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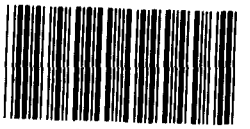
Report to the Chairman, Committee on Science, Space, and Technology, House of Representatives

June 1992

TECHNOLOGY TRANSFER

Japanese Firms Involved in F-15 Coproduction and Civil Aircraft Programs



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GAO

United States
General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

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June 10, 1992

The Honorable George E. Brown, Jr.
Chairman, Committee on Science,
Space, and Technology
House of Representatives

Dear Mr. Chairman:

In response to your request concerning the impact of U.S. military aircraft cooperative programs with Japan, we examined the Japanese aerospace industry's production, employment, market share, and trade over the past decade. We also (1) obtained information on Japanese aerospace companies' participation in the U.S. civil jet aircraft industry, specifically in Boeing and Douglas Aircraft Company[1] programs, (2) identified Japanese companies participating in the F-15 coproduction program, and (3) determined which of those were involved in the development and production of Boeing and Douglas civil aircraft.

Background

Coproduction is a U.S. government program implemented either by a government-to-government arrangement or through specific licensing arrangements by designated commercial firms. These programs enable foreign entities to acquire the know-how to manufacture or assemble, repair, maintain, and operate all or part of a specific defense item or weapon, communication, or support system.

In 1978, the United States and Japan signed a coproduction agreement for the F-15 fighter aircraft. McDonnell Douglas Aircraft Corporation, the U.S. prime contractor on the F-15, entered into a commercial licensed production agreement with Mitsubishi Heavy Industries, transferring manufacturing and technical expertise. Other U.S. F-15 contractors also entered into separate, individual licensing arrangements with Japanese companies for the production of numerous F-15 systems and subsystems.

In 1982,[2] we reported that through military aircraft coproduction, the United States was assisting Japan in developing its civil aircraft industry. The FS-X codevelopment program highlighted U.S. concerns about the

[1]Douglas Aircraft Company is the commercial division of McDonnell Douglas Aircraft Corporation.

[2]U.S. Military Coproduction Programs Assist Japan in Developing Its Civil Aircraft Industry (ID-82-23, Mar. 18, 1982).

transfer of military technology to Japan for possible commercial application.[3] On the other hand, some studies indicate that transfers of military aerospace technologies to civil aircraft may be decreasing, as civil aircraft must be proven safe and efficient, while for military aircraft, emphasis is on ultra-high performance.

U.S. Suppliers' Role in an Increasingly International Aerospace Industry

The 1991 Council on Competitiveness report on aerospace described the world aerospace industry as comprised of a few large, integrated producers that draw from an extensive, varied, and increasingly international supplier base. The report described the industry structure as a three-tier supplier network pyramid, which in the United States includes an estimated 15,000 companies.

Since World War II, the United States has possessed a commanding lead in aerospace. However, with the globalization of aerospace production and marketing, the need to spread financial risk in the development of new civil aircraft, and the narrowing of the U.S. technological lead, foreign producers are becoming increasingly competitive with U.S. subcontractors and suppliers. In addition, Boeing and Douglas Aircraft Company, the two remaining U.S. prime civil jet producers/integrators, face serious international competition from the European Airbus consortium.

The U.S. aerospace supplier and technology base is also declining. Various government and academic sources report a narrowing of the U.S. technological lead in aerospace, and recent reports by the Joint Chiefs of Staff and the Council on Competitiveness state that the U.S. supplier base in aerospace is shrinking.

Results in Brief

Although Japanese aerospace market share remains small when compared to that of the United States and Europe, the Japanese aerospace industry has grown over the past decade in terms of production, employment, market share, and trade. The Japanese government, in concert with industry, is targeting aerospace for development and promotion, with particular emphasis on international relationships and supply of components and parts in the world market.

[3] U.S.-Japan Codevelopment: Review of the FS-X Program (GAO/NSIAD-90-77BR, Feb. 6, 1990).

We identified 32 Japanese aerospace firms participating in Boeing and Douglas civil aircraft programs either as partners or major subcontractors. Boeing's relationship with Japanese companies was more extensive than that of Douglas. Japanese firms have been awarded contracts to supply items to Boeing and Douglas civil aircraft but not always solely on the basis of price, delivery, and/or quality competitiveness. Other factors, such as informal understandings that subcontract business would be placed in Japan and program financing and partnerships, also led to civil aircraft contract awards to Japanese suppliers. Awarding contracts in this way may not be unique in the aerospace industry. Eighteen of the 40 Japanese companies we identified as being involved in F-15 coproduction are also involved in development and/or production of U.S. civil aircraft.[4]

Many factors contribute to a company's competitiveness in supplying aircraft parts and components. No single, causal relationship exists between Japanese companies' participation in the F-15 coproduction program and their involvement in the production and development of Boeing and Douglas civil airplanes. However, experience with U.S. military and civil aircraft programs, along with evolving commercial and financial relationships, has contributed to Japanese companies' ability to obtain contract awards in U.S. civil aircraft programs.

Japanese Aerospace Industry Growth Over the Past Decade

Since World War II, when the Japanese aircraft industry was forced to disband, the industry has been gradually rebuilt through international licensing agreements and Japanese government industrial targeting. Although its market share remains small in comparison to that of the United States and Europe, the Japanese aerospace industry has expanded throughout the 1980s in terms of production, employment, market share, and trade.

According to Japan's Ministry of International Trade and Industry (MITI), Japanese aircraft production increased from $1.2 billion in 1980 to $5.2 billion in 1988 and to $5.5 billion in 1990 in current dollars (see fig. II.1 in app. II); and from $2.3 billion in 1980 to $4.3 billion in 1988, in constant 1985 dollars (see fig. II.2 in app. II). Also, Japanese space industry production increased from $558 million to $2.0 billion in current

[4]A list of 39 Japanese companies involved in F-15 coproduction is provided as appendix IV. The list does not include all such companies based on the State Department's determination that disclosure of a more complete listing containing licensing information is restricted by statute. The complete listing was provided to the Committee under separate cover.

dollars between 1980 and 1989. Overall, employment in the Japanese aircraft industry increased by 9 percent from 26,373 in 1980 to 28,810 in 1990; space industry employment increased by 61 percent from 6,013 in 1980 to 9,690 in 1989. On the basis of statistics compiled by the Commission of the European Communities, we calculated that the Japanese aerospace market share increased from 1.6 percent in 1980 to 3.6 percent in 1989.[5]

Japanese aerospace imports were primarily from the United States, which has maintained a trade surplus with Japan in the sector.[6] According to MITI statistics, Japan's aircraft imports overall increased from $1.3 billion in 1980 to $4.2 billion in 1990 in current dollars. Japanese aerospace exports were also predominantly to the United States. Exports of Japanese aircraft products increased from $91 million in 1980 to $590 million in 1990 in current dollars (see fig. II.3 in app. II). Between 1980 and 1989, Japanese space industry exports grew from $113 million to $378 million in current dollars; space imports during that same time period increased from $110 million to $234 million in current dollars.

Continued Japanese Government Support

The Japanese Aircraft Industry Council was formed in 1986 and subsequently established guidelines for the aircraft industry. The council reported these guidelines to the MITI and emphasized participation in joint, international aircraft development projects to spread risk in the high costs of aerospace development; the improvement of basic and applied research; the strengthening of marketing capability; and the collection of foreign and domestic information on aircraft markets and technology. The council identified technology targets for international development projects, including alloys and composite materials, new wing designs, and electronic navigation equipment.

Although the Japanese aerospace industry currently does not have the ability to independently develop, produce, and market large civilian aircraft, Japanese government and industry have goals of becoming significant players in the global aerospace industry—particularly in the

[5]The data used were expressed in current values and reflect market share among seven European nations, the United States, Japan, and Canada only.

[6]According to Department of Commerce statistics, the U.S. aerospace trade surplus with Japan increased from $1.1 billion in 1980 to $3.6 billion in 1990. The 1990 figure includes a $2.1 billion delivery of new passenger and cargo aircraft.

parts and components market. The Japanese government has targeted the aerospace industry for development and, according to U.S. government analyses, hopes to make aerospace one of Japan's major industries in the 21st century. Japanese aerospace firms receive government subsidies and encouragement to participate in international, high technology aerospace projects. U.S. Department of Defense officials noted that the Japanese government and industry are also targeting aircraft engines.

Japanese Focus on International Relationships, Components, and Parts

In 1986, Japan's Aircraft Industry Promotion Law of 1958 was amended to encourage international collaborative efforts in aerospace. The amended law emphasized promoting the aircraft industry, improving the industry's technology, and furthering international exchange.[7] The law indicates that Japan seeks to acquire state-of-the-art aerospace technologies through international joint ventures.

The Japanese government provides conditional loans to Japanese aerospace firms participating in overseas programs. These loans are offered at below-market rates and require repayment only if the programs are successful. For example, according to a U.S. government analysis, the MITI made $106.2 million available for Japanese companies participating in the Boeing 767; government-supported interest rates may be extended for an estimated $822 million for loans on the Boeing 777.

Japanese firms are competing with U.S. firms as suppliers of parts and components to U.S. civil aircraft. A Commerce Department analysis indicates that U.S. aircraft manufacturers may increasingly select Japanese over domestic subcontractors through the 1990s.

In addition to supplying parts and components to U.S. and European aircraft producers, Japanese aerospace companies are involved in a variety of international cooperative programs in aerospace. Japanese firms participate in cooperative civil jet and engine programs with The Boeing Company, General Electric, and Pratt and Whitney of the United States; SNECMA of France; and Rolls-Royce of Great Britain. Japanese companies have also engaged in aerospace research with Daimler-Benz of Germany.

[7]The law defines "aircraft" to include parts, components, and materials for components. "International joint development" means joint design, fabrication, testing, or attendant activities that are carried out between Japanese and foreign corporations.

Japanese Participation in U.S. Civil Aircraft Programs

Thirty-two Japanese aerospace firms participate in The Boeing Company and Douglas Aircraft Company civil aircraft programs either as partners or major subcontractors. The U.S.-Japanese industry relationship is more extensive with Boeing than with Douglas. Japanese firms have been awarded contracts to supply items to Boeing and Douglas civil aircraft but not always solely on the basis of price, delivery, and/or quality competitiveness considerations. Other factors, such as informal understandings that subcontract business would be placed in Japan and program financing and partnerships, also led to civil aircraft contract awards to Japanese suppliers. Awarding contracts in this way may not be unique in the aerospace industry.

The Boeing Company Programs

The Boeing Company, the world's largest producer of civil jet transport aircraft, has a long-standing, close, and cooperative relationship with Japanese aerospace manufacturers. The Society of Japanese Aerospace Companies reported that Japanese companies supply 70 percent of the parts and components furnished to Boeing by companies outside the United States. Japanese products on Boeing planes include aircraft fuselage panels, tail cones, and landing gear structures; parts and components for air data inertial reference systems, displays, and communications systems; actuators and valves; and aluminum and lightweight composite materials. Data on major and first-tier Japanese suppliers to Boeing are shown in table III.1 in appendix III.

Boeing representatives cited various reasons for developing and maintaining their relationship with the Japanese. Reasons included Japanese investment of capital to share risk in the high costs of airplane development; maintaining access to Japan's airplane market; drawing on Japanese expertise and production capabilities to contribute to overall product quality; and preventing the Japanese from cooperating with Boeing's competitors. Boeing noted that it had been successful in gaining access to the Japanese market. One Japanese airline purchased more Boeing 767s than any other non-U.S. airline, and Boeing expected Japan to continue to be the largest non-U.S. buyer of Boeing aircraft through the year 2005.

Three of the largest Japanese aerospace firms formed a consortium to participate in the development and production of the Boeing 767 and 777 jetliners. On the Boeing 767 and 777 programs, Mitsubishi Heavy Industries, Kawasaki Heavy Industries, and Fuji Heavy Industries invest in, develop, and produce a certain percentage of the jets' airframes (15

percent for the 767 and about 20 percent for the 777).[8] Two other Japanese companies, Shin Meiwa and NIPPI (Japan Aircraft Manufacturing Company), are designated "prime subcontractors" to the three heavy industries on the 777 program. Other linkages have been forged between U.S. and Japanese companies to develop and produce Boeing aircraft systems. For example, Japan Aviation Electronics supplied 80 percent of the accelerometers for Honeywell's navigation instruments on Boeing planes and was selected to participate in development of the 777 Liquid Crystal Display Units.[9] In addition, the Japanese firm, Teijin Seiki, has teamed with Lear-Siegler on the 777 flight control system.

In 1991, more than 260 Japanese personnel were in Seattle working on the Boeing 777 program; according to Boeing, 187 of these personnel were aerospace engineers. The Japanese engineers used Boeing's computer-aided design equipment in the development of their designated subsystems for the Boeing 777. Boeing officials stated that the Japanese engineers were restricted from access to certain elements of the computer-aided design system. At the time of our work, Boeing was establishing computer data links with the key Japanese companies participating in the 777 program. Thirty Boeing engineers were in Japan working on the Boeing 777.

Boeing Procurement Process

Generally, Boeing applies a limited,[10] competitive bidding process. Boeing selects a number of firms it knows to be capable of meeting specifications for required components and parts and requests from these firms price and quality information on the designated components. The company then chooses a supplier from among the bidders. Boeing officials stated that they generally selected suppliers on the basis of quality and price. They did not generally open components and parts contracts again for bids until the supplier had provided the quantity designated in the contract.

[8]The airframe represents about 50 percent of the value of a jet aircraft—the other 50 percent includes the engine, avionic and electronic subsystems, and final integration.

[9]This effort was disrupted by allegations that Japan Aviation Electronics transferred missile and aircraft parts to Iran. Honeywell officials told us they had since switched to a domestic supplier of accelerometers.

[10]For purposes of this report, a limited competitive bidding process contrasts with one in which open, publicly advertised requests for bids are employed.

With respect to contracting with Japanese companies, the three main 767 and 777 program participants and many other Japanese companies supply parts and components to Boeing aircraft. Japanese program participants ("partners" on the 777) are guaranteed contracts within the purview of the 767 and 777 program agreements. In other cases, Japanese companies participate in a limited, competitive bidding process with other Boeing suppliers.

Boeing officials stated that Japanese buyers of Boeing civil aircraft did not exert pressure on the company to ensure that Japanese products were used in the jets they purchased. They added that they had never entered into an offset[11] arrangement with the Japanese. Boeing officials stated that their selection of Japanese suppliers was voluntary and of mutual benefit to Boeing and the Japanese. However, Boeing officials would not certify that for each item procured from Japanese companies, no U.S. firm could supply the same quality item at a lower price. They speculated that in some situations, no comparable U.S. alternative existed or was available.

Douglas Aircraft Company Programs

Douglas Aircraft Company has a more limited relationship with Japanese suppliers than Boeing. Japanese suppliers to Douglas programs are listed in table III.2, appendix III. Like Boeing, in dealing with Japanese suppliers, Douglas hopes for increased access to capital, labor, and overseas markets. Douglas has not engaged in program partnerships with Japanese firms.[12]

Douglas Procurement Process

According to company officials, Douglas generally uses a limited competitive bidding process in supplier selection. The company surveys various suppliers to determine whether they are qualified to produce an item according to applicable standards. After identifying a minimum of two sources of equal capability, Douglas issues requests for proposals or quotes. While price is of primary importance in selection, quality and delivery considerations may prevail. Douglas officials told us, however, that foreign purchasers of civil aircraft often place local content

[11]Offsets are a range of industrial and commercial compensation practices required by foreign governments and firms as conditions for the purchase of military exports.

[12]In November 1991, McDonnell Douglas announced that Douglas Aircraft was selling 40 percent equity interest in the company to Taiwan Aerospace Corporation. However, Taiwan Aerospace recently announced it is changing the terms of the transaction.

requirements[13] and requirements to purchase unrelated items on Douglas as conditions for sales.

In the case of Japan, while there are no formal offset arrangements with specific goals to be achieved, there is an understanding that Douglas will place subcontracts with Japanese firms in connection with an aircraft purchase. On the basis of this understanding, Douglas sometimes executes directed procurements[14] to Japanese suppliers. Also, Japanese airlines have requested that specific, buyer-furnished equipment produced in Japan be placed on the aircraft they purchase. Finally, due to other business relationships, Douglas tries to consider Japanese suppliers whenever possible.

We did not systematically examine Douglas' contract award process but found a case in which the primary reason for selecting a Japanese supplier had been a directed procurement. After 8 years, however, Douglas was recompeting the contract for this item because of price and quality concerns.

Japanese F-15 Coproducers in U.S. Civil Aircraft Programs

We could not obtain comprehensive data on Japanese companies' participation in either civil or military aircraft coproduction programs. We identified 40 Japanese companies participating in the F-15 coproduction program (see app. IV). Eighteen of these companies are also involved in production and/or development of Boeing and Douglas civil aircraft (see tables III.1 and III.2, app. III). Some major or first-tier Japanese suppliers to U.S. civil aircraft programs do not appear to have been involved in the F-15 coproduction program.

We recognize that some technologies and performance characteristics of military and civil aircraft systems may differ and that a variety of factors contribute to a company's ability to compete or otherwise participate in civil aircraft programs. Nevertheless, we found 10 cases in which corresponding items were coproduced by Japanese companies in the F-15 program and supplied by the same Japanese companies to U.S. civil

[13]Local content requirements involve a purchaser's requirement that items produced in its country be placed on or in the aircraft it is purchasing.

[14]Directed procurements are noncompetitive contracts directed by Douglas as a result of management decisions for a variety of reasons. Reasons include the need to place business in a particular buyer country or a supplier's quality, technology, price, or historical manufacturing of an item.

aircraft. Brake components, actuation devices, instrumentation, landing gear, airframe structures, generators, and lights were the items we identified. For example, the Japanese firm Teijin Seiki received technical and manufacturing assistance from a U.S. firm to produce F-15 actuators.[15] Teijin Seiki now supplies actuators to Boeing and Douglas civil jets and recently won the contract for Boeing 777 actuators over a U.S. firm that had previously supplied actuators to Boeing aircraft. Sumitomo Precision, the Japanese firm coproducing the landing gear on the F-15, is a major subcontractor on the landing gear for Boeing civil jets. Shinko Electric coproduced the electric generator system on the F-15 and supplies motors and generators to Boeing civil aircraft.

The Japanese firms involved in these cases are noted in the tables in appendixes III and IV. Because comprehensive data on Japanese participants in the F-15 and U.S. civil aircraft programs were not available, additional cases of corresponding items may exist.

However, a more direct link can be drawn between coproduction of U.S. military aircraft and Japanese firms' competitiveness for producing military aircraft parts and components. A 1991 U.S. Air Force survey of potential U.S. and Japanese suppliers for the FS-X fighter codevelopment program showed that the F-15 and other U.S. military aircraft coproduction programs contributed to the competitiveness of many Japanese companies for FS-X subcontracts. For example, Japanese firms cited experience on the F-15 or other U.S. coproduction programs to show they were capable of and competitive for supplying heads-up displays, brakes, actuators, generators, accelerometer assemblies, and numerous other components.

Details of our scope and methodology are in appendix I. As requested by your staff, we did not obtain formal agency comments on a draft of this report. Portions of a draft were reviewed by agency and industry officials, and their comments were incorporated as appropriate. A more comprehensive listing of U.S.-Japanese F-15 coproduction items than is presented in appendix IV was provided to the Committee under separate cover. That listing was restricted by the State Department based on its

[15]Actuators are mechanical devices for controlling movable surfaces on an aircraft such as flaps, ailerons, and landing gear.

determination that public disclosure of its contents containing licensing information would be restricted by statute.

As arranged with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 15 days after its issue date. At that time we will send copies to other interested congressional committees. We will also make copies available to others upon request.

Please contact me at (202) 275-4128 if you or your staff have any questions concerning this report. Major contributors were Thomas J. Schulz, Associate Director; Davi M. D'Agostino, Assistant Director and Evaluator-in-Charge; and Teresa M. Hathaway, Evaluator; National Security and International Affairs Division.

Sincerely yours,

Joseph E. Kelley

Joseph E. Kelley
Director, Security and International
Relations Issues

Contents

Abbreviations

MITI Ministry of International Trade and Industry (Government of Japan)

Scope and Methodology

We examined various indicators relating to the progress of the Japanese aerospace industry from 1980 through 1990, including production, employment, and trade, as well as the Japanese aerospace industry's market share. We identified Japanese companies involved in coproduction of the F-15 fighter aircraft and the items they were producing. We further obtained data from Boeing and Douglas Aircraft on Japanese major and first-tier suppliers to their civil aircraft programs and the items they supplied. Because Boeing would not provide data on all its suppliers, we did not investigate Japanese production activity at the second and third tiers. Also, as agreed with Committee staff, we did not include in our scope Japanese companies' involvement in U.S. civil jet engine development and production. Because of our limited access to records, we did not examine individual contract awards in the Boeing and Douglas civil aircraft programs. Furthermore, we did not include in our scope Japanese ownership of or equity in U.S. aerospace suppliers.

We obtained information on the Japanese aerospace industry from the Departments of State, Defense, and Commerce; the Federal Aviation Administration; the International Trade Commission; the Library of Congress; and the Embassy of Japan in Washington, D.C. For information on the global and U.S. aerospace industries, we reviewed reports from the Council on Competitiveness, the Joint Chiefs of Staff, the Defense Science Board, the Aerospace Industries Association, the Massachusetts Institute of Technology Working Papers on Industrial Productivity, the Society of Japanese Aerospace Companies, and the international and industry press.

Statistical data on the Japanese aerospace industry were based on Japanese Ministry of International Trade and Industry documents; data on market share were taken from the Commission of the European Communities' documents. We converted the data using annual exchange rates from the Economic Report of the President and industry deflators from the Commission of the European Communities' 1990 report, The European Aerospace Industry: Trading Position and Figures.

We obtained information on Japanese participation in U.S. civil aircraft programs from Boeing's Commercial Airplane Group in Seattle, Washington, and Douglas Aircraft Company in Long Beach, California. We obtained additional information through Department of State and Department of Commerce documents, U.S. and Japanese industry association reports, and industry press.

Douglas Aircraft provided comprehensive data on purchase orders from Japanese suppliers for its civil aircraft programs. However, Boeing did not provide data on Japanese suppliers it was willing to certify as comprehensive. As a result, we tailored the information supplied by Douglas to show a level of detail comparable to that provided by Boeing.

We compiled information on Japanese participants in F-15 coproduction using documents obtained from the U.S. Air Force, the McDonnell Douglas Aircraft Corporation, and other sources. We contacted various U.S. F-15 contractors for additional information and to verify the data we obtained. We reconciled data from the various sources to generate the information listed in appendix IV. In this report, we did not use information derived from license applications without consent from the U.S. companies involved.

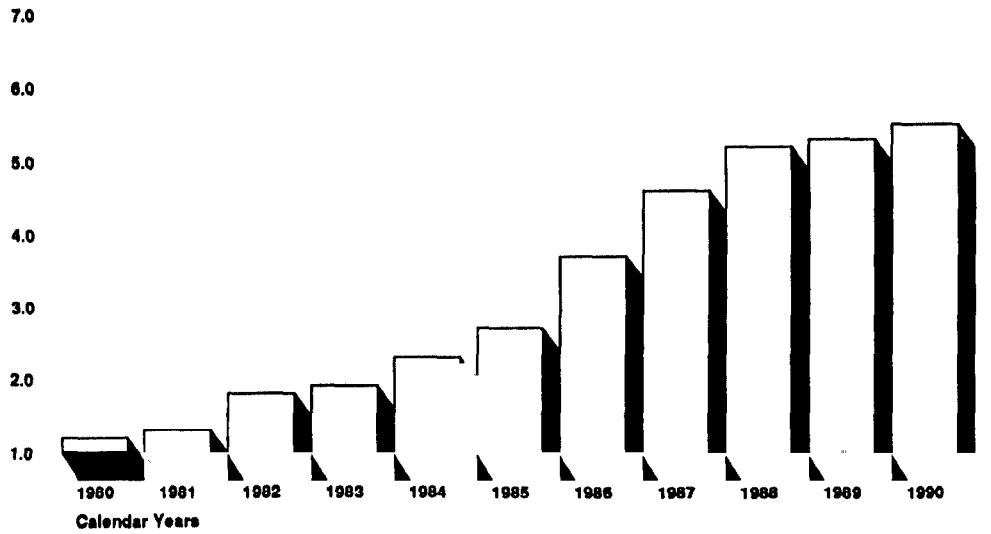
Due to the lack of a single comprehensive source of information on agreements for F-15 coproduction with Japan as well as information obtained from Department of Defense officials, we did not capture all the Japanese firms and items involved in the F-15 coproduction program. In addition, we did not have insight into all subcontracting activity performed by Mitsubishi Heavy Industries on the F-15 in Japan. The main agreement between Mitsubishi and McDonnell Douglas gives Mitsubishi the right to subcontract but does not identify the Japanese subcontractors they have engaged.

Our analysis of Japanese F-15 coproducers that are also partners or first-tier suppliers to U.S. civil aircraft programs may be limited by the possibility that some of the Japanese F-15 coproducers may have been subject to mergers or acquisitions or may have changed their names since the F-15 coproduction program began in 1978. This analysis was also limited by the factors previously discussed. We did not determine the degree of similarity between the F-15 items coproduced and the items actually supplied to U.S. civil aircraft.

We conducted our work between August 1991 and February 1992 in accordance with generally accepted government auditing standards except as noted above.

Japanese Aircraft Industry Production and Trade

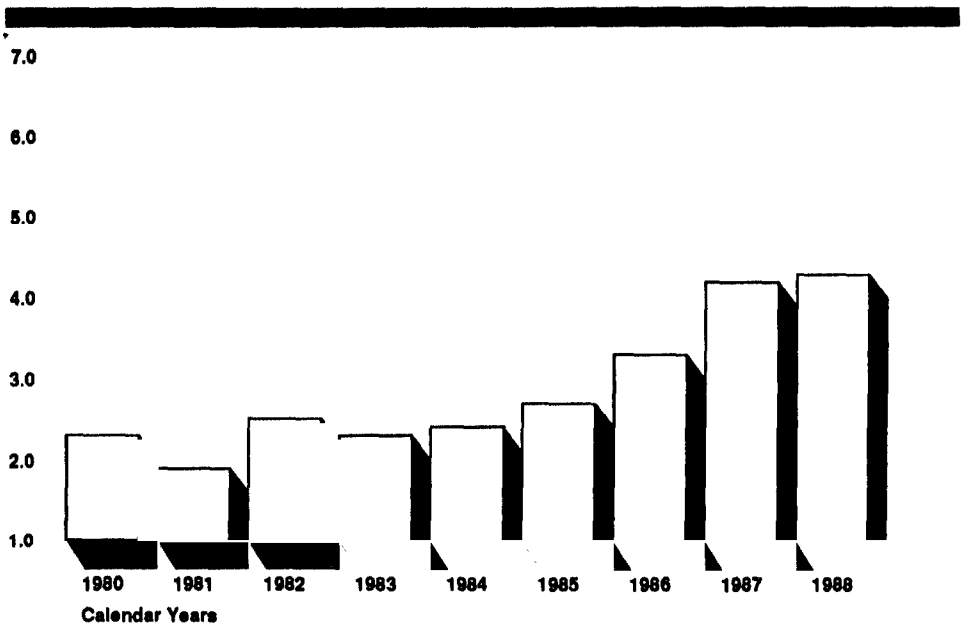
Figure II.1: Japanese Aircraft Production: 1980-1990 (Current Dollars in Billions)



Source: Japanese Ministry of International Trade and Industry

GAO Note: Values converted from yen to dollars using Economic Report of the President exchange rates.

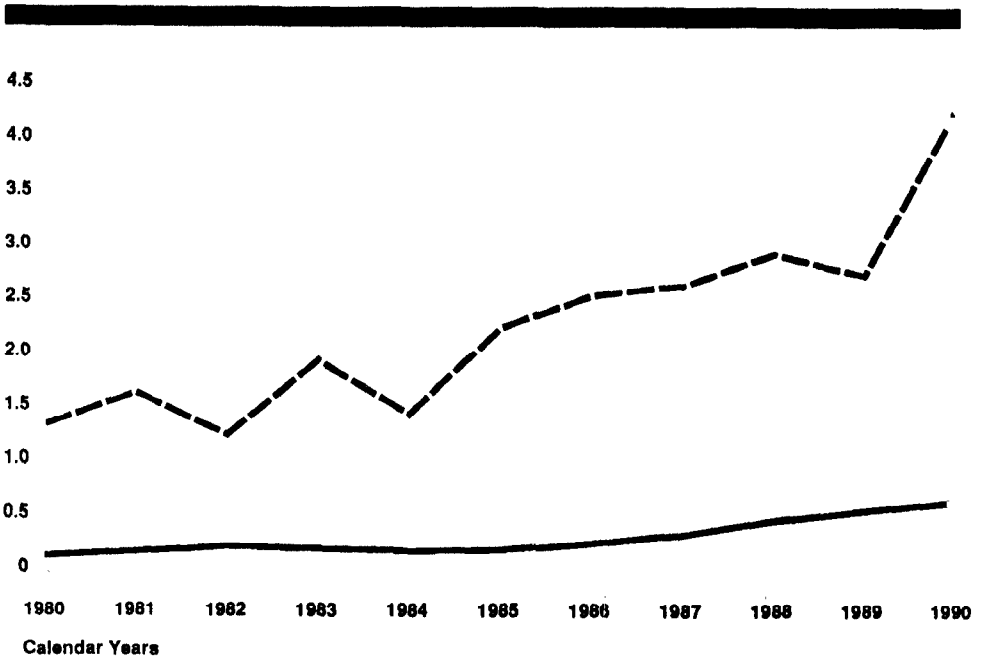
Figure II.2: Japanese Aircraft Production: 1980-1988 (Constant 1985 Dollars in Millions)



Source: Japanese Ministry of International Trade and Industry

GAO Note: Values converted from yen to dollars using Economic Report of the President exchange rates; Values deflated using Commission of European Communities sectorial deflator.

Figure II.3: Japanese Aircraft Trade: 1980-1990 (Current Dollars in Billions)



Source: Japanese Ministry of International Trade and Industry

GAO Note: Values converted from yen to dollars using Economic Report of the President exchange rates.

Major Japanese Participants in U.S. Civil Aircraft Programs

Table III.1: The Boeing Company

Japanese manufacturer	Item and/or activity	Programs
Commercial Airplane Company (Mitsubishi, Fuji, and Kawasaki)	Joint program management	767
Daido Steel	Steel products	767
*FUJI HEAVY	Airframe, composite structures	747, 757, 767, 777, 7J7
Furukawa Aluminum	Aluminum forgings, extrusions	757, 767
Jamco	Galleys, lavatories	727, 737, 747, 757, 767, 777
JAPAN AIRCRAFT (NIPPI)	Structural components (ribs, elevators)	757 (767)
Japan Aircraft Development Corporation (Mitsubishi, Fuji, and Kawasaki)	Joint program management	777, 7J7
JAPAN AVIATION ELECTRONICS	Flat panel displays, air data inertial reference systems	(737) (747) (757) (767) 7J7
*KAWASAKI HEAVY	Airframe, gear boxes	707, 727, 737, 747, 767, 777, 7J7
*KAYABA INDUSTRY	Valves, actuators, nose-gear selector, brake metering valve	737, 757, 767, 7J7
Kobe Steel	Titanium and steel forgings for fittings and gear boxes	737, 747, 757, 767
Koito Industry	Passenger seats	737, 747, 757, 767
*KOITO MANUFACTURING	Lights (reading,map,logo), exit signs	737, 747, 757, 767
Matsuhita Electric	Entertainment systems, audio tape reproducer, cathode ray tubes	707, 727, 737, 747, 757, 767, 7J7
*MITSUBISHI ELECTRIC	Fuel shut-off valves, electric chimes, actuators, speaker	747, 757, 767
*MITSUBISHI HEAVY	Airframe, valves	737, 747, 757, 767, 777, 7J7
NEC CORPORATION (NIPPON ELECTRIC)	Digital autonomous terminal access communication systems	7J7
Nippon Miniature Bearing	Bearings, electric motors	747, 757, 767
SHIMADZU	Power unit-cargo door hinge, gear boxes, valves, actuators	737, 747, 757, 767 7J7
*SHINKO ELECTRIC COMPANY	Electric motors, electric generators	(747) (757) (767)
SHIN MEIWA	Structural components (ribs)	(757) 767, 777
Shin-Nippon Koki	Machine tools	Used on variety of programs
Showa Aircraft Industry	Honeycomb	737, 747, 767, 7J7
Sony Corporation	Audio components	777
SUMITOMO ELECTRIC	Fiber optic couplers	7J7, (777)
*SUMITOMO PRECISION	Landing gear structures	(757) (767)

(continued)

Japanese manufacturer	Item and/or activity	Programs
Suwa Seikosha Company	Flat panel displays	7J7
*TEIJIN SEIKI	Yaw damper servos, power control actuators, spoiler	737, 747, 757, 767, 777, 7J7
Tenyru Industries	Seats	727, 737, 747, 767
*TOKYO AIRCRAFT INSTRUMENT	Instruments, gyro, tachometers	747, 757, 767
Toray	Carbon fiber	777
TOSHIBA	Cathode ray tubes	767
Toshiba Corporation	Machine tools	Used on variety of programs
YOKAHAMA RUBBER	Honeycomb core products for lavatory modules	737, 747, 757, 767

Source: The Boeing Company. Boeing noted that products and/or activities shown are only representative items and do not represent all products and services that Japan provided.

Notes:

Programs in parentheses indicate significant indirect participation.

7J7 is a joint Boeing/Japanese program that has been indefinitely delayed. Japanese companies printed in upper case also participated in F-15 coproduction; Japanese companies preceeded by an asterisk participated in F-15 coproduction on corresponding items and equipment.

Table III.2: Douglas Aircraft Corporation

Japanese manufacturer	Item and/or activity	Programs
FUJI HEAVY	Aileron and trailing edge assemblies	MD11
KAWASAKI HEAVY	Fairings, seals	MD80
*MITSUBISHI HEAVY	Composite material and panel assembly, tailcone assembly	MD80, DC10, MD11
Jamco	Lavatories	MD11, MD80
*TEIJIN SEIKI	Actuator assembly	MD11
Tenyru Industries	Seat cover, ash tray	DC10

Source: McDonnell Douglas Aircraft Corporation. Information was adapted by GAO.

Note: Japanese companies printed in upper case also participated in F-15 coproduction; Japanese companies preceded by an asterisk participated in F-15 coproduction on corresponding items and equipment.

Japanese Participants in F-15 Coproduction

Japanese company	U.S. company	F-15 item
Daicel	Explosive Technology	Shielded mild detonating cords
Daicel	OEA, Inc.	Propellant actuated device items
Daicel	Talley Industries	Propellant actuated and mechanical devices
Daicel	McDonnell Douglas	ACES II escape system
Daicel Chemical	Teledyne McCormick Selph	Inter-seat sequencing parts
Daikin Kogyo	Aircraft Porous Media	Filtration equipment/F-100 engine
Eagle Industry	EG&G	Gear box, main shaft seals/F-100 engine
*FUJI HEAVY		Subcontractor to Mitsubishi Heavy Industries (MHI) on main F-15 agreement
Fujitsu Limited	Litton Industries	Repair/radar target data processor
Hitachi	McDonnell Douglas	Data link set
Ishikawajima Harima	Allied/Garrett	Repair/fuel control components
Ishikawajima Harima	Ex-Cell-O	Augmentor spray manifold assemblies/F-100 engine
Ishikawajima Harima	Bendix (now Allied-Signal)	Service/F-100 engine components
Ishikawajima Harima	Colt Industries	Overhaul/main fuel pump/ F-100 engine
Ishikawajima Harima	Rohr Industries	Machining/F-100 engine forward duct
Ishikawajima Harima	Hamilton Standard/United Technologies	Repair and maintenance/ Electronic engine control and augmentor fuel pump/ F-100 engine
Ishikawajima Harima	Bendix (now Allied-Signal)	Fuel control system/ F-100 engine
Ishikawajima Harima	Hamilton Standard/ United Technologies	Augmentor fuel pump
Ishikawajima Harima	Pratt-Whitney	F-100 engine
Ishikawajima Harima	TRW	Electrochemically machined parts
JAPAN AVIATION ELECTRONICS	Honeywell	Gyro/radar antenna system
JAPAN AVIATION ELECTRONICS	General Electric	Automatic flight control system
JAPAN AIRCRAFT (NIPPI)		Subcontractor to MHI on main F-15 agreement
*KAWASAKI HEAVY		Subcontractor to MHI on main F-15 agreement
Kanto Koku Keiki	Lear Siegler	Altitude indicator
KAYABA INDUSTRY	Allied-Signal	Carbon brakes
KAYABA INDUSTRY	Pneumo Corporation (now National Waterlift)	Bypass, first ramp, diffuser
*KAYABA INDUSTRY	Bendix (now Allied-Signal)	Wheel and brake components

(continued)

Japanese company	U.S. company	F-15 Item
*KOITO MANUFACTURING	McDonnell Douglas	Various display panels, lights and indicators, test set
MITSUBISHI ELECTRIC	Hughes	APG 63 radar
MITSUBISHI ELECTRIC	Varian Associates	Traveling wave tubes
MITSUBISHI ELECTRIC	Magnavox Electronics	ARC 164 radio
MITSUBISHI ELECTRIC	Plessey Dynamic	Electromechanical actuators
*MITSUBISHI ELECTRIC	McDonnell Douglas	Flashers and actuators
MITSUBISHI ELECTRIC	Rockwell International	Direction finder set
MITSUBISHI ELECTRIC	TRW	Fuel transfer and booster pumps
MITSUBISHI ELECTRIC	IBM	Service/central computer
*MITSUBISHI HEAVY	McDonnell Douglas	F-15 aircraft
MITSUBISHI HEAVY	McDonnell Automation	Software/loft surfaces
MITSUBISHI HEAVY	MOOG	Control stick, boost and pitch compensator
MITSUBISHI HEAVY	Garrett (now Allied-Signal)	Jet fuel starter
MITSUBISHI HEAVY	MOOG	YAW ratio controller
MITSUBISHI HEAVY	McDonnell Douglas	Avionics shop services
MITSUBISHI HEAVY	Pneumo Corporation (now National Waterlift)	Stabilator
MITSUBISHI HEAVY	Abex Corporation	Overhaul/AP-19 fuel pump
Mitsubishi Precision	McDonnell Douglas	Interference blanker
Mitsubishi Precision	Singer Company	Eddy current damper
Mitsubishi Precision	SCI Systems	Integrated communication navigation identification system
Mitsubishi Precision	Goodyear Aerospace	Simulators
Mitsubishi Rayon	Swedlow	Transparent enclosures
Nippon Aviotronics	McDonnell Douglas	Various display panels, lights and indicators, test set
NIPPON ELECTRIC (NEC)	Rockwell International	TACAN RT-1159/A and adapter mount
Nippon Seiko	Beaver Precision	Exhaust control ball screw assembly
Omori Seikoki (also listed as Osaka Sanso Kogyo)	ARO Corporation	Converter
Seiritsu Kogyo	Abex Corporation	AP-19 pump test stand
SHIMADZU	McDonnell Douglas	Overspeed detection unit
SHIMADZU	McDonnell Douglas	Heads up display (HUD)
SHIMADZU	McDonnell Douglas	Multi-stage improvement program video tape recording system for HUD
SHIMADZU	Garrett (now Allied-Signal)	Ejection seat sequencers, cabin pressure regulator, cabin safety valves, environmental control system, air cycle AC system
Shin Chuo Kogyo	McDonnell Douglas	Multiple ejector racks (bomb racks)

(continued)

Japanese company	U.S. company	F-15 Item
SHIN MEIWA	Sargent-Fletcher	600 gallon nestable fuel tank
*SHINKO ELECTRIC	Lear Siegler	Electric generator system
SHINKO ELECTRIC	Dynamic Controls	Armament control system
SHINKO ELECTRIC	Dynamic Controls	Programmable armament control system (and software)
SHINKO ELECTRIC	Dynamic Controls	Avionics cooling monitor unit
SHINKO ELECTRIC	A-T-O (now Interstate Electronics)	Contactors/generating system
SHINKO ELECTRIC	Teledyne	Event history recorder/ F-100 engine
SHINKO ELECTRIC	Bendix (now Allied-Signal)	Various regulators, generators
SHINKO ELECTRIC	McDonnell Douglas	Caution light panel, landing gear control indicators, exceedance bit control panel, avionics status panel
Sumijiu Tokki	General Electric	Service/ammunition handling system
SUMITOMO ELECTRIC	Engineered Fabrics	Fuel tanks
Sumitomo Heavy (formerly Nittoku Metal)	General Electric	Ammunition handling system
Sumitomo Heavy	General Electric	20mm gun
Sumitomo Heavy	TRW	Air foils/F-100 engine
SUMITOMO PRECISION		Subcontractor to MHI on main F-15 agreement
SUMITOMO PRECISION	Pneumo Corporation (now National Waterlift)	Aileron
*SUMITOMO PRECISION	Pneumo Corporation (now Cleveland Pneumatic)	Main landing gear
SUMITOMO PRECISION	Crane Hydro-Aire	Hytrol skid control system
TEIJIN SEIKI	Parker Hannifin	Hydraulic valves
TEIJIN SEIKI	Pneumo Corporation (now National Waterlift)	Nose steer, input-nose steer, flap drive
*TEIJIN SEIKI	Ronson Hydraulic	F-15 components (valves, actuators)
TEIJIN SEIKI	Sundstrand	Fuel and pneumatic valves
TEIJIN SEIKI	Ex-Cell-O	Fuel nozzles/F-100 engine
TEIJIN SEIKI	Textron	Electrohydraulic servovalves, spool, sleeve assembly
TEIJIN SEIKI	Hydraulic Research	Hydraulic servo valve
TOKYO AIRCRAFT INSTRUMENT	Gull Airborne	Fan turbine inlet temperature indicator
TOKYO AIRCRAFT INSTRUMENT	Rockwell International	Horizontal situation indicator set
TOKYO AIRCRAFT INSTRUMENT	Litton Industries	On-board oxygen generating system
*TOKYO AIRCRAFT INSTRUMENT	McDonnell Douglas	Various display panels, lights and indicators, test set

(continued)

Japanese company	U.S. company	F-15 item
TOKYO AIRCRAFT INSTRUMENT	Ragen Data Systems	Vertical speed, air speed and mach, and angle-of- attack indicators
Tokyo Keiki (now Tokimec)	Sperry (now Honeywell)	Air data computer, attitude heading reference system, vertical situation display
Tokyo Keiki	Bendix (now Allied-Signal)	Service/avionic intermediate shop
Tokyo Keiki	Applied Technology	Computer cards-radar warning receiver
Tokyo Keiki	M.C. Aerospace	Hydraulic valves and components
Tokyo Keiki	Bendix (now Allied-Signal)	Omni-blade antenna
Tokyo Keiki	Litton Industries	Radar signal processing system
TOSHIBA	Litton Industries	Assembly/LN-31 inertial navigation system
TOSHIBA	Litton Industries	Assembly/LN-94 inertial navigation system
TOSHIBA	General Electric	Lead computing gyro system
Toshiba Electric	General Electric	Service/lead computing gyro system
Toyo Communications	Bendix (now Allied-Signal)	Airborne transponders
Toyo Communications	Teledyne Electronics	RT-1063B/APX-101(V) identification friend or foe (IFF) transponder
Toyo Communications	Hazeltine	APX-76A IFF interrogator
Yokogawa Electric (formerly Hokushin Electric)	Simmonds Precision	Fuel quality gaging system and fuel liquid oxygen indicator
Yokogawa Electric	Allied/Garrett	F-100 engine parts
Yokogawa Electric	Bendix (now Allied-Signal)	Nozzle position transmitters
Yokogawa Electric	Hamilton Standard/United Technologies	Assembly, test, and service/electronic air inlet controller
YOKOHAMA RUBBER	SSP Products	Pneumatic, fuel duct assemblies
YOKOHAMA RUBBER	Goodyear Aerospace (now Engineered Fabrics)	Fuel tanks
YOKOHAMA RUBBER	Brunswick Defense	Repair/filament wound radome
YOKOHAMA RUBBER	Federal Mogul	Duct assembly

Source: Compiled by GAO from various industry and Japanese sources.

Notes: Japanese companies shown in upper case are also participating in U.S. civil aircraft programs as partners and/or major suppliers; Japanese companies preceded by an asterisk are participating in U.S. civil aircraft programs on corresponding items and equipment.

One U.S. company requested that its F-15 coproduction arrangements with Japanese companies not be included in this report. This resulted in the exclusion of one Japanese company involved in the F-15 program.

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