Patriot Missile Sales:
A Case Study in Offset Sales Arrangements

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DEFENSE PREPAREDNESS

Armaments cooperation, including coproduction, is an integral part of U.S. efforts to improve acquisition management and modernize conventional forces. The objectives of these efforts are to develop, field, and support--through equitable burdensharing--the most effective and interoperable conventional military equipment for U.S. forces and those of its allies and friends. The support we have received from Congress has been a vital part of our ability to establish growing defense cooperation partnerships with various countries.

To gain the benefits of technological advances elsewhere, DOD has instituted management practices and organizational changes to assure that allied developments and products are thoroughly considered in U.S. acquisition strategies and decisions. This has resulted in a greater commitment to force modernization by our allies. Through armaments cooperation and reciprocal defense trade, the economic burden is shared and access to the best technology is enhanced. The result is more modern and common equipment delivered sooner to all allied forces with concomitant improvement in the viability of coalition strategy.

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[The following represents] a case study of Patriot missile sales to the Governments of the Federal Republic of Germany (FRG), Japan (GOJ), the Netherlands (GON), the related offset agreements, and an overview of the potential impact of the transactions on U.S. industrial competitiveness. The case study does not attempt to assess United States foreign or defense policies or objectives associated with these sales. This case study focuses only on industrial competitiveness which is only one factor in the complex decision making process on defense exports.

Introduction

The Patriot surface-to-air missile was chosen for examination because the sales encompass various types of defense-related offsets, including coproduction, licensed production, subcontractor production, overseas investment, technology transfer, and countertrade. There are several limitations to this case study. Because these three sales are so recent, it is difficult to quantify at present their impact on overall U.S. industrial competitiveness or on the subcontractor base. No survey of U.S. industry was conducted, nor was the DPA 309 data base used, as these transactions are outside the time frame for that file. However, Table II.B.1 puts the case study transactions in the same format as the information in the DPA 309 data base. [The DPA 309 data base is a system employed by the Office of Management and Budget for tracking and analyzing offset sales programs which are reported annually to Congress pursuant to Section 309, Defense Procurement Act (DPA).]

The Patriot surface-to-air missile (SAM) system is the first new heavy SAM system fielded by the U.S. in over 20 years. The military operational requirement for the Patriot stems from the need to improve air defense in Northern and Central Europe. Over 75% of U.S. Patriot battalions will be deployed to Europe. Although there are numerous light, low altitude SAM systems deployed in NATO, SAM systems capable of countering medium and/or high-level aircraft attacks are outmoded in many respects.

TABLE II.B.1
Patriot Sales and Offset Transactions
(U.S. $ millions)

	Germany	Netherlands	Japan	Totals
Sales Value	872	305	1,125	2,302
Offset Obligation	500	305	--	805

The Patriot system is capable of attacking enemy aircraft at all practical altitudes from sea level to up to 90,000 feet, and is the first land based system deployed in the Free World that can launch missiles against multiple targets simultaneously. Previous Army systems, such as the HAWK (Homing All the Way Killer) missile, while capable of engaging several targets in rapid succession, can only track one target at a time. The Patriot is therefore a "force-multiplying" system. It offers improved reliability, range, and requires far fewer radars and other components than previously deployed systems in the NATO arsenal. Its combination of mobility, reliability, and firepower make it superior to all but the most advanced Soviet SAM systems.

The Patriot system was developed during the early 1970s, at a cost of more than $2.2 billion and began operational deployment in the early 1980s. It was designed primarily for the NATO European theatre of operations, and the participation of NATO European countries in its procurement is essential if the system is to provide an effective air defense shield for NATO forces. Since 1975, the United States has been actively promoting the system to allied countries. These activities have resulted in the three sales discussed here and negotiations are continuing with Italy, Belgium, and other countries.

The Patriot is the only SAM system of its type in the Free World. The only potential competitor to the system is Hughes Aircraft's proposed NIKE Phoenix system which exists only in concept. Hughes proposes to develop an improved system from the aged NIKE. It would incorporate modern target acquisition and fire control technologies. As yet, no prototype of the proposed system has been built, and therefore it is not yet in the demonstration phase.

Some of the more important high technology products in the Patriot include avionics, advanced metallurgical products, advanced plastics and ceramics, composites, propulsion systems, computer hardware and software, and instrumentation. In addition, production of the Patriot requires the use of numerous manufacturing and process technologies. Some of the more advanced and critical types include computer-aided design and computer-aided manufacturing (CAD/CAM), powder metallurgy, systems integration, advanced alloying processes, robotics, factory testing equipment, laser welding and metrology, and CNC machine tools.

Table II.B.2 shows U.S. merchandise trade with the three countries included in the case study in 1985.

TABLE II.B.2
U.S. Merchandise Trade with Selected Countries, 1985
(U.S. $ millions)

	Total Exports	Total Imports	Military Exports	Military Imports	Balance All Trade	Balance Mil. Trade
Germany	9,050	20,239	125	23	-11,189	97
Netherlands	7,269	4,081	51	11	3,188	40
Japan	22,631	68,783	440	19	-46,152	421

Patriot Sale to the Federal Republic of Germany (FRG)

In 1984, the U.S. Secretary of Defense and the FRG Minister of Defense signed the Agreement Implementing Cooperative Measures for Improving Air Defense in Central Europe. The agreement was based on the principle of substantially improving NATO air defenses through equitable defense burdensharing and mutual reinforcement of the individual defense capabilities of both countries. Both parties were to benefit from the enhanced deterrence facilitated by the strengthening of NATO air defenses and the standardization of equipment.

The FRG agreed to buy 27 Roland fire units, to be deployed and manned by FRG Air Force personnel at U.S. Air Force main operating bases in Germany. The Roland is a low-altitude SAM system, built jointly by France and the FRG.

For the FRG, the purchase of the Roland offered the dual advantages of supplying their air defense battalions, and increasing production of the German-built Roland. They will also replace missiles in existing German air defense battalions with Patriots, and man them for the common air defense of Germany. Further, the Germans also agreed to provide mutually agreed improvements worth $50 million toward projects which the U.S. and the FRG agree are beneficial to the air defense of the NATO Central Region.

The U.S. Government agreed to grant the FRG an additional 14 Patriot fire units in exchange for the Roland protection and FRG operation and maintenance of an additional 12 U.S.-owned fire units. The latter group is to be operated and maintained by the FRG air defense forces for a period of 10 years.

The FRG purchased 14 Patriot fire units from the U.S. government for $872 million in 1984 dollars. The U.S. cost of the complete Patriot system is $100 million per fire unit. The main reason that the price [for the FRG] is lower is that the FRG will build their own truck/trailer units, electric generators, communications and identification friend or foe equipment, and other FRG organic items. The price was also reduced by the decision to waive non-recurring production and R&D charges.

In a separate agreement, Raytheon agreed to provide German industry with $500 million dollars in offsets for contracts for the manufacture of Patriot components and spare parts, and for logistical services. The period of performance extends to the year 2000. The components to be coproduced by German firms include: rocket motor, warhead, safe and arm device, igniter, display and controls, IFF antenna, IFF antenna elements, missile TWT [traveling wave tubes], missile batteries, missile CRAF, modules, cables and distribution boxes. However, those components that make Patriot a state-of-the-art air defense system (e.g., the system radar sets and missile guidance section and software) will be produced in the United States.

Five firms in the FRG are licensed to produce major subsystems for the Patriot system at a total value of more than $300 million. Two-thirds of the production will be undertaken by

Messerschmitt, Boelkow, and Blohm (MBB), the German contractor for the production arrangement. The firms and the components they produce include:

German Firm	U.S. Licensor	Component	Quantity
MBB	Raytheon	Rocket Motors	1,980
		Propulsion Section Assemblies	1,980
		Missile Round Assemblies	1,980
		Safety and Arming Devices and Warheads	1,680
		Control Section Assemblies	840
AEG	Raytheon	Traveling Wave Tubes	1,680
Siemens	Raytheon	Displays and Controls	36
		IFF Antennas	37
Diehl	Eagle Picher	Batteries	1,680
	Raytheon	Electronic Modules	10,316
Motorenwerk Bremerhaven	Raytheon	Cables	16,416

Many of the individual components of the Patriot missile system are not state-of-the-art technology. What makes the Patriot a superior system is its design for the integration of its components and the manufacturing technology embodied in the production of the missile. The Patriot is a classic example of applied engineering: it achieves its exceptional capabilities through superior design engineering. Components of relatively low sophistication are wedded in a system resulting in superior performance. The significance of these characteristics of the Patriot system is that FRG industry may gain access to a number of production management techniques more advanced than those currently in use in the FRG missile industry. The FRG currently manufactures only one SAM missile, the Roland, in cooperation with Aerospatiale [in France].

U.S. contractors whose parts and components are being produced in the FRG may also face new competitors in bidding on future Patriot orders, whether such orders are placed in the U.S. or a foreign government. Furthermore, if commercial applications are related to the military technologies/capabilities acquired by the new competitor, the commercial markets of the U.S. subcontractor could be threatened as well.

Eagle Picher, for example, the single source for batteries used in the Patriot missile as well as many other weapon systems (including 11 U.S. frontline precision guided missiles), is duplicating its capabilities through a joint venture with Diehl in Germany. Additionally, these capabilities will be triplicated by Mitsubishi Heavy Industries in Japan under their Patriot coproduction agreements. While batteries are undoubtedly a vital component in the Patriot system and this excess production capacity may be useful in a mobilization emergency, one can question whether it makes economic sense to create two new and/or enhanced competitors and excess production capacity in such a narrow market.

Further, [Germany's] AEG, a world leader in the design and production of travelling wave tubes (TWT), will be making 1,680 TWTs for Patriot. Japan will also be producing TWTs under their Patriot coproduction agreement. Factory test equipment and other capabilities necessary for TWT production will be copied and reproduced in the FRG and Japan as well. In a report on the Microwave Tube Industry completed by the Commerce Department in September 1984, it was noted that U.S. exports of high value TWT's play an important role in the industry's continued profitability. From a long-term perspective, enhanced competitors in Europe and Japan could be expected to diminish the export potential from the U.S. and erode the profit opportunities of the

remaining high value TWT industry in the U.S. The low-value end of the TWT industry in the U.S. is already threatened by import competition.

The FRG will design and build their own truck/trailer units and electric generator units for the Patriot, taking potential sales away from the U.S. contractor, Southwest Mobile Systems. This will also affect component vendors that supply parts to Southwest and could reduce Southwest's future sales if the German truck/trailer contractors bid on future Patriot orders. Mann, the German truck/trailer manufacturer, bid [unsuccessfully] on the original Patriot orders for the U.S.

In addition, the basic inefficiencies associated with offsets (i.e., duplication of production facilities, excess capacity, uncompetitive components and subsystems) may further add negative competitive impacts to the buyer and/or seller. The U.S. Army estimates the German per unit coproduction costs for the complete Patriot missile system to be twice that of Raytheon's unit costs. The higher costs are attributable to high start-up costs, investment in tools and equipment, transportation charges for materials and supplies, and workforce training amortized over fewer units.

The FRG Patriot sales agreement is an example of an international arms sale where the foreign policy considerations and military operational requirements for the air defense of NATO Europe may compete with considerations of trade balance and industrial competitiveness considerations. While U.S. industry will benefit from the FRG order for 14 Patriot fire units and NATO will gain from improved air defense capability and interoperability, the impact of the direct offsets in the form of coproduction, subcontracting, and technology transfer may contribute to the capabilities of German industry and may have future negative effects on subcontractors of the U.S. defense base.

Patriot Sale to the Netherlands

The background of the sale of four Patriot fire units to the Netherlands is similar to that of the FRG sale. In an effort to meet the priority requirement to increase NATO Europe's air defense capabilities, the U.S. responded to the Netherland's request for a proposed Patriot sales package. This package was modified during subsequent negotiations to include offsets.

The sale of Patriot to the Netherlands was unusual in that it involved both direct and indirect offsets to be provided by Raytheon, and direct fulfillment of a $70 million offset to the Netherlands by the United States Government. The fulfillment of offsets by the U.S. Government is not a standard practice. The DOD policy (Duncan Memorandum) on offsets states that the U.S. Government will "not normally enter into offset agreements." However, in this case it was deemed necessary for foreign policy and national security reasons.

The basic structure of the U.S.-Netherlands agreement was as follows: The Netherlands would buy four Patriot fire units (reduced strength, five launchers per set--a total of 160 missiles), for $305 million under an FMS sales agreement. The Netherlands also agreed to make manpower and other services valued at $33 million available for use by the U.S. The U.S. prime contractor, Raytheon Corporation, agreed to "best efforts" to provide the Netherlands with $235 million in direct and indirect offsets. The period of performance of the contract is 1984 through 1999.

The total offset commitment to the Netherlands--$305 million--is equal to 100% of the purchase price of the Patriot fire units to be implemented over a 15 year period. The Netherlands is another case where foreign policy considerations and military operational requirements may compete with future industrial competitiveness considerations.

The U.S. prime contractor, Raytheon Corporation, will benefit from increased sales of the Patriot, but at a cost of absorbing $115 million in direct offsets and $120 million in indirect offsets. Raytheon will discharge its indirect commitment through the purchase of goods and services in the

Netherlands before the end of 1999. As part of the Patriot coproduction agreement ($65 million), Fokker aircraft of the Netherlands will be producing electronic circuit boards (modules) and electronic power supplies (small transformers), and will duplicate Raytheon's special factory test equipment.

In addition, the U.S. Army will buy 1,980 (+/- 3%) Patriot missile cannisters, with a value of about $70 million, which will be produced in the Netherlands, displacing potential sales of U.S. companies. This is the U.S. government financed offset which distinguishes the Netherlands arrangement from the others in the case study.

Patriot Sale to Japan

The Patriot sale to Japan contributes to the foreign policy and national security objectives of the U.S. by improving the military capabilities of Japan; furthering rationalization, standardization, and interoperability; and enhancing the defense capability by replacing aging NIKE Hercules systems. Because of domestic Japanese political considerations, Japan will not enter into an FMS program of this magnitude. Consequently, DOD entered into a coproduction Memorandum of Understanding with the Government of Japan for the Patriot program.

Under the terms of the agreement, Japan will produce 26 Patriot fire units in cooperation with Raytheon Corporation. One of the unusual aspects of the agreement is that Raytheon and its subcontractors (Martin Marietta, Eagle Picher, Hazeltine, and others) in essence will be licensors and subcontractors to the Japanese. With Mitsubishi Heavy Industries acting as prime, the Japanese will produce all components (electronics, mechanical components, metal parts, microwave, propulsion, etc.) of the Patriot system except the fuse and the program guidance, and the surveillance and identification software.

Estimated fees and orders from Japan to Raytheon and other U.S. companies will approximate $776 million or 29.6% of the estimated total contract value of $2.6 billion. The U.S. government will sell another $345 million, or 13.1% of the value of the contract. Overall, the U.S. will receive 43% of the value of the sale.

The agreement also highlights the importance to Japan of obtaining U.S. technology and production know-how for future defense and commercial industrial goals. The Department of Defense estimated that Japan, because of uneconomical production runs in coproducing the Patriot, will pay between 55 and 80 percent more for the system than had it been directly purchased from the U.S. Raytheon Corporation.

From an industrial competitiveness standpoint, the U.S.-Japan coproduction agreement has several major negative features. For an outlay of equal to less than one-half the FMS face value of 26 Patriot fire units, the Japanese government will establish the full production, engineering, management, and technology transfer required to greatly enhance their production experience in the missile sector of the aerospace industry. The Japanese Government has identified aerospace as a priority for industrial development. The Patriot coproduction program will further this objective.

The Japanese are at least equal to, and in some circles, considered superior to U.S. firms in making the hardware components, such as computer numerically controlled machine tools and robotics that make up automated factory systems. They also offer the hardware at substantially lower prices than their U.S. competitors. U.S. firms are currently the world leaders in developing flexible manufacturing systems software. This gives U.S. builders of factory automation systems a major competitive advantage over rivals in Japan since the software is by far the most important element of these systems. The historic weakness of Japanese companies in the factory automation field has been in the development of systems software. The Japanese are making every effort to

license CAD/CAM technologies from leading U.S. firms. If they are successful, they may, as they have done with other technologies, develop a productivity advantage in this area as well.

The Japanese are already capable of producing most of the parts and components that comprise the Patriot system. For example, Japanese firms are the dominant competitors in many of the commercial markets for items such as semiconductors, optical components and bearings, where they are gaining substantial market positions in the United States. All they require for the Patriot coproduction is some additional engineering, test equipment, and production experience.

The U.S.-Japan Patriot coproduction agreement will achieve U.S. national security objectives, and provide a 1/3 share in the production of an additional 26 Patriot fire units to the U.S. prime contractor and associated subcontractors and vendors. On the other hand, the production and the technology gained by the Japanese may be detrimental to U.S. industrial competitiveness in the long term.

CONCLUSIONS

The Patriot missile system sales have had these effects from an economic perspective:

- Increased the sales income of the U.S. prime contractor and some related subcontractors.
- Increased employment in the United States and abroad.
- Increased the production and decreased the cost of Patriot missiles and components in the United States and abroad.
- May have increased the number of competitors by transferring technology, management know-how, and tooling to foreign defense industries.

Offsets are a major factor in the competition for international defense sales, even in the sale of systems such as the Patriot missile which has no competitors. Foreign purchasing governments use offsets as a trade management tool for the purposes of preservation of foreign exchange, the targeted development of selected industrial sectors, and the enhancement of the capability of domestic industries through technology transfer. In the future, we can expect increased numbers of foreign competitors for both complete and partial weapons systems as well as commercial products because of arrangements such as the Patriot deals.

The Role of the Arms Control and Disarmament Agency (ACDA) in Security Assistance and Arms Transfers

[The following is a reprint of an 8 April 1987 statement by ACDA.]

The role of ACDA in U.S. security assistance is legislated by Section 511 of the Foreign Assistance Act of 1961, as amended. This provision requires that all decisions to furnish military assistance be coordinated with the Director of the Arms Control and Disarmament Agency and the Director's opinion be taken into account on the extent to which proposed military assistance might:

(1) contribute to an arms race;
(2) increase the possibility of outbreak or escalation of conflict; or
(3) prejudice the development of bilateral or multilateral arms control arrangements

ACDA participates in the Security Assistance Program Review Working Group (SAPRWG) which develops proposed fiscal year U.S. security assistance programs. ACDA's role in the group is to ensure that arms control considerations are fully taken into account in the development of proposed country programs. ACDA, along with other participants in the working group, receives as an important input the Annual Integrated Assessment of Security Assistance (AIASA) prepared by our embassies. ACDA reviews each proposed country program and drafts a separate section on arms control considerations in the annual *Congressional Presentation for Security Assistance Programs (CPD).*

In addition, under Sections 38 and 42 of the Arms Export Control Act, ACDA must evaluate and render its opinion from an arms control standpoint on proposed Foreign Military Sales and commercial export license requests for military equipment. The Agency makes its views known to the Department of State on about 1,500 cases per year.

The primary office within ACDA responsible for implementing and carrying out the Director's statutory requirements in security assistance and arms transfers is the Arms Transfer Division of the Nuclear and Weapons Control Bureau.