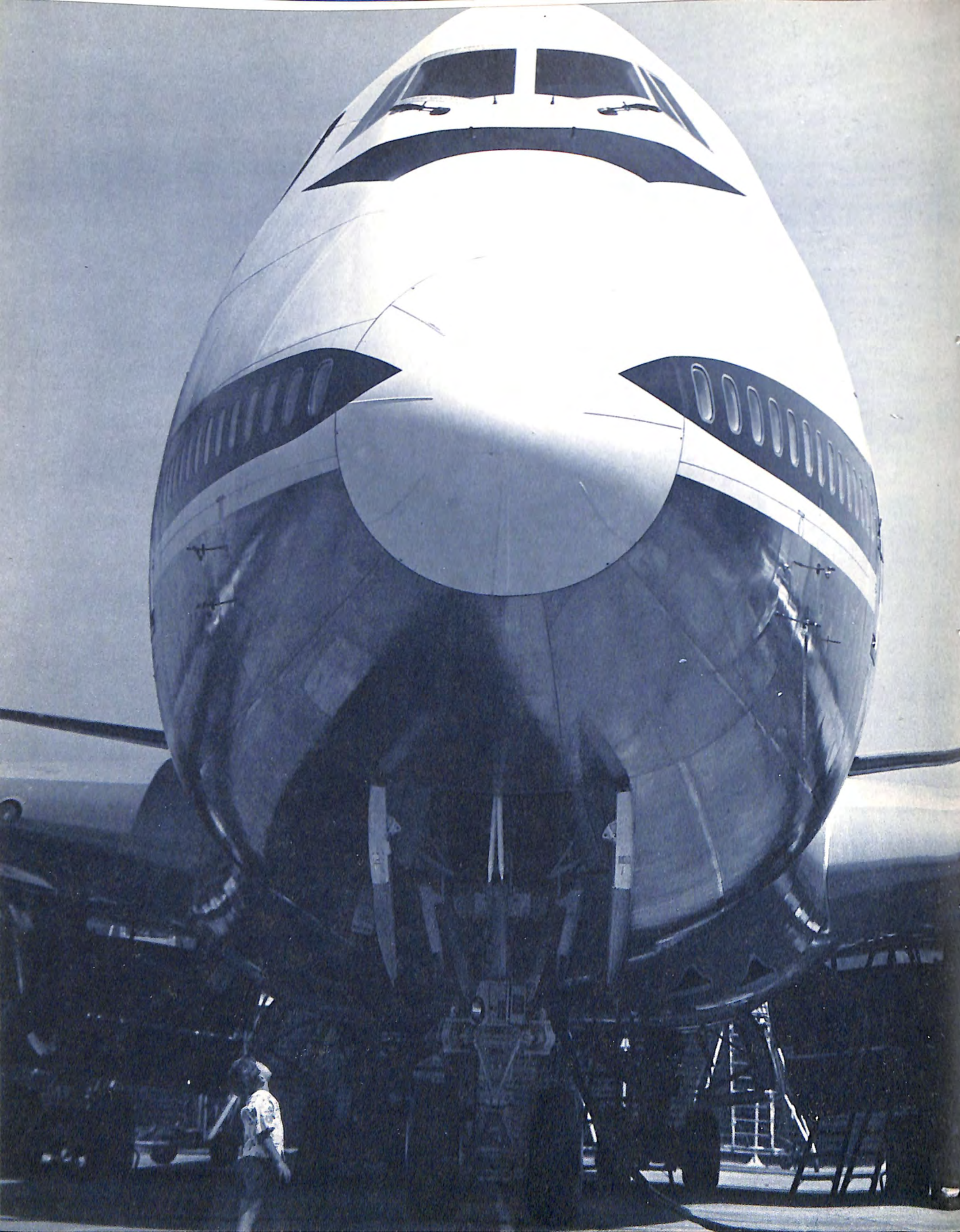
UTC Develops New Steering System for Titan III-C

A new rocket steering system, offering significant cost savings for a versatile space launch vehicle — the Air Force Titan III-C — has been successfully tested.

The advanced steering system operated perfectly several times during the static firing of a powerful, seven-segment, 1.4-million-pound-thrust solid propellant rocket conducted by United Technology Center, an associate contractor for the Titan III program.

The steering system is planned for use on the 2.4-million-pound-thrust launch stage UTC produces for the Titan III-C. It is expected to be used on flights beginning in early 1971.

The new steering system will reduce the 500-ton booster stage by approximately 8,700 pounds in liftoff weight. In turn, this will permit a significant increase in the vehicle's payload at no increase in unit launch vehicle costs.



AIR TRAVEL'S SPACIOUS AGE

A Pan American 747, first model of the new generation of wide-bodied jet transports to enter airline service, on January 21 lifted off the runway at John F. Kennedy International Airport and headed for London, England, on its first commercial flight. There were 358 passengers aboard.

Less than six months later, after delivery of fifty 747 aircraft to 11 airlines by The Boeing Company, the 747 carried its one-millionth passenger — a record of passenger acceptance that is unequalled in air transportation history. More than half of these passengers were carried across the Atlantic Ocean.

Two other wide-bodied jet models will join the 747 in commercial service in the fall of 1971. They are the Lockheed L-1011 and the McDonnell Douglas DC-10. Both aircraft were rolled out recently. The capability of the air transportation industry to meet the predicted increase in air travel is assured. Depending on the interior configuration selected by the airline, the 747 will carry 370 to 490 passengers; the DC-10 and L-1011 will carry between 270 to 345 passengers. (The DC-10 made its first flight in late August.)

The first jet transport model, introduced in commercial service in 1958, required a year following the start of service to carry a million passengers. Twin-engine transports of the 1930's, which got modern air transportation off the ground, carried 21 passengers and operated two years before carrying their first million passengers.

In logging their one-millionth passenger, early aircraft made an estimated 200,000 flights, because the average passenger load up to 1928 probably would not have been more than five per flight. The twin-engine transports of the 1930's required about 50,000 flights to carry one-million passengers and the 707 required approximately 15,000 flights. The 747 pared the number of flights to carry one million passengers to only 5,000. Greater numbers of people have been able to travel without an increase in air traffic which relieves both airways and airport congestion.

Passenger acceptance has been remarkable. The Boeing Company conducted a survey after its 747 had been in service six months and found these facts:

- Ninety-one percent of those polled who had flown three or more times in a 747 said they preferred the superjet over any other jet transport plane. Of those who had flown twice, 79 percent preferred it, and 81 percent of those who had flown once before preferred it.
- Eighty-four percent of all travelers polled preferred the superjet as a means of travel. Eighty-seven percent of those traveling for pleasure preferred the airplane, as did 86 percent of the women passengers.
- In reply to the question, "What do you like about the 747?", spaciousness was noted by more than 50 percent of the passengers. Smooth flight was commented on by 23 percent, 16 percent noted general comfort, 16 percent seating comfort, and 5 percent the airplane's interior quietness.
- In answering the question, "What did you dislike?", crowded feeling was commented on by 14 percent; movies, audio and lights, 10 percent; lavatory location and number, 8 percent; and service, 7 percent.
- In studying the superjet's ground operations statistics, the survey found that average boarding times for 228 passengers, a typical load, was 15.2 minutes. On 70 percent of the flights studied, baggage-handling crews had delivered the first bag to the pickup area in 10 minutes or less.
- Passenger load factors exceeded expectations. On the North Atlantic, between start of service January 21 and July 26, passengers occupied 61 percent of the available seats; on the New York City-San Juan, Puerto Rico route, the figure was 85 percent between February 7 and July 26; United States domestic routes showed an

average load factor of 64.1 percent between start of service February 25 and July 26; and on the Pacific Ocean routes between March 10 and July, the load factor was 67.5 percent.

• Cargo hold load factors for the same periods amounted to 42 percent on the North Atlantic and 45 percent on Pacific Ocean routes.

The new wide-bodied jets abound in superlatives. The tail section of the 747 towers six stories above the ground, and the aircraft weighs 357 tons. Parenthetically, about 500 pounds of that weight consists of the paint for the airline stripe and insignia on the tail and fuselage.

The first commercial trans-Atlantic flight took place in 1939 in an aircraft that measured 52 feet in length (less than the height of the 747's tail). It carried 12 passengers, less than the crew of 14 used in the 747's trans-Atlantic operations. Each aircraft has a fuel capacity of more than 46,000 gallons; that would keep the family car going for nearly sixty years. The "gee whiz" list is almost endless.

The experience of operating air carriers has been encouraging. Pan American engineers recently reported their findings in a technical paper presented to the American Institute of Aeronautics and Astronautics' Second Aircraft Design and Operations Meeting. The report stated:

"... we should take note of published or implied criticisms that the 747 may be too big for its time. We heartily disagree.

"In the first place, the useful service life of a transport airplane is now at least 15 or more years. Historically, airplanes that appeared too big when introduced have almost invariably proven too small long before their service life is expended. The 747 size was actually selected for the projected traffic for the 1973-75 time period, assuming the use of a growth engine and probably increase in weight. With the load factors that have been experienced to date, history may already be repeating itself. It is of course much too early to make such a conclusion, for winter seasons and competition from other 747s may take their toll. If the early indications of direct operating costs are confirmed over the long run, quite a bit of new technology will be required to meet such costs with another airplane. Thus, all the indications point to the probability that long before 1975 the airplane will not be considered too big, and we confidently expect to be studying growth versions before that time....

"The B-747 is a magnificent transport aircraft, and will be here a long time, one that should go down in history with the best like the DC-3, JU-52, DC-6B and B-707-320B."

THE POWERPLANTS

New technology engines power the three models of the superjets. The engines are about two-and-one-half times more powerful than the last generation of turbine engines, operate more quietly and produce virtually no smoke plumes. All produce thrust in the 40-50,000-lb. range. The General Electric CF6-6 is used on the DC-10; the Pratt & Whitney Aircraft JT9D is used on the 747 and the Series 20 of the DC-10; the L-1011 uses the Rolls-Royce RB.211.

George A. Warde, vice president-operations, American Airlines, reported that after placing a 747 in service last March the carrier ran the aircraft for 45 straight days without missing a schedule. He said this airplane is a "draw" — on one day five flights recorded a 94 percent load factor.

The conception of a revolutionary jet transport started nearly a decade ago when market researchers determined that aircraft of this size would be needed to fill the anticipated growth in passenger and cargo traffic. An engineering group was organized to detail and refine earlier investigations and just four years before the first commercial flight of the aircraft the decision was made to proceed. The first order was placed by a carrier one month after the decision was made to proceed.

The corporate stakes in such a decision are immense. The new wide-bodied jets, although subsonic in speed, are as revolutionary for air transportation as the change from piston-power to jet-power for air transports. The decision by Pan Am to buy 25 of the 747s involved $590 million for a plane that literally existed only on paper. This order was later increased to 33 aircraft bringing the carrier's direct financial commitment to $764 million. The Boeing Company laid its corporate existence and reputation on the line to deliver.

The L-1011 and the DC-10 differ from the 747 principally in that they are powered by three engines compared with four for the 747. They are highly flexible to accommodate a wide variety of route lengths. All three aircraft have more efficient, higher-thrust engines and advanced aerodynamic design which combine to make

Lockheed Aircraft Corp. executives pose with their new jetliner, the L-1011 which was rolled-out recently. From left are Daniel J. Haughton, board chairman; Charles S. Wagner, Lockheed-California Co. president; and William M. Moran, executive vice president, commercial programs.

the Direct Operating Cost (DOC) per seat mile less than the DOC for earlier jet transports.

To the passenger, a singularly remarkable fact is that the engines used on the wide-bodied jets are substantially quieter than the engines used on earlier jet transports, but they are almost two-and-a-half times as powerful. They produce more than 40,000 pounds of thrust, and represent a major advance in propulsion technology.

The new aircraft, despite their size and sharply increased passenger carrying capability, will not require major changes at existing airports where the earlier jet transports operate from. Their take off and landing characteristics, low engine noise levels and the virtual elimination of smoke emission make them welcome airport neighbors.

New facilities were required to build the huge transports. At Everett, Washington, 30 miles north of Seattle, Boeing built on a 780-acre area a $200 million plant. Contained within its 200 million cubic feet are areas for manufacturing, sub-assembly, major and final assembly operations. Adjacent to it are a mock-up building, housing the full-scale replica of the aircraft, a building for cleaning, sealing and painting airplane sections before they go into final assembly; a static test building and a fatigue test position. Also at the site are a 16-million gallon holding basin to catch surface runoff water, and a three-mile railroad spur — the second steepest standard gauge railroad in the nation. It was built to bring in construction steel for the building and production parts assemblies.

In the Douglas plant at Long Beach, Calif., work on the DC-10 is concentrated in a three-building complex consisting of more than 1.2 million square feet of factory area. Included is a 392,000-square-foot facility for final assembly, functional checks and customer inspection.

Final assembly of the DC-10 begins with the joining of the center fuselage section to the wings. The aircraft moves through additional assembly line positions for interior fittings.

The completed aircraft rolls off the assembly line to a pneumatic test area before it is weighed and delivered to the flight ramp where crews conduct hydraulic, electrical and fueling tests and run-ups in preparation for flight.

Lockheed constructed a $50 million facility for assembly and flight test of the L-1011 near Palmdale, Calif. The facility covers more than one-third of 677 acres. It encloses nearly 1,300,000 square feet of floor space under roof. The facility required 20,000 tons of steel for structural framing, 183,000 cubic yards of cement and approximately 25,000 tons of additional building materials.

Assembly activity for the L-1011 is accommodated entirely inside the final assembly hangar, the plant's largest structure. The building is big enough for production of future aircraft twice the size of the L-1011 which measures 900 by 590 feet. About two acres of work platforms surround the fuselage assembly line.

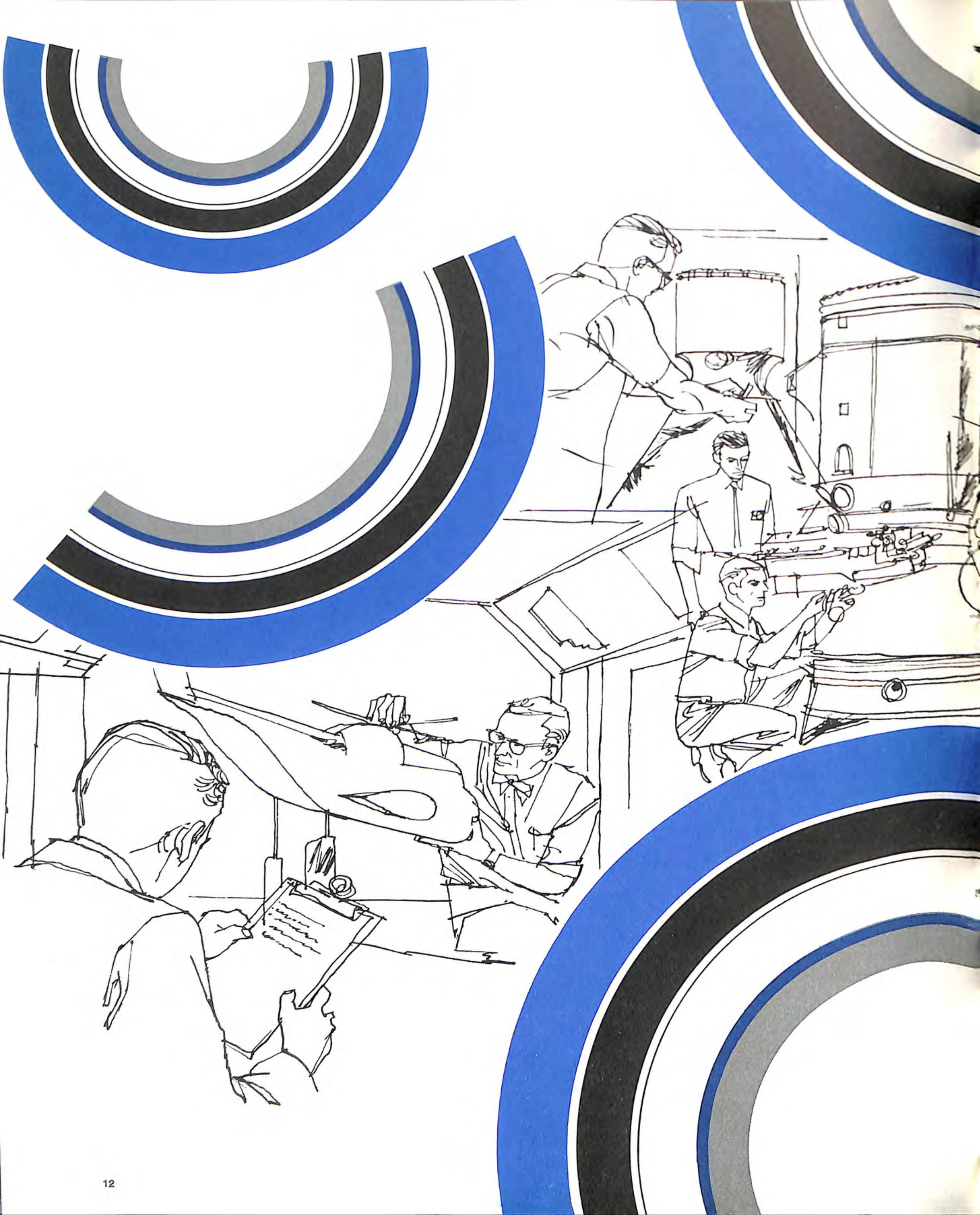
The work on these aircraft is spread across the entire nation. For the L-1011, suppliers in 45 states and five foreign countries are furnishing materials, parts, equipment and services. These items range from a small collar-button size door stop manufactured by Union Carbide at Kokomo, Indiana, to huge 88- by 24-foot high wing segments made by Avco Corporation at Nashville, Tennessee. Awards to subcontractors and suppliers for the L-1011 have exceeded $2 billion. Including second and third tier subcontractors, vendors and suppliers, an estimated 14,000 U. S. companies alone are expected to participate in the L-1011 program.

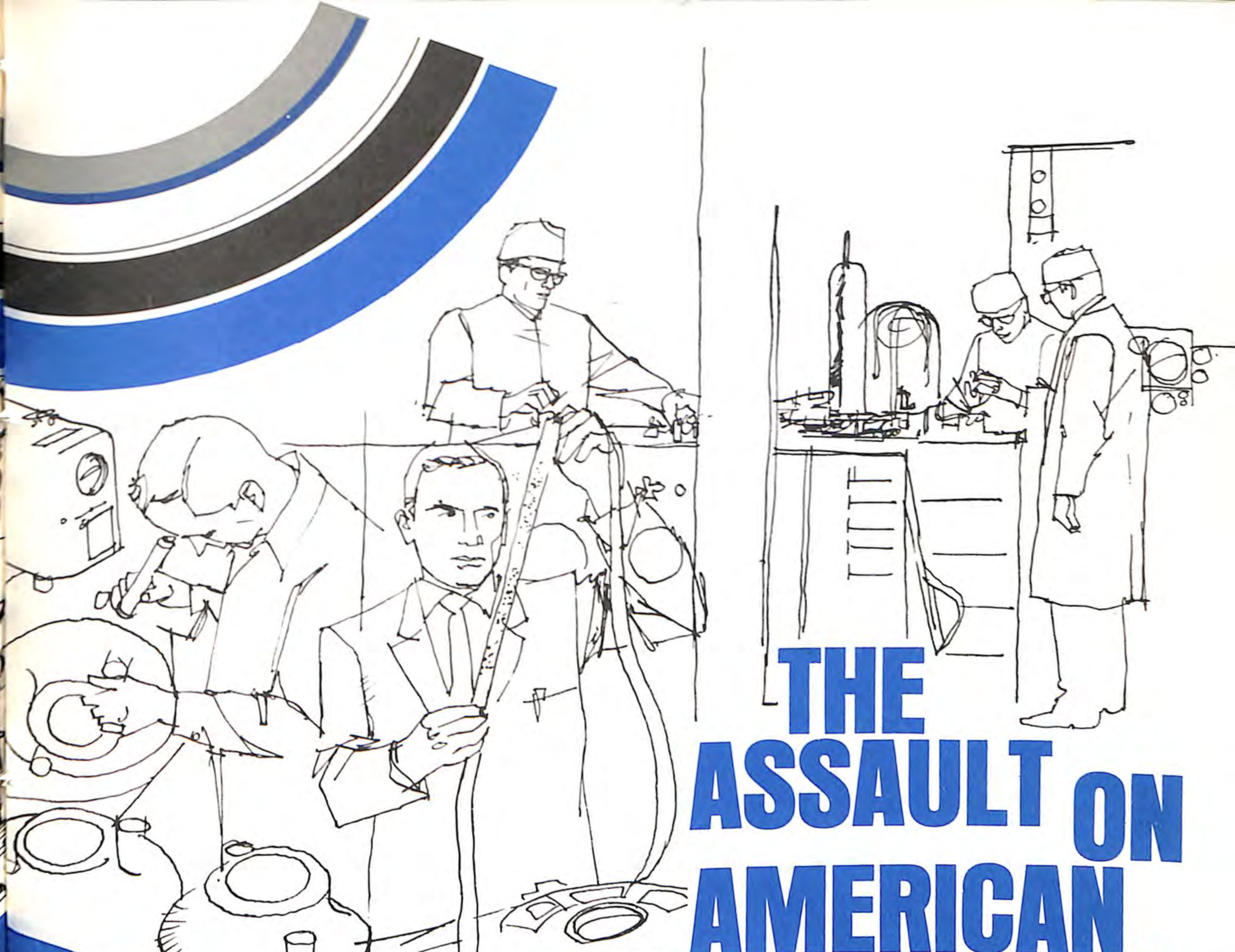
On the 747, Boeing estimates that at peak production in 1971 there will be approximately 1,500 prime suppliers and an additional 15,000 secondary suppliers in 49 states and six foreign countries. Nearly 65 percent of the weight and 50 percent of the dollar value of each superjet will be subcontracted.

The reports on these high-performance aircraft of course stimulated company historians to look back on their civil aircraft production efforts over the years. At Boeing, the historian noted that the first 747 wing removed from the assembly fixtures weighed 28,000 pounds, about 10 times the gross weight of the 1916 B & W, the first airplane built by Boeing. At McDonnell Douglas, their historian recorded a "twist" to the latest "DC" model. Douglas responded in 1932 to an airline request for a three-engine transport with the DC-1. It had only two engines, but surpassed the performance specified for the three-engine aircraft. McDonnell Douglas responded in 1968 to a request from American Airlines for a two-engine transport with the DC-10 which has three engines. In both cases, the result was the same: the requesting airline got a lot more airplane than it asked for.

In the case of the new generation of wide-bodied jets, the beneficiaries of new air transport technology are spread across the globe: air carrier passengers and shippers.

Fifty bagpipers, one for each year of the fiftieth anniversary of the company, greeted the McDonnell Douglas DC-10 at roll-out ceremonies at the Douglas Aircraft Co. division in Long Beach, Calif. The new transport made its first flight about a month later.





THE ASSAULT ON AMERICAN INDUSTRY

Mr. Anderson

The following article was excerpted from a speech by Robert Anderson, President and Chief Operating Officer, North American Rockwell Corp., before the Commonwealth Club in San Francisco, Calif.

The military/industrial relationship that we hear so much about in this country was not invented in 1968 or 1969.

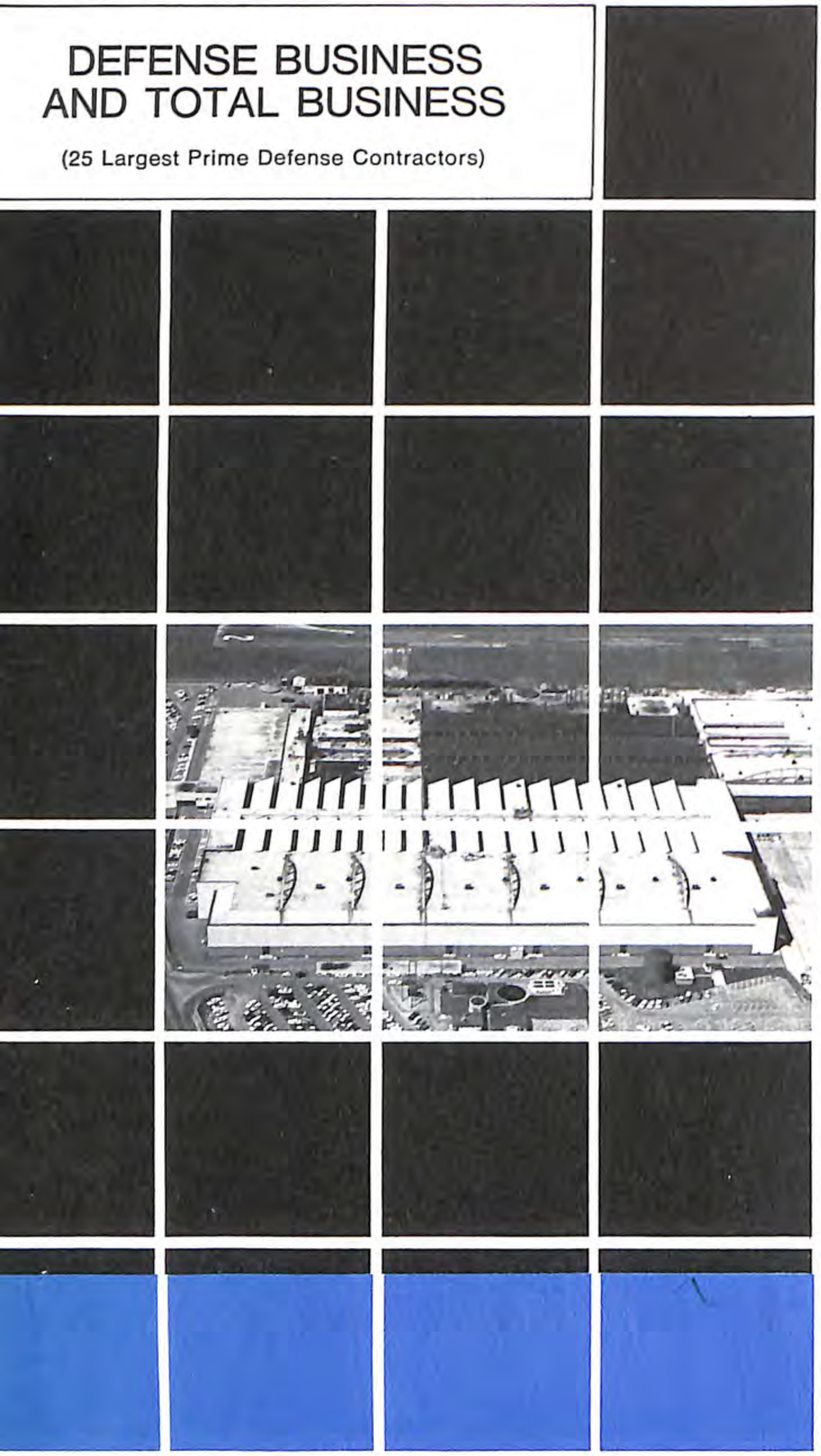
It's existed for nearly two hundred years, but it's only become a significant factor with the advent of sophisticated weapons systems which demand the closest teamwork between industry and the government.

That teamwork has meant much to this nation's security.

Yet, despite the high priority we all place on national survival, the defense industry today is being subjected to incredible denunciation. The attack has a violence unparalleled in American history.

DEFENSE BUSINESS AND TOTAL BUSINESS

(25 Largest Prime Defense Contractors)



TOTAL BUSINESS

DEFENSE BUSINESS

Only a small number of large aerospace companies depend almost entirely on government work. *Moody's Industrials* reported that in 1969 the defense business portion of the 25 largest prime defense contractors amounted to less than *one-seventh* of the total business of these companies.

Although some of the provocative headlines would have us believe otherwise, most Americans do *not* believe that large corporations are inherently evil, or that preparation for defense is *of itself* immoral.

Yet so vehement have been the attacks, that many sincere people are troubled when they read of excessive profits, cost overruns, lack of government control over expenditures, and so on.

We have a two-fold danger facing us in the continued harangue by those who oppose this relationship. The first is the undermining of public confidence in the integrity of defense procurement. The other is the destruction of morale of the dedicated men and women who are part of the defense establishment — whether in government or industry.

I can't be entirely objective in my approach, for North American Rockwell is one of the nation's major aerospace contractors and was recently awarded the very large Air Force B-1 weapons system contract.

However, I do believe there are two factors that enable me to take a broad view of the entire controversy. First, North American Rockwell is one of the major aerospace companies that is substantially engaged in both commercial and government activities. Also, in my own case, because I came from the automotive industry less than three years ago, I believe I can view the matter with a new perspective.

LARGEST MANUFACTURING EMPLOYER

Aerospace represents a great portion of American industry. There are one million, two hundred thousand people employed in building this country's military and commercial aircraft, its defense missiles, its space vehicles, its advanced guidance systems and its rocket engines. It's the largest manufacturing employer in the nation.

Aerospace in 1969 had sales of more than $28 billion. Its export sales of more than $3.1 billion made it the biggest industrial contributor to our balance of payments.

The opponents of this business, which has contributed so much to the military security and the economic growth of the country, have rallied around the phrase, "The military industrial complex," giving the words an accusatory ring.

It was General Eisenhower, as you know, who originated the phrase when he urged the nation to guard against "the acquisition of unwarranted influence by this complex," and he has been quoted out of context ever since.

Completely lost in the sound and fury created by those who picked up only the partial statement is the full meaning of his remarks. "A vital element in keeping the peace," General Eisenhower continued, "is our military establishment. Our arms must be mighty, ready for instant action, so that no potential aggressor may be tempted to risk his own destruction . . . We can no longer risk emergency improvisation of national defense; we have been compelled to create a permanent armaments industry of vast proportions."

It is essential to keep in mind that the role of the military/industrial complex is not in *making* public policy, but in carrying it out. Viewed in that respect, industry and government must work together toward common goals. It would be a national disgrace *if they did not*.

THE CHARGES

One of these pertains to the size of the defense and aerospace industry. "Most of the big military contractors," they say, "could not survive without weapons business," — with the implication that corporations are influencing defense expenditures.

True, there are a handful of major aerospace companies almost entirely devoted to government work. However, according to *Moody's Industrials*, the defense portion of the 25 largest prime defense producers in 1969 accounted for *less than one-seventh* of their total business. Most aerospace companies are becoming increasingly diversified, with a wide range of commercial and industrial endeavors. Typically, they subcontract half of their prime contracts.

Let me assure you that American industry *can* survive without the so-called "crutch" of defense spending. Nevertheless, the defense industry *is* being hurt badly by the ceaseless attack on the integrity of its highly skilled employees who see years of dedicated effort being dismissed as of no importance or as of outright moral harm.

Another belief propagated is that spending for aerospace and defense needs has grown during the past five or six years at the expense of providing for health, income security, aid to the poor, education, and other social programs.

First, let me emphasize that it is the elected representatives of the people, and not industry, who rightfully set national priorities.

The significance of Congressional-established national priorities was stated with great clarity last December by Dr. Arthur Burns, now chairman of the Federal Reserve Board, who said, "The explosive increase of federal spending during (the decade of the '60s) is commonly attributed to the defense establishment, or more simply to the war in Viet Nam.

"The fact is, however," Dr. Burns continued, "that civilian programs are the preponderant cause of the growth of the federal budget. When we compare the budget of 1964 with the estimates for this fiscal year, we find that total federal spending shows a rise of $74 billion, while defense outlays are larger by only $23 billion . . . Thus, the basic fiscal fact is that spending for social programs now dominates our public budgets."

Dr. Burns' comments are underscored by the fact that in this current fiscal year, we will spend less on defense as a percentage of our gross national product — 7 percent — than in any one year in the past 20 years.

RESEARCH AND DEVELOPMENT

This country is in second place behind the Soviet Union in the development of new weapons system. Let me repeat, *we are behind* the Russians at this moment.

The Soviet Union has invested the equivalent of $16 billion this year in defense-related research, development and applications. What has the United States allocated?

$13 billion — $3 billion less than the Soviet Union.

Those figures, by the way, are taken from statements by Dr. John S. Foster, Director of Defense Research and Engineering.

What adds to the seriousness of this lagging research and development effort is the certainty that never again will we have the luxury of time to catch up if an enemy attacks. Never again will we have the nearly two years between the invasion of Belgium and the sinking of the Lusitania. Never again will we have a year and more between the battle of Britain and the disaster at Pearl Harbor.

Defense-related research and development is a vital activity.

However, the critics are suspicious of any activity, including research and development, because of what they contend are the "fat profits" in aerospace participation.

DEFENSE PROFITS

The most penetrating and exhaustive analysis of corporate profits was a study by the Logistics Management Institute, a non-profit organization, which compared the profits of 40 companies substantially engaged in defense production, with 3,500 companies not engaged in defense.

The results of this broad-based analysis showed that profit on sales for the commercial and industrial companies was almost double that for defense-related works, and profit on investment in non-defense efforts, since 1963, was 40 per cent to 74 per cent greater.

At North American Rockwell, we've had a striking demonstration of this disparity in percentage of profits. Our Commercial Products Group, last year, had sales which amounted to only 40 per cent of the $2.6 billion corporate total — yet that group contributed over 75 per cent of our entire corporate earnings.

What could be more graphic than those percentage figures?

Related to this matter of profits is another popular myth about the supposedly low risk involved in aerospace programs. The critics would have the public believe there is no risk in advancing the frontiers of technology; or to the extent there *is* risk, that the federal government underwrites all the risk involved in space and defense programs.

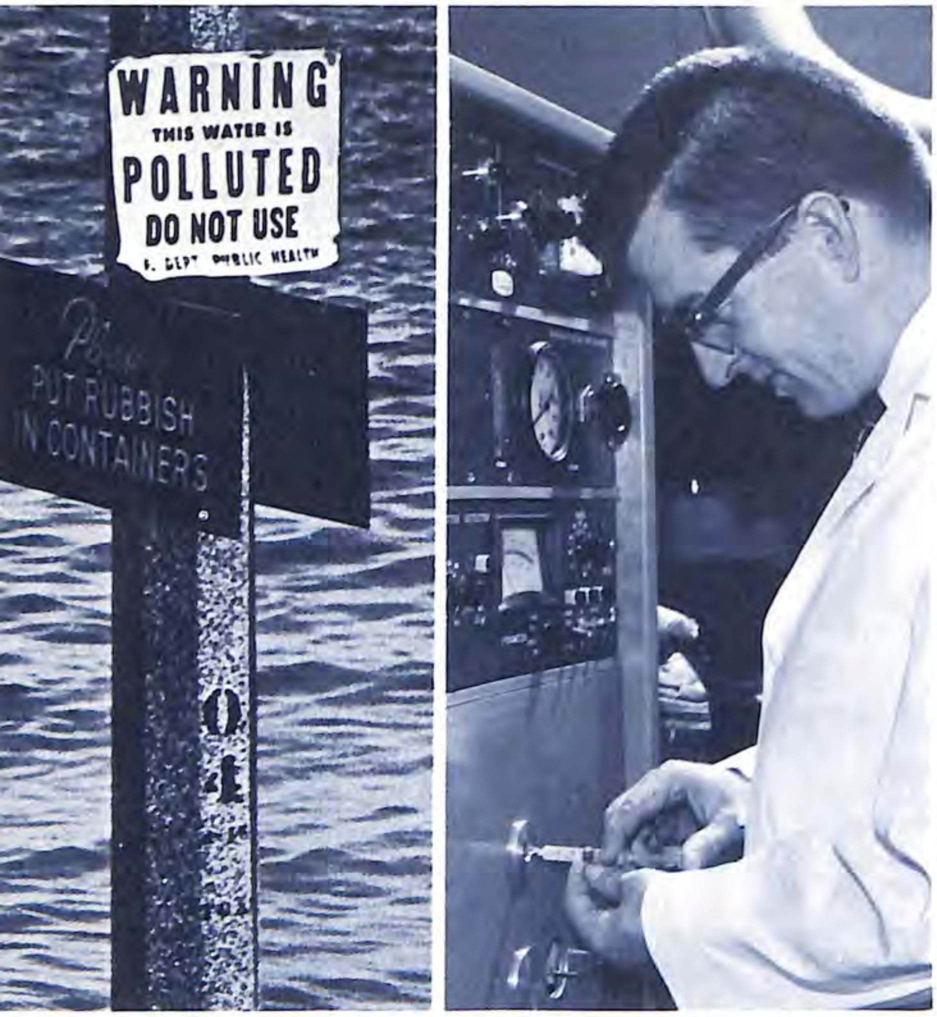
Again, the facts just do not support this belief.

FINANCIAL RISKS

Until recently, when there was a change in the contract ground rules, financial risk had shifted so heavily to the industry side that a company could be betting its corporate existence that it would be able to remain afloat while producing the goods or services required by the government.

As an automotive man, I was amazed by my first encounter with the Total Package Procurement Concept.

The fixed-price total package procurement process embraces the entire span of a program from concept through development, into production. The concept was supposed to eliminate both schedule slips and unpredictable cost increases. Further, it was intended to balance the contractor's commitment along the thin line



Solution of the nation's major domestic problems, such as air and water pollution, will require a high level of technology. This capability exists in the aerospace industry which has been the creative and innovative force for man's greatest technical achievements.

between appropriate financial risk, on the one hand, and catastrophic corporate loss on the other.

In practice, the concept not only delayed the procurement of many needed systems and equipment, but it also fostered an utterly unrealistic budgeting process.

The *Harvard Business Review* referred to this concept as "being at war with reality." It simply did not recognize the facts of life as known by American industry.

Can you imagine an automobile manufacturer contracting at a fixed price to deliver a model 1977 automobile six years from now? And an automobile, let me add, is infinitely less complicated than a modern weapons system.

That's exactly what was asked of the aerospace industry.

Those much-publicized cost overruns were not synonymous with waste; neither were they a symbol of excessive profits. Rather they were the surface reflection of the cost uncertainties inherent in developing and manufacturing advance systems.

No business is ever perfect, of course, but what is never captured in the blazing headlines of cost overruns is the reality of endless changes, of inflation, of the costly impact of solving problems which could not be foreseen. These are the realities which accompany the advancement of technological frontiers.

Under Deputy Secretary of Defense David Packard we have new, positive, realistic thinking on this contract question. Recently, he issued a milestone directive that talks common sense regarding improvement in the management of programs, the necessity for practical trade-offs between operating requirements and engineering design, risk assessment, and sensible program scheduling.

The Secretary placed his finger on the solution when he said, "When risks have been reduced to the extent that realistic pricing can take place, fixed-price type contracts should be used."

With the major contracts now being let by the Department of Defense, Industry will be able to fulfill its responsibilities more effectively and efficiently than in the past. They allow the latitude necessary in developing these highly complex, highly sophisticated weapons systems, while at the same time giving the government its full dollar's worth.

AEROSPACE EXPERTISE

In this troubled world beset by man-made problems in population, in transportation, in housing, in communications, and in pollution, there is need for exactly the type of expertise demonstrated by the aerospace industry during this past year in America.

The problems facing us are gigantic, nation-wide, even world-wide in scope. Their solution will require technical skill and management skill of the highest order. The best management, in terms of inventiveness is in the industry that has built the world's foremost supersonic, trisonic, and hypersonic aircraft; the industry that has developed "miracle" guidance systems; the industry that has ringed this nation with defensive ICBM's, and bridged the gap to the moon.

But I do not want to leave you with the mistaken impression that we stand now as pillars of strength ready to take on all adversaries. We have been hurt by this endless tirade of abuse, and all of us in business must act vigorously to overcome this constant erosion of American defense capability.

We are determined to resist that erosion.

This nation *must* continue its technological leadership. To default, to let that leadership slip away to Russia without further protest, means the passive acceptance of major risks in our national security.

And without security all else is fruitless.

America's defense shield must not be shaped by harangue and denunciation and newspaper headlines.

It must continue to be forged in the councils of the Presidency, within the Joint Chiefs of Staff, and in the Congress of the United States.

The need for a strong industrial base, for a strong, free American industry to help carry out their decisions, is self evident.

In this technological age, let us continue to answer the world-wide technological challenge.

Let the industry that has responded so many times before get on with the job.

AIA MANUFACTURING MEMBERS

Abex Corporation
Aerodex, Inc.
Aerojet-General Corporation
Aeronca, Inc.
Aeronutronic Division, Philco-Ford Corporation
Amphenol Connector Division
  The Bunker-Ramo Corp.
Avco Corporation
The Bendix Corporation
The Boeing Company
Chandler Evans, Inc.
  Control Systems Division of
  Colt Industries, Inc.
Curtiss-Wright Corporation
Fairchild Hiller Corporation
The Garrett Corporation
Gates Learjet Corporation
General Dynamics Corporation
General Electric Company
  Aerospace Group
  Aircraft Engine Group
General Motors Corporation
  Allison Division
The B. F. Goodrich Company
  Aerospace & Defense Products
Goodyear Aerospace Corporation
Grumman Aerospace Corporation
  A Subsidiary of Grumman Corporation
Gyrodyne Company of America, Inc.
Hercules Incorporated
Honeywell Inc.
Hughes Aircraft Company
IBM Corporation
  Federal Systems Division
International Telephone and Telegraph Corporation
  Defense-Space Group
    ITT Aerospace/Optical Division
    ITT Avionics Division
    ITT Defense Communications Division
Kaiser Aerospace & Electronics Corporation
Kaman Aerospace Corporation
Kollsman Instrument Corporation
Lear Siegler, Inc.
Lockheed Aircraft Corporation
LTV Aerospace Corporation
The Marquardt Company
Martin Marietta Corporation
McDonnell Douglas Corp.
Menasco Manufacturing Company
North American Rockwell Corporation
Northrop Corporation
Pneumo Dynamics Corporation
RCA
  Defense Electronic Products
Rohr Corporation
Singer-General Precision, Inc.
  A Subsidiary of the Singer Co.
Solar, Division of International
  Harvester Co.
Sperry Rand Corporation
  Sperry Gyroscope Division
  Sperry Systems Management Division
  Sperry Flight Systems Division
  Vickers Division
Sundstrand Aviation, Division of
  Sundstrand Corporation
Teledyne CAE
Teledyne Ryan Aeronautical
Textron Inc.
  Bell Aerospace Company
  Bell Helicopter Company
Thiokol Chemical Corporation
TRW Inc.
Twin Industries Corp.
  Division of the Wheelabrator Corp.
United Aircraft Corporation
Universal Oil Products Company
Westinghouse Electric Corporation
  Aerospace Electrical Division
  Aerospace Division
  Astronuclear Laboratory

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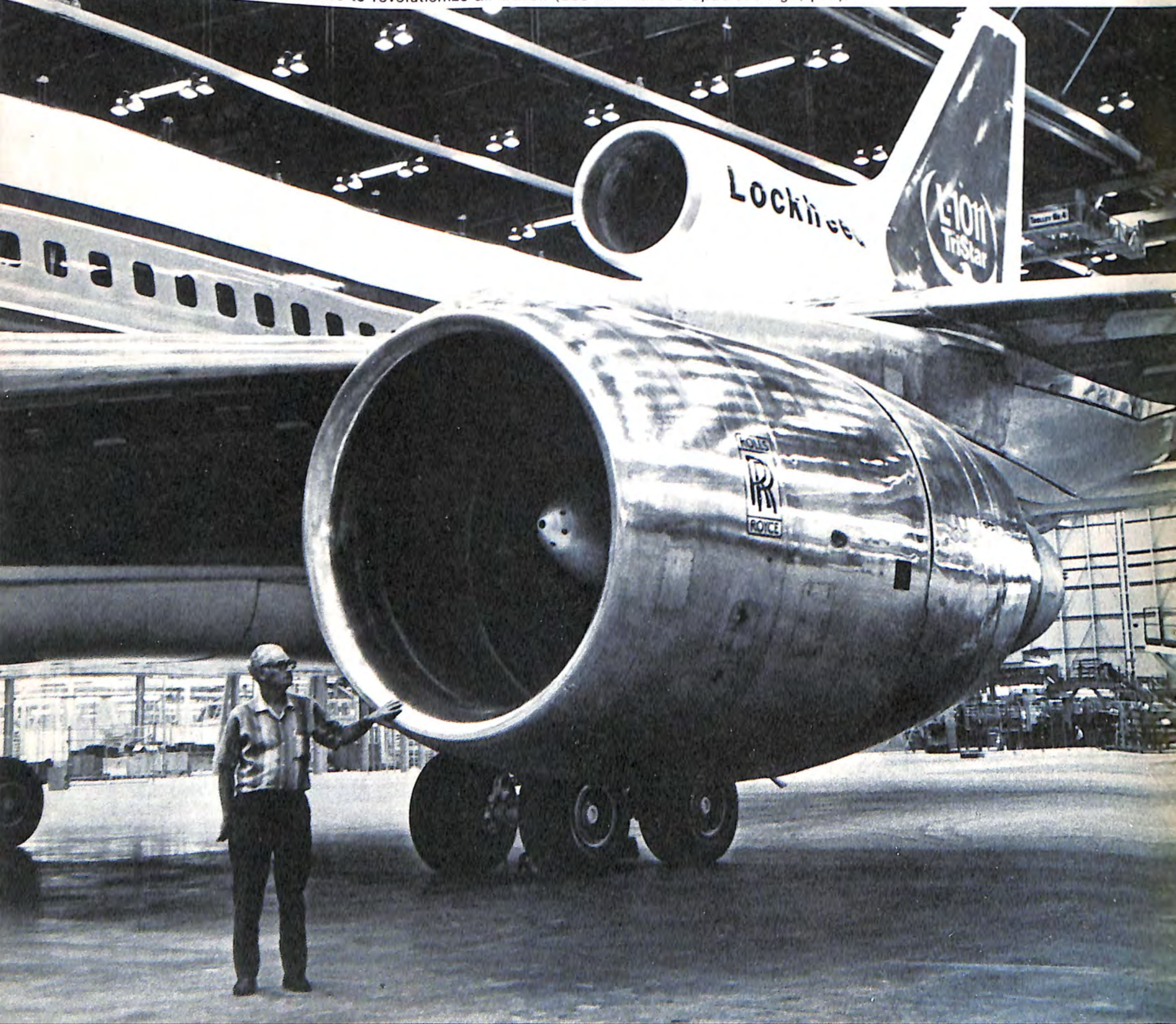
Air intake of the turbojet engine for this wide-bodied transport is more than seven feet in diameter. New models of jet transports promise to revolutionize air travel. (See *Air Travel's Spacious Age*, p. 8).



aerospace

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PEOPLE MOVERS

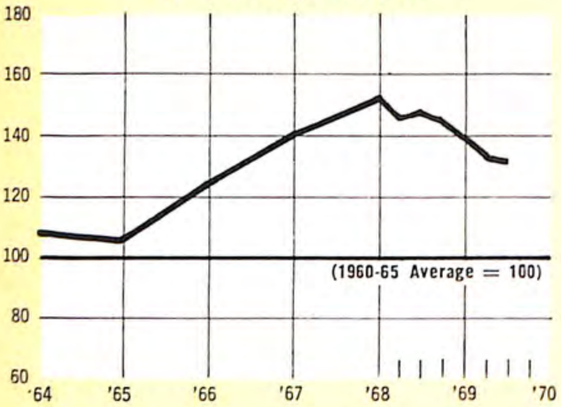
BY CARLOS C. VILLARREAL

Administrator,
Urban Mass Transportation Administration
Department of Transportation

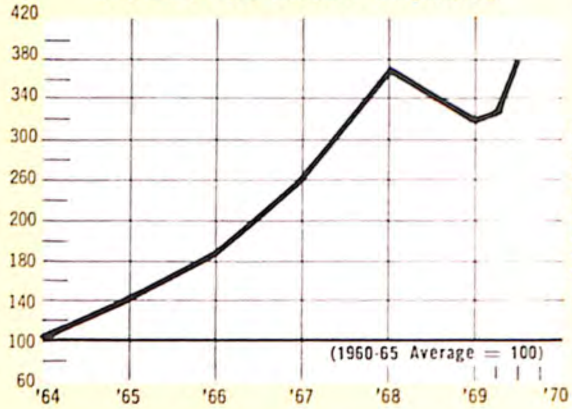
AEROSPACE ECONOMIC INDICATORS

CURRENT

Total Aerospace Sales

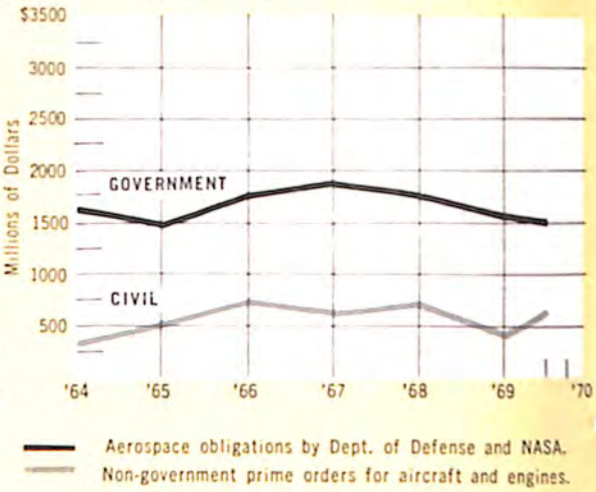


Value of Civil Aircraft Shipments



OUTLOOK

New Orders — Monthly Average



ITEM	UNIT	PERIOD	AVERAGE 1960-65 *	LATEST PERIOD SHOWN	SAME PERIOD YEAR AGO	PRECEDING PERIOD †	LATEST PERIOD
AEROSPACE SALES: Total	Billion $	Annual Rate	19.4	Quarter Ending June 30 1970	29.8	26.9	25.8
	Billion $	Quarterly	4.8		6.3	6.0	6.5
DEPARTMENT OF DEFENSE							
Aerospace obligations: Total	Million $	Monthly	1,151	June 1970	2,027	895	2,351
Aircraft	Million $	Monthly	601	June 1970	1,431	649	1,500
Missiles & Space	Million $	Monthly	550	June 1970	596	246	851
Aerospace expenditures: Total	Million $	Monthly	1,067	June 1970	1,399	1,217	1,340
Aircraft	Million $	Monthly	561	June 1970	851	763	773
Missiles & Space	Million $	Monthly	506	June 1970	548	454	567
Aerospace Military Prime Contract Awards: TOTAL	Million $	Monthly	920✢	June 1970	1,712	797	1,744
Aircraft	Million $	Monthly	447	June 1970	1,175	591	1,032
Missiles & Space	Million $	Monthly	473	June 1970	537	206	712
NASA RESEARCH AND DEVELOPMENT							
Obligations	Million $	Monthly	215	Sept 1970	325	210	263
Expenditures	Million $	Monthly	130	Sept 1970	303	274	290
BACKLOG (60 Aerospace Mfrs.): Total	Billion $	Quarterly	15.3#	Quarter Ending June 30 1970	29.4	27.1	25.1
U.S. Government	Billion $	Quarterly	11.6		15.0	13.4	12.6
Nongovernment	Billion $	Quarterly	3.7		14.4	13.7	12.5
EXPORTS							
Total (Including military)	Million $	Monthly	110	Aug 1970	300	277	188
New Commercial Transports	Million $	Monthly	24	Aug 1970	53	96	17
PROFITS							
Aerospace — Based on Sales	Percent	Quarterly	2.3	Quarter Ending June 30 1970	3.3	2.3	2.1
All Manufacturing — Based on Sales	Percent	Quarterly	4.8		5.1	4.0	4.4
EMPLOYMENT: Total	Thousands	Monthly	1,132	Aug 1970	1,344	1,144	1,124E
Aircraft	Thousands	Monthly	469	Aug 1970	592	504	493E
Missiles & Space	Thousands	Monthly	496	Aug 1970	577	471	463E
AVERAGE HOURLY EARNINGS, PRODUCTION WORKERS	Dollars	Monthly	2.92	Aug 1970	3.96	4.11	4.19E

R Revised
E Estimate
* 1960-65 average is computed by dividing total year data by 12 or 4 to yield monthly or quarterly averages.
† Preceding period refers to month or quarter preceding latest period shown.
# Averages for 1961-65.
✢ Averages for fiscal years 1960-1965.

Source: Aerospace Industries Association

R&D NEGLECT

The following is excerpted from a speech recently made by Senator Joseph M. Montoya before the U. S. Senate.

. . . periodically there develops in this nation a mania to turn the R&D professional into a sacrificial offering upon the altar of economy. Where once the workings of this community appeared as an almost mystical salvation in time of danger, they suddenly are deemed obscure and superfluous as the nation becomes plagued with shortsighted pragmatism.

. . . the Soviet Union has been focusing its attention, more than ever before, upon increased strategic weapons strength. It is the complex nature of these weapon systems that they must be developed with intense long-range commitments of national research and development resources. The Soviet Union has apparently made this commitment with such direction and drive that its national goal is certainly one of international technological preeminence. It is all too clear that our neglect of research and development will lead only to a bizarre form of unilateral disarmament.

Now clearly it is not possible to devote all of the nation's defense expenditures toward R&D leaving nothing for actual weapons production. A proper and balanced funding allocation must be determined in order to realize the effectiveness of our weapons systems. And this allocation is a responsibility which we in our legislative capacity must oversee with wisdom and firmness . . . .

Further, one wonders how such developments can take place when vast segments of the R&D community are being completely dismantled. Many scientists who hold advanced positions with long years of experience in their respective fields have found their offices closed and their jobs terminated as defense production cutbacks have been improperly translated into a license for R&D cutbacks. When any nation allows its senior scientists to stand in unemployment lines, as they now are doing in this country, then that nation has sanctioned an unacceptable waste of human resources, and the only conclusion that can be reached from such examples is that we are confronted with a careless, reckless, almost mindless deterioration of our R&D capability which, if allowed, can lead . . . to unilateral disarmament with all its inherent dangers. . . .

Today we must underscore a fundamental priority — that basic requisite of any nation — *survival*. And today more than ever this survival is a function of advanced research.

We may apply this research toward defense-oriented goals and see its impact translated into the solution of a variety of civilian problems. Likewise, many civilian research programs, such as space exploration, have vast military consequences.

But the days are long past when Americans can consider those expenditures allocated in pursuit of national research goals as impractical. Such flirtations with false pragmatism produce nothing more than false economy. For indeed, it is the very pinnacle of pragmatism to seek firm and considered foundations for any future. . . .

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CONTENTS

The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems;

Foster understanding of the aerospace industry's responsibilities in the space exploration program;

Foster understanding of civil aviation as a prime factor in domestic and international travel and trade;

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

AEROSPACE is published by the Aerospace Industries Association of America, Inc., the national trade association of the designers, developers and manufacturers of aircraft, missiles, spacecraft, their propulsion, navigation and guidance systems and other aeronautical systems and their components.

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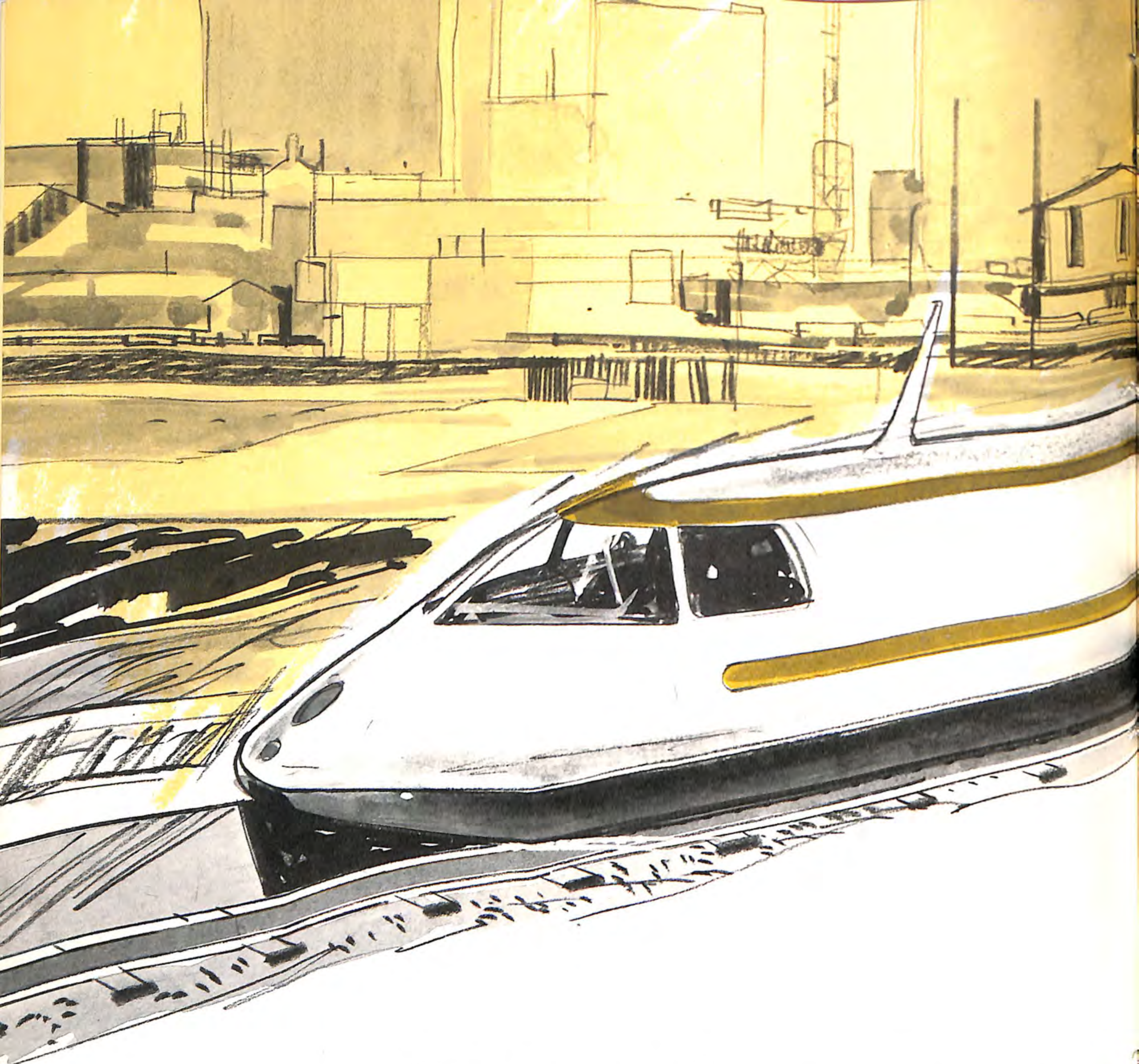
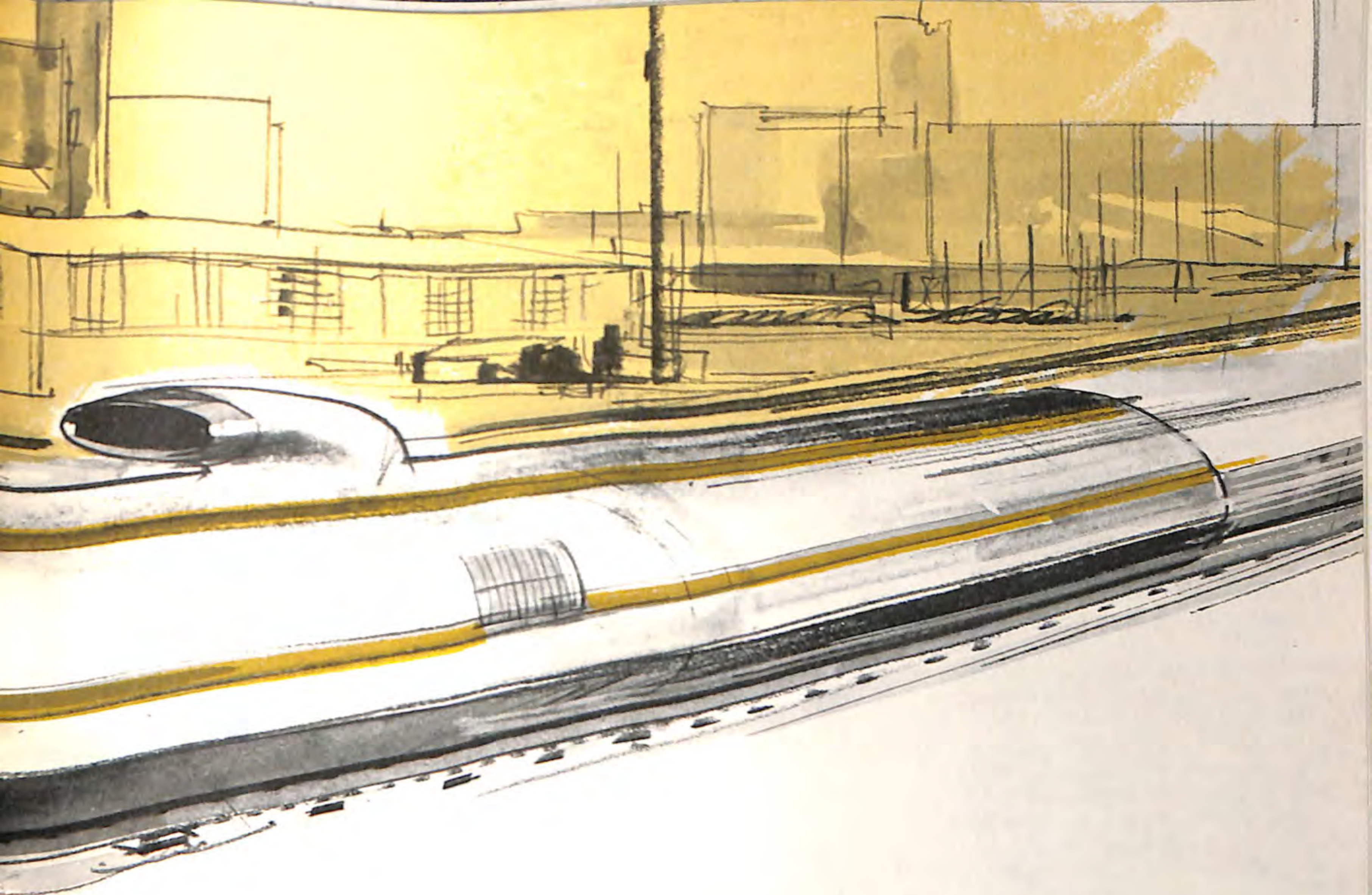


Improving urban transportation has become a top-priority job for America, and one to which the aerospace industry is making and can continue to make vital contributions.

Over three-fourths of the people of the United States live in urban areas. In scores of cities our society is paying the price of decades of ignoring or inadequately addressing the problems of public transportation.

While it is impossible to measure the cost with any precision, it is obvious that the near-strangulation of traffic in our metropolitan areas has cost billions of dollars through delays in the delivery of goods and the performance of services. More burdensome is the price we pay in terms of wasted human time —countless man- and woman-hours irrevocably lost every day because of snarled transit systems, hours which must be subtracted either from productivity on the job or, more often, from the individual's personal time.

Much of our national transportation system is either underbuilt, over-taxed, neglected, or in serious disrepair. By 1980, we will need to double the people- and goods-carrying capacity of



PEOPLE MOVERS

By CARLOS C. VILLARREAL

Administrator, Urban Mass Transportation Administration
Department of Transportation

our national transportation network *to just stay even with the demand.*

We need to make large investments in multi-modal and intermodal transportation centers. We must virtually start from scratch to build efficient, high-volume public transportation systems for our cities. To accomplish all of this will take very large amounts of funding, probably $28-34 billion in the next 10-15 years.

Federal funding for mass transit began with a small demonstration program of $25 million in 1961. In the remainder of the decade of the 60s a total of $1 billion has been made available in Federal funds for transit, and local matching funds have perhaps doubled that figure. Now, President Nixon has signed into law legislation passed overwhelmingly by Congress that will provide for Federal commitments to transit of a billion dollars *annually* during the next 12 years.

This Urban Mass Transportation Assistance Act is a landmark piece of legislation that provides for $3.1 billion in Federal investment during the next five years. It will enable us to begin improving existing bus and transit systems and to develop completely new systems. If we succeed in substituting attractive, high-capacity buses, commuter rail cars and other transit vehicles for low-density private automobiles, city streets will be less congested and essential truck and freight traffic will move with new freedom and efficiency.

We should be able to develop terminals from intercity bus and truck operations, either over or under freeway rights-of-way, also served by high-speed airport access systems and rapid transit. This will require better design of transportation facilities, and that in turn will call for the application of systems management and technology from other industries—particularly the industry that is the largest repository of advanced techniques, aerospace.

In this connection, the agency I head, the Urban Mass Transportation Administration of the Department of Transportation, recently formally solicited for organizations with systems management experience and expertise. We want aerospace and other companies with systems management know-how to identify themselves and make themselves available as potential contractors for the big transit programs we will be helping to fund.

A sizeable number of member companies of the Aerospace Industries Association are already involved in advanced research, development and production for ground transportation. Some of this work by divisions of AIA members is financed by grants from UMTA to local authorities; other programs are company-financed. There are also contracts being performed with funding from other DOT agencies. The scope of this activity by aerospace firms may come as something of a surprise. Let me give you some examples of projects in which aerospace companies have participated.

SAN FRANCISCO BAY AREA RAPID TRANSIT (BART)

An outstanding example of rapid transit extension is the Bay Area Rapid Transit (BART) System, in the San Francisco area. When BART goes into operation in the fall of 1971, it will provide almost 65 miles of new rapid transit service, financed in part with Federal funding.

Rohr Corporation has already delivered the first prototype copies of BART cars, among the world's most advanced transit vehicles. It will produce a total of 250 under a $66.7-million contract awarded in July 1969. These vehicles are built more like modern jet aircraft than conventional transit cars, and will offer greater comfort and safety for the rider than any system previously produced.

Westinghouse is the major subcontractor for the BART cars, supplying propulsion systems, brakes, trucks (including wheels and axles), air conditioning and auxiliary power system.

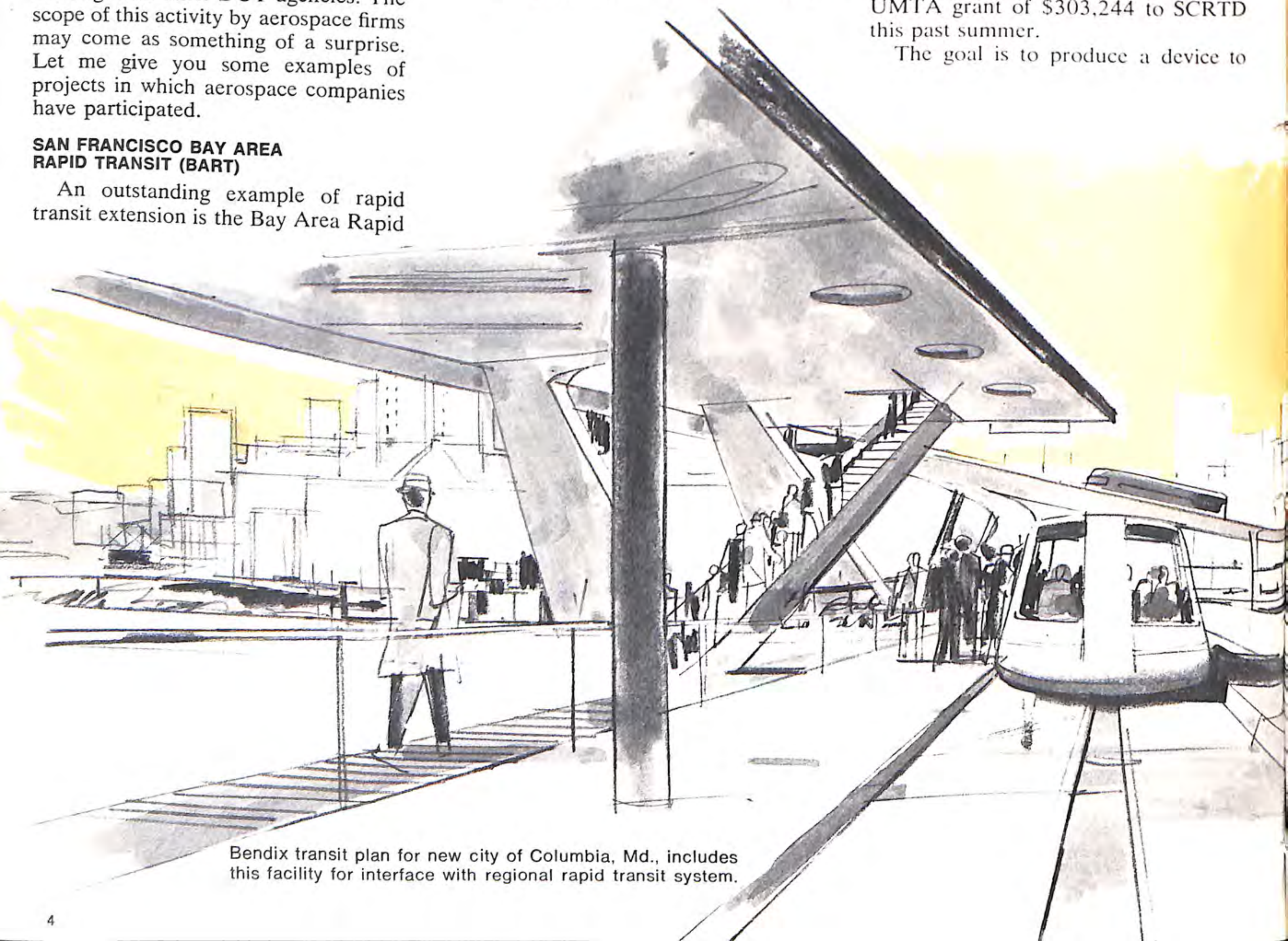
Other AIA member companies involved in BART include Hercules, which did special-purpose explosive work in the long Berkeley-Walnut Creek tunnel excavation through an UMTA grant; Kaiser (Construction), which also worked on the tunnel; Westinghouse's Transportation Division, which produced the computerized automatic train controls; Garrett-AiResearch, which developed a DC propulsion system; and IBM's Federal Systems Division, which is developing an automatic fare collection system.

The fare collection system, using electronics similar in sophistication to those employed in the company's currently operating computers, will provide graduated charges for riders who will carry credit card-like tickets to gain entry through automated entrance gates.

SCRTD DIESEL EXHAUST EMISSION CONTROL

The Atomics International Laboratories of North American Rockwell Corporation is working with the Southern California Rapid Transit District (SCRTD) to develop and demonstrate a diesel exhaust emission control system to eliminate smoke and odor and substantially reduce noise. The program is being carried out under an UMTA grant of $303,244 to SCRTD this past summer.

The goal is to produce a device to



Bendix transit plan for new city of Columbia, Md., includes this facility for interface with regional rapid transit system.

catalyze the exhaust and reduce pollutants in bus diesel engine emissions and conduct tests during transit operations. Once developed, the device will be installed on a bus engine and operated over typical bus routes.

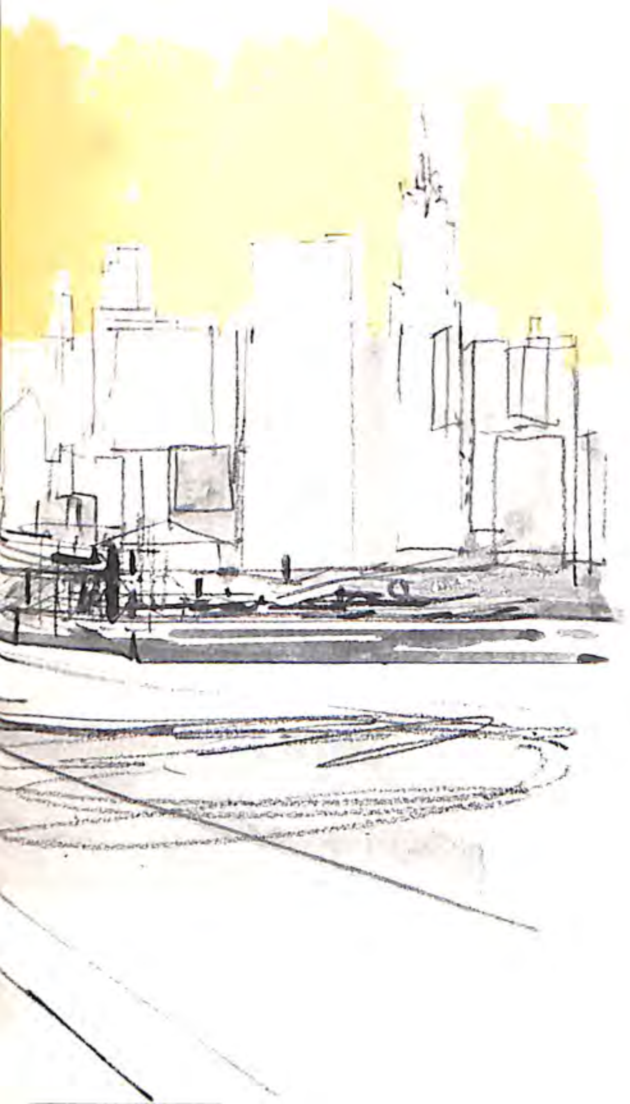
NR will utilize techniques of the atomic energy industry. Pollutants are removed from the exhaust gas by a catalytic molten salt scrubber developed to remove pollutants from commercial stack gases.

This project is extremely important—to California and the entire nation—for several reasons:

—It shows how it is possible to transfer technology and experience from the aerospace and atomic energy fields to public transportation.

—Economic benefits accrue to transportation and to advanced technology from this exchange. Of special importance are new markets for aerospace companies.

—The experience to be gained can be especially valuable to other cities—and not just in the transportation field. This project will demonstrate how the aerospace, defense and atomic energy industries can apply their capabilities toward solving urban problems.



OTHER ENVIRONMENTAL IMPROVEMENT

Another UMTA grant utilizes General Motors Corporation's Environmental Improvement Package (EIP) program—emission-control devices for existing GM diesel buses. These are basically super filters capable of removing large amounts of pollutants from bus exhausts. They recently went into service on four San Francisco buses, and are slated to be installed on four buses in Washington, D.C., and three in San Antonio.

Still another UMTA grant, of $1,121,000, is helping to develop and test steam-powered bus engines. Unlike the GM EIP and catalytic converter systems, which are essentially modifications for existing diesel engines, the steam bus engines will be entirely new propulsion devices.

Other companies are developing separate steam power plants for testing in San Francisco, Oakland, and Los Angeles. The first test vehicles should be operating on San Francisco or East Bay streets by next July.

TRACKED AIR CUSHION RESEARCH VEHICLE

A major leap forward in both transit speed and pollution control is forthcoming in the tracked air cushion research vehicle (TACRV). This highly advanced vehicle will ultimately be capable of traveling at 300 miles per hour and be powered by electric linear induction motors (LIM) which are pollution-free and virtually noiseless.

Grumman Aerospace Corporation has won a contract valued at an estimated $3 million for engineering design and technological studies for the test vehicle and the guideway on which it will operate. The TACRV runs on a thin cushion of air that supports and guides it and which is supplied by the vehicle itself.

AiResearch Division of The Garrett Corporation is the prime contractor for development of the 8,000-horsepower LIM propulsion system, under a contract valued at about $770,000.

Both of these contracts were awarded by the Office of High-Speed Ground Transportation in the Federal Railroad Administration, another agency of the Department of Transportation. AiResearch has already constructed and is testing a 2,500-hp motor at its Torrance, Calif., plant, and will ship the test vehicle to the FRA's new facility at Pueblo, Colo., in early 1971. This vehicle rides conventional rails with steel wheels and is capable of speeds up to 250 miles per hour.

When the motor design is completed, the Department will contract for construction of the LIM, which then will be tested in the TACRV at FRA's Pueblo facility.

A third contract will be awarded soon by the Office of High Speed Ground Transportation for the design of a wayside power collection system to power the LIM.

The TACRV is expected to reach full fruition in 6 to 10 years. In the meantime, an interim, 150-mph tracked air cushion vehicle (TACRV) system, partially funded by UMTA, will connect the Los Angeles International Airport with the San Fernando Valley by late 1972.

Secretary of Transportation John A. Volpe announced in June that a grant of $50,000 had been awarded to the Los Angeles Department of Airports to finance an initial feasibility study of the 16.3-mile access line. He said he had approved an amendment to the same grant for an additional $250,000 for preliminary engineering and marketing studies.

The Los Angeles Department of Airports this September awarded Kaiser Engineers a contract to design the substructures for the system.

The tracked air cushion vehicles will run on guideways elevated from 20 to 60 feet along the San Diego Freeway right-of-way, with one intermediate station at Wilshire Boulevard adjacent to the UCLA campus, and will terminate at the Sepulveda Dam recreation area. Passengers will be airline-ticketed and their baggage collected at the Sepulveda and Wilshire stations. There will be no further baggage handling by passengers until they reach their ultimate destination.

The total cost of the line, including guideways, stations and other supporting facilities is expected to exceed $50 million. This cost will be divided essentially on a 50-50 basis by UMTA and the Los Angeles Department of Airports.

Several firms involved in the field of high-speed ground transportation have already expressed interest in producing the vehicle for the system, and others are being invited to join in. Vehicle suppliers will also be invited to share the cost with the Government.

Secretary Volpe described the project as "perhaps the most exciting new development in the entire field of transportation and environmental control."

These are major examples of projects in which combinations of aerospace manufacturing companies are engaged. In addition, one can list examples of other work that is in progress—either with UMTA or other Department of Transportation funding support, direct or indirect, or through in-house financing.

The Transportation Systems Department of Bendix's Aerospace Systems Division is involved in numerous transportation programs.

Columbia Transportation Program—Columbia, Maryland, is a new, planned town currently being constructed in the Baltimore-Washington corridor by the Rouse Company. Occupying about 15,000 acres, it is expected to have a population of about 110,000 by 1982.

The Columbia Association retained the Bendix Corporation, Ann Arbor, Michigan, as prime contractor and technical director for the Columbia Transit Program, which is aimed at providing the community with a balanced and integrated transit system.

Bendix recently submitted a final report on Phase 1 of the program, which was devoted to concept formulation. Financed in part by UMTA, the report suggests three alternative configurations "in decreasing order of attractiveness": an automated system which would operate on an exclusive right of way in conjunction with manually driven vehicles operating in the low-density areas; a similar system with manually operated rather than automated vehicles used on the primary right of way; or a minimal service system of manually operated vehicles intended to serve the needs of those lacking any other transportation.

After approval has been obtained for one of the three alternatives, the program will move into Phase 2—preliminary design. Several additional contractors will be selected for this phase.

Headway Sensing for Automatically Controlled and Guided Vehicles—The Bendix Aerospace Systems Division was awarded a DOT contract to conduct a program to assess the state-of-the-art in sensing headway (the separation measured in time between two vehicles traveling on a guideway) and recommend preliminary design and breadboard programs which would test, evaluate and demonstrate the technology. The headway-sensing and signal conditioning study is applicable to single-mode Automatically Controlled Guideway Vehicles (ACGV), where a high degree of performance of such equipment is imperative.

A final report recommends further test and evaluation of two solid-state radar sensors and one wayside headway sensing system relying on a sensing net of presence sensors.

Dual-Mode Vehicle Controls Program—The Aerospace Systems Division is developing a transit system in which vehicles would be driven normally, just as today's automobiles, when on conventional streets or highways, but capable of fully automatic operation on special right-of-way networks called "guideways." The guideway system would have strategically located entrances, and the driver would manually drive to his local entrance, register his destination and proceed at high speed (60 mph) under automatic control. Routing or path selection would also be automatic.

Commuters on New York City's IRT subway line, built at the turn of the century, may soon be riding in air-conditioned comfort as a result of

'Space-Age Expertise' Cited in TurboTrain Renewal

The high-speed TurboTrain service between New York and Boston has been extended and may soon be expanded.

Extension of the one-train-a-day roundtrip service beyond its scheduled termination on Oct. 22 was announced by President Nixon ten days in advance of that date during a speech at Stamford, Conn. The President said that Transportation Secretary Volpe had recommended the extension "because of our resolve to apply available space-age technology and expertise to earth-bound problems."

He also said that within three months a new agreement may be forthcoming which might add to the present Turbo service schedule.

Turbo service began in April, 1969, under a contract among the U.S. Department of Transportation; United Aircraft Corporation, which built the two gas turbine-powered trains; and the Penn Central Railroad, which operates the trains.

The TurboTrain, which has achieved speeds of 170 miles per hour on Penn Central's special test track in New Jersey, has a maximum permissible speed of 120 mph on the New York-Boston run because it must use old tracks. It actually averages 62.7 mph and trims about 40 minutes from conventional train time on the route. Its popularity with the riders is reflected, however, in its 83 percent load factor.

The two trains, each with three cars and a capacity of 144 passengers, can serve about 130,000 passengers a year.

Key features of the TurboTrain include utilization of an aircraft-type gas turbine engine for power, a pendulous banking suspension system, and use of aerospace technology throughout.

technology developed by the Stratos Division of Fairchild Hiller in aerospace environmental control.

It was long thought to be impossible to air-condition cars of the IRT line, the first portion of the New York subway system to be constructed. Now under financing provided by UMTA, Stratos will design, develop, fabricate and install pre-packaged air-conditioning units in two subway cars similar to those in use on the IRT line. Delivery is scheduled for next spring. After test and evaluation of these units, officials of New York's Metropolitan Transit Authority (MTA) will decide whether to air-condition the remaining 1,800 IRT cars.

In addition to its work on the Linear Induction Motor (LIM) for the tracked air cushion research vehicle (TACRV), cited earlier, the AiResearch division of Garrett is pursuing two other major programs:

— *GT-II Dual Mode Gas Turbine Electric Rail Car* — This propulsion system was developed and tested for the New York Metropolitan Transit Authority (MTA) under the auspices of UMTA. The car has been running on the Long Island Railroad for several months, and AiResearch is now working on a passenger version of this type of commuter car.

— *Energy Storage Car*—Garrett has proposed to the New York MTA an energy storage system for use on subway vehicles. The proposal is being reviewed by UMTA. No hardware has yet been developed or tested.

Goodyear Tire & Rubber Company, the parent corporation of Goodyear Aerospace Corporation, has developed a "waitless" urban transportation system that can help relieve traffic problems in central business districts, airport terminals and other major centers.

Called the "Carveyor," the Goodyear system, developed without the aid of tax monies or grants, utilizes moving sidewalks and ramps together with small passenger cars riding on an endless series of conveyor belts. The wheelless cars can handle up to 22,000 passengers per hour.

Riders would board the cars from a platform moving at 1½ miles an hour, the same speed at which the cars move as they pass through a station; as the cars leave a station they move over a bank of accelerator wheels which increase their speed to as high as 15 miles an hour. As they enter the next station decelerator wheels slow them down so that passengers can exit onto another moving ramp.

The City of San Jose, California, has tentative plans to install a six-mile Carveyor system, beginning in 1972. Other cities have expressed interest.

Grumman Allied Industries, a subsidiary of Grumman Aerospace Corporation, has developed and produced the first of a series of miniature buses designed to help solve some mass transit problems. Built around standard GM chassis, the first units produced will carry 17 passengers (13-14 if modified to accommodate luggage). Later, utilizing a larger Ford chassis, the company plans to develop a 21-passenger version.

The Sperry Management Systems Division of Sperry Rand Corporation under a joint UMTA-Federal Highway Administration contract, is developing a system of improved management of cloverleaf space through gaiting access and egress. This involves monitoring of vehicle traffic in lanes, then feeding this data into a computer to change the flow of traffic.

I mention these companies merely to illustrate how the present capabilities of aerospace firms have already been transferred to the solution of urban transportation system problems. Coming from the aerospace industry, as I do, I am convinced that there is a wealth of available technology we have the opportunity to use in the public transportation system of the future.

Our transit needs are great and the demands too large for us to forgo the use of any know-how and skills applicable to the solution of these needs. The aerospace industry has much to offer and we expect to avail ourselves of it.

Demonstration model of Goodyear's Carveyor system. Passengers board cars from platform moving at 1½ mph, matching the speed of the cars. As cars leave station they pass over wheels that increase speed to 15 mph; another set of wheels decelerates inbound cars for passenger exit onto moving ramp.

AEROSPACE NOTES

Power Control System Aids Large Aircraft

Bendix Electric Power Division has developed an advanced electric distribution and management system which provides better electric power control for large aircraft at enormous savings in weight and cost.

The development is called the Airborne Display and Electric Management System (ADEMS) and it is currently undergoing evaluation tests by The Boeing Company.

ADEMS greatly reduces wire weight and complexity from the aircraft's electrical load center to the flight deck and also provides more protection for the aircraft electric system and processes sub-system operating data.

A wire bundle with a cross section area about the size of a telephone pole, currently used in large aircraft between the electrical load center and the flight deck, could be replaced by wiring having a cross section area the size of a pencil.

The ADEMS system, very simply, essentially eliminates all of the wires associated with the aircraft circuit breakers themselves out of the cockpit area by placing the circuit protection at the area where it is needed rather than at the end of some very long wires.

Computer Helps Solve Metallurgical Problems

Pressing problems facing the metallurgical community today can be effectively attacked by the enormous potential of the computer, Robert B. Muchmore, a TRW vice president, reported recently.

Digital computers, for instance, can be used to help solve air and water pollution problems caused by firms processing metals.

This was one of several suggestions for future uses of computers in the metallurgy field proposed by Muchmore before a computer technology session at the annual meeting of the American Society for Metals.

In the area of pollution, he said the computer's mathematical modeling capability can be applied to determine how corrective actions would affect pollution before any money is invested in the actions themselves.

Muchmore indicated that computer modeling could also be applied to the current and urgent problems of improving alloys for jet engines and salt water conversion equipment.

'Way Out' Rocket Engine Ready for Mars Mission

Rocket engines that will function further from Earth than ever before have been delivered to the Jet Propulsion Laboratory by Rocketdyne, a division of North American Rockwell Corp.

The engines are the first of a new breed of engine that will make future interplanetary space exploration easier.

This advanced propulsion system will enable two Mariner spacecraft to orbit Mars for a minimum of 90 days late in 1971 and map 70 percent of the planet's surface.

The spacecraft will travel 260 million miles to reach Mars — more than 1000 times the distance to the moon. The journey will take 190 days.

The use of beryllium metal in the new engine allows a new cooling principle to be applied in which liquid fuel is sprayed on the inside wall of the engine to absorb heat flowing through the wall from the hot nozzle throat.

The engine weighs 17 pounds and has a thrust of 300 pounds. It uses pressure fed, storable propellants (nitrogen tetroxide and monomethyhydrazine). The engine is capable of multiple starts and could operate almost indefinitely.

On Mars missions five engine starts will be required. Four may be used for course correction and orbit trim and the other will be a long duration firing of up to 15 minutes to put the spacecraft in orbit around Mars. This is one of the longest firing requirements yet imposed in a NASA project.

Concepts Being Developed For Orbiting Space Station

General Electric's Space Systems has joined with North American Rockwell to help the National Aeronautics and Space Administration (NASA) develop concepts for a 12-man space station. GE's role includes defining requirements for scientific experiments to be performed aboard the space station.

The first space station, planned for launch late in 1977, will be used as an orbiting manned scientific laboratory. A twelve man alternating crew will stay there for periods of up to six months, spending their time on a wide variety of experiments over the projected 10 year station lifetime.

Eventually the space station will be expanded into a space base, a center for almost all activities in space, including refueling space craft, launching interplanetary flights, and quarantining travelers on their return to earth.

Being developed in conjunction with the space station is a space shuttle, a reusable two-stage vehicle which will ferry men and materials into orbit and back to earth, landing at conventional airfields.

NASA has developed a preliminary list of candidate experiments to be carried out in the space station, chosen from among thousands of projects submitted by scientists and organizations. They cover a variety of scientific disciplines and have been grouped into Functional Program Elements (FPE) — experiments which have similar support requirements and use common equipment.

Electronic Device Counts Astronaut's Heart Beat

Two scientists at Lockheed Missiles & Space Co. have developed an electronic timepiece which accurately counts the heart rate of a laboring astronaut.

The laboratory device can take precise measurements from a person whose heart rate is approaching 200 beats per minute.

When fully developed into flight hardware, the Cardiotachometer could be built into an astronaut's pressure suit to provide earthside physicians with highly accurate and continuous heart rate monitoring during space walks or work on the lunar surface.

Inside the spacecraft, the device could be part of a medical station where astronauts would be given periodic physical examinations during their mission.

Aerospace physicians need accurate physiological information on astronauts working in space because there is scant scientific data covering the effects of zero gravity on the heart and circulatory system.

COMSAT Orders Huge Communications Antenna

Another major link in the world-wide ground network used for commercial communications via satellites will be built by Philco-Ford Corporation under terms of a contract awarded by the Communications Satellite Corporation (COMSAT).

Philco-Ford received a $1.3 million contract to design and build a giant 97-foot-diameter dish antenna for the COMSAT-operated earth station at Andover, Maine.

The Andover station is the first U.S. station that began commercial service via the Early Bird satellite in June, 1965. The new Philco-Ford antenna will replace the large "horn" antenna that was built in 1961/62, and that has been used in commercial service the past five years.

The new antenna will be another link in an international communications system involving more than 76 member nations — known as the International Telecommunications Satellite Consortium, or INTELSAT. COMSAT represents the U.S. in INTELSAT and also acts as manager of INTELSAT's international partnership.

In space, INTELSAT satellites now are stationed in synchronous orbits 22,300 miles above the earth over the Atlantic, Pacific and Indian Oceans, providing global coverage.

When completed the Philco-Ford antenna at the Andover station will be capable of sending and receiving satellite-relayed television, telephone, telegraph, facsimile and computer data signals through an Atlantic area INTELSAT satellite.

The giant new antenna will weight 375 tons and the tip of the dish-shaped transmitting and receiving apparatus will stand 11 stories high.

Operating on a wheel and track principle as developed by Philco-Ford, the massive structure rotates on three wheels on a track mounted on a 61-foot-diameter and 16-foot-high concrete base.

Philco-Ford has previously designed

and built 97 foot antennas for COMSAT-operated earth terminals at Etam, West Virginia; Cayey, Puerto Rico; Jamesburg, Calif.; and Paumalu, Hawaii; and has also built similar large antennas in other parts of the world, including a complete earth station in Korea which went into operation in June, 1970.

Satellite Engine Produces One-Tenth Pound of Thrust

A satellite-steering engine which produces thrust only one-tenth of a pound has passed flight readiness tests at Hamilton Standard.

The engine, designed for the Naval Research Laboratory, will be used on a satellite as a flight experiment to determine its operational life characteristics.

In the tests, the hydrazine-fueled engine was pulsed 100,000 times to demonstrate its performance capabilities. Pulsing of the mini-thrust engine was followed by one hour of continuous firing.

The first flight of the satellite, equipped with two of the small thrusters, is scheduled for launch in December, 1970. The third engine will be used either as a spare or for further test evaluation.

The monopropellant engines will precisely control the attitude and maneuvers of the satellite. They develop thrust through a controlled flow of hydrazine fuel into a chamber where it is decomposed by a catalyst.

New Sighting System Tested for HueyCobra

Preliminary flight test programs for a gyro-stabilized sighting system developed by the Bell Aerospace Division of Textron for the U. S. Army's new AH-1G HueyCobra helicopter Multi-Weapon Fire Control System (MWFCS) has been successfully completed.

Designated the Stabilized Optical Sight (SOS), the system underwent its tests at Bell's main plant near Niagara Falls, N. Y., International Airport.

In addition to the SOS, the Multi-Weapon Fire Control System includes a digital computer, ruby laser rangefinder, quadrant detector, helmet sight, weapons panel and an image intensification unit for night viewing.

This system is the second in a series of two configurations. In early 1969 a similar system was completed for the UH-1B Huey helicopter. Both systems are identical in operation and application, but each is designed for use in their respective helicopters.

Under development since mid-1967, the Multi-Weapon Fire Control System is designed to enable a helicopter gunner to track and accurately zero in his weapons on stationary and moving ground targets.

BY DON BOSTWICK

Executive Vice President
Export-Import Bank
of the United States

In the fiscal year which ended June 30, 1970, the Export-Import Bank of the United States set a record by helping to finance the sales abroad of $1.7 billion worth of U.S. commercial jet aircraft. This was nearly all the export sales the industry made, and it was 30 percent of the business done by Eximbank, which supported altogether $5.5 billion in exports during the year.

Other types of aerospace exports benefited from Eximbank assistance in fiscal 1970, among them a satellite station, airport construction and equipment, general aviation aircraft, engines and parts. But special efforts were made in behalf of commercial jets, particularly the wide-bodied ones whose sales have been complicated by long-term financing problems.

The Bank supported the sales of twenty B-747's and sixteen DC-10's during the year. The total contract

price of these thirty-six aircraft was $893 million. Preliminary commitments have been issued to support sales of the L-1011.

The aircraft industry is the major beneficiary of Eximbank operations, and rightly so. In the world of workable economics, aerospace is the young prodigy. Its great potential must not be wasted, especially here in America where it grew up and where American ingenuity made it flourish.

With feet planted in a present that it finds already obsolete, and its gaze fixed on a marvelous future that it can never catch up with entirely, this young industry hovers over the modern scene like an Olympian god of old, busily reducing the interval between two infinites — time and space — so that man can go more, see more and do more in his lifetime. Already, aerospace has removed the shackles which have bound man to the planet Earth since the beginning of time.

Future possibilities would give the industry a valid claim to Eximbank's special attention even if it were not such an important source of exports now. But it's that, too. The total aerospace industry is selling 12 percent of its products abroad, the export value this year running at the rate of about $3.5 billion.

A few months ago, in response to the industry's urgings, Eximbank extended its terms on big commercial aircraft financing from seven to ten years. This was a difficult decision to make, for two reasons. First, there is a limitation on the Bank's money resources, and second, there is a balance of payments problem.

Our statisticians found that over a period of several years, the pay-back on ten-year loans will run about

bank
ORT GENERATOR

$1 billion a year less than it would have on seven-year loans. This fact, of itself, has an adverse effect on the nation's balance of international payments, and Eximbank's major goal at this time is to help equalize our payments account through export financing. President Nixon himself set the goal of equalization and asked that it be achieved by the end of fiscal 1972. It was necessary, therefore, to match the prospective longer-range benefits of aircraft exports against both the short-term balance of payments requirement and Eximbank's limited money resources, in order to justify the ten-year repayment term. But we did find adequate justification.

Moreover, we are able to defend our support of the industry when called upon to do so. Occasionally a complaint is heard, based on lack of information about Eximbank operations, that we are financing jet aircraft exports unnecessarily; that foreign airlines could get the money from their own governments or from private sources without Eximbank help.

Our answer is that Eximbank enters into a transaction only after its Board of Directors has determined that such participation is necessary in order to complete the export sale. One of our basic policies is to avoid offering financial assistance if it can be obtained from private sources, and another, incidentally, is not to lend money unless there is reasonable assurance of repayment. These policies have been applied to every aerospace sale that Eximbank has supported.

As to the criticism that the Bank has helped to finance sales to government-owned airlines in countries which have adequate dollars, it often happens that the central bank of an economically sound country, such as Japan, will, for reasons of its own, require the national airline to seek other financing. And a commercial source may be hard to find without the help Eximbank provides.

Another growing problem for U.S. exporters is the competition from foreign aircraft producers, all of whom get subsidies from their governments. For example, the American industry is up against the British-French A-300B, the French Mercure II, and the German VFW-614 in short haul competition, and the British-French Concorde and Russian TU-144 in the supersonic category. One American airline recently bought passenger aircraft from Japan.

Eximbank has three general types of assistance — loans, guarantees and insurance. Loans and financial guarantees are available for long-term (more than five years); the commercial bank guarantee and insurance programs both are available for the medium-term (one to five years) transactions; and insurance can be provided for short-term transactions.

Our policy now is to limit direct lending to transactions in which a commercial bank or other private source agrees to participate. By this means, Eximbank's resources are made to go farther. In fact, it was with authorizations of $598 million that Eximbank supported the record-breaking total of $1.7 billion of aircraft exports last fiscal year. This was not a record in authorizations for us. In 1967, authorizations were $789 million, but they supported a lower amount of jet exports. Now private sources are putting up more of the money. Actually, billions of dollars of private funds have been brought into export financing by this participation plan.

Under the plan, commercial banks have been providing a little more than half the financing of wide-bodied jets, and 40 percent of other jet exports. Financing takes the form of a credit extended to a non-U.S. purchaser of U.S. goods or services. The money goes to the U.S. supplier and the foreign purchaser pays it back, with interest and in dollars.

The participating bank may be either a U.S. or a non-U.S. institution. Eximbank may, where necessary, agree to take the later maturities, so that the private bank is paid off first. And it will guarantee the private bank's portion of the loan against either commercial or political risk, or both.

Eximbank also will provide, without cost or obligation, a preliminary commitment to participate in a transaction. The buyer, seller or the commercial bank involved may apply for the commitment. The chief value to the exporter is that it enables him to offer financial terms in his initial sales presentation.

There is also a discount loan procedure available on medium-term transactions, although it does not apply to sales of the big jets. Where it applies, Eximbank will at any time lend the private bank up to 100 percent of the value of the export debt obligation. The interest Eximbank charges the commercial bank in this case is one percent less than the bank charged the borrower, or one-half of one percent if the transaction has been insured or guaranteed by Eximbank. And finally, it is possible for the private bank to get a preliminary commitment for a discount loan before it even enters the transaction. Thus, the private banker has the assurance of immediate cash availability if he should run into a liquidity problem.

As can be observed from the nature of participation financing, the extension of repayment terms from seven to ten years means smaller repayments to private banks as well as to Eximbank, and where the participants are U.S. banks, there is a further adverse effect on our balance of payments position. This, too, was taken into account before Eximbank decided on the longer-term financing, and it is further evidence of the importance placed on aircraft exports.

Eximbank charges 6 to 7 percent interest on its direct loans for aircraft. Commercial banks charge more, but when their rate is blended with the 6 percent, the effective rate is proving to be competitive generally with rates provided by foreign firms, even with their government subsidies. The average effective rate for all Eximbank participation contracts in fiscal 1970 was 7.97 percent.

COMMERCIAL JET AIRCRAFT LOAN ACTIVITY

(IN THOUSANDS)

Fiscal Year	Total Contract Price	Eximbank's New Gross Authorizations
1957	$ 29,866	$ 16,500
1958	104,700	46,000
1959	24,604	14,376
1960	150,299	93,110
1961	140,170	93,835
1962	5,365	3,650
1963 *	—	—
1964	46,191	32,557
1965 *	—	—
1966	118,887	94,362
1967	1,164,664	789,183
1968	787,978	336,780
1969	450,979	197,487
1970	1,672,223	598,219
	4,695,926	2,316,059
July/September 1971	150,248	62,865
Total	$4,846,174	$2,378,924

* Only guarantees were made in 1963 and 1965.

Of course, while financing is usually the matter of first concern, customers for aerospace products should know better than anyone else that other considerations can sometimes be even more important. Performance, for example — a Far Eastern country which based its aircraft purchases on price incentives, sidelines benefits, guarantees of replacements and a few other factors subsequently found its operating costs so high, and passenger acceptability so low, that it could not do a profitable business. After changing to American aircraft, this country now has a successful line.

Our projections at Eximbank indicate that about $22 billion in financing will be required over the next ten years to support aerospace exports. We are endeavoring to broaden our base of operations to meet this and other challenges in the years ahead.

Much will depend on the effort being made in Congress to remove Eximbank from the unified federal budget process, which restricts the present use of available resources. There is no question of allotting the Bank more funds, but rather of letting it apply more businesslike procedures so that it can do more with what it has, under the same Congressional controls as now.

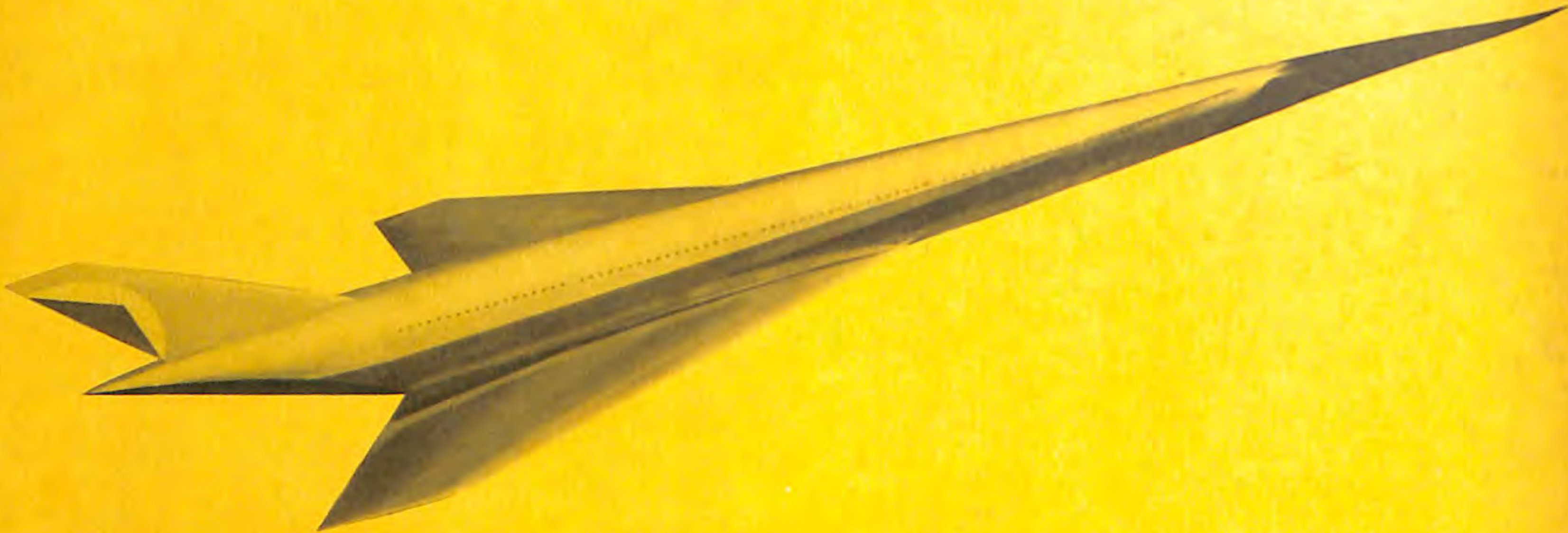
Another enterprise, soon to be in operation and with great potential benefits for the aerospace and other industries is PEFCO — the Private Export Finance Corporation. This is a carefully planned arrangement by more than fifty of the nation's leading banks for a consortium, to be underwritten by Eximbank, for dealing in export paper.

Eximbank will also step up its present special efforts to be helpful in financing the overseas sales of used aircraft. The rapid modernization of our own airlines means more equipment on hand, and export possibilities will continue to be of growing importance.

Any export promotion activity has its first impact on the affected industry, in the form of increased sales and, hopefully, more profits. But the benefits do not end with the industry, by any means. Everything that Eximbank is doing could be well justified in the name of expansion of our domestic economy — more jobs and a higher standard of American living.

Right now, however, exports mean more than ever to us. President Nixon is succeeding admirably in maintaining international confidence in the dollar in the interests of world stability. His efforts will depend to a large degree on achieving a balance in our international payments account — proving to the world that we can keep our house in order in spite of our many world commitments. The best way to obtain this balance is to increase our exports.

The aerospace industry can help itself, the nation and the world by being alert to every possible opportunity to sell abroad. And Eximbank will continue, as required, to support the industry's efforts.

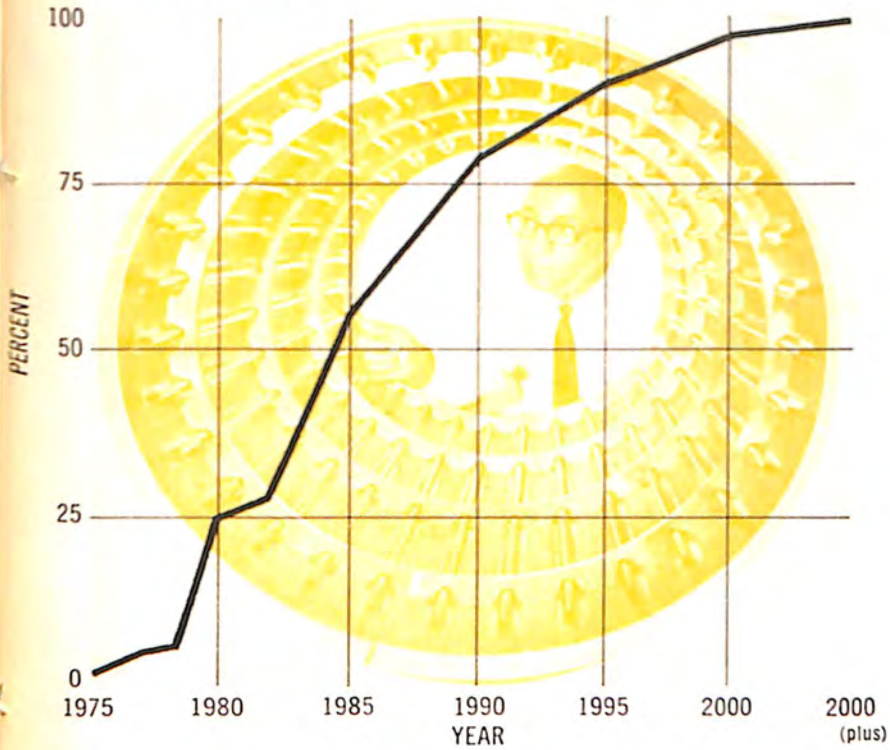


AIR TRANSPORTATION THE 21st CENTURY

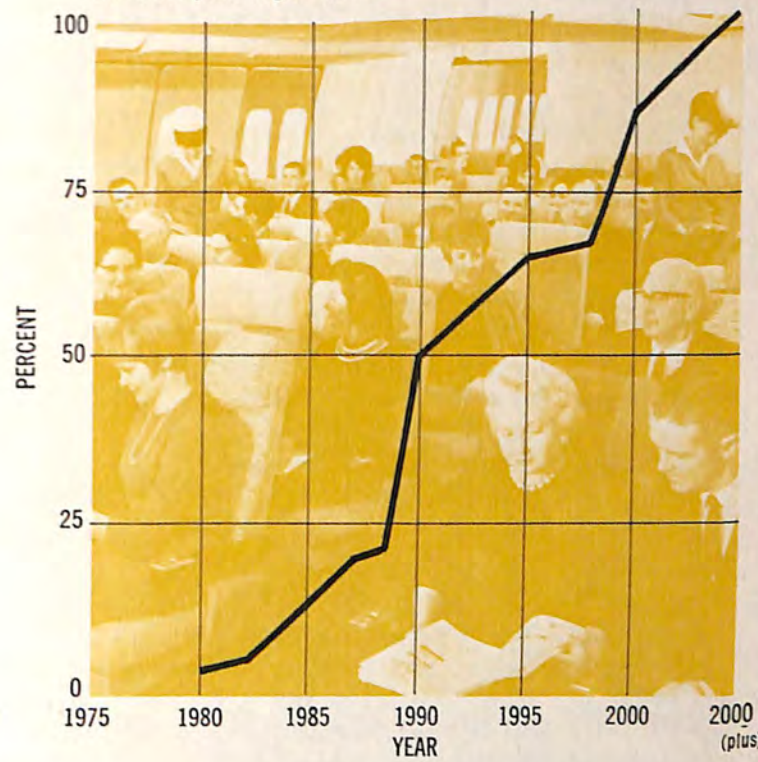
The all important "people-factor" was introduced into a survey by McDonnell Douglas Corporation aimed at estimating long-range trends in air transportation. The informed opinion of air transportation experts was sought and scientifically measured. ■ The experts who received the questionnaire were from four segments of the air transportation industry. These included: The U.S. and foreign air carriers. This segment, concerned with serving the public's air travel needs, had 75 participants. ■ Federal, state and local government agencies. This segment, responsible for developing a safe and adequate air transportation system, had 109 representatives. ■ Aviation writers and editors from the news media, who report on the current and future health of the industry. This segment had 76 participants. ■ The commercial aircraft manufacturing industry was represented by 44 engineering, manufacturing, marketing and financial experts from the McDonnell Douglas Corporation. ■ A feature of this survey was the use of the Delphi Technique developed by the Rand Corporation. Employing this technique each participant was asked to make an anonymous forecast of future air transportation developments, and then was given a second opportunity to revise or stay with his predictions after seeing the first returns from the survey. ■ The participants' first forecasts were tabulated, grouped and analyzed. A composite feedback of the forecasts was then returned to the participants. They could either stay with their original opinions or they could revise them. In the final round, more than 50 percent of the participants revised their original forecasts. ■ McDonnell Douglas reported that each round of the survey took between two and three months to complete. A 25 percent response is usually considered satisfactory. In this survey 43 percent responded to the first questionnaire and 32 percent replied to the second and final round. This above average return indicates the validity of the findings and the interest of the experts in the future of air transportation. ■ In the survey, questions were asked about future air transportation developments and the date each event in question would occur. The areas covered were advances in air transportation technology, development of air cargo, passenger preference for air transportation, seat capacities for future aircraft and new markets for air transportation usage.

The following charts show some of the major questions asked and the responses. The chart line indicates the percentage of respondents holding the view that the indicated year would be equaled or bettered.

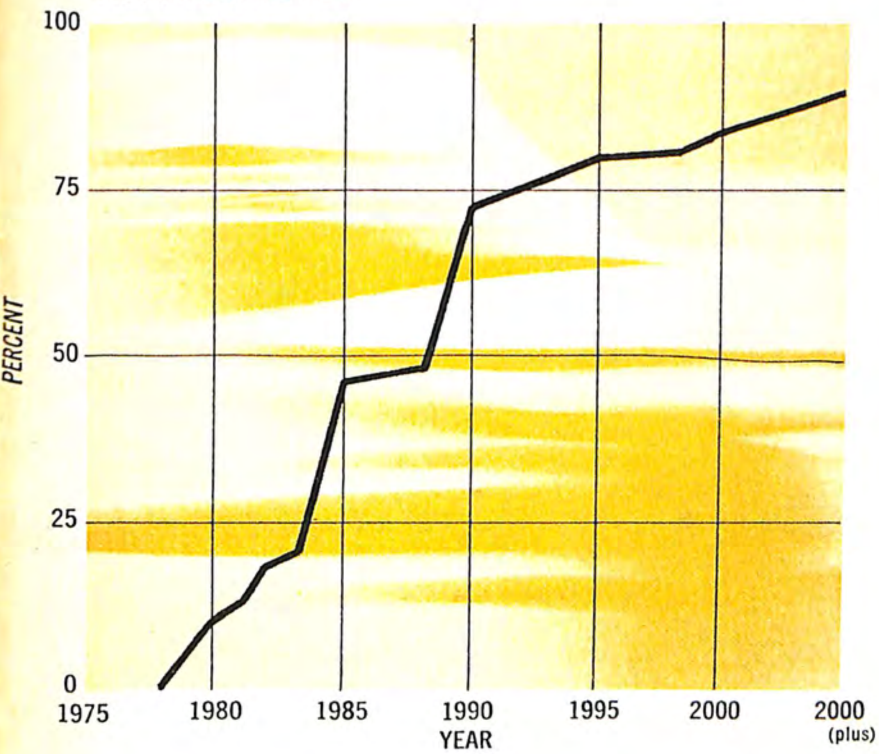
In what year do you anticipate that the new exotic materials, such as boron filament and beryllium, will be commercially competitive and in general usage to partially replace the conventional aluminum, titanium and steel in aircraft structures?



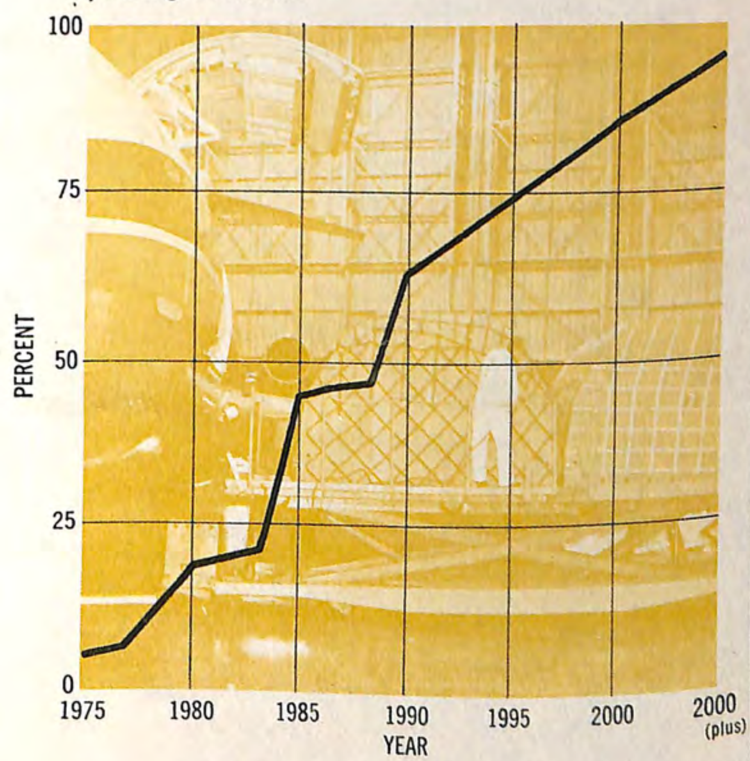
The present level of the Free World certificated and chartered revenue passenger miles is approximately 190 billion. In what year will this traffic reach one trillion revenue passenger miles?



When will a 1,000-passenger aircraft be introduced into commercial service?



In what year do you anticipate that the revenue from commercial air cargo on certificated airlines will equal passenger revenue?



CONTRACT RISK REPORT

The national strength and technological progress may suffer unless government and industry work together to correct shortcomings in the defense contracting system that create undue risks to contractors, Aerospace Industries Association reports.

This warning was made in a detailed AIA review of areas of defense procurement in which risks to contractors have increased markedly during the last decade. The report has been presented to the Commission on Government Procurement, appointed to study procurement procedures and ways to improve them.

AIA noted that during the last 10 years "numerous laws, administrative regulations and contracting policies have been implemented with the cumulative effect of making government work a venture of higher risk and less potential profit for many private contractors."

As weapon systems grew vastly more sophisticated, design and production increasingly were conducted in an "invent as you go" environment of advancing technology in which accurate forecasts of final costs became virtually impossible. Costs rose, criticism of the defense industry increased, and more complex controls were established — with the effect of further shifting the financial risks of defense work to the contractors, thus reducing their potential profits.

The resulting imbalance between profit opportunity and risk assumption must be resolved, AIA said. "If it is not, industry executives, responsible to their shareholders, will be hard pressed to justify the commitment of corporate resources to (government contracting), thus weakening the strength of the industrial and technological base required for the nation's defense."

The report summary cited numerous examples of the transfer of contract risk from the government to industry during the last decade. A partial list follows.

Contract Types — Increasing use has been made of fixed-price contracts, for which a contractor may bid unrealistically in order to offer a competitive price. Thus he commits himself to a price and performance schedule at a time when it may be impossible to anticipate technical problems that develop.

Warranties — A series of clauses were added to the Armed Services Procurement Regulation (ASPR) during the mid- and late 1960s to establish and expand warranty provisions. (No specific provisions existed in ASPR previously). In general, warranties on commercial products are given only after substantial experience regarding frequency of defects and associated costs; Department of Defense (DoD), however, has begun requiring warranties before products are adequately well defined, tested or proved. Contractors may incur stiff penalties.

Ultra Hazardous Risks — Existing indemnification statutes fail to provide financial protection for contractors (or the public) in cases of a catastrophic event — e.g., a rocket or missile explosion — under a government contract.

Non-Recovery of Costs — During the decade, ASPR revisions have increasingly developed an environment of *disallowance* rather than *allowance* of costs considered by contractors to be normal in the conduct of business. Recovery of some of these costs has been specifically precluded — for example, a contractor who borrows money in order to meet contract commitments has to report such a transaction, but the interest on such loans is disallowed as a recoverable item of cost.

DoD/Logistics Management Institute (LMI) industry profit reviews have shown that unallowable costs exceed one and a half percent of sales; this is a primary reason for the fact that defense contract profits, measured against sales and against invested capital, are lower than profits realized by defense contractors from their non-government work and by non-defense companies. In 1968, the latest year surveyed by LMI, profits (before taxes) as a percentage of sales were 3.9 percent for defense contracts compared with 9.4 percent for durable goods manufacturing as a whole.

Terminations — When the government exercises its right to terminate a contract for convenience, Weighted Guidelines are not applied sufficiently in profit determination, nor is recognition given to achievement under incentive contracts. Furthermore, in some situations no profit is allotted for undelivered subcontracted effort on a terminated contract. Still further, ASPR prohibits partial payments of profits and provides inadequately for recovery of losses of useful value incurred when a contractor acquires capital facilities specifically for performing a contract which is later terminated. Such facilities may then be of little or no value to the owner.

Cost or Pricing Data — A law requires contractors to submit accurate, complete and current "cost or pricing data" during negotiations, but does not define the term, which is only loosely defined in ASPR. The administrative expense and effort demanded to meet this requirement is burdensome, but a contractor must comply or risk inequitable price reductions.

Administrative Settlement of Contract Breaches — Contracting officers are uncertain as to their authority to settle claims for breach of contract. An appeal board may hear and decide one type of claim but not others, and appeal under the disputes procedure may result in a dismissal on the ground that the claim is for breach of contract, thus possibly foreclosing any remedy.

Management Systems and Controls — Accelerating use of the "systems" approach in the 1960s has placed new demands on contractors making proposals on major systems. The contractor must supply a highly detailed systems description for controlling and managing program performance, and the winner must demonstrate the systems to the contracting agency's satisfaction. Contractors must document their management systems with manuals, instructions and procedures which are subject to periodic Government audit or review; interpretations by the auditors establish the extent and cost of additional effort required.

AIA MANUFACTURING MEMBERS

Abex Corporation
Aerodex, Inc.
Aerojet-General Corporation
Aeronca, Inc.
Aeronutronic Division, Philco-Ford Corporation
Amphenol Space & Missile Systems Division
  The Bunker-Ramo Corp.
Avco Corporation
The Bendix Corporation
The Boeing Company
Chandler Evans, Inc.
  Control Systems Division of
  Colt Industries, Inc.
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Grumman Aerospace Corporation
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Gyrodyne Company of America, Inc.
Hercules Incorporated
Honeywell Inc.
Hughes Aircraft Company
IBM Corporation
  Federal Systems Division
International Telephone and Telegraph Corporation
  Defense-Space Group
    ITT Aerospace/Optical Division
    ITT Avionics Division
    ITT Defense Communications Division
Kaiser Aerospace & Electronics Corporation
Kaman Corporation
Kollsman Instrument Corporation
Lear Siegler, Inc.
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TRW Inc.
Twin Industries Corp.
  Division of the Wheelabrator Corp.
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Westinghouse Electric Corporation
  Aerospace Electrical Division
  Aerospace Division
  Astronuclear Laboratory

AEROSPACE INDUSTRIES ASSOCIATION
1725 De Sales St., N.W., Washington, D. C. 20036

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Tracked Air Cushion Research Vehicle (TACRV) designed by Grumman Aerospace Corporation for U.S. Department of Transportation (See *People Movers*, p. 2).