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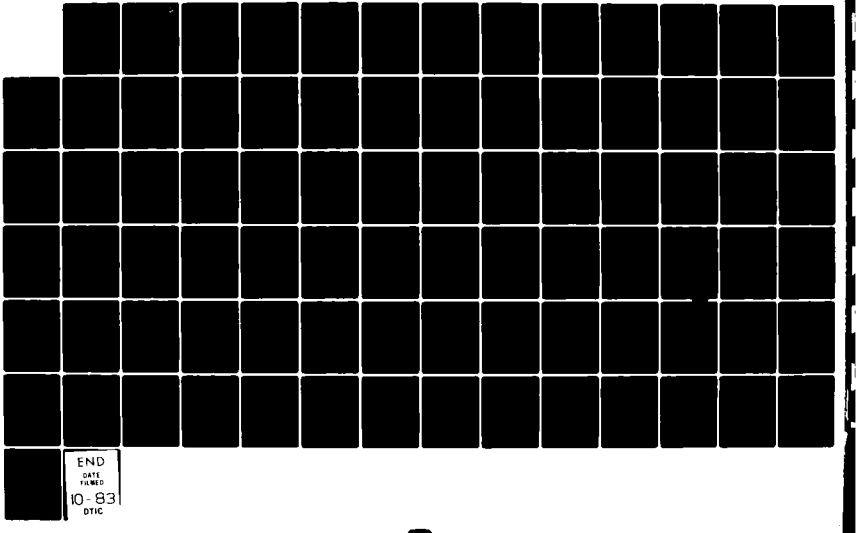

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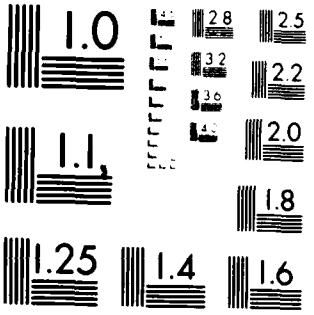

# INTO THE CRYSTAL BALL

## THIRD WORLD MILITARY INDUSTRIES: IMPLICATIONS FOR THE GLOBAL ARMS TRANSFER SYSTEM AND U.S. NATIONAL SECURITY INTERESTS

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May 1980

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ABSTRACT

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THIRD WORLD MILITARY INDUSTRIES: IMPLICATIONS FOR THE GLOBAL ARMS TRANSFER SYSTEM AND U.S. NATIONAL SECURITY INTERESTS

Stephanie G. Neuman, Columbia Uninversity

Since the late 1970s, the character of the world arms trade has changed. Each year the transfer of technical data and industrial know-how has increased in proportion to the sale of military end-items and new arms production facilities have appeared, particularly in the third world. This paper examines the implications of these developments for the industrialized world. It analyzes the extent to which weapons production is increasing in the third world, its impact on the structure of the world arms transfer system, and its significance for U.S. interests.

Part I analyzes the quantitative and qualitative capabilities of third world industries. It concludes that the number of LDCs producing major weapons will not increase dramatically in the future; that LDC defense production will remain a small fraction of the world's arms trade; and that military industries in the third world will concentrate on older, less complicated defense items relative to the more advanced and critical technologies manufactured in the developed world. Third world countries will also continue to be dependent on the major suppliers for the transfer of sophisticated weapons for their inventories, for modern tooling and manufacturing equipment required to upgrade their defense industries, for components demanding technically complex production skills, such as jet engines, composite metals, etc. For those LDCs with defense industries, licensing and coproduction agreements, and joint ventures will increasingly be the vehicles through which military technology is transferred.

Part II. concentrates on the disparities among arms producers and examines various socio-economic factors which might explain the reasons for them. It concludes that factors of scale, particularly the existence of a large military to provide an adequate internal market, combined with adequate financial resources to support the necessary industrial infrastructure determine a state's comparative military industrial capabilities.

Part III. examines developments in defense industrial production in other parts of the world. It finds that the world military-industrial system, like arms production in the third world, is structured by factors of scale and comparative advantage. It concludes that as the military industries of states grow, the inherent constraints of size and infrastructure create a hierarchically structured world arms trade and production system. Although the capabilities of individual countries may advance or decline as a by-product of technological diffusion and political necessity, over time the unequal distribution of resources among states will tend to ensure and perpetuate a global hierarchy of capabilities.

Part IV. speculates on the world military industrial system and the role of the U.S. in it. Extrapolating from trends in current data, the paper concludes that despite the complexity of the emerging world arms transfer system, and the changes it augurs for the global political and economic order, the United States will remain a dominant power in the new balance.

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INTO THE CRYSTAL BALL

# THIRD WORLD MILITARY INDUSTRIES: CAUSES AND CONSEQUENCES*

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## Introduction

Since the late 1970s, the character of the world arms trade has been changing. For a larger number of countries technology, not military end-items, has become the new medium of exchange. As the transfer of technical data and industrial know-how has increased in proportion to the sale of finished systems, new arms production facilities have appeared, particularly in the third world, throwing traditional supplier-recipient relations into a state of flux.

The implications of these developments are not fully understood or predictable. What is certain, however, is that the emerging global military industrial system is already beginning to pose new security dilemmas for decision-makers in supplier states. This study analyzes the extent to which arms production is growing in the third world,[1] and its impact on the global arms trade and military industrial system.

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*I am indebted to my research assistant, Christine Evans, who spent long, arduous hours organizing and analyzing the data.

[1]For the purposes of this study, the term "third world" is used synonymously with "developing", "less developed," "LDC", "industrializing", "less industrialized", "newly industrializing", countries or states. These terms refer to the regions of Africa, the Middle East, Latin America, and Asia (excluding Australia, New Zealand, and Japan.)

B. The Debate

A serious debate has been underway in American academic and policy-making circles regarding the shape of the international system and the role of the major powers in it.[1] Although several schools of thought differ on U.S. foreign policy alternatives, the current consensus now is to think of the international system as increasingly interdependent and therefore beyond the control of any one state or group of states. As communications shrink the globe, a complex system of interdependencies,[2] and/or interconnected chessboards of issues,[3] bind states into every tighter relationships, eroding their ability to determine foreign policy outcomes.[4] In this perceived new world order (or disorder), the hegemony of the major powers is no longer pervasive, and foreign policy for them has become less an exercise in control over events than a process of adapting to what is unavoidable and/or blocking their most negative effects.

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[1]Some of the participants in the debate are: Kenneth Waltz, "Theory of International Relations," in International Politics: Handbook of Political Science, vol. 8, eds. Fred I. Greenstein and Nelson W. Polsby (Reading, Mass: Addison Wesley, 1975), pp. 24-33; Robert Keohane and Joseph Nye," Power and Interdependence (Boston, Mass.: Little Brown, 1977); Stanley Hoffmann, Primacy or World Order? (New York: McGraw-Hill, 1979); Earl Ravenal, Never Again: Learning from America's Foreign Policy Failures, (Phila., Pa.: Temple University Press, 1978); Bruce Russett, "The American Retreat from World Power," Political Science Quarterly, vol. 90, no. 1 (1975); James F. Petras, "The Myth of the Decline of Capitalism," Telos, No. 28, (Summer 1976), pp. 181-87; Richard Rosecrance, ed., America as an Ordinary Country: U.S. Foreign Policy and the Future, (Ithaca, N.Y.: Cornell University Press, 1976).

[2]Nye and Keohane, op. cit.

[3]Stanley Hoffmann, op. cit.

[4]Joseph S. Nye, Jr. "U.S. Power and Reagan Policy," Orbis, vol. 26, no. 2 (S er 1982), pp. 391-411 (pp. 391-397).

To some, the cause of political fragmentation can be found in technology transfers. As Robert Gilpin writes:

> The transfer of advanced techniques from advanced societies to less advanced societies is undoubtedly one of the most significant causes of the redistribution of power in an international system.[1]

To others it is specifically the proliferation of arms production facilities to the LDCs which symptomize the disintegration of hegemonical power. Steven E. Miller observes:

> The indigenous weapons production phenomenon is one small dimension of a much larger development: the diffusion of power throughout the international system. This has occurred in the economic and political realms as well as in the military. In each case this has involved the erosion of the incredible concentrations of political, economic, and military power in the hands of a small number of large industrial states.[2]

In this conception, interdependence is a zero-sum pie. Indigenous production capabilities, specifically military production capabilities, become a symbol not just of the growing self-sufficiency of key third world producers, but of the erosion of the traditional suppliers' influence as well. In the following pages, the validity of these assumptions will be examined and discussed.

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[1] Robert Gilpin, War and Change in World Politics (Cambridge University Press, 1981), p. 180.

[2] Steven E. Miller, "Arms and the Third World, The Indigenous Weapons Production Phenomenon," unpublished paper prepared for The Programme for Strategic and International Studies, The Graduate Institute of International Studies, University of Geneva, 1980.

B. A Stratified World Order.

Two conclusions, based on observed trends derived from the present writer's data, are presented to demonstrate the actual potential of third world military industries. Taken together these conclusions offer an alternate view of the present and future structure of the international system to that presented by the interdependency theorists. It is postulated here that: first, although the number of LDCs producing arms [1] and the amount of weapon systems they collectively manufacture are increasing,[2] various factors are at work which significantly constrain their capabilities; second, as a result, the international world order, as reflected by the shape of the world arms transfer system, will remain heirarchical. In the real world, where resources are inequitably distributed among states, dependence and interdependence are relative not absolute values. Large well-endowed states have more leverage than other states, and will therefore, by their mere weight continue to dominate the international system.

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[1] The term "production" is used here in the generic sense to include all phases of the maintenance and/or manufacture of defense items. This usage conforms to the United States Department of Defense definition of co-production which encompasses any program which "enables an eligible foreign government, international organization or designated commercial producer to acquire the 'know-how' to manufacture or assemble, repair, maintain and operate, in whole or in part, a specific weapon, communication or support system, or an individual military item." [U.S. Department of Defense Directive 2000.9 (ASD-I and L), International Co-production Projects and Agreements Between the United States and Other Countries or International Organizations, January 23, 1974.]

[2] This study analyses the production and trade of major weapon systems only. In conformity with the SIPRI definition of major weapons, it includes aircraft, missiles, armored vehicles and ships. Small arms, artillery and ammunition are not included.

Part I. Third World Military Capabilities.

A. Quantitative Capabilities. Available evidence indicates that defense production in the third world will remain a small fraction of the world's arms trade. This conclusion is based on trends in the dollar value of arms exports and the number of producers entering the system. First, as Table 1. indicates, the dollar value of arms exports from third world countries represents only a small percentage of the total arms trade. In 1978, they amounted to 3.2 percent of the world total. Since 1969, (with the exception of 1972,[1]) arms exports from industrializing countries have stayed within a two to four percent range. What is more, these figures may overestimate LDC domestic arms exports, since existing data sources do not distinguish between indigenously produced exports and third country transfers.[2]

Export figures for large third world countries do not always accurately reflect the size of their production output. India, for example, after equipping its arms forces has little surplus left for export.[3] The same has been true for Brazil in the past, which did not begin exporting until the late 1970s. Nevertheless, in comparison with other states world-wide, to date the ability of the LDCs to duplicate in quantity what large industrialized countries can manufacture and export has not been demonstrated. Since 1972, two developed countries, the U.S. and USSR, have transferred approximately 70 percent of the dollar value

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1. According to one ACDA official, the large percentage increase in 1972 of third world exports to 8.84 percent was due to an estimated $700 million delivery of arms from China to North Vietnam. (Interview, April 1980.)

2. The term "third country transfer" refers to the sale or gift of arms from Country A to Country B. At some point in time, Country B then transfers those arms to a third country, Country C.

3. SIPRI in 1982 reported negotiations between Liberia and and India for the transfer of three Indian Chetak helicopters to Liberia. (SIPRI Yearbook, 1982, p. 222).

TABLE 1: DOLLAR VALUE OF THIRD WORLD ARMS EXPORTS AND PERCENTAGE OF TOTAL EXPORTS BY MAJOR WEAPON EXPORTERS, 1969-78.*
(constant 1977 dollars in millions)

| COUNTRY | 1969 | | 1970 | | 1971 | | 1972 | | 1973 | | 1974 | | 1975 | | 1976 | | 1977 | | 1978 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $ | % | $ | % | $ | % | $ | % | $ | % | $ | % | $ | % | $ | % | $ | % | $ | % |
| Argentina | | | | | | | 14 | 0.5 | 13 | 0.3 | | | | | | | 5 | 0.1 | | |
| Brazil | | | | | | | | | | | | | 33 | 0.3 | 84 | 0.8 | 20 | 0.2 | 83 | 0.7 |
| China-PRC | 227 | 6.9 | 308 | 9.8 | 367 | 10.3 | 1199 | 27.5 | 307 | 4.6 | 170 | 2.1 | 200 | 2.5 | 148 | 1.9 | 110 | 1.4 | 130 | NA |
| Cuba | | | | | | | | | | | | | 33 | 0.8 | 127 | NA | 10 | NA | | |
| Egypt | | | | | | | | | | | 6 | 0.3 | | | | | 50 | 2.9 | 74 | 4.6 |
| India | | | | | | | 28 | 0.8 | | | 12 | 0.3 | 22 | 0.5 | 21 | 0.4 | 40 | 0.6 | 9 | 0.2 |
| Iran | | | | | | | | | | | 48 | 0.2 | 55 | 0.2 | 31 | 0.1 | 20 | 0.1 | 18 | 0.1 |
| Israel | 8 | 0.7 | 7 | 0.6 | | | 14 | 0.9 | 26 | 1.4 | 36 | 1.6 | 55 | 2.6 | 148 | 5.8 | 60 | 1.9 | 93 | 2.6 |
| Jordan | | | | | | | | | 6 | 6.8 | 12 | 6.5 | 22 | 13.1 | 5 | 2.4 | | | 9 | 3.4 |
| Korea, N. | | | | | | | | | | | | | 11 | 1.3 | 84 | 13.2 | 20 | NA | 65 | NA |
| Korea, S. | | | | | | | | | | | | | 5 | 0.1 | 5 | 0.1 | 110 | 1.1 | 55 | 0.5 |
| Kuwait | 8 | 0.3 | | | | | | | | | | | | | | | | | | |
| Libya | | | | | | | 7 | 0.2 | | | | | 5 | 0.1 | | | 20 | 0.2 | 9 | 0.1 |
| Morocco | | | | | | | | | | | | | | | 5 | 0.4 | 10 | 0.8 | | |
| Nigeria | | | | | | | | | | | | | | | | | 5 | negl | | |
| Pakistan | 8 | 0.7 | | | | | | | | | | | 5 | 0.5 | | | | | 27 | 2.0 |
| Saudi Arabia | 8 | 0.3 | | | | | | | | | 12 | negl | 11 | negl | | | 10 | negl | 27 | 0.1 |
| Singapore | | | | | | | 14 | 0.5 | | | | | 11 | 0.2 | 21 | 0.3 | 10 | 0.1 | 9 | 0.1 |
| S. Africa | | | | | | | 7 | 0.1 | 6 | 0.1 | | | | | 5 | 0.1 | 50 | 0.5 | 4 | negl |
| Syria | | | | | | | | | | | | | 5 | 0.5 | | | | | | |
| Taiwan | | | | | | | | | | | | | | | 10 | 0.1 | 10 | 0.1 | | |
| Turkey | | | 7 | 0.9 | | | 14 | 1.1 | 13 | 0.8 | | | 5 | 0.4 | 10 | 0.5 | | | 9 | 0.4 |
| United Arab Emirates | | | | | | | | | | | 6 | 0.1 | 11 | 0.1 | | | | | | |
| Vietnam, N. | | | | | | | | | | | | | | | | | 5 | NA | | |
| Vietnam, S. | | | 7 | NA | | | | | | | | | | | | | | | | |
| Total Dollar Value | 259 | | 329 | | 367 | | 1,297 | | 371 | | 302 | | 489 | | 704 | | 565 | | 621 | |
| Total World Arms Exports | 9519 | | 9036 | | 9362 | | 14,680 | | 17,625 | | 14,334 | | 14,029 | | 17,352 | | 19,300 | | 19,177 | |
| Third World % of World Arms Exports | 2.72% | | 3.64% | | 3.92% | | 8.84% | | 2.10% | | 2.11% | | 3.49% | | 4.06% | | 2.93% | | 3.24% | |
| # of Third World Exporters | 5 | | 4 | | 1 | | 8 | | 6 | | 8 | | 16 | | 14 | | 18 | | 15 | |

* This table was derived from United States, Arms Control and Disarmament Agency, World Military Expenditures and Arms Transfers: 1969-1978, pp. 122-158.

NA - not available
negl - negligible (less than 0.01%)

ACDA includes the following note in its table (p. 158):
"Total imports and total exports are total trade figures as reported by individual countries. What is included may differ from country to country."

of the arms trade (see Table 10., below), whereas 14 third world countries export three percent of the world dollar total (see Table 1.). The latest ACDA figures for 1979 do not show much change in their relative capabilities. Even if the dollar value of exports is limited to third world countries, the magnitude of the difference between industrialized and industrializing countries is strikingly apparent (see Figure 1., below).

Figure 1.

Total Military Export Sales to Third World Countries
1954-1982

| | |
|---|---|
| $100 billion and up | U.S. and U.S.S.R. |
| $10 - $40 billion | Western Europe (France, Great Britain, Federal Republic of Germany, Italy) |
| $5 - $10 billion | Poland, Czechoslovakia, and China* |
| $2 - 3 billion | Switzerland (retransfers), Brazil, Rumania, Republic of Korea, Canada, and the Netherlands |
| less than $1 billion | all other transfers (with the exception of Israel, and Argentina, all exports in this category are retransfers). |

Source: Department of State interview

*China did not join the ranks of significant exporters until 1981. Exports to Iraq during the Iran/Iraq War were responsible for the dramatic rise in the dollar value of Chinese military transfers.

Second, the number of countries entering the arms production business seems to have plateaued in recent years. Although the number of LDC producers almost quadrupled (rising from 4 to 14) between 1950 and 1960, the rate of increase slowed to 1.5 (14 to 21) between 1961 and 1970, apparently stabilizing at that level. Between 1971 and 1980 the number of third world producers increased by a factor of 1.2 (26 in 1980), and to date no newcomers have been added to their ranks.[1]

The concentration of defense industries in the third world further underlines this trend. Despite the dramatic rise in number of weapon systems produced in industrializing countries since 1950, (from 10 to 178 in 1980, or by a factor of 18), only a few countries contributed to this increase. During 1950-54 three countries (60%), Argentina, Brazil, and India were responsible for 80% of all major weapons produced in the third world (8 out of 10).[2] During the 1960-64 period, as other states joined the ranks of producers, Argentina, Brazil, India, and China (representing 29% of the 14 producers) were responsible for 66% of the major military systems

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[1] Because it is a member of NATO, Turkey is not included in the category of industrializing countries, even though, according to most socioeconomic indicators, it is similar to many of the countries so categorized. Turkey is now in the process of becoming a more active arms producer. In 1981 it ratified an agreement with the U.S. that stiplulated terms for the modernization of the moribund Turkish defense industry. Cooperation in the production of fuzes, propellants, explosives, rockets and improvements in Turkish aircraft and tank overhaul capabilities were projected. Also under consideration were projects to build a modern frigate, improve naval overhaul capability, and a tank up grading program for the M-48 tank. United States. Senate, Committee on Foreign Relations. (United States-Turkey Defense and Economic Cooperation Agreement, 1980. Hearing before the Subcommittee on Europe and the Middle East. 96th Congress, 2nd session, May 7, 1980. Also, "Bilateral Agreement Bolsters U.S. Basing Plan," Defense Electronics, April 1981, pp. 45-46.)

[2] China, devastated by revolution, did not fully resurrect its arms industries until the late 1950s.

produced in the third world (33 out of 50). In 1975-80, these four producers were joined by Israel. Together they produced sixty percent (106) of the total 178 major weapon systems processed in LDC industries. If the arms produced by three other countries, South Africa, Taiwan, and South Korea are added to the total, then eight producers (30 percent) are responsible for 133 (75 percent) of the indigenously produced weapons in the third world. (See Table 2.) Thus, although the number of defense items made in the LDCs has increased since 1950, they are the product of expanding industries within a relatively stable group of industrializing producers.

In the coming years some LDCs may initiate new arms industries[1], while others may drop out of weapons production (as Burma, Iran, and Vietnam did), but if past trends are good indicators of the future, any large and/or permanent increase in the number of third world producers is unlikely.

B. Qualitative Capabilities. The world arms transfer system is structured by qualitative as well as quantitative differences in military industrial capabilities. Generally, smaller less industrialized countries produce fewer, older, and less complex defense items--the so-called "vintage", and "intermediate" military components and systems--rather than the "advanced", "lead-edge", or "critical" technologies

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[1] Peru, for example, which until now only produced ships, will establish an indigenous aircraft industry. With the assistance of Italy's Aermacchi, an assembly line will be set up for the MB-339 trainer and light strike aircraft. (Milavnews, August 1981, and October 1981.)

Table 2.

Number of Producers and Number of Major Weapon Systems Made in the Third World 1950-1980*

| | 1950-54 | 1960-64 | 1975-80 |
|---|---|---|---|
| No. of Main Producers | 3 (60%) | 4 (29%) | 5 (19%) |
| No. of Major Weapon Systems Produced By Main Producers | 8 (80%) | 33 (66%) | 106 (60%) |
| Total No. of Producers | 5 | 14 | 27 |
| Total No. of Major Weapon Systems Produced By All LDC Producers | 10 | 50 | 178 |

*Derived from Neuman Data.

manufactured in the industrialized world.[1] These differences are evidenced by: a) the type of weapons produced; b) level of defense industrial production capabilities; c) the technological age of weapons produced.

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[1] These terms are often difficult to define precisely. Generally, it is the newest defense items, incorporating the latest technological inventions, which determine the relative level of sophistication of other military equipment. The meaning of "vintage", or "intermediate," or, for that matter, other qualitative descriptors such as "advanced", "lead-edge", or "critical," is therefore constantly changing. What may be considered "intermediate" in the developed world may be judged to be "advanced" for a third world defense industry. As one U.S. official observed: " 'Intermediate' weapon systems in the U.S. are generally considered to be subsonic jet aircraft, transport aircraft, medium and light armored vehicles, missile patrol boats, frigates, patrol submarines, tactical missile systems, radars and battlefield electronics. However, in the third world, for many countries these are 'advanced' systems. Only a few of the LDCs can produce a few of them. None can produce all of them." (Interview with a U.S. State Department official, November 1979.)

However, to the consternation of methodological purists, it is not always as easy to determine the relative technological sophistication of weapon systems, as the above statement would imply. This is particularly true for "vintage" and "intermediate" defense items. Third world countries are constantly modernizing older weapon systems with new components, further smudging the already gray line between categories. Korea, for example, has improved the Western Electric Nike Hercules missiles with modifications which include: "Upgrading some electronics to solid state for improved reliability, improved conventional warhead munitions, and the capability to operate the missiles in a ground-to-ground mode." (Bruce Smith, "Koreans Seek New Military Air Capacity," Aviation Week and Space Technology, October 22, 1979, pp. 62-3.) Israel's upgrading manufacturing capabilities are also considerable. During a recent tour of the Israeli tank depot, the present author saw Centurion tanks refurbished with new assemblies and a forty year old APC (armored personnel carrier) modified with half-tracks and rebuilt to modern specifications.

Some effort has been made to define the terms "lead-edge" and "critical" (often used interchangeably) more exactly. Maurice J. Mountain regards "critical technology" as those weapon systems in which the U.S. and its allies now have, or are likely to have, a margin of technological superiority over the USSR and the Warsaw Pact countries. "To be critical, it is not enough that a technology be essential or unique to the particular product or weapon system to which it applies, but it must also be sufficiently esoteric to be known only to a few." ("Technology Exports and National Security," Foreign Policy, no. 32 (Fall 1978), p. 96.

Several U.S. agencies have cooperatively produced a list of military critical technologies in an attempt to change the way American exports are screened. The "Table of Contents" alone, which was published in the Federal Register (October 1, 1980), required 12 pages of small type. Although the complete list of technologies is currently classfied, it at least establishes a ceiling for policy-makers from which other defense items can be compared. (Aviation Week and Space Technology, October 13, 1980, p. 23.

1. Type of Weapons Produced. There is, in the third world, an inverse relationship between the complexity of a military item and the number of states producing it (Neuman data, not included here). Small arms, for instance, although not examined in this study, are at once the least complicated of defense items to manufacture and comprise the oldest and most ubiquitous defense industries in the third world.[1] The next rung in the production hierarchy is naval craft, followed by aircraft, missiles, and armored vehicles, in that order, with each of the ascending categories associated with progressively fewer producers. During the 1975-80 period, of the 27 countries maintaining arms industries, 24 were building ships, 13 were turning out aircraft, eight were producing missiles, and seven were processing armored fighting vehicles.[2]

Another hierarchy of production capabilities appears in the data which, like a Chinese puzzle box, applies within each successive class of weapon. Thus, the association noted above between technical skill requirements and the number of producing countries holds within weapon categories as well as between them. To illustrate: Table 3. breaks down the category "ships" into types of vessels produced since 1950 in the third world. We find that the larger ships demanding sophisticated industrial production skills, such as destroyers, frigates, corvettes, and submarines are turned

[1] Herbert Wulf, et. al. Transnational Transfer of Arms Production Technology, (A report written as a contribution to the United Nations study on the relationship between disarmament and development, n.d. [c. 1980], Institut für Friedensforschung und Sicherheitspolitik, Study Group on Armaments and Underdevelopment, University of Hamburg, Germany), p. 10.

[2] The Neuman data breaks down the arms industries operating in the third world between 1950-80 by category of weapon produced. With the exception of China (which maintained a ship industry in 1950), the oldest LDC producers (Argentina, Brazil and India) began with aircraft industries producing simple trainers. Later, because new states initiating arms industries were often relatively small in size and industrial infrastructure, even trainers were beyond their need and capability, and small naval craft became the most common major military-industrial product in the third world.

Table 3.

Third World Production of Naval Vessels, 1950-1979/80[1]

| Country | Small Naval Craft | Destroyers | Frigates Corvettes | Submarines |
|---|---|---|---|---|
| Argentina | 6 | 1 | - | 1 |
| Brazil | 7 | 1 | - | - |
| Burma | 1 | - | 1 | - |
| Chile | 4 | - | - | - |
| PRC | 12 | 1 | 4 | 2 |
| Colombia | 3 | - | - | 1 |
| Dominican Republic | 2 | - | - | - |
| Ecuador | - | - | 1 | - |
| Egypt | 1 | - | - | - |
| Fiji | 1 | - | - | - |
| Gabon | 1 | - | - | - |
| India | 5 | - | 2 | - |
| Indonesia | 2 | - | - | - |
| Israel | 4 | - | 1 | -* |
| No. Korea | 13 | - | 1 | 2* |
| So. Korea | 4 | - | 1 | - |
| Mexico | 4 | - | - | - |
| Peru | 5 | - | 1 | - |
| Philippines | 1 | - | - | - |
| Singapore | 2 | - | - | - |
| So. Africa | 2 | - | - | - |
| Sri Lanka | 1 | - | - | - |
| Taiwan | 2 | - | - | - |
| Thailand | 2 | - | - | - |
| Venezuela | 1 | - | - | - |
| Total | 86 | 3 | 12 | 6 |

[1]Neuman data.

*one is a midget submarine

out in smaller numbers by fewer countries than small naval craft. Between 1950 and 1979/80, 24 states manufactured small naval craft in comparison to eight LDC producers of frigates and corvettes, three of destroyers, and four of submarines. Furthermore, whereas 86 models of small naval craft have been produced in less industrialized countries, only three types of destroyers, 12 types of frigates and corvettes, and 6 types of submarines have been made in LDC industries.

A similiar pattern holds for other categories of weapon systems. Out of 26 LDCs manufacturing arms in 1980, seven supported industries for armored fighting vehicles. Of these, five produced tanks, but only one (China) had acquired this capability by 1960. The other tanks are more recent accomplishments. India's licensed Vijanta (a version of Great Britain's Vickers 37) went into production in 1966. Israel began manufacturing its Merkava tank in 1977,[1] and both Argentina's (German designed) TAM and Brazil's X1A2 (based on the American M3A1 Stuart) started production in 1979. South Africa's Ratel tank, developed from their Eland armored car went into production in 1980.

Yet another third level of technological stratification reaches down to the components contained within the various defense items. Regardless of weapon type, some components on even simple items demand production skills beyond the capacity of third world defense industries. They are often too complex for prevailing technical skill levels, and/or prove to be uneconomical to produce domestically. As a rule

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[1] According to one source, the proportion of local to foreign components is now 58 percent, but it is expected to rise to 80 percent in the future. (D. Krivine, "Chariots of Steel", The Jerusalem Post Magazine, November 11, 1981, p. 4.)

the LDCs fabricate the simpler components and spare parts of weapons and assemble the less complex sections. The more complicated components, such as engines, electronics, and armaments are, for the most part, supplied from abroad.[1]

By way of example, there are now seven kinds of armored fighting vehicles produced in the third world,[2] but few, if any, can be classified as a completely indigenous product. Argentina buys most of the vital parts for its TAM tank from Germany, e.g. diesel engines, transmissions, track units, wheel systems, electronics, optics, fire control components, and special steel for the hull.[3] Brazil's locally designed armored car, the

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[1] For reasons discussed elsewhere, the capabilities of defense industries are rarely described in open sources. A recent survey of Egypt's military industries, designed to encourage Western investment, offers a unique view of the type of defense items produced in third world countries. For example, Egypt's airframe and engine factories, considered to be comparatively advanced by third world standards, were judged by U.S. officials to be adequate to participate in a F-16 coproduction program. Production, however, will be limited to the manufacture of detail parts and the assembly of a number of less complex items for both the airframe and the Pratt and Whitney F-100 engine. If the U.S. State Department approves, and presumably if Egypt can find adequate financing, plans call for the Egyptian aircraft factory to produce: engine access doors and centerline beam assembly; the nose gear door; the engine nozzle fairing; an underwing launcher adapter for the AIM-9L air-to-air missile; an electronic countermeasures adapter; a weapon pylon, the centerline pylon; and fuel tanks.

A similar modest program is planned for Egypt's engine factory. It now produces spare parts, blades for compressors and turbines and gears used in rebladng and overhauling Soviet built engines, and turbine blades for the American GE J-79 engine. For the F-100 engine program, six engine test cells are being upgraded to enable Egypt to participate. There are also plans for the overhaul of the French Mirage 5 Atar-9C engine and for the assembly of Larzac engine modules. (Clarence A. Robinson, Jr., "Factories Tool for Alpha Jet Program," Aviation Week and Space Technology, January 18, 1982, pp. 61-66.)

[2] Argentina, Brazil, China, India, Israel, So. Korea, and South Africa. Prior to the revolution, Iran rebuilt U.S. M-47 tanks, but is not known to have done so since.

[3] Milavnews, July 1981, p. 1.

EE-9 Cascavel, contains a number of critical components which are either imported or produced by foreign companies in Brazil, for example, the turret, diesel engine, gears, and 90 mm. gun.[1] Less is known about the foreign input of other armored vehicle manufacturers. South Korea's armored personnel carrier is license produced (Italy's Fiat-664) as are India's tank and armored personnel carrier. Although little is known about the extent of domestic manufacture, neither the design nor development is indigenous. China's tank and armored vehicles are also based on foreign (Soviet) designed models; local manufacturing input probably approaches 100 percent. Both Israel's Merkava-1 and So. Africa's Ratel tanks are cited as "indigenous" products, even though it is well established that a significant foreign factor is present in both countries' production programs.

The same pattern characterizes other military items. Virtually all modern engines (for aircraft, missiles, helicopters, tanks and ships) are either license produced or imported. Both Israel and India have tried to develop their own advanced jet engines, yet neither has been able to progress beyond the test stage. Other aircraft industries in the developing world have not even attempted to develop their own engine models.[2]

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[1] SIPRI YEARBOOK, 1981, p. 77.

[2] Ibid. and Helena Tuomi and Raimo Väyrynen, Transnational Corporations, Armaments and Development, A Study of Transnational Military Production, International Transfer of Military Technology and Their Impact on Development (Finland: Tampere Peace Research Institute, 1980), p. 91.

2. Level of Industrial Production Capacity. As observed above, many weapon systems produced in the third world are licensed, i.e. utilize imported data packages as their source of design and technical information. According to public record, approximately 253 major military industrial projects have been initiated in less industrialized countries since 1950. Of these, over half are cited as under license.

These figures, however, underestimate the dependency of third world industries on foreign technology. So-called "indigenous" defense items, which may have been designed specifically for a third world country or represent systems which have been reverse engineered or are manufactured without benefit of license, still generally require foreign components (as discussed above) and more often than not utilize imported natural resources and production equipment, the assistance of foreign designers, technicians, and sometimes, managers and labor.[1] Nevertheless, because of lack of information and oftentimes deliberate misrepresentation on the part of LDC defense industry officials, these weapon systems are referred to in the open literature as "indigenous".

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[1] Argentina's IA-33 Pulqui II aircraft program, which produced six prototypes, illustrates the extent of foreign involvement in unlicensed third world manufacturing efforts. Designed by a German aircraft engineer, Dr. Kurt Tank, in 1950, the project supported an undisclosed number of German engineers and at least one German test pilot. Dr. Tank's design resembled very closely an earlier Focke-Wulf design the materials used in the Pulqui II airframe and engine were largely European. Dr. Tank left Argentina in 1955. He was replaced by another German designer, Dr. Reimar Horten, who stayed until 1961.

The HF-24 produced by India between 1964 and 1976 is another example of the same dependency on foreign inputs. It too was the result of Dr. Kurt Tank's efforts. The team initially composed of eighteen German engineers, three Indian design engineers, and about twenty-two other Indian engineers with design experience began work 1956-58. No indication of the amount of other technical assistance is given, or its duration. (SIPRI, The Arms Trade with the Third World, New York: Humanities Press, 1971, pp. 763-4; 745.)

Even when the majority of manufacturing tasks are executed locally, using domestic resources, few countries in the world other than the U.S. and U.S.S.R. are able to maintain a large research and development (R&D) capability.[1] According to the author's data, no LDC has achieved an independent R&D and production capability for one complete major weapon system. Some have reached prototype stage, but to the author's knowledge none have been manufactured in numbers. As discussed above, Israel has almost achieved independent capability in armored vehicles, but engines and some electronics are still imported. The same is true for Israel's new aircraft program, the Lavi, which is intended to reduce Israel's dependence on foreign suppliers. Much of the plane will be designed and fabricated domestically (e.g., the fuselage, empennage, landing gear, and engine mounts), but the wings (made of composite materials) will be designed and initially manufactured by an American aerospace firm, and the engine will be license produced.[2]

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[1] Most of the arms produced in China, for example, are based on Soviet models which were either license produced previously, or were replicated without benefit of technical data packages. Examples are: [aircraft] F-6 (MiG-19); BT-5 (Yak 18); AN-2; F-7 (MiG-21); B-5 (developed from IL-28); [Missiles] CSA-1 (SA-2); AT-1; CSSN-1 (SSN-2).

Israel's M-5 Nesher aircraft was converted from France's Mirage III which was embargoed during the 1967 war. (Production ended in 1975.) The Kfir-C2 fighter was developed from the Mirage V by Israel Aircraft Industries.

North Korea's fast attack craft ("Iwon"-class and "Ku Song"-class are similar to the Soviet "P-2" and "D-3". These are generally classified as "indigenous" in the literature.

[2] Interview with an IAI engineer, August 14, 1982. According to a New York Times article based on information from the Israeli Defense Ministry, the Lavi engine will be made with the cooperation of Pratt and Whitney, at a factory in Bet Shemesh near Jerusalem. "Israel to Build Jet Fighters to Ease Reliance on U.S.," The New York Times, February 3, 1982.

The limited nature of third world arms production is also demonstrated by the small number of countries producing --regardless of amount of foreign input-- all four categories of weapons: aircraft, missiles, ships, and armored fighting vehicles. This so-called "across-the-board" capability is a relatively recent accomplishment in the third world, albeit for very few states. As Table 4. shows, until the 1965-69 period, no LDC was able to support arms industries in every category. By 1980 only six countries (Argentina, Brazil, China, India, Israel, and South Africa)[1] or less than one-quarter of the LDC producers were sustaining production lines for all four weapon types.[2] Of these, only China maintains a relatively independent capability, although (as discussed below) the products represent vintage technology.

3. Age of Technology. Since 1950 there has been an undeniable advance in the military industrial capabilities of third world countries.[3] But despite these gains, in comparison to the industrialized world, a large gap continues to exist.

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[1] South Korea is not included here because the missile program for the Nike-Hercules SAM was not confirmed in 1980 as in production.

[2] See Tables 5a. and 5b.

[3] For example, in the early 1950s, only eight models of propeller-driven light trainer aircraft (in Argentina, Brazil, and India) and two small patrol craft (in China and Colombia) were made in the LDCs. By the end of the 1970s, 24 less industrialized states were producing a variety of ships, 13 were involved in the manufacture of aircraft, eight were turning out missiles, and seven were making armored fighting vehicles. However, in all but the major producers (Argentina, Brazil, India, China, Israel, and South Africa, and to a lesser extent Taiwan and South Korea) production still centered around light trainers and coastal patrol boats. (There are some exceptions: North Korea also produces a frigate and small submarines; the Philippines, Pakistan, Indonesia and Nigeria also assemble helicopters.)

Table 4.

Number of Industrializing Countries with an Across-the-Board Military Industrial Capability*
1950-1980

| | 1950-54 | | 1955-59 | | 1960-64 | | 1965-69 | | 1970-74 | | 1975-80 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| No. of Countries with an across-the-board capability | 0 | | 0 | | 0 | | 3 | 21.0 | 3 | 14.0 | 6 | 22.0 |
| Total No. of Industrializing Producers | 5 | | 12 | | 14 | | 14 | | 21 | | 27 | |

*Derived from Neuman data.

Table 5b

Third World Independent Weapons Production Capability, 1980*

| Country | Aircraft | Helicopters | Missiles | Warships | Armored Fighting Vehicles |
|---|---|---|---|---|---|
| China-PRC | F-9;F/B FT-6;Adv Tr | Mi-4 | ShShM; ATM; SAM | patrol boats, destroyers, subs | Armoured cars, battle tanks |
| India | Gnat-2Ajeet;F HJT-16Kiran;Tr | SA 315;SA 316 | | | |
| Israel | Kfir-C2 F/Tr | | Jericho SSM | | |
| South Africa | | | | | Ratel MBT Impala II AC |

*Independent production as defined here is the capability to locally produce almost the entire weapon system, including the powerplant, regardless of the weapon system's design origin.

Table 5a

THIRD WORLD COUNTRIES PRODUCING ALL FOUR TYPES OF MAJOR WEAPON SYSTEMS, 1980; (examples of most advanced weapon system under production)

| Country | Aircraft | Helicopters | Missiles | Warships | Armored Fighting Vehicles |
|---|---|---|---|---|---|
| Argentina | IA-58;COIN/F | Hughes 500** | Mathago ATM | Type 42 Destr** | TAM med tank** |
| Brazil | EMB 121;Trsp | SA-315B** | MAS-1 ASM | Niteroi Destr** | EE9/11 APC |
| China-PRC | F-9;F/B | Mi-4 | CSSN-1 ShShM | Luta Destr | T-60/63 tanks |
| India | Mig-23;F** | SA 315** | SS.11 ATM** | Leander Frig** | Vijayanta MBT** |
| Israel | Kfir-C2;F | Hughes 500**+ | GabrielShShM | Reshef FPB | Merkava-1 MBT |
| Korea,South | F-5E/F; F/Tr** | Hughes 500** | Nike-Hercules SAM**+ | PSMM-5 FAC** | Fiat 6614 APC** |
| South Africa | MB326 Lt Str ** | --- | R440 SAM** | Reshef FPB** | AML 60/90 AC** |

*Sources: SIPRI, World Armaments & Disarmament Yearbook, (1973-80), Jane's All the World's Aircrafts, (1959-80), Jane's Fighting Ships, (1950-80); Aviation Advisory Services, MILAVNEWS, (1963-1980). Please refer to Appendix II for a description of the local manufacturing of these weapons.

** production of foreign design under license
+ prospective

Even "advanced" LDC defense products are usually of older design, and therefore require "less complex" skills, resources, and manufacturing techniques than their Western or Soviet counterparts. For example, Chinese defense industries are, for the most part, producing technologies which were researched, designed and developed thirty years ago. The F-6 (the Chinese version of the Soviet MiG-19, which is the most important component of the Chinese Liberation Army Air Force [PLAAF], is 1950s technology.[1] Similarly, the Y-10 turbojet transport aircraft, currently in flight development, is, according to some observers, a Chinese copy of the Boeing 707,

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[1]The MiG-19 is technically less complex than either the Soviet MiG-21 or MiG-23 Flogger. Carrying the Soviet designed Izumrud radar, it has only limited all-weather capabilities, and only moderately effective air-to-air ordnance delivery equipment. (Genuine air-to-air attack radar systems have been standard equipment on Soviet and U.S. fighters for a quarter of a century. Even Northrop's F-5E, developed from the F-5A during the 1960s [and coproduced by the Taiwanese] is reported to carry more effective air-to-air ordnance.) (James B. Linder and A. James Gregor, "The Communist Air Force in the 'Punitive' War Against Vietnam," Air University Review, September/October 1981 (67-77), pp. 69 and 75.)

a U.S. design of the 1950s.[1] The only aircraft presently in the PLAAF inventory that can qualify as modern is the Shenyang F-7 and F-8 (the Chinese version of the MiG-21F). However, these plans have experienced so many design problems that production may have ceased with about 80 aircraft in current service.[2]

A considerable time lag between design and development in the industrialized world, and production in the third world has characterized most major weapon systems processed by the LDCs. For example, although there is some variation among the five categories of defense items listed in Table 6., military technologies produced by third world countries under license in 1980 were, on average, designed and developed 22 years before. It is interesting to note that the data presented in Table 6. also reflect the relative production complexity of the various weapon systems, with aircraft (predominantly trainers) and naval vessels (mainly small coastal patrol craft) averaging 10 years in contrast to the average 27 and 25 year "vintage" of armored

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[1] Milavnews, January 1981, p. 4.

[2] Recent reports suggest that severe financial and technical constraints have prevented the Chinese from making more advanced armaments. The F-9 (sometimes designated the F-6bis), for example, is a modified and upgraded version of the Soviet MiG-19. Although even in design it does not compare to current Soviet or American fighters in technological complexity and capabilities, it represents a significant effort on the part of the Chinese to compensate for some of the inadequacies of the earlier models produced for the PLAAF (e.g. the F-4 and F-5 MiG-17, and the earlier version of the MiG-19 (F-6) -- specifically in radar (to provide an effective air-to-surface and air-to-air attack capabilities) and ordnance. Apparently, plagued by operation problems, it is estimated that no more than 300 of the F-9s are currently in service. Various sources believe that production has ceased and that the cause is "the longer frontal fuselage and extra weight which have penalized the F-9s performance in comparison with the basic MiG-19." (Linder and Gregory, op. cit., p. 69.) Another recent study corroborates the above findings. China's Military Power, issued in August 1982 by the China Council of the Asia Society (written by June Teufel Dreyer) reported that although China has large numbers of combat aircraft, "the majority lack the advanced avionics equipment that would enable them to fight at night or in poor weather. Most navigation is visual. Design problems have thus far plagued the development of aircraft capable of achieving supersonic speeds. . . .Weapons are mainly copies of much older Soviet models. While some Chinese equipment has been updated, much is still 20 to 30 years behind the state of the art."

Table 6.

Technology Gap
Average Age of Military Items Produced Under License by LDCs in 1980
By Category of Weapon System *

| Country | Aircraft | Aircraft Engines | Missiles | Naval Vessels | Armored Fighting Veh. |
|---|---|---|---|---|---|
| Argentina | 20 | -- | -- | 10 | 28 |
| Brazil | 18 | 29 | 20 | -- | -- |
| Egypt | -- | -- | 22 | -- | -- |
| India | 17 | 30 | 21 | 19 | -- |
| Indonesia | 12 | -- | -- | -- | -- |
| Israel | -- | 25 | -- | -- | -- |
| Nigeria | 16 | -- | -- | -- | -- |
| North Korea | -- | -- | -- | -- | 29 |
| Pakistan | 24 | -- | 23 | -- | -- |
| Paraguay | 23 | -- | -- | -- | -- |
| PRC | 27 | 30 | -- | 31 | -- |
| Philippines | 20 | -- | -- | -- | -- |
| South Africa | 11 | 29 | 15 | 8 | 21 |
| South Korea | 16 | 20 | -- | 16 | -- |
| Average Total | 19 | 27 | 20 | 19 | 25 |

GRAND TOTAL AVERAGE 22 years

*Derived from Neuman data. This table presents only an approximation of the age of licensed military technologies produced in third world countries. 1) The date for original R&D generally represents the date of successful prototype operation. When this information is not available, date of delivery to the military service of the innovating country is used instead. Average dates, therefore, may underestimate the technology gap. 2) Only those weapons known to be in production in 1980 were included here. 3) Defense items research and designed by a supplier solely for production in the LDC are not included, since the actual "vintage" of the technologies is not known. 4)No attempt is made to disaggregate the above categories of weapon systems into simpler and more complex items, e.g. the category naval vessels includes small coastal patrol boats as well as frigates and destroyers; the category AFV includes armored cars and tanks. Again, average dates probably underestimate the technology gap between industries in industrialized and industrializing countries.

fighting vehicles.

These general observations are supported by other data sources using other methods of analysis. Integrating arms production information collected by Robert Harkavy for 1938 amd 1968 [1] with the present writer's data for 1979/80, all LDC producers were evaluated in terms of their comparative military production capabilities for each time period.[2] We found that in spite of unmistakable progress within LDC defense industries, there is a general levelling off process at the intermediate stage of industrial/production capability, above which most third/world countries do not rise.[3] Even the reputedly more advanced producers, such as Argentina, Brazil, South Africa, North Korea, South Korea, and Taiwan, continue to fabricate simple defense items, engage in extensive license production of less advanced weapon systems,[4] and in some instances assemble more advanced components.[5] But the skills required for the most advanced levels of production continue to elude them.

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[1] Robert E. Harkavy, The Arms Trade and International Systems, (Cambridge, Mass.: Ballinger Publishing Co., 1975), pp. 188-191.

[2] An Index of Military Production Capability was used, based, in part, on Robert Harkavy's "Dependence-Autarky Continuum" (Ibid., pp. 184-187). Seven levels of military production capability were established by evaluating three production factors: 1) the relative sophistication of the weapon system produced; 2)the type of manufacturing skills utilized (e.g., fabrication, assembly, overhaul, etc.) and/or the proportion of components and resources imported; 3) the source of R&D. Each major weapon system produced in the LDC was coded according to the above criteria and then an average was calculated for each of the four categories of weapon systems produced indigenously. Index levels 5,6,7 refer to "less advanced" industrial capabilities; levels 3 & 4 are "intermediate"; and levels 1 & 2 describe the "more advanced".

[3] Some countries, such as Sri Lanka, have remained at a rudimentary level of production (level 5), almost totally dependent on foreign suppliers for all but the simplest technologies.

[4] South Korea's and Taiwan's arms industries are largely dependent on licensed production and the importation of U.S. components.

[5] Brazil's arms industry is essentially an assembly type of operation, dependent upon imported subsystems.

In sum, in comparison to the industrialized world, most major weapon systems produced in industrializing countries represent older, simpler technologies which incorporate significant inputs from the country of original research, design, and development. For the majority of LDCs there have been few technical breakthroughs in recent years. Some have initiated the production of new weapon systems,[1] but few have been able to substantially raise the level of their manufacturing expertise (Israel is an outstanding exception), or reduce their reliance on foreign assistance. (China has achieved independence at the cost of operational capability.)

These findings raise several questions about the sources of military industrial capability. How can the observed disparities among the LDCs be explained? Why has the technological gap between the third world and the industrialized world persisted and grown larger? What factors determine the long-term indigenous arms production capabilities of states and their place in the global military industrial system? It is to these questions this paper now turns.

## Part II. Disparities Among Arms Producers: An Attempt at Explanation.

### A. Factors of Scale and Third World Production.

In view of the on-going heated debate over the guns vs. butter issue, there has been relatively little empirical attention given to the socio-economic sources of national military-industrial capabilities.

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[1] Brazil exemplifies the continuing dependence of third world industries on Western technology. The Brazilian-Italian joint venture agreement to build a new strike aircraft stipulates that Italian industry will contribute 70 percent of the total construction and assembly, which includes the more technically complex components and industrial procedures. Brazil will undertake the remaining 30 percent, comprising the wings, tail unit, and local assembly. (Milavnews, December 1982, p. 7.)

To the present writer's knowledge, there have been three attempts to empirically analyze why there are disparities among LDC producers,[1] one of which also includes developed countries.[2] There has been little replication of method, however, since with the exception of GNP used by two of the studies, each author chose different indicators of measurement.[3]

It was decided to test here, as far as possible, the various socio-economic variables used by the earlier studies to determine whether some were stronger measures of capacity than others. In order to generalize about the structure of the global military-industrial system, it was also decided to test them first, in the third world and then, on the basis of our findings, compare

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[1]Herbert Wulf, et. al., Transnational Transfer of Arms (A report written as a contribution to the United Nations study on the relationship between disarmament and development, [n.d., c. 1980], Study Group on Armaments and Underdevelopment, University of Hamburg, Germany), pp. 39-40; Robert Harkavy, The Arms Trade and International Systems (Cambridge, Mass.: Ballinger Publishing Co., 1975), Table 6-2., pp. 188-191; Ilan Peleg, "Military Production in Third World Countries: A Political Study," in Threats, Weapons and Foreign Policy, vol. 5, SAGE INTERNATIONAL YEARBOOK OF FOREIGN POLICY STUDIES, eds. Patrick J. McGowan and Charles W. Kegley (Beverly Hills, Cal.: Sage Publishers, 1980), pp. 209-230.

[2]Robert Harkavy, op. cit.

[3]Harkavy used GNP (as a measure of gross economic output or national power) and GNP per capita (as a measure of economic development). He found that "GNP remains a fairly good indicator of the ability of nations to manufacture weapons. For indigenous development capability, however, reasonably high per capita GNP appears to be a prerequisite. . ." (p. 204). Wulf used two basic indicators: the industrial base as measured by the share of output of "relevant industries (e.g., iron and steel, non-ferrous metal, metal products, machinery [not electrical], electrical machinery, and transportation equipment) as a percent of total output in manufacturing; and the manpower potential, which includes two indicators: 1)the number of employees engaged in work in the "relevant" industries; and 2) the number of scientists, engineers, and technicians in research and development for the latest year available. Peleg chose GNP as an indicator of financial resources and 1) contribution to world scientific authorship, 2) number of scientific journals, and 3) number of students in engineering and natural sciences as indicators of scientific and educational potential. We decided not to use Wulf's industrial base variable since, as Wulf himself points out, the UN sources from which it is derived include a "high import content" in the domestic output figure -- making it somewhat unreliable. For like reason, the manpower potential indicator used here is different from Wulf's. Peleg's indicators for "scientific and educational potential" also proved problematic. The

[fn. cont. next page]

them with developments in the industrialized world. In addition, it was decided to enlarge the list of indicators to include those measuring size. Given the importance ascribed to "economies of scale" by economists[1] and policy-makers alike[2], we hypothesized that large countries, with large populations would offer more attractive markets, a greater labor pool from which to draw the necessary technical, professional, and managerial manpower, which would, in turn, serve to encourage and sustain domestic industrial military development. Although these factors are normally associated with civilian industrial production, there seemed little reason to suppose that the same factors of scale might not be equally important to the development of military industries. Furthermore, the size of a country and its population also, generally, dictate the size of the army. It seemed logical to assume, therefore, that the existence of a large

[fn. cont. from previous page]
data for the first two were not available beyond 1965, and information for the third proved incomplete for a large number of LDCs. Instead, we substituted: 1) the percentage of labor force in industry, and 2) the number of professional and technical workers as a percentage of economically active population as indicators of available manpower resources, skilled and unskilled. Unfortunately, the data base for our manpower indicators also has serious gaps of information. It was simply the best of not very good manpower statistics.

[1] Simon Kuznets, Six Lectures on Economic Growth (New York: The Free Press, 1959). Kuznets discusses the problem of size in the economic growth process. He suggests that the economic structure of a small country will of necessity be less diversified than larger units and production more concentrated in fewer industrial sectors. He gives several reasons for this concentration of industrial structure in smaller states. First, because smaller countries have less territory than large, the diversity of their natural resources is likely to be less. Second, the minimum scale of a plant, particularly for modern industries (e.g. automobiles, airplanes, heavy electrical generators, etc.) can be sustained by a small country only at an economic loss or on the basis of exports, which are often controlled by a changing and volatile market. Third, smaller resources, even if extensive in one sector, such as oil, means the country's limited capital and manpower will be concentrated in one or a few sectors. "A large nation can divide its greater volume of resources among a greater number of sectors with potential comparative advantage." (p. 92)

[2] Geoffrey Pattie, MP and British Parliamentary Under-Secretary of State for Defence for the Royal Air Force discusses the British defense dilemma in the Government's first Defence White Paper. He argues the need for the U.K. to create scale in production. "Overseas sales are, I believe, an important element in any defense industrial strategy. Extra orders beyond those from the UK mean more work, benefit to the balance of payments, economies of scale and thus reduction in the unit cost to ourselves." Geoffrey Pattie, "Needed: A Defense-Industrial Strategy for the UK," Defense and Foreign Affairs, no. 9, 1980, pp. 6-12 (p. 8).

(or small) military will determine both the market and possible economies of scale for domestically produced military items. Hence, size of population, land, and the military were added to the list of indicators and the LDCs ranked accordingly.

A weighted average index of military production capability was also constructed for all LDCs from three separate ranking indexes. First, each producer was ranked on the basis of:

1) Length of Production Experience -- the number of years since 1950 in which at least one weapon system was produced;

2) Production Capacity -- the number of major defense items in production since 1950;

3) Technical Capabilities -- the level of technical production achieved by 1979/80.[1]

The numerical values of each of the three indexes were then summed, averaged, and ranked for each producer, providing an average index and rank order of LDC military production capabilities. The weighted index of military production capability and ranking were then correlated with each of the seven economic indicators to determine degree of association for individual LDCs.

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[1]See fn. 2, p. 25, above for a more complete description.

Correlations were run for two data bases: First, the 26 LDC producers were arranged in rank order of military capability and socio-economic correlations run across the seven indicators to determine which factors are associated with what level of arms production. Second, all LDCs, producers and non-producers alike,[1] were analyzed according to region to a) determine whether relative regional weight is related to military production capability; and b) as a control, to find out whether observed associations between variables define only differences in capabilities among LDC producers, or whether they also explain why some third world countries do and some do not produce arms.

The results of the correlations are presented in Table 7. We had speculated that factors of scale might determine the extent and level of arms production in the third world, and there is considerable evidence to support that hypothesis. Generally, for each region, countries with the largest populations, producing the highest GNP, and sustaining the largest military forces, are also the largest and most sophisticated producers of weapons. Land size is also strongly correlated in Latin America and South Asia but not in the Far East where small states, such as Taiwan, the two Koreas, and Singapore out produce other larger states in the region, e.g. the Philippines, Thailand, and Indonesia.

Inadequate data on technical, professional, and industrial workers prevented a statistical analysis on that variable for all regions but Latin America where the correlation is strongly positive. However, skilled manpower may not be a separate and independent indicator of arms production capability, but rather another measure of a country's population size. States with more people generally contain

[1] Countries with populations numbering less than one million were not included.

## Table 7. Rank Correlations
### Military Production Capability and Economic Indicators

| Ranked Economic Indicators Correlated with Military Production Capability Ranks | Correlation Coefficients (Kendall's tau) Latin America (22) | South Asia (7) | Far East (14) | All Arms Producers (26) |
|---|---|---|---|---|
| 1. Population | .709* | .810* | .483** | .234**** |
| 2. Land Size | .642* | .714* | .379**** | .271**** |
| 3. Size of Military | .748* | .714* | .602* | .449** |
| 4. GNP[2] | .605* | 1.000* | .759[d]* | .489** |
| 5. GNP per capita | .194**** | .524*** | .319****[a] | .176**** |
| 6. No. of professional workers | .718*[b] | n.a.[c] | n.a.[d] | .439**[e] |
| 7. No. of industrial workers | .680* | n.a.[c] | n.a.[d] | .406**[f] |

**Explanation:** The regional data base includes 22 countries in Latin America, 7 countries in South Asia, and 14 countries in the Far East. These regions were analyzed because they contained the largest number of arms producers: 9 in Latin America, 3 in South Asia, 10 in the Far East. (In 1979/80 the Middle East had only 2 arms producers; Sub-Sahara Africa - 2; No. Africa- none.) The three regions displayed above also contained the most complete data, with the exceptions noted below.

The last column "All Arms Producers" consists of the 26 LDC arms producers world-wide, ranked according to their comparative arms production capabilities.

In all data bases there were countries with equivalent military production capabilities. This is particularly true for the regional breakdowns where there were many countries with no military industrial experience. There were, therefore, a large number of tied rankings. For this reason, Kendall's tau rank correlation was used in preference to the more common Spearman rank correlation. The latter can be used only when there is a relatively small number of ties. However, the more sophisticated statistical treatment cannot make up for this weakness in the data, and so our computations should be considered only approximations.

Consistent with Spearman rank correlations, the relationships indicated by the tau coefficients are:

1 = perfect ranking agreement on both variables
-1 = perfect negative association
0 = independence, no relationship.

The raw data for all the regions are displayed in Table 14.

**Notes:**

* Correlation coefficients are statistically significant at the .001 level with a two-tailed test. The null hypothesis of no relationship can be rejected.

** Correlation coefficients are statistically significant at the .01 level with a two-tailed test. The null hypothesis of no relationship can be rejected.

*** Correlation coefficients are statistically significant at the .05 level with a two-tailed test. The null hypothesis of no relationship can be rejected.

**** Correlation coefficients are not statistically significant at the .05 level. There is not sufficient evidence presented by these data to enable us to reject the null hypothesis.

[a] N=11 for the Far East; information not available for Vietnam, Kampuchea, and Laos.

[b] N=21 for Latin America; information is not available for Haiti.

[c] N= 4 for South Asia; information not available for Afghanistan, Bangladesh, and Bhutan.

[d] N=6 for the Far East; information not available for China, Vietnam, Burma, Taiwan, No. Korea, Kampuchea, Laos, and Mongolia.

[e] N=20 for total arms producers; information not available for Bangladesh, Burma, China, Nigeria, No. Korea, and Taiwan.

[f] N= 7 for Far East; information not available for China, Kampuchea, Laos, Mongolia, No. Korea, Taiwan, Vietnam.

[g] N= 11 for total arms producers; information not available for Bangladesh, China, Nigeria, No. Korea, Taiwan.

**Source:** Our reference for statistical methods and Normal Distribution Table for tests of significance) is: Robert M. Blalock, Jr., Social Statistics (New York: McGraw-Hill Book Co., 1979), pp. 434-39.

a larger number (if not proportion) of skilled manpower than countries with fewer people. (Although not shown here, there is a perfect correlation between population size and number of professional, technical, and industrial workers among the four most populous Latin American states.)

Only GNP per capita, used as a measure of "economic (technological) development",[1] (but not of size or scale) shows a weak and statistically not significant relationship to arms production capability. (South Asia, where per capita GNP is uniformly low, has only a weak association.)

For the 26 arms producers as a group, given the considerable differences in absolute size among them, and the role political factors can play at any one point of time in history,[2] the association between the seven variables and arms production capability is, predictably, somewhat weaker. Nevertheless, there are relatively high and significant associations among size of military, GNP, and military industrial capability which holds across regions and across arms producers. Again, because of poor data, the positive association between the number of professional, technical, and industrial workers must be treated with some caution. (See Table 7.)

What emerges within the third world, then, is an hierarchically shaped arms production system based, for the most part, on factors of scale. On a region by region basis, the largest defense producers are generally also those countries with the biggest militaries and GNPs, who

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[1]Robert Harkavy, op. cit., p. 204.

[2]See discussion below, p. 36-7.

dwarf quantitatively, if not always qualitatively, the capabilities of their smaller, poorer neighbors. Thus, China, representing 69 percent of the Far East in population and contributing 50 percent of its military manpower, manufactures three to four times the number of weapon systems of its closest regional competitor. China is also the only country in the Far East with an across-the-board manufacturing capability.

India, like China, dominates its region (South Asia) in population (76 percent), size of military (68 percent), area (63 percent), GNP (78 percent) and in the number of weapons it makes (81 percent). India is also the only state in South Asia with an across-the-board capability.

In Latin America, two states dominate the region's defense production. Brazil and Argentina, rank first and third respectively, in terms of size of population and GNP, and first and second in size of military, together produce 66 percent of the region's indigenous arms. Both have achieved across-the-board capabilities. It is interesting to note that Mexico, the second most populous country with the second largest GNP, but with a relatively small military (8.4 percent of the region) has sustained only a small industry for light naval craft. There have been reports recently about a plan to establish an aircraft industry. But if, as these findings suggest, the size of the military is associated with weapons production, then unless Mexico enlarges its armed forces considerably, the prospects for extensive arms production remain remote.

Unlike the other three regions, Africa produces few arms. Excluding the political imperatives which drive South African

defense industries,[1] only Nigeria, the most populous African country with the largest military and GNP, is in the early stages of domestic arms production. Given the small size and relative poverty of the other African countries, it is unlikely that indigenous military industries will be established eleswhere in the area in the foreseeable future.

In the Middle East, as in the case of South Africa, political factors have taken precedence over factors of scale in determining arms production capacity. Israel, ranked seventh in size (3 percent of the area's population) and seventh in military manpower (3 percent), not only makes 79 percent of the region's weapon systems, but also sustains an across-the-board capability. Similarly, Iran, with the second largest population and army, and the highest GNP has been unable to proceed with its military industrial plans because of its recent revolution. Egypt, the most populous of the Middle Eastern states, with the largest army, is ranked only fifth in national wealth (GNP--7.2 percent of the region). Although it hopes to create a viable domestic military industry, to-date the lack of financial resources has circumscribed Egypt's plans and capabilities.

These findings, then, lend support to our original hypothesis which relates scale to military industrial production. The existence of a large military to provide an adequate market,[2] combined with a generous national income to support the necessary

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[1] South Africa contains only 8 percent of Sub-Sahara Africa's population, maintains an army comprising 9 percent of the region's forces, but produces 26 percent of its goods and services (GNP). For further discussion of the role of political factors, see below, pp. 36-37.

[2] If the size of the military is too small to create an economy of scale, indigenous production is very costly

industrial infrastructure significantly affect a state's long-term ability to produce major weapon systems as well as the quantity and quality of its product.[1]

Our findings also suggest that the research question being asked by the field--how does defense production affect economic growth within the LDCs?--may be less important and less interesting than the question--how does economic growth affect defense production? A recent empirical study by Robert Jackman concludes that both size and wealth are determinants of economic growth. He finds that the highest growth rates were in the "wealthiest Third World countries." Thus population size serves as an intervening variable. Although it has no systematic effect among low income countries, it has a systematic positive effect among the countries in the medium income category. According to Jackman, "This pattern is fully consistent with the argument that among middle income countries, size has a positive impact on economic growth because it allows for economies of scale."[2]

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[1] Writing about the necessary conditions for industrial development, Denis Goulet observed that the ability to produce state-of-the-art technology depends on the research and development (R&D) capability of a country. This in turn requires large sums of ready capital, a pool of skilled researchers, and access to manufacturing and marketing units. Without these factors, an indigenous industry of significant dimension with across-the-board sophistication is impossible to achieve. In third world countries, as Goulet points out, research and development in sophisticated technologies is out of the question because production scales do not allow amortization of high and risky research costs. "Only special circumstances make it profitable to build research and development units, and these must be limited to a few technologies." (Denis Goulet, "The Dynamics of International Technology Flows," Technology Review, May 1978, p. 3.)

[2] Robert Jackman, "Dependence on Foreign Investment and Economic Growth in the Third World," World Politics, XXXIV, no.2 (January 1982), pp. 173-196 (p. 192). Chenery and Syrquin also find that size is particularly important in the development process for those LDCs above the lowest income levels. They hypothesize that countries with larger incomes have relatively advanced economic infrastructures and can, therefore, take advantage of economies of scale. (Hollis Chenery and Moises Syrquin, Patterns of Development, 1950-1970. New York: Oxford University Press, 1975, ch. 4.).

Thus economic growth, whether in the civilian or military sector, is associated with scale (size and GNP). It may well be that economic growth itself has (positive or negative) effects on defense production rather than vice versa. At any rate, it is an hypothesis worth further investigation.

There will, of course, always be exceptions to the rule of socio-economic scale. Political factors apparently stimulate (as in the case of Israel and South Africa) or constrain (as in the case of Egypt, after the signing of the Camp David accords and the withdrawal of Arab funding from the Arab Industrial Organization (AOI) during the late 1970s; Iran subsequent to the 1979 revolution; and China since the 1960s) defense production beyond what would be expected from countries of a certain size and wealth.

Embargos, for example, have played a particularly strong role in motivating political leaders to establish military industries.[1] Of the current six major third world arms' manufacturers, all, at one time or another, have had to contend with significant restrictions on the flow of military equipment to them from one or more major supplier.[2]

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[1] Ilan Peleg, op. cit., p. 219. The author concludes: "Whatever its economic and scientific abilities, and these are extremely important, a Third World nation needs very strong motivation in order to establish, maintain, and develop a weapons industry. Motivation, in addition to economic-scientific-technological capacity, is a prerequisite for weapons self-production."

[2] Brazil and Argentina were subject to U.S. restrictions in 1977; Israel to restrictions from France in 1967 and the U.S. in 1973 and 1982-83; India was embargoed by the U.S. during 1965-75 and China by the U.S.S.R. in 1962 and the U.S. since 1948; South Africa has been subject to a voluntary UN embargo since 1963 and a mandatory one since 1977. Several of the second rank LDC producers have also experienced political restrictions on their arms deliveries. e.g., Taiwan in 1978 from the U.S., and the Democratic Republic of Korea in 1974 from the USSR.

On the other hand, countries such as Pakistan, Chile, Iraq, and Guatamala have also faced politically inspired arms limitations from major suppliers[1] and yet have not become major producers.

The historical evidence then seems to support our hypothesis regarding scale: political factors may be important intervening variables, determining both the initiation of and the short-term success or failure of LDC military production efforts, but in the long-term, it is factors of scale that account for the quantity and quality of industrial production and the ultimate prosperity of national defense industries.[2]

Part III. Scale, Comparative Advantage,[3] and the Structure of the World Arms Transfer System. In this section, the above findings are compared with developments in other parts of the world. It is hypothesized here that if factors of scale determine the defense production capabilities of industrialized as well as third world countries, then a world military industrial system will eventually emerge which will see

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[1]Pakistan was embargoed by the U.S. between 1965-75; Chile by the U.S. since 1974; Guatamala between 1978 and 1983. Restrictions on Iraq were imposed by the Soviet Union between June 1963 and May 1964.

[2]The oldest and largest of the third world arms producers, China, India, and Brazil are all regional leaders, ranking first in size of population, military, and GNP. Argentina, also among the oldest of the producers ranks second in size of military and third in size of population and GNP among Latin American states. Its production capabilities are also markedly less than its larger competitors.

[3]The theory of comparative advantage developed by the classical economist David Ricardo, attributed the costs and benefits of international trade to differences among countries in the relative opportunity costs (costs in terms of goods given up) of producing the same commodities. For example, if country A must give up three units of good x for every unit of good y produced, and country B must give up two units of good x for every unit of good y produced, both countries would benefit if country B specialized in the production of y and country A specialized in the production of x.

states producing and selling those items they can manufacture with the greatest relative efficiency. The largest most advanced industrialized countries will concentrate on developing sophisticated technologies, leaving the production of less advanced items and components to the industries of smaller or less advanced economic systems.

A. Factors of Scale and Defense Production in the Industrialized World. A recent analysis of NATO finds that factors of scale do mould Europe's defense production in ways similar to those observed within LDC industries. The study describes a well-defined, three-tiered structure of capabilities between the more and less developed European member states as measured by both how much and what they produce.[1]

Thus, the three most industrialized countries of Western Europe (as measured by GNP), the Federal Republic of Germany (FRG), the United Kingdom, and France, which represent about 53 percent of the population of NATO Europe, were found to contribute 80 percent of its arms industry output. The next three most industrialized and populous states--Italy, the Netherlands, and

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[1]Robert A. Gessert, "Industrial Considerations in Transatlantic Weapons Cooperation, Part 1: European Industry and Political Perspectives," International Defense Review, June 1979, p. 3.

Belgium, total approximately 25 percent of the NATO European population and produce 12 percent of its military industrial output. The remaining seven states of NATO Europe account for about 23 percent of the population and less than 8 percent of the defense industry output of NATO Europe.[1] As Table 8. illustrates, qualitative differences were found to separate the industries of Europe as well.[2]

If the United States is included, another fourth tier of defense production capability is superimposed on top of NATO Europe. (See Table 8.) Given the relative factors of scale, the dollar value of U.S. defense production is two-thirds higher than that of NATO Europe. Together, the six major industrial states of NATO Europe export less than one-third the value of U.S. military exports and import over five times the value in arms (over 70 percent of which comes from the U.S.) imported

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[1] Military size further underlines the stratification of NATO Europe. The combined militaries of the U.K., France, and the FRG comprise 44 percent of NATO Europe's armed forces. Italy, the Netherlands, and Belgium account for 23 percent. The other seven states combined total 33 percent of the forces. If Turkey, with a 485 thousand man military is excluded, the remaining six countries contribute only 10 percent to NATO Europe's military manpower.

[2] France and the United Kingdom particularly, with the FRG growing rapidly, produce a broad spectrum of weapon systems. The same is not true for the second and third tier countries. Italy is an exception. It has maintained a defense sector almost as broad as the top three but it is more heavily dependent on the U.S. for both development and production, assembling most major items. ("Special Report: Defense Electronics Exports, NATO Seeking Cohesive Armaments Policy," Defense Electronics, May 1979, p. 58.) Belgium and the Netherlands, because of their small size, have accepted more limited goals for their military industries, maintaining development and design capabilities in specialized defense sectors only (e.g., the Belgians in small arms and certain electronics; the Dutch in general electronics and some aspects of ship design.) Nevertheless, although individual countries at the second and third tiers may produce specialized items, all but Italy must import most of their military hardware. ("Special Report," p. 58.)

## Table 8: Factors of Scale and NATO

| | % of[1] GNP | % of[1] population | % of[1] military forces | Arms Industry Output[2] % | Qualitative Capabilities |
|---|---|---|---|---|---|
| **NATO EUROPE** | | | | | |
| FRG<br>U.K.<br>France | 66.0 | 53.0 | 44.1 | 80.0 | Sophisticated across-the-board (Germany constrained by political factors) |
| Italy<br>Netherlands<br>Belgium | 23.0 | 25.0 | 23.0 | 12.0 | Italy, across-the-board (assembly), sophisticated but in specialized defense sectors only |
| Greece<br>Portugal<br>Denmark<br>Norway<br>Luxembourg<br>Iceland<br>Turkey | 11.0 | 23.0 | 33.0* (10.0) | 8.0 | less advanced or no industry |
| **NATO EUROPE & U.S.** | | | | | |
| United States | 50.0 | 41.0 | 39.0 | 66.0 | Sophisticated across-the-board; lead-edge in computers, PGMS, radars, missles, electronics, fighter aircraft. |
| FRG<br>U.K.<br>France | 34.0 | 32.0 | 27.0 | 27.00 | |
| Italy<br>Netherlands<br>Belgium | 12.0 | 15.0 | 14.0 | 4.0 | |
| Greece<br>Portugal<br>Denmark<br>Norway<br>Luxembourg<br>Iceland<br>Turkey | 5.0 | 14.0 | 20.2* (6.0) | 2.7 | |

**Sources:**

[1] USACDA, World Military Expenditures and Arms Transfers, 1970-79.

[2] Robert A. Gessert, "Industrial Considerations in Transatlantic Weapons Cooperation, Part I: European Industry and Political Perspectives," International Defense Review, June 1979, p.3

* If Turkey with a 485,000 man military is excluded, the remaining six countries account for the percent within parentheses.

by the U.S.[1] Thus, when compared with the U.S., European states are subject to the same constraints of economic scale which stratify the third world. It would appear that as long as the United States continues to enjoy the relative advantage associated with scale, it will remain the technological leader of the Western defense industrial system.[2]

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[1]Gessert, op. cit., p. 5.

[2]The constrast in capabilities between the U.S. and other European states can be seen in two key sectors: aerospace and research and development (R&D). The entire European aerospace industry, generally acknowledged to be the most technically demanding, generates only about one-fifth the sales of its American counterpart For instance, only 1,100 examples of France's highly successful Mirage III could be sold, while the U.S. produced almost 4,000 F-4 Phantoms. (Richard M. Saunders, "Standardization: In Search of the Holy Grail," Army Magazine, February 1979, p. 2.)

A similar observation has been made regarding military R&D. Thomas A. Callaghan has estimated that in 1974, Europe spent $2.5 billion on military R&D, while the U.S. spent $7.6 billion. This has meant that individual European countries have had to depend upon U.S. R&D efforts for many systems. The Tornado MRCA, a joint European endeavor, reportedly absorbed about 25 percent of West Germany's R&D funds. Even so, the Tornado program was still heavily dependent on U.S. R&D since 30 percent of the cost of each Tornado plane reflects imported American electronic equipment. ("Special Report," op. cit., pp. 58-68; Paul Lewis, "Europe's Fighter Jet Program," The New York Times, November 13, 1979.)

For like reasons, associated with scale, European arms industries are also more dependent on third world markets than the U.S., since European procurement alone cannot provide sufficient economies of scale. France and Britain, for example, depend on foreign markets for 20 to 30 percent of their total arms sales respectively. The U.S., on the other hand, relies on these markets for only five percent of its total foreign sales. "U.S.-Made Harpoon Battles French Exocet for Canadian contract," Washington Post, July 8, 1982, p. 5.

There is some evidence that a corresponding stratification by scale and function is evolving in Eastern Europe. Apparently, the Soviet Union's defense industry dominates the production of Warsaw Treaty countries. The Soviets maintain large-scale, across-the-board production in all armaments areas, while that of other Warsaw Treaty / states is limited and more specialized. Furthermore, much of the production of non-Russian producers is based on Soviet designs and licenses. As one study concludes:

> The question of specialization and decisions of the location of specialized plants within the WTO are solved on the basis of technological level and the best skills in each country, i.e., a kind of comparative advantage principle works within WTO defense production.[1]

Although information is not readily available about the Warsaw Pact's defense production, one analysis of Czechoslovakia's aerospace sector supports the conclusion that some division of labor has occurred between them. The USSR is the Czech aerospace sector's largest customer, as well as its largest supplier, but Soviet exports include a broad spectrum of advanced technologies, such as large and medium aircraft, helicopters, and a range of electronic instruments, engines and other technical equipment. Other than a Czech-built military trainer (the Turbolet) which was to be acquired by other Warsaw Pact countries, including the Soviet Union, Czechoslovakia's exports to the USSR are comprised largely of airframe components and equipment (such as aircraft seats).[2]

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[1] Helena Tuomi and Raimo Väyrynen, op. cit., p. 105.

[2] "Czechs Gear for East Europe Sales," Aviation Week and Space Technology, June 11, 1979, p. 282.

The data therefore suggest that factors of scale are shaping the world's military industries into a hierarchy of productive capabilities.[1] What has been described is a series of regional systems which are neither neatly ordered nor perfectly integrated. However, it can be anticipated that as new producers enter the system and political barriers become more permeable (as they already are[2]), the world's defense industries will be moulded increasingly by economic factors into a global hierarchical system which capitalizes on the comparative advantages of its members.

[1] Table 8a. provides a comparative picture of national and regional military industrial capabilities in terms of number of weapon systems produced. SIPRI data is used for all countries other than the LDCs. According to SIPRI figures, the U.S. alone manufactures over half the number of systems produced by NATO Europe and Canada, and almost as many (119) as produced by 21 countries in the third world (131). The Soviet Union is the second largest national producer (86). Only a fraction of U.S. systems are produced under license, none of the Soviet Union's, whereas 25 percent of Eastern Europe's and 34 percent of the third world's military industrial output is licensed. Since engines and other major components are not included here, the actual number of licensed products is higher for Eastern Europe, the third world, as well as Western Europe.

[2] Lessons from recent wars suggest that acquisition patterns, once constrained by bloc membership, are no longer predictable. Third country transfers are eroding the political/ideological barriers that, with few exceptions, characterized the arms trade. For example, during the Indo-Pakistan war of 1971, Pakistan, embargoed by the U.S., received supplies for its American arms inventory from Jordan and Iran. Similarly, Ethiopia entered the war with Somalia with a U.S. trained and supplied military. Cut off from resupply from the U.S., Ethiopia continued to receive American items from countries such as Yugoslavia, Libya, Israel, and Vietnam. Somalia, on the other hand, received Soviet equipment from Egypt and Iraq. (See Robert Harkavy, "Toward Comparing Recent Wars in the 'Arc of Crisis': Lessons for Defense Planners," in Defense Planning in Less Industrialized Countries, ed. Stephanie Neuman, (Lexington Books, forthcoming). The Iran-Iraq war also demonstrated the increasingly porous nature of arms supply patterns. Iran, embargoed by the U.S. received American spares and consummables from Israel, and Soviet systems were acquired from Libya, Syria, and North Korea. Iraq received Soviet items from Egypt. In Afghanistan, another example, the Mujahudin rebels received Soviet built SA-7 man-portable surface-to-air missiles from Egypt. Sold to Pakistan (funded by the U.S.), the missiles were then transferred to the Afghan rebels. (International Report," Defense Electronics, October 1982, p. 19) In the aftermath of the Falklands War, Argentina decided to rebuild its airforce by buying 22 Mirage III-C fighter jets from Israel. These French-built Mirages are an addition to 10 Mirage V aircraft Argentina bought from Peru during the 74 day war with Britain. ("Argentina Acts to Buy 22 Jets," Washington Times, July 30, 1982, p. 5.)

These examples demonstrate the futility of erecting barriers to the flow of technology and equipment in a system of multiple suppliers. Although most of the equipment itemized here was not produced in the transferring country, the trend toward diversification and third country resupply will surely grow, creating at once a more homogeneous and hierarchical global arms transfer system.

TABLE 8a COMPARATIVE PRODUCTION CAPABILITIES WORLD-WIDE
NO. OF WEAPON SYSTEMS IN PRODUCTION, 1979

| | | Aircraft* | AFV* | Missiles* | Ships** | Total | Licensed |
|---|---|---|---|---|---|---|---|
| **NATO** | | | | | | | |
| U.S. | | 59[b] | 13 | 23[b] | 24 | 119 | 2 |
| Canada | | 4 | 1[a] | 1[a] | 1 | 7 | 2 |
| Western Europe-NATO | Total | 68 | 30 | 48 | 84 | 230 | 15 |
| Belgium | | 2 | 3 | 2[c] | 1 | 8 | 2 |
| Denmark | | - | - | - | 3 | 3 | 0 |
| France | | 25 | 12 | 17 | 16 | 70 | 0 |
| FRG | | 3 | 7 | 4[c] | 6 | 20 | 2 |
| Greece | | - | - | - | 5[c] | 5 | 2 |
| Italy | | 18 | 3 | 6[b] | 9 | 38 | 1 |
| Netherlands | | 5 | - | - | 3 | 8 | 0 |
| Norway | | - | - | 3[b] | 7[b] | 10 | 2 |
| Portugal | | - | - | - | 9[f] | 9 | 0 |
| Turkey | | - | - | 1[a] | 4[f] | 5 | 4 |
| U.K. | | 15 | 5 | 13[c] | 21 | 54 | 2 |
| OTHER EUROPE | Total | 12 | 10 | 5 | 11 | 38 | 4 |
| Austria | | - | 2 | - | - | 2 | 0 |
| Finland | | 2[b] | - | - | 6 | 8 | 1 |
| Ireland | | - | 1 | - | 1 | 2 | 0 |
| Spain | | 3[b] | 1 | - | 4[b] | 8 | 2 |
| Sweden | | 3 | 2 | 5 | - | 10 | 0 |
| Switzerland | | 4[b] | 4 | - | - | 8 | 1 |
| MULTINATIONAL EUROPE | Total | 8 | 0 | 7 | 0 | 15 | 0 |
| Bel/FRG/Netherlands | | 1 | - | - | - | 1 | - |
| France/FRG | | 1 | - | 4 | - | 5 | - |
| France/U.K. | | 5 | - | - | - | 5 | - |
| FRG/Italy/U.K. | | 1 | - | - | - | 1 | - |
| France/Italy | | - | - | 2 | - | 2 | - |
| France/FRG/U.K. | | - | - | 1 | - | 1 | - |
| OTHER INDUSTRIALIZED | Total | 19 | 2 | 7 | 20 | 48 | 1 |
| Australia | | 3 | - | 1 | 4[b] | 8 | 1 |
| Japan | | 16 | 2 | 6[c] | 14 | 38 | 2 |
| New Zealand | | - | - | - | 2 | 2 | 0 |
| Total Non-U.S. Industrialized Market Economies | | [111] | 43 | 68 | 116 | 338 | 24 |
| WARSAW TREATY ORGANIZATION | | | | | | | |
| U.S.S.R. | | 31 | 8 | 23 | 24 | 86 | 0 |
| EASTERN EUROPE | Total | 9 | 6 | 0 | 7 | 22 | 6 |
| Czechoslovakia | | 3 | 2 | - | - | 5 | 0 |
| Germany, D. R. | | - | | - | 3 | 3 | 0 |
| Hungary | | - | 1 | - | - | 1 | 0 |
| Poland | | 3[b] | 2[b] | - | 3[f] | 8 | 2 |
| Romania | | 3[c] | 1[a] | - | 1[a] | 5 | 4 |
| OTHER EASTERN EUROPE | | | | | | | |
| Yugoslavia | | 3[b] | 1 | 1[a] | 4 | 9 | 2 |
| MULTI-NATIONAL EAST EUROPE | | | | | | | |
| Romania/Yugoslavia | | 1 | - | - | - | 1 | 0 |
| Total Non-U.S.S.R. East Europe | | [13] | 7 | 1 | 11 | 32 | 8 |
| THIRD WORLD*** | Total | 62 | 25 | 21 | 45 | 131 | 45 |
| Argentina | | 6[c] | 3[a] | 1[c] | 4[b] | 14 | 4 |
| Brazil | | 10[g] | 5 | 3[c] | 1[a] | 19 | 7 |
| China | | 9 | 8 | 5 | 10 | 10 | 0 |
| Colombia | | 1 | - | - | 1 | 2 | 0 |
| Dominican Rep. | | - | - | - | 1 | 1 | 0 |
| Ecuador | | - | - | - | 1 | 1 | 0 |
| Egypt | | - | - | 1[a] | - | 1 | 1 |
| Fiji | | - | - | - | 1 | 1 | 0 |
| India | | 10[c] | 2[b] | 3[c] | 5[c] | 20 | 7 |
| Indonesia | | 5[g] | - | - | 1 | 6 | 4 |
| Israel | | 6 | 4 | 3 | 3 | 16 | 0 |
| Korea, No. | | - | - | - | 10[c] | 10 | 2 |
| Korea, So. | | 2[a] | 1 | - | 2[b] | 5 | 3 |
| Mexico | | - | - | - | 1[a] | 1 | 1 |
| Nigeria | | 1[a] | - | - | - | 1 | 1 |
| Pakistan | | 3[a] | - | 1 | - | 4 | 3 |
| Paraguay | | 1[a] | - | - | - | 1 | 1 |
| Peru | | - | - | - | 2[b] | 2 | 1 |
| Philippines | | 3[c] | - | - | - | 3 | 2 |
| So. Africa | | 3[f] | 2 | 2[b] | 2[b] | 9 | 5 |
| Taiwan | | 2[b] | - | 2[a] | - | 4 | 3 |

Sources: * SIPRI Yearbook, 1980, pp. 44-56;
** SIPRI Yearbook, 1979, pp. 72-151 for ships produced in industrialized countries.
*** Neuman data

[a] licensed. [b] 1 system licensed. [c] 2 systems licensed. [d] 9 systems licensed.
[e] light planes list not complete because of large number of types. SIPRI counted export versions primarily. [f] 3 systems licensed. [g] 4 systems licensed.

B. Functional Specialization and Comparative Advantage.

It is difficult to predict how fast the proliferation of indigenous defense industries will spread. Much depends on internal and external conditions and the strategic environment of individual countries. It is not, however, difficult to deduce from existing trends that as more third world states establish production lines, it will become increasingly difficult for them, as well as their competitors, to export their products unless some functional specialization takes place. Previous third world arms buyers, turned producers will utilize their own domestically produced weapons, in effect shrinking the size of the potential third world export market and accentuating the problem of achieving scale for other less industrialized producers. As a result, unit costs will rise, forcing third world states to accept some kind of division of labor among their industries based on the principle of comparative advantage.

The same will be true for the industrialized world's less advanced and intermediate level defense products. The simpler, often lower priced military items produced by some third world countries can be expected to have particular appeal to other budget conscious developing countries. Furthermore, the prospect of diversifying their sources of supply and thus reducing dependence on the major powers, combined with the advantage of utilizing military items tested in third world environments are perceived as decided benefits by third world

buyers.[1] For these reasons, LDC defense products promise to offer competition to some military industries in the developed world.

In the near future, competition will most likely be felt by those Western industries producing vintage and intermediate level systems, particularly weapon platforms.[2] The Brazilians, for example, capitalizing on the growing preference among LDC planners for diversified suppliers, now promote their weapons in terms of their ability "to withstand the harsh environmental conditions and indifferent maintenance" commonly found in developing countries, and "Brazil's strong [especially post-

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[1] Israel's Gabriel missile, for example, has proven attractive to many third world countries because of its combat experience. During the 1973 Arab-Israeli War, the Israeli Navy reportedly sank 19 vessels, 13 using Gabriel missiles. (Graham Warwick, "Israeli combat experience incorporated in latest missiles," Flight International, December 26, 1981, p. 1886.) Recognizing the appeal of "battle-tested" equipment for LDC buyers, a senior Armscor official touted South African military wares in terms of their "being battle-tested in Namibia, and offered to take prospective buyers to operations areas for on-the-spot evaluation." (Milavnews, November 1982, p. 14.)

The dual-use character of some LDC products also have appeal to third world defense planners. For example, civilian light planes, such as the Israeli Arava or Brazil's Bandeirante can be used as an auxiliary gunship, a COIN plane, or as a crop duster.

Special features designed for a particular battle environment are another consideration for third world customers. The Brazilian EE-11 Urutu--an amphibious, six-wheeled armored vehicle which is light, fast, easy to operate and maintain, and generally "designed for areas that are tropical and untracked," -- has been popular among countries with similar requirements. (Warren Hoge, "Brazil's Arms Find Willing Buyers in the Third World," The New York Times, August 9, 1981.)

Finally, some countries, such as Brazil and Israel, make missiles, bombs, rockets, and other items especially designed to fit American, European, and Soviet equipment. These sources may have obvious appeal in situations where, for whatever reason, the major producers refuse to sell these items. Rumors that Brazil was supplying Argentina with consummables during the Falkland War circulated widely. Similarly, Israel is reputed to have resupplied Argentina (during the Falkland incident) and Iran during the Iran/Iraq War with equivalent items. (Jacquelyn S. Porth and Gregory Copley, "Performance Under Pressure: Defense Production in the Southern Cone," Defense and Foreign Affairs, August 1982, pp. 12, 13, 15, 823, (p. 15); and Jerusalem Post, August 20, 1982.

[2] Some Western industries are apparently preparing to actively engage in the competition. France's Dassault-Breguet has developed the Mirage 3NG upgraded from the Mirage 50) as an "advanced technology export competitor to the Northrop F-5G and Israel's (IAI) Kfir." (Jeffrey M. Lenorovitz, "Mirage 3NG Starts Final Ground Checks," Aviation Week and Space Technology, Nov. 22, 1982, pp. 52-55.)

1973) independence vis-a-vis Western and Eastern blocs."[1] The Indonesian government's decision to buy 2,400 light trucks from Brazil rather than Japan (many of which are destined for military service), is offered as evidence that Brazil is now competing with the major and traditional arms exporting nations.[2]

1. Intra-Third World Trade.

That intra-third world trade is, in fact, growing is demonstrated by the rising number of third world countries purchasing major equipment produced in other LDC industries. Since 1975, for example, one or another of Israel's patrol boats, aircraft, and missiles have been sold to over 17 countries in Latin America, Asia, and Africa.[3] Brazil, too, has sold a wide variety of equipment--armed reconnaissance cars, trainer planes, and/or patrol boats--to other industrializing states,[4] and Argentina's IA-58A twin turboprop aircraft have been bought by Uruguay.[5] Since the cessation of U.S. aid programs in 1977 because of human rights violations, Guatemala has purchased military equipment worth over $100 million from other sources, primarily Israel, but also from Argentina.[6]

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1 John Hoyt Williams, "Brazil, Giant of the Southern Hemisphere," National Defense, November 1982, pp. 16-20, (18-20) ). Another example of the growing competition is a recent Venezuela procurement decision. After considering competing submissions by Euromissile and Israel, the government selected the Roland SAM system in preference to the Israel sale. (Milavnews, December 1982, p. 22).

2 Ibid.

3 Argentina, Colombia, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Chile, and Venezuela in Latin America; Malaysia, Taiwan, Thailand, and Singapore in Asia; South Africa, Swaziland, and Uganda in Africa. (Neman data).

4 Brazil's customers include Abu Dhabi, Bolivia, Chile, Libya, Paraguay, Quatar, and the Sudan. (Neuman data).

5 Milavnews, July 1981, p. 2.

6 Milavnews, January 1983.

When countries such as China and Mexico announce plans to modernize their military, rumors abound regarding prospective arms sales. In the past, attention focused on suppliers in the developed world. Significantly, rumors now include third world producers. There have been reports, for instance, that Brazil and Mexico plan to set up a production line for Embraer's Ipanema light aircraft in Mexico,[1] that Mexico has procured a license to produce the Israeli Arava STOL transport,[2] and that Mexico is planning to coproduce TAM tanks with Argentina.[3] Press speculation about an Israeli mission to China suggests that a joint venture to adapt China's aging Soviet T-32 (sic) tanks for modern warfare could result.[4] It is also said that Brazil is negotiating with China over a sale of armored vehicles (EE-9 Cascavel and the EE-11 Urutu).[5] Perhaps only a few of these arrangements will materialize, but the activity of third world producers and the interest of third world buyers is clearly on the rise.

As the reports cited above imply, some LDCs are beginning to transfer not just military hardware but technological know-how and industrial infrastructure for defense

[1] U.S. Department of Defense Inte... ...-04676-78.

[2] Edward Kolodziej and Robert Harka... Security System," Journal of Inte... 1980), p. 81.

[3] "Latin's Begin to Invest Heavily in Armamen... Commerce, January 6, 1982, p. 11.

[4] "Israelis to vist China in reported arms de... 10, 1982. The article states that "China' Soviet style T-32 tanks." However, the IISS, does not list a T-32 tank in China's inventory referring to the T-34.

[5] Defense and Foreign Affairs Weekly Report o... March 13, 1980. John Hoyt Williams, op. ci...

industry. China, for instance, helped Pakistan establish an aeronautical complex for aircraft and engine assembly and overhaul. A factory erected with Chinese assistance now rebuilds F-6s for the Pakistani airforce.[1] Israel, too, is reported to be transferring technical assistance to other third world countries. For example, South Africa is/producing/ reported to be/ several/ products, including the Gabriel missile under license,[2] and Taiwan's Hsiung Feng missile is considered to be a Taiwanese version of Israeli technology.[3] Rumors about the construction of a frigate in Taiwan with both Israeli and South African assistance, although unverified, persist.[4]

Similar trends are underway in Latin America. Paraguay is producing under license from Brazil the EMB-326 Xavante (originally a 1950s Italian trainer). It is the only major weapon system known to be produced in Paraguay. Mexico,too, is contemplating indigenous production of aircraft, specifically, the Brazilian EMB-326 and either Brazil's EMB-110 transport or Israel's Arava 202 transport.[5] In either case, the choice of license is apparently being made between third world industrial products.

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[1] "The Chinese supplied a turnkey operation, funding and supplying a complete F-6 (MiG-19SF) rebuild factory, including all equipment, machine tools, steam generating plant and electrical fittings "down . . . to the last nut and bolt. All that was required of Pakistan was supply of the factory site, labor force and cement, sand and water." As the next stage in the development of Pakistan's aerospace capabilities, another facility is planned which will manufacture under license the Swedish Saab-Scania MFI-17 (known in Asia as the Mushshak, for which Pakistan has sales rights in Southwest Asia. "Chinese Assisting Pakistani Industry," Aviation Week and Space Technology, March 30, 1981.

[2] "South Africa Promotes Sale of Modern Arms," Washington Post, September 27, 1982, p. 1.

[3] G.W.P. Goldrich and P.D. Jones, "The Far Eastern Navies," U.S. Naval Institute Proceedings, March 1982, pp. 60-65 (p. 62).

[4] Ibid.

[5] Neuman data.

2. LDC Military Exports to Industrialized Countries.

Through a series of offset arrangements, joint ventures, and the establishment of subsidiaries in third world countries, a form of reverse trade, primarily in less advanced military equipment, is beginning to develop between North and South. Egypt, for instance, currently coproducing the Franco/German Alpha Jet trainer, is sending back simple components to France.[1] Also, Brazil's largest aircraft maker (Embraer) makes vertical tail assemblies and pylons for the F-5E and exports them to the U.S. as part of the agreement under which Brazil buys F-5s for its airforce.[2] Taiwan

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[1] Clarence Robinson, "Egypt's Technology Shift: Factories Tool for Alpha Jet Program," Aviation Week and Space Technology, January 18, 1982, pp. 61-66. Of the 45 Alpha Jets ordered, eight are being supplied in completed form. The remaining 37 are being assembled with some component construction at the Helwan Aircraft Division. Eighty of the 116 Larzac 04 turbofan engines are also being assembled. (Milavnews, January 1983, p. 8.)

[2] "Brazil Emerges as a Supplier of Arms," Los Angeles Times, July 12, 1977.

manufactures assemblies which are also shipped back to Northrop's production line in California.[1] Components for Alouette helicopters produced in India are resold to France,[2] and Israel Aircraft Industries, Ltd. (IAI) makes conformal fuel tanks for McDonnell Douglas.[3] In effect, these third world industries are functioning as subcontractors for industries in supplier countries.

But licensing and offset agreements have gone beyond subcontracts on purchased equipment. Many now include other unrelated defense items produced in third world countries, establishing an incipient "two-way street" of arms transfers between suppliers and recipients. Thus, France has contracted to buy (and has received) Brazil's Xingu trainers (EMB-121),[4] and the U.S. Army will purchase two-way radio's from Israel's Tadiran factory.[5] Lately there have even been a few direct sales from third world industries to the industrialized world without benefit of offset agreements. The Swiss, for example, are purchasing artillery shells from the Israelis,[6] and the Russians reportedly concluded negotiations with Brazil for 90 mm. cannons to be mounted on combat vehicles.[7]

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[1] Captain R. Kenneth Bowers, "Coproduction: The U.S. F-5E in Taiwan and Switzerland," Defense Systems Management Review, Vol. 2, No. 2 (Spring 1979), pp. 34-45 (p. 44).

[2] SIPRI YEARBOOK, 1981, p. 77.

[3] Aerospace Daily, April 27, 1981, p. 323.

[4] Brazil has also trained French aircrews and ground personnel at Sao José dos Compos. Milavnews, June 1982, p. 16.

[5] "E-Systems Protests Foreign Arms Deals," The New York Times, May 13, 1982, D-2.

[6] The Jewish Week-American Examiner, June 13, 1982, p. 19.

[7] O Estado de Sao Paulo, February 4, 1979, p. 1.

the World

3. The Product Life Cycle and Arms Production System.

These developments, although just begining in the military sector, are an extension of trends already underway in the civilian sector of international trade. Relatively simple technologies, with uncomplicated wiring, for example, are no longer made in the United States, i.e. toasters, black and white t.v.s, sewing machines, etc. Automobiles may be the next product to "go" to less developed countries for production. It has been reported that some Latin American countries are banding together to form the "Andean Group" in order to produce cars for their own use. As one American commentary observes:

> It is becoming increasingly clear that producing the entire vehicle (automobile) at home may no longer be the most economical approach. Increasingly, major Western automobile companies are shifting parts of their production offshore to take advantage of lower manufacturing costs, and are integrating production facilities globally.[1]

There is good reason to suppose that this process of technological diffusion, the so-called "product life cycle"[2] will characterize the military as well as the civilian sector in the future.

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[1] "The Western Automobile Industry at the Crossroads," Transatlantic Perspective, no. 4 (January 1981), pp. 9-14 (p. 13).

[2] The "product life cycle" model, developed in the United States, describes the stages through which a manufactured item passes in terms of the investment behavior of U.S. industries. First, American companies generate new products and processes in response to factors of production in the U.S. Second, as the domestic market becomes satiated, these products and processes are introduced abroad by exporting. Third, as the technology ages and diffuses, and the export position of the original U.S. companies threatened (either by local competition or competitive exports from other countries), the U.S. companies establish subsidiaries overseas in order to retain their competitive advantage by utilizing the lower cost factors abroad to lower costs. Fourth, although the American companies retain their oligopolistic advantage for a period of time, it is eventually lost as foreign companies imitate and produce similar products and/or services, and rivals invest in the same overseas market. (For a complete analysis, see Raymond Vernon, Sovereignty at Bay: The Multinational Spread of U.S. Enterprises, New York: Basic Books, 1971.)

As Table 9. indicates, since 1972 the number of major U.S. weapon systems delivered to the third world has declined, reducing the U.S. share of the non-Communist world's arms trade.

Some elements within the United States have been less than delighted by these developments. The question of protecting America's "technological lead" has been, in the last few years, an issue of growing debate,[1] and rumblings can be heard within segments of U.S. industry regarding lost jobs and foreign exchange earnings as a result of offset agreements with foreign countries. Brazilian aviation export-financing policies, for instance, have been increasingly criticized by some U.S. manufacturers which charge the Brazilians with unfair trade subsidy practices.[2] So too, an electronics company, E-Systems, in a campaign to stop foreign industries from selling weapons and equipment to U.S. forces under special diplomatic agreement, took particular umbrage over an Israeli company's successful

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1 For example, see: Department of Defense, An Analysis of Export Control of U.S. Technology--A DOD Perspective, A report of the Defense Science Board Task Force on Export of U.S. Technology (February 1976); American Enterprise Institute, Legislative Analysis: Proposals for Reform of Export Controls for Advanced Technology August 1979; A Symposium on "Trade, Technology, and Leverage," Foreign Policy, 32 (Fall 1978), pp. 63-106; Richard Burt, "U.S. Seeks to Guard Technological Edge," The New York Times, December 11, 1977; "Offsets and Technology Transfer," Aviation Week and Space Technology, July 26, 1982.

2 "Brazilian Export Policy Sparks Criticism," Aviation Week and Space Technology, June 21, 1982, p. 60. Fairchild Aircraft Corp. recently lost its bid for import duties against Brazil's Embraer Bandeirante commuter aircraft before the U.S. International Trade Commission. Fairchild charged that its Metro commuter aircraft sales had been injured by the Brazilian financing subsidy (nine percent interest rate) to its customers. The American company claimed that "its share of the 19-passenger commuter transport market dropped from 60% in 1978 to a current 30% while Embraer's share rose proportionately." (Aviation Week and Space Technology, September 27, 1982, p. 24.)

bid to provide the U.S. Army with radios.[1]

The Europeans, on the other hand, seeking to extend their own defense production lines and markets, view joint ventures in the third world as a golden business opportunity, and are arranging a growing number of collaborative efforts with third world industries.[2] For third world leaders, these arrangements

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[1] "E-Systems Protests Foreign Arms Deals," The New York Times, May 13, 1982, p. D-2 Tadiran, the Israeli company which won the Army contract, underbidding E-systems by $9 million, is 42 percent owned by General Telephone and Electronics Corporation and 42 percent owned by Koor Industries, Ltd., one of Israel's largest industrial companies. E-Systems appealed the Army's decision to the U.S. Defense Department and General Accounting Office (GAO). When the GAO ruled against E-Systems, the company sought a restraining order vs. the Tadiran contract from the U.S. District Court in Dallas, Tex. Majority Leader James C. Wright (D.-Tex.) introduced an amendment to the defense authorization bill which would deny the Pentagan the right to choose a non-U.S. company as sole producer of any item of military equipment for the U.S. It has been reported that some compromise will be reached. "We'll probably have to give E-Systems a piece of the [Army] radio action," a Pentagon official observed, whether the Wright amendment passes or not. "Congress vs. the Pentagon on 'Buy American,' Business Week, pp. 58-9.

[2] The following examples of joint ventures between European and third world industries were reported in 1981: Brazil-Italy - A joint venture agreement (joint investment) to produce a strike fighter aircraft was concluded in June 1980. The agreement included joint production of a Sauro-class conventionally powered submarine. In a separate arrangement, a new subsidiary or Oto Melara, to be called Oto Brazil, will be set up to produce artillery and small guns in Brazil; Brazil-Germany - Krauss-Maffei (FRG) in association with two private Brazilian arms companies and under Engesa's supervision, agreed to produce the Leopard family of tanks (30,40,60 tons). It was also reported that a Krupp affiliate (NAK) will manufacture light infantry support tanks in Brazil;
India-West Germany - Dornier and HAL were discussing joint development of a civil transport aircraft; India-France: SNIAS and HAL agreed to jointly develop a new armored helicopter to be powered with Turbomeca engines;
Korea-Great Britain - Korea and BAe negotiated an agreement to establish a joint venture plant in Korea which would produce some of the simple components for the Hawk and possible other BAe products in conjunction with So. Korea's initial order for 18 Hawks.

not only facilitate the transfer of major defense technologies and industrial know-how, but represent a means by which complex organizational and managerial techniques, quality control methods, and technical skills can also be acquired. Judging from the plethora of agreements, both the Europeans and the third world are finding the marriage of their mutual needs in the defense sector to be compatible.

Part IV. The Future World Military Industrial System.

There can be little question that the trends described above are altering the character of the global arms trade. The world is facing a constantly escalating level of defense production in both quantitative and qualitative terms. Today's advanced military technology is tomorrow's intermediate-level weapon system, and through a network of offsets and joint ventures, today's buyer is often tomorrow's producer. [1]

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[1] The relationship between arms purchases and arms production is examined in Stephanie Neuman, "Arms Transfers, Indigenous Defense Production and Dependency," The Security of the Persian Gulf, Hossein Amirsadeghi (ed.), (London: Croom-Helm, 1981), pp. 131-150.

Nevertheless, although the world arms production system pictured here is dynamic rather than static, the indicators suggest that it will remain essentially hierarchical in structure. If the observations we have made here are accurate, then as the industrial capabilities of the member states grow, the inherent economic constraints of size and infrastructure can be expected to maintain the tiered character of the global defense production system described above. Although the capabilities of individual countries may advance or decline as a by-product of the process of technological diffusion, over time the unequal distribution of resources among states will tend to ensure and perpetuate a global hierarchy of capabilities.

History demonstrates that in the long run technology is highly perishable. It dissipates rapidly with time as the concept becomes broadly known and understood. Industrial leadership, whether civilian or military, is not protected by attempting to preserve existing and therefore obsolescing technical capabilities. As one technologist has observed: "Technical superiority is maintained most effectively by active continuous replenishment of 'old technology' through research and development."[1]

But as this paper has tried to demonstrate, the capability for sophisticated R & D is limited to a few industrial systems which stand at the apex of a stratified world military production

[1] Statement by Jack I. Hope, quoted in John F. Judge, "Exporting Technology: An Exercise in Ignorance," Government Executive, July 1977, (no page number).

system. As one study found, virtually all research and development takes place in industrialized countries, 85 percent in the U.S. and the Soviet Union alone.[1] In fact it is only these two states out of the world's 188+ sovereign entitities that have the size, capacity, wherewithall, and perceived need to produce a complete range of the most advanced weapons.[2]

A. Technological Change and the Structure of the System. The significance of this discrepancy in military production capabilities for the structure of the international system cannot be overlooked. Technological advances in the U.S. and U.S.S.R. industries are already transforming their military inventories and war fighting capabilities. For example, both the U.S. and the Soviet Union are seriously engaged in military-related R&D in laser technology. Both have research programs costing billions of dollars,[3] a price few other nations can afford.[4] It is

[1] If France and Britain are added, the share of the industrialized countries increases 90 percent. (Inga Thorsøn, "Study on Disarmament and Development," The Bulletin of Atomic Scientists, June/July 1982, pp. 41-44.) In general, third world countries have not had much success with their attempts to develop more advanced systems (e.g., high performance aircraft, long-range or complex missiles, main battle tanks, etc.) India's experience with the MiG-21 is a case in point. Fifteen years after production began, India found it necessary to import 40-50 percent of the components. On the basis of this and other findings, one study concludes that advanced systems manufactured independently by third world countries will continue to require considerable foreign assistance in both design and production. Foreign designers may be retained to design "indigenous" systems, but the independent design, development, and even production of advanced components is still many years away. (K. Nagaraja Rao and Jack Philip Ruina, Disarmament and Development: The Case of Relatively Advanced Developing Countries, unpublished research report, August 1980, pp. 21 and 29.

[2] Between the two superpowers, only the U.S. has been able to build and maintain the most sophisticated production and R&D bases which enables it to maintain a lead in technological innovation. Commenting on the U.S. advantage in certain weapon systems Maurice J. Mountain observes: " . . . the U.S. advantage derives in the first instance from superior guidance and control systems, liquid and solid propulsion systems, advanced computers, composite materials, basic airframe fastening techniques, active and passive sonar systems, cable technology and signal processing." ("The Continuing Complexities of Technology Transfer," Government Executive, January 1979, pp. 46.)

[3] According to one report, the Russians have had a research program devoted to the military uses of lasers underway since 1970 which costs "billions of dollars". The U.S. has spent "more than $2 billion in laser weapons research for more than a decade." ("The Coming Space War," Foreign Report, September 16, 1982, pp. 1-3.) Large increases in spending for military uses of space are planned over the next five years by the U.S. Department of Defense. The Reagan Administration plans to increase

[fn. cont. next page]

believed by some analysts, that the next generation of laser weapons will transform warfare on the ground and extend the battlefield to outer space possibil y within the next decade, making obsolete many existing conventional technologies.[1]

Developments in microelectronics and computers, areas in which the U.S. is said to enjoy an estimated five year lead over the Soviet Union, are already having these effects.[2] They have enabled the U.S. to produce a whole generation of so-called "smart weapons: or "precision guided munitions" (PGMs) which are easier to operate and maintain, smaller and lighter to transport, endowed with accuracy that approaches "one shot, one kill", and provide a stand-off capability which keeps operators isolated from the

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[fn. cont.]
the military space budget from the current $6.4 billion a year to $14 billion a year by FY 1988, without allowance for inflation. ("U.S. to Increase Military Funds for Space Uses," The New York Times, September 29, 1982, p. 1.)

[4]In the sphere of space technology, in general, the U.S. and U.S.S.R. lead. Military applications, explorations of space, manned orbital missions--all of these are beyond other countries' capabilities. Budgetary comparisons with Europe, for example, reveal that Europe's combined expenditure on space projects are less than 20 percent of the NASA budget, i.e. NASA's budget in 1981 amounted to $5.54 billion and Europe's to a little over $1 billion. (John H. Hoagland, Western Europe as a Space Power," Europe/America Letter, June 1982, pp. 15-30.

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[1]Former Air Force Secretary Hans Mark has been a strong proponent of laser research and its military-related potential. See his speech reported in the Albuquerque Journal, January 16, 1982. Dr. Patrick Friel, a former Department of Defense official, concurs with Secretary Mark. His views appear in Defense Daily, June 29, 1982, p. 326 and June 30, 1982, p. 332. Other specialists disagree, contending that laser technologies are not cost effective and that various countermeasures could easily defeat them. The most detailed analysis appears in a Massachusetts Institute of Technology study written by Kosta Tsipis and Michael Callahan and reported in The Wall Street Journal article "Laser Arms in Space Termed Impractical and a Potential Trigger to Nuclear War," December 22, 1980, p. 10.) But whether laser weapons prove to have a revolutionary effect on warfare or not, it is clear that space technology is the new military frontier--one that is dominated by only the U.S. and the U.S.S.R. If the military-related technological space revolution is not yet upon us, it is apparently coming.

[2]A large literature describing thse developments is available. Some examples are: William Perry and Cynthia A. Roberts,"Winning Through Sophistication: How to Meet the Russian Challenge," Technology Review, July 1982, pp. 27-35; David M. Russell, "PGMs Achieve Stand-off Range with Sophisticated Guidance Systems," Defense Electronics, November 1982, pp. 94-98; "Killer Electronic Weaponry: Tipping the Balance in Military Power," Business Week, September 20, 1982, pp. 74-77, 80, 84.

densest part of the battlefield. [1] Similarly, electronic cameras can now photograph enemy activity from great distances in the sky and relay precise images instantaneously to small ground read-out stations (small enough to fit into a van). [2] Computers built with very high speed integrated circuits (VHSIC)--tiny silicone chips that have tremendous signal-processing speed and capacity--will soon facilitate rapid communication among command posts, helicopters, armored vehicles, infantry, and reconnaissance satellites making possible a swift and coordinated tactical response.[3] As one analyst has observed:

> Traditionally, war is fought on the ground, at sea, and in the air. Now a fourth dimension is emerging which threatens to dominate warfare by the 21st century--the electromagnetic spectrum. An electronic war would respect no geographical border, nor service roles and missions. . .[4]

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[1] For example, an Army and Airforce program, "Assault Breaker", is developing an array of long-range missiles, mines, cluster bomblets, and other guided munitions that can be fired from aircraft as well as artillery. These weapons will be equipped with autonomous guidance systems which seek targets independent of the launching aircraft, allowing a plane to send a PGM toward a battle area and retreat before coming within detection range of the enemy air defense system. In a battle, for instance, if radar surveillance indicates that enemy armor is massing behind the front lines, one scenario uses a special missile which would be directed toward that area. Flying over the tanks, the missile would spew out 30 or more rockets that float slowly down on parachutes scanning the terrain below with sensors turned to find armored vehicles. When contact is made, these rockets cut their parachutes and swoop down on the tanks. It is estimated that one of these "Assault Breaker" missiles could destroy an entire tank company, up to 30 miles behond the battlefield. Eventually, it will be possible to sow some of these missiles like mines, which lie in wait until their sensors detect armor approaching and then ambush enemy tanks at short range. (See "Killer Electronic WEaponry," Business Week, p. 76; and "Tomorrow's infantry: more lethal and much swifter," Business Week, October 18, 1982, pp. 189-90, 194.)

[2] Infra-red sensors will soon make it possible to achieve a stand-off imaging capability under all weather conditions. Benjamin F. Schemmer, " 'Electronic Cameras' with Instantaneous Ground Read-out Now Make Real-time, Precision Tactical Targeting Operationally Feasible," Armed Forces Journal International, November 1982, pp. 70-72 (p. 70).

[3] Ibid. and "Tomorrow's infantry . . ." op. cit.

[4] Graham Warwick, "Electronics on the offensive," Flight International, October 23, 1982, PP. 1221-1222 (1221).

And another concluded even more enthusiastically:

> A turning point in the history of warfare was reached in 1982. A pair of brushfire wars finally proved what military strategists had increasingly been predicting: that the outcome of future battles will hinge less on how many tanks, ships, or aircraft are deployed than on the new technology of electronic warfare.[1]

The reverberations of these technological changes are being felt in defense establishments all over the world. In the U.S., each military service is in the process of developing separately and jointly new strategies for offensive and defensive warfare.[2] As a result, the Pentagon has set into motion a spiralling demand for increasingly sophisticated EW equipment, electronic countermeasures (ECM - designed to foil an enemy's use of EW) and electronic counter-counter measures (ECCMS - designed to thwart hostile ECMs). Accordingly, defense spending has shifted away from platforms (e.g. aircraft, armor and artillery, ships) to their weapons, information processing devices, and other electronic

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[1] "Killer Electronic Weaponry," Business Week, September 20, 1982, p.74.

[2] EW has prompted important changes in U.S. doctrine in all three services, which include striking deep behind enemy lines and using integrated tactics of destruction, disruption, and deception made possible by recent electronic innovations. The Army, for example, has a brand new doctrine called Air Land 2000 that stressses a more mobile, maneuverable, "counter strike" style of fighting designed to cope with larger numbers of enemy ground forces. (For a full description see: Deborah Shapley, "The Army's New Fighting Doctrine," The New York Times Magazine, November 28, 1982, pp. 36-42, 47,48,50,52,56; Tony Velocci, "Battle Doctrine for the 21st Century," National Defense, November 1982, pp. 11-14; "Tomorrow's Infantry: More lethal and much swifter," Business Week, October 18, 1982, pp. 189-190, 194; "Killer Electronic Weaponry,"Business Week, September 20, 1982, pp. 74-77,80,84).

The U.S. Navy has also completed an Electronic Master Plan devised to merge air and submarine defenses and to "orchestrate all the jamming, decoys, cover and deception measures available to carrier battle groups." ("Killer Electronic Weaponry," Ibid., pp. 76-77; see also, William J. Ruhe, "Antiship Missiles Launch New Tactics," U.S. Naval Institute Proceedings, December 1982, pp. 60-65; Norman Friedman, "Naval Airborne Early Warning," Naval Forces, No. V.,vol. III, pp. 78-82; Mark Reardon, "All the Chips at Sea: How Computers Have Revolutionized the U.S. Navy," Seapower, July 1982, pp. 24-30.)

The Airforce has set up a special Electromagnetic Combat Office responsible for coordinating EW research and plans for future contingencies. ("Killer Electronic Weaponry," Ibid., p. 76.)

items.[1] Demand has grown to the point that all three U.S. armed services are expected to more than double their funding for electronic warfare production and R&D by 1986.[2]

The Russians, working hard to close the technological gap with the U.S., are attempting to obtain production "know how" by all means possible.[3] The Europeans, too, are considering the application of a wide array of new conventional technologies to a revised NATO strategy which they believe will raise the threshold at which nuclear weapons would be used to blunt a Soviet attack. As Germany's former Undersecretary of Defense, Dr. Kurt Leister, commented: "While conventional weapons cannot 'replace' nuclear weapons, they can reduce our dependence on early use of nuclear weapons."[4] Understandably, there is considerable motivation on the part of the Russians and Europeans to incorporate modern electronic equipment into their force structures.

But constraints of scale and/or comparative advantage have slowed industrial progress in all countries except the U.S. As one European military officer remarked: "The price of this electronic

[1] See William Perry and Cynthia Roberts, op. cit.

[2] It has been predicted that the total American EW market will expand by 123 percent by 1986, representing a 14.5 percent rate of annual growth. ("14.5% Annual Growth for U.S. EW market," Defense Electronics, November 1982, pp. 52, 54, 56.

[3] An extensive literature on the control of technology transfers to the Soviet Union has appeared in academic journals and the press. Apparently, the areas of particular interest to the Russians are: microelectronics, computer know-how, especially in software and supercomputers, e.g. IBM-compatible data base management systems; ICBM (Intercontinental Ballistic Missiles) guidance systems; SLBM (Submarine Launched Ballistic Missiles) guidance systems; solid rocket propulsion technology; MIRV (Multiple Independently Targeted Re-entry Vehicle) ballistic missile capability--for digital computers onboard; signal processing software for satellite/antisubmarine sensors), laser weapons technology, and advanced composite metals techniques. (See: John Hillkirk, "Software is the stuff of espionage," USA Today, October 22, 1982, p. B-1; "Killer Electronic Weaponry," op. cit. pp. 77-78; James L. Buckley, "Control of Technology Transfers to the Soviet Union," Department of State Bulletin, August 1982, pp. 71-73; Gerhard Mally, "Technology Transfer Controls," Atlantic Community Quarterly, Fall 1982, pp. 233-238; Eugene B. Skolnikoff, "Technology Transfer and Security," Europe/America Letter, October 1982, pp. 18-26.

[4] Benjamin F. Schemmer, "NATO's New Strategy: Defend Forward, But Strike Deep," Armed Forces Journal International, November 1982, pp. 50,51,54,55,56,58,59,62,63,64, 65, 68.

[5] Defense and Foreign Affairs Weekly Report o
March 13, 1980. John Hoyt Williams, op. ci



one-upsmanship can escalate beyond the means of even industrialized Europe. How much can smaller countries afford?"[1] In the Soviet Union, where scale is not the problem, a centralized system of planning and supply, and the lack of economic incentive, apparently have prevented their high technology industries from keeping pace with U.S. technical advances.[2] As one analyst concludes:

> The United States still has a comparative advantage in developing new industries such as these. First, the United States has the largest and most innovative complex of scientific institutions in the world, the main source of the industries of the future. Second, the United States has by far the largest defense budget among its allies. This has provided and can continue to provide, through long-term procurement contracts, exactly what new companies in new industries need to get them through the first, difficult stages of growth.[3]

For third world countries, these developments must demonstrate how difficult it will be for them to change the existing world military-industrial balance. If even in the United States, the exacting production and technical skills required by increasingly sophisticated EW devices threaten to concentrate production in larger companies already experienced in electronics' manufacture, and eliminate many smaller and/or new companies from the market,[4] then what competitive advantage can industries in the developing countries hope for? Their

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[1] "NATO Leaders Propose More High Tech Weapons," Baltimore Sun, December 2, 1982, p. 4.

[2] William Perry and Cynthia Roberts, op. cit., p.30.

[3] James R. Kurth, "Military Power and Industrial Competitiveness: The Industrial Dimension of Military Strategy," Naval War College Review, September/October 1982.

[4] "Killer Electronic Weaponry," op. cit., pp. 80 & 84.

prospects must seem grim indeed. For by the time even the most industrially advanced third world countries master today's conventional technologies, these systems will be out-of-date, and the LDC industries will be caught in a game of "catch-up" again.[1]

Other developments in microelectronics also hold negative promise for third world industries. Computerization of the factors of production and assemblies in the North threaten to erode their current comparative advantage of lower labor costs, and diminish the incentives for Western industries to locate assembly plants in the LDCs.

B. The U.S.' Competitive Advantage.

Evidence of the U.S. competitive advantage, the product-life cycle at work, and the enduring structure of the world's military industrial capabilities, can be found in Table 9. Between 1972 and 1981, the total number of weapon systems delivered by the U.S. to the third world declined, and the U.S. share of exports dropped in all categories except the most advanced , e.g. supersonic combat aircraft and surface-to-air missiles. The data imply, that as military products have aged, other suppliers (chiefly European) have acquired a larger share of U.S. markets in the third world (e.g.: light armor, warships, small submarines, subsonic aircraft [trainers],

[1]The difficulties U.S. industries face in gearing-up for production of new technologies serve to illustrate the problem. For example, normally it takes an American company three-and-a-half to five years to build a new plant of any size and get it into production; finding sufficiently trained technicians has become an equally time-consuming effort. Technology has become so advanced, unskilled labor cannot be quickly retrained as was the practice in the U.S. during WWII. "The tolerances are too tight, the equipment too sophisticated. It takes three years for a machinist apprentice to complete his rigorous course; the better part of a year to retrain someone who has been producing autos to work on high technology aerospace parts. . ."
Robert J. Carlson, "Strengthening the Defense Industrial Base: An Aircraft Engine Manufacturer's View," Paper delivered before a Conference of The Scientists Institute for Public Information, Boston, Mass.: The Harvard Center for Science and International Affairs, The American Academy of Arts and Sciences, May 10, 1982, p. 3.

Table 9

Number and Percent of Major Weapon Systems Delivered to the Third World by Suppliers: A Comparison Between 1972 and 1981*

| | 1972 | | 1981 | | |
|---|---|---|---|---|---|
| | No. | % | No. | % | % Change |
| **GROUND WEAPONS** | | | | | |
| **Tanks and Self-Propelled Guns** | | | | | |
| US | 430 | 18.0 | 255 | 10.9 | - 7.1 |
| USSR | 770 | 32.3 | 1060 | 45.2 | +12.9 |
| Other Communist European | 280 | 11.7 | 325 | 13.9 | + 2.2 |
| Major West European | 205 | 8.6 | 110 | 4.6 | - 4.0 |
| Minor West European | - | - | 140 | 6.0 | + 6.0 |
| Other | 700 | 29.4 | 455 | 19.4 | -10.0 |
| Total | 2385 | | 2345 | | |
| **Light Armor** | | | | | |
| US | 910 | 32.3 | 470 | 19.0 | -13.3 |
| USSR | 955 | 34.0 | 1005 | 40.6 | + 6.6 |
| Other Communist European | 300 | 10.7 | - | - | -10.7 |
| Major West European | 540 | 19.2 | 885 | 35.8 | +16.6 |
| Minor West European | - | - | 30 | 1.2 | + 1.2 |
| Other | 110 | 3.9 | 85 | 3.4 | - 0.5 |
| Total | 2815 | | 2475 | | |
| **Artillery** | | | | | |
| US | 1150 | 13.7 | 380 | 9.0 | - 4.7 |
| USSR | 730 | 8.7 | 1060 | 25.1 | +16.4 |
| Other Communist European | 1275 | 15.2 | 590 | 14.0 | - 1.2 |
| Major West European | 310 | 3.7 | 120 | 2.8 | - 0.9 |
| Minor West European | 230 | 2.7 | 305 | 7.2 | + 4.5 |
| Other | 4695 | 56.0 | 1775 | 42.0 | -14.0 |
| Total | 8390 | | 4230 | | |
| **NAVAL WEAPONS** | | | | | |
| **Major Surface Warships** | | | | | |
| US | 5 | 50.0 | 10 | 24.4 | +25.6 |
| USSR | 2 | 20.0 | 7 | 17.1 | - 2.9 |
| Other Communist European | - | - | 1 | 2.4 | + 2.4 |
| Major West European | 3 | 30.0 | 16 | 39.0 | + 9.0 |
| Minor West European | - | - | 3 | 7.3 | + 7.3 |
| Other | - | - | 4 | 9.8 | + 9.8 |
| Total | 10 | | 41 | | |
| **Minor Surface Warships** | | | | | |
| US | 28 | 26.2 | 5 | 7.4 | -18.8 |
| USSR | 15 | 14.0 | 14 | 20.6 | + 6.6 |
| Other Communist European | 1 | 0.9 | - | - | - 0.9 |
| Major West European | 29 | 27.1 | 20 | 29.4 | + 2.3 |
| Minor West European | - | - | 24 | 35.3 | +35.3 |
| Other | 34 | 31.8 | 5 | 7.4 | -24.4 |
| Total | 107 | | 68 | | |
| **Guided Missile Boats** | | | | | |
| US | - | - | - | - | - |
| USSR | 13 | 92.9 | 7 | 35.0 | -57.9 |
| Other Communist European | - | - | - | - | - |
| Major West European | 1 | 7.1 | 9 | 45.0 | +37.9 |
| Minor West European | - | - | - | - | - |
| Other | - | - | 4 | 20.0 | +20.0 |
| Total | 14 | | 20 | | |
| **Submarines** | | | | | |
| US | 5 | 41.7 | - | - | -41.7 |
| USSR | 2 | 16.7 | 1 | 20.0 | + 3.3 |
| Other Communist European | - | - | - | - | - |
| Major West European | 3 | 25.0 | 4 | 80.0 | +55.0 |
| Minor West European | - | - | - | - | - |
| Other | 2 | 16.7 | - | - | -16.7 |
| Total | 12 | | 5 | | |

| | 1972 | | 1981 | | |
|---|---|---|---|---|---|
| | No. | % | No. | % | % Change |
| **AIR WEAPONS** | | | | | |
| **Supersonic Combat AC**** | | | | | |
| US | 70 | 14.7 | 165 | 24.8 | +10.1 |
| USSR | 235 | 49.5 | 425 | 63.9 | +14.4 |
| Other Communist European | - | - | - | - | - |
| Major West European | 65 | 13.7 | 35 | 5.3 | - 8.4 |
| Minor West European | 15 | 3.2 | - | - | - 3.2 |
| Other | 90 | 19.0 | 40 | 6.0 | -13.0 |
| Total | 475 | | 665 | | |
| **Subsonic Combat AC** | | | | | |
| US | 170 | 66.7 | 75 | 53.6 | -13.1 |
| USSR | 55 | 21.6 | 10 | 7.1 | -14.5 |
| Other Communist European | 5 | 2.0 | 5 | 3.6 | + 1.6 |
| Major West European | 5 | 2.0 | 30 | 21.4 | +19.4 |
| Minor West European | - | - | - | - | - |
| Other | 20 | 7.8 | 20 | 14.3 | + 6.5 |
| Total | 255 | | 140 | | |
| **Helicopters** | | | | | |
| US | 550 | 67.5 | 15 | 38 | -63.7 |
| USSR | 95 | 11.7 | 195 | 48.8 | +37.1 |
| Other Communist European | - | - | 75 | 8.8 | + 8.8 |
| Major West European | 170 | 21.0 | 145 | 36.3 | +15.3 |
| Minor West European | - | - | 5 | 1.3 | + 1.3 |
| Other | - | - | 5 | 1.3 | + 1.3 |
| Total | 815 | | 400 | | |
| **Other Military AC** | | | | | |
| US | 550 | 70.5 | 75 | 14.0 | -56.5 |
| USSR | 15 | 1.9 | 90 | 16.8 | +14.9 |
| Other Communist European | 35 | 4.5 | 80 | 15.0 | +10.5 |
| Major West European | 110 | 14.1 | 55 | 10.3 | - 3.8 |
| Minor West European | 45 | 5.8 | 130 | 24.3 | +18.5 |
| Other | 25 | 3.2 | 105 | 19.6 | +16.4 |
| Total | 780 | | 535 | | |
| **Surface to Air Missiles** | | | | | |
| US | 400 | 20.5 | 480 | 47.1 | +26.6 |
| USSR | 1340 | 68.7 | 300 | 29.4 | -39.3 |
| Other Communist European | - | - | - | - | - |
| Major West European | 210 | 10.8 | 40 | 3.9 | - 6.9 |
| Minor West European | - | - | - | - | - |
| Other | - | - | 200 | 19.6 | +19.6 |
| Total | 1950 | | 1020 | | |

*Source: Derived from--U.S. Department of State, Conventional Arms Transfers in the Third World, 1972-1981, August 1982.

**AC=aircraft

[1]The categories of weapons include: Ground Weapons--heavy armor (light medium, and heavy tanks and self-propelled guns), light armor (armored personnel carriers, infantry combat and armored reconnaissance vehicles, scout cars), artillery (tube artillery, multiple-rocket launchers, mortars and recoilless rifles over 100mm); Naval Weapons-- major surface vessels (warships of destroyer escort and larger size, tank landing ships, and larger amphibious vessels, including minesweepers and landing craft), submarines and guided-missile patrol boats; Air Weapons--combat aircraft (bombers, fighters, attack aircraft and armed trainer/light strike planes), helicopters, and other military aircraft (transports, communications or utility, antisubmarine warfare, and unarmed trainers).

[2]"Other European Communist" includes: Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, and Yugoslavia.

[3]"Major West European" includes: France, West Germany, Italy, and the United Kingdom.

[4]"Minor West European" includes: Austria, Belgium, Finland, Greece, Ireland, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and Turkey.

[5]"Other" includes: 60 or more other countries which transfer weapons to the third world. Many if not most of the major weapon systems transferred are "re-transfers" (re-exports of older weapons acquired elsewhere). Brazil, Israel, and China are exceptions, exporting indigenously produced military items as well as retransfers.

and other military aircraft [mainly transports]).[1] But in those military items requiring new, advanced technologies, the U.S. has increased its share of exports to the third world.[2] Were export data available on deliveries of different kinds of missiles (such as air-to-air [e.g., the AIM-9L] or air-to-ground [e.g., laser guided] missiles), radars, communication equipment, surveillance planes (AWACs and E2Cs), avionics, composite materials know-how, and other advanced components, the U.S. lead in exports to the third world would no doubt appear even more pronounced.[3]

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[1]The major weapon system deliveries registered in Table 9. for "Minor West European" and "Other" are mainly re-exports. In the "Other" category of the 60+ countries which transfer arms to LDCs, Brazil, Israel, China, South Africa, India, and Argentina export indigenously produced military items as well.

[2]Although the Soviet Union also increased its share of the supersonic fighter market in the third world, it lost 39.3 percentage points in deliveries of surface-to-air missiles. It is interesting to note that the shift away from platforms (to their weapons) in U.S. defense spending has been mirrored in the decline of U.S. platform deliveries to the LDCs in 1981, and a rise in Soviet and European deliveries in this category.

It is expected that American EW companies will experience a rapid growth in export sales, particularly after the demonstrated skill of U.S. EW equipment during the 1982 Lebanon War. See: Drew Middleton, "Soviet Arms Come in Second in Lebanon," The New York Times, September 19, 1982, p. E 2; Anthony H. Cordesman, "The Sixth Arab-Israeli Conflict: Military Lessons for American Defense Planning," Armed Forces Journal International, August 1982, pp. 29, 30, 32 (pp. 30 & 32); "Lebanon Proved Effectiveness of Israeli EW Innovations," Defense Electronics, October 1982, pp. 41-44; Richard C. Gross, "The Air War Over Lebanon: TACs Advantage," Defense Science and Electronics, vol. I, no. 3, pp. 11-12, 19 & 80; "Killer Electronic Weaponry," op. cit., p. 84.

[3]The 1981 U.S. decision to sell Saudi Arabia five Boeing E-3A AWACS and other equipment (for $8.5 billion) is a case in point. In addition to the AWACS, the package includes 6 KC-135 aerial refuelling tankers, 1,177 AIM-9L Sidewinder air-to-air missiles and long range fuel tanks for the 62 F-15 fighter aircraft already on order, and 22 ground based radar installations. As The State Department data (upon which Table 9. is based) is now organized, only the aircraft would be included in number of deliveries. The missiles, fuel tanks, and radar installations would not be represented. If several other 1981 U.S. arms transfer agreements are considered: e.g., 24 F-16 fighter aircraft to Venezuela; 36 F-16s to Korea (costing $900 million); 40 F-16s to Pakistan -- part of a $3.2 billion five-year military and economic aid package which includes anti-tank missiles, and advanced communication systems, it is apparent that the observed increase of advanced American military equipment deliveries to the third world in 1981 will be repeated in subsequent years. (See SIPRI YEARBOOK, 1982, pp. 177-82 for further discussion of U.S. arms transfer agreements with the LDCs.)

The dollar value of arms sales to the third world presented in Table 10. suggests this is so.[1] Because factors of cost and technological sophistication are generally closely related, the fact that the U.S., in spite of the declining number of deliveries, still commands the largest dollar share of third world arms sales implies that the demand for and transfer of advanced American technology is greatly responsible for continued U.S. predominance in the LDC arms market.[2] This finding also underscores what we have hypothesized, namely that it is the factors of scale and comparative advantage which structure the world's arms trade and to-date constrain military industrial production in other countries. Apparently, contrary to the predictions of interdependence theorists, the process of technological innovation promises not future world equality, but the perpetuation of an hierarchically ordered world military industrial system.

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[1]Although the various data sources do not agree on the dollar value of individual suppliers' deliveries, nor do they present equivalent information, there is general concensus among them that in terms of dollars earned, U.S. arms sales dominate the third world's arms trade. See: United States Department of State, Conventional Arms Transfers in the Third World, 1972-81, August 1982, which presents the dollar value of arms agreements, and Table 10, which is based on the SIPRI YEARBOOK, 1982 dollar value estimates of arms deliveries to the third world.

[2]Given the size and content of the arms sales described above (fn. 3, p. 61), it can be expected that the dollar value of U.S. deliveries in this category will increase appeciably during the 1980s. It should be pointed out that Tables 9. and 10. underestimate the export activity of the major suppliers in general and of the U.S. in particular. The U.S. State Department data, from which Tables 9. and 10. are derived, incorporate all major weapon systems but not licensing and servicing fees, manufacturing equipment or component exports. To take only one example of the data distortion which occurs -- the American components in Brazil's Bandeirante, which total 54 percent of the cost of the aircraft are not counted as U.S. exports. Rather the total export value of the finished Bandeirante aircraft is credited to Brazil (in the "Other" category). The omission of licensing fees underestimates the dollar value of U.S. and Western European exports specifically, since the Soviet Union is less forthcoming in permitting licensed production of their major weapons. SIPRI Registers identify 61 U.S. major weapons being produced under license outside the U.S., while the Soviet Union has only 10 similar arrangements with Czechoslovakia, Poland, and India. (SIPRI YEARBOOK 1982, p. 185.)

Table 10.

$ Shares of Exports of Major Weapons to the Third World By Supplier 1972-1981*

(U.S. $ million, at constant 1975 prices)

| Country | 1972-1976 | % | 1977-1981 | % | % Change |
|---|---|---|---|---|---|
| USA | 9,787 | 38 | 17,696 | 37 | -1 |
| USSR | 8,499 | 33 | 15,783 | 33 | 0 |
| France | 2,576 | 10 | 5,740 | 12 | +2 |
| United Kingdom | 2,318 | 9 | 1,913 | 4 | -5 |
| Italy | 515 | 2 | 2,392 | 5 | +3 |
| Others | 2,060 | 8 | 4,305 | 9 | +1 |
| Total | 25,755 | | 42,315 | | |

*Source: Derived from SIPRI YEARBOOK, 1982, p. 177. The data represent deliveries of major conventional weapons: aircraft, warships, armored vehicles, and missiles.

C. Into the Crystal Ball.

Conclusions drawn from this paper suggest first: that today's leading LIC arms producers, Argentina, Brazil, China, Israel, India, South Africa (and to a lesser extent South Korea and Taiwan), are unlikely to be followed by a second tier of LIC competitors. This is not to imply that other third world countries will not expand their military industrial capabilities and even supplant some of today's LIC producers.[1] Rather, the data suggest that because most third world countries lack the combination of socio-economic preconditions (financial resources, a sizable pool of trained manpower, and a large military) requisite for a viable military industry, the number of LIC producers of major weapons is likely to remain limited.

Second, the data indicate that the successes of LDC producers to date are narrowly based and their entry into the increasingly sophisticated range of military industries is becoming progressively more difficult. Just as the LDC producers are beginning to come to terms with existing platform technologies, the U.S. and U.S.S.R. are expanding their military industrial horizons, creating a demand for new, advanced products all over the world, and condemning third world industries to yet another round of "catch up."

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[1] As discussed above, p.36, political factors can create, at least for a time, both "over-achievers" and under-achievers" within the ranks of LDC arms producers. Over the long-run this may prove equally true for European arms industries. One might argue that the relative inability of Western European governments--for fear of the political consequences of laying off employees--to permit any sector of their arms industries to reduce capacity despite inadequate demand, is an exercise in "over-achievement" which factors of scale will eventually normalize.

What, then, can be read in the crystal ball? How will the global arms transfer system develop in the future? How will the new producers be integrated into the established framework of the arms trade? What will their role be and how will it impact on the interests of the major industrialized suppliers?

As implied by the analysis of arms exports above, the world is witnessing a revolution in defense planning and procurement practices which in turn are creating a new global division of labor in the military sector. Rising weapons' costs which have accompanied rapid technological innovation are placing increasing pressure on militaries in the major industrialized countries to keep platforms in service for longer periods, while spending available monies on improving the weapons they carry. As internal markets for new platforms shrink among the major powers, fewer older models will be available for sale to third world countries[1] and the prohibitive costs of sophisticated major weapon systems promise to keep LDC demand for them low.

First /within the industrialized world, some restructuring among military industries is probably inevitable. Retrofitting and the upgrading of existing systems for internal use promise to absorb increasing amounts of production time among former

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[1] Within U.S. industrial circles, thought has been given to the conversion of surplus civilian aircraft for export to industrializing countries. Some believe these used carriers (e.g., DC-8s, Boeing 707s, Boeing 747s, DC-10s) can be upgraded and retrofitted for use by third world militaries. Israel, perhaps in anticipation of such a market, has perfected an air-refueling device which can be used for the Boeing 707. (Interviews with U.S. and Israeli defense industry representatives).

platform fabricators,[1] while increasing demand for new engines, components, microelectronics, laser technologies, etc. will encourage diversification among older industries and the growth of new ones.

To meet the continuing demand for military technology from third world countries, particularly those with limited financial resources, various changes in the world market can be anticipated. First, in the industrialized world, a rise in the custom design, development, and production of "export only systems," financed by the buyer or "on speculation" by the manufacturer already has begun. Northrop's F-5G and the French Mirage F-3GN are only two examples.[2] These systems are designed for countries which cannot maintain and/or afford the more expensive and sophisticated versions, and are also often better tailored to the customer's regional defense requirements than the advanced items designed and developed for the European battlefront.

Second, in response to the economic needs of third world countries, and the new production realities within the industrialized world, an increase in various kinds of "offset," arrangements

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1 Computers, for example, in a variety of shapes, sizes, and capabilities are being installed ("embedded") in almost every ship, plane, and weapon system--old and new--in the Pentagon's inventory. Computers are being used for everything from sighting guns, processing radar and sonar signals with tremendous speeds, providing rapid data handling for battle command systems, to the more mundane task of monitoring fuel levels. ("Rule Dispute Snarls Military Computers," Baltimore Sun, November 21, 1982, p.1). The Luftwaffe is now also extending the service lives of its Phantoms by installing new weapon system computers in over 160 of their F4Fs. Future prospects include upgrading to increase airframe life from 4,000 to 6,000 hours and a fitment of look-down radar to be purchased from the U.S. (Milavnews, January 1983, p. 9).

2 The Northrop Corporation developed the F-5G without government funds, and without specific orders, put it into production, with the expectation that there will be a market for more than 1,000 intermediate-level aircraft. (Benjamin F. Schemmer, "Pressures Build For DOD to Buy and Help Sell Northrop F-5G as its Business Prospects Look Bleaker Than Advertised," Armed Forces Journal International, September 1982, pp. 88-104). The Mirage F-3GN was designed with a similar market in mind, see fn 2, p45 above.

is already underway and can be expected to continue. More third world states are searching for means of reducing costs by performing some kind of production task (such as assembly, and/or some component manufacture) in-country, or by exporting items back to the original supplier.[1] As noted above, European manufacturers have accepted these arrangements as part of the price of doing business in the third world (and demand similar concessions from U.S. defense industries for their own purchases), but thus far the official American response has been less than enthusiastic. Present trends indicate, however, that "offset" agreements in various guises will be the future currency of the arms transfer system,[2] and if the U.S. wishes to compete, it will have to negotiate similar arrangements.

Third, there will be a growth in the licensing to and production of older, or de-graded military technologies in the LDCs.[3] In addition, to the simpler components, larger numbers of subsonic aircraft, transports, medium and light armored vehicles, missile patrol boats, frigates, patrol submarines, tactical missile systems, radars, and some battle field electronics will be manufactured or assembled

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[1] When procurement of a complex and costly weapon system from a foreign supplier is pending, the LDC government in question is confronted by one or more of the following interrelated problems: 1) the outflow of foreign currencies; 2) an increase in technical and logistic dependency; and 3) the under-utilization of domestic defense industrial facilities and skilled labor (where they exist). In order to lessen or "offset" these negative features, the procuring country will demand either compensation for all or part of the worth of the purchase in reciprocal exports, or it will insist on coproduction of the weapon system in-country. The Brazilian Government, for example, requires 50 percent offsets on all aviation imports. Some of these offsets have been achieved through co-production agreements, but others have been realized through non-military exports, e.g. coffee, sugar, soybeans, and other agricultural products. "Latin American Leaders Offer Challenge to U.S. Industry," Aviation Week and Space Technology, June 21, 1982, pp. 60-61.

[2] Barter agreements between European arms suppliers and third world oil producers, although not often publicly mentioned, are becoming more common as "offsets". For example, between 1978 and 1980 Saudi Arabia's orders represented 20% of total French arms exports. Subsequently, one-half of France's oil imports came from Saudi Arabia. Similar arrangements were struck with the Iraqis. (Roger Faligot,"Arms for the Middle East: Mitterand puts the profit motive first," The Middle East, October 1982, pp. 23-26.)

[fn. cont. next page]

under license in the third world and in some of the smaller European countries, whereas the manufacture of these items (in both number and variety) will decline in the larger, advanced industrial societies.

Fourthly, it is also likely that trade between third world countries will grow and broaden to include many small European states (e.g. Sweden, the Netherlands, Spain, Belgium, Switzerland, Austria, Czechoslovakia, Poland, Yugoslavia). More of the LDCs are choosing to diversify their sources of weapon supply,[1] in spite of the attendant maintenance problems, rather than subject themselves to the political pressures associated with single source supply relationships. Past and present lessons in this regard, have not been lost on the system's weaker states, and increased self-help among them can be expected in the future.

Mutually advantageous trade agreements are most likely to evolve between the smaller European states (those cited above, including Australia, New Zealand, and Canada are already active in this area) which specialize in the production of one or more high technology systems (or subsystems), and third world countries which seek to either purchase items they do not manufacture, or to upgrade older weapons currently in service. Smaller European countries can also provide training or technical assistance,[2]

[fn. cont.,] Thailand, for example, will assemble 47 of the 53 Fantrainer 60s aircraft has purchased from the FRG, as part of a coproduction agreement which also allows for some domestic component manufacture. This will include wings, the construction of which will be changed from the present composites, to an all metal structure more suited to the capabilities of Thailand's emergent aerospace industry. (Milavnews, October 1982, p. 21).

[1] See discussion of intra-third world trade, above pp. 46-49.

[2] Examples include Iraq, which during 1982 received supplies from Spain and Switzerland, in addition to France and the U.S. Spain has also been linked unofficially with the training of Iraqi pilots and ground crews. Switzerland is reported to have overhauled helicopters for the Iraqis. Argentina has purchased 27 Kurassier Ught tanks from Austria and the Benin government took delivery with 1982 of a transport plane from Holland. Bolivia plans to purchase all 52 of Belgium's surplus F-104G Starfigliters. (Milavnews, January 1983, pp. 1-24).

and in some instances serve as a source for older surplus military equipment. Barter arrangements which exchange natural resources such as oil, perhaps other manufactured goods--including military-related items produced in third world industries, to offset the cost of military assistance, will probably be a logical next step for resource needy Europeans and the financially strapped LDCs.

As noted above, similar developments are now underway in the third world, with the more industrially advanced beginning to provide like services to the less industrialized among them.[1] Here barter financing already characterizes an increasing number of military sales.[2]

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[1] Older military equipment, usually purchased elsewhere, rather than indigenously produced weapon systems, make-up a large proportion of the intra-third world arms trade. All of Libya's and Saudi Arabia's exports, for example, are third country transfers. Argentina's orders from Israel in 1982/3 are reported to include 22 Israeli produced versions of the French Mirage 5 (Daggers) as well as 16 French Mirage IIICJs, and 18 U.S. A-4E/Skyhawks. The Argentinians have also purchased 10 French Mirage 5Ps from Peru and 12 EMB 326 Xavante armed trainers made by Brazil. It is rumored that Israel is offering sizable stocks of weapons captured from the PLO in Lebanon (which were, for the most part, retransfers themselves) at very low prices to Costa Rica, Honduras, El Salvador and Guatemala. (Milavnews, January 1983, pp. 1-2, and 19). Thus arms provided by LDC suppliers represent a mixed bag of third country transfers and domestically produced items with the largest proportion represented by the former rather than the latter.

[2] Recent examples include Iran and North Korea. It is reported that in return for oil shipments and hard currency, North Korea has been the source of about 40 percent of the $2 billion worth of weapons, ammunition, and equipment acquired by Iran in 1982. Supplies have included 150 T-62 tanks, 400 guns, 1,000 mortars, 600 AA guns and 12,000 smaller weapons and ammunition of Soviet, Chinese and indigenous origin. North Korea also despatched 300 military instructors to train Iranian forces. Iran's suppliers during 1982 included Libya, Syria, Israel, the U.S.S.R. and several European countries. (Milavnews, January 1983, p. 20).

Brazil too, has been negotiating barter arms sales. To compete with British and French companies, a team of Brazilian negotiators "appears ready to close a sizable contract for armored vehicles with Nigeria-possibly a barter arrangement for petroleum." A similar arrangement seems imminent with the Congo and oil-rich Angola. Commenting on these developments, one observer writes: "There is no indication that the Brazilian drive (to sell arms) will lessen in the future: quite the contrary . . . The economic "miracle" of the early 1970's, threatened by OPEC's spiralling prices (Brazil imports three-quarters of its oil) literally demands that Brazil increase its exports in all areas . . . The fact that many of the major weapons

Statistical evidence of these trends can be found in almost all available data. Table 11., below derived from SIPRI Registers, shows the extent to which LDC recipients are diversifying their sources of supply. Between 1971/2 and 1981/2, the number of third world states receiving arms from four or more suppliers trebled, rising from 10 to 32. By 1981/2, thirty-nine percent of the LDCs receiving arms were acquiring them from four or more sources, a rise of 24 percentage points over 1971/2, while other categories of recipients--those receiving arms from one, two, or three suppliers--declined in number.[1]

Table 9. (above) based on State Department figures, indicates that since 1972 there has been a significant rise in the number of weapon systems transferred to the less industrialized states from "Minor European States" in all their export categories other than supersonic aircraft. And Table 12., (below) derived from SIPRI data, shows the rising proportion of LDCs receiving military equipment from the smaller European and other third world states. The number of industrializing states supplied by the former rose from 24.2 percent in 1971/2 to 46.9 in 1981/2 (an increase of 23 percentage points); the number receiving arms from the latter grew from 18.2 percent to 26.3 percent during the same time period, an increase of 26 percentage points.

(footnote cont'd)

sales have been made to oil-exporting nations (Libya, Iraq, Qatar, Abu Dhabi, Angola, Nigeria, Indonesia) reveals a . . . compelling motivation." (John Hoyt Williams, "Brazil: Giant of the Southern Hemisphere," National Defense, November 1982, p. 20).

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1 In addition to Iran, discussed above (fn 2, p. 72), there are many examples of diversified sources of supply to third world states in 1983. These include: Iraq which has and will receive military equipment from France, the U.S., Spain, Switzerland, and possibly West Germany. Argentina has committed itself to the purchase of over $1 billion for arms replacement from Israel, Peru, Brazil, France, Austria, West Germany, and possibly the Soviet Union. Egypt will receive defense items from China, France, the U.S. and Great Britain. India has contracted to purchase weapons from France, the U.K., West Germany, and the U.S. (Milavnews, January 1983, pp. 1-24).

Table 11.

Diversification of Military Suppliers:
Number of Third World Countries
Receiving Arms From One, Two, Three, or Four + Suppliers
1972/3 - 1981/2

| | 1972/3 No. of 3rd World Recipients (66) | | 1981/2 No. of 3rd World Recipients (83) | | % Change |
|---|---|---|---|---|---|
| | No. | % | No. | % | |
| No. of Suppliers | | | | | |
| One Supplier | 30 | 46.0 | 24 | 29.0 | - 17.0 |
| Two Suppliers | 15 | 23.0 | 19 | 23.0 | 0.0 |
| Three Suppliers | 11 | 17.0 | 8 | 10.0 | - 7.0 |
| Over Four Suppliers | 10 | 15.0 | 32 | 39.0 | + 24.0 |

Source: Derived from SIPRI Register of World's Arms Trade, SIPRI YEARBOOK, 197 , pp. 267-286; SIPRI YEARBOOK, 1982, pp. 194-238.

Table 12.

Number of Third World Countries
Receiving Major Weapon Systems
By Regional Suppliers
1972/3 - 1981/2

| Regional Suppliers | 1972/3 No. of 3rd World Recipients (66) No. | % | 1981/2 No. of 3rd World Recipients (83) No. | % | % Change |
|---|---|---|---|---|---|
| U.S./U.S.S.R. | 42 | 63.6 | 59 | 71.1 | + 7.5 |
| Major European States* | 40 | 60.6 | 52 | 62.7 | + 2.1 |
| Minor European States** | 16 | 24.2 | 39 | 46.9 | +22.7 |
| Third World States*** | 12 | 18.2 | 37 | 44.5 | +26.3 |

Source: Derived from SIPRI Register of the World's Arms Trade, SIPRI YEARBOOK, 197 , pp. 267-286; SIPRI YEARBOOK, 1982, pp. 194-238.

*France, United Kingdom, Italy, Federal Republic of Germany

**Austria, the Netherlands, Belgium, Spain, Switzerland, Sweden, Ireland, Yugoslavia, Poland, Democratic Republic of Germany, Czechoslovakia; also includes Australia, Canada, and New Zealand

***China, Israel, Brazil, Argentina, South Africa, South Korea, Libya, Iraq, Saudi Arabia, Egypt, Indonesia, Singapore, India, Turkey, Algeria, Chile, Iran

Conclusion

Thus, a division of labor within the world's military industrial production and arms transfer systems seems about to take place. The two largest and most industrialized states -- the U.S. and U.S.S.R. -- will specialize in the research and development of the world's most sophisticated technologies.[1] Gradually, the composition of their exports will shift from complete weapon systems to other kinds of defense-related equipment and services. For the rest of the world's smaller and/or less industrialized states, symbiotic relationships will emerge involving cooperative manufacturing and trade relationships. In such a system, the future for the larger, industrially advanced LDCs is not unpromising. There will be opportunities for them to handle not only more complex production tasks, but the manufacture and export of intermediate-level weapon systems, components, and miscellaneous services to other third world and small country buyers, and perhaps to the industrial giants as well.

However, although the new division of labor implies a greater degree of interdependence in the world's arms production and trade system, it also implies the perpetuation of a considerable amount of dependency for the smaller or less industrialized states. There is, for example, no sign that the LDCs will ever reach a saturation point in their demand for advanced components, composite materials, computers, computer software, engines, simulators,

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[1] It is not inconceivable that China will one day join the ranks of the world's sophisticated arms producers, since its size provides the necessary factors of scale to make such production possible and profitable. Political factors and economic constraints, however, make such an eventuality a very long-term possibility.

scientific instruments, etc. which remain beyond their production capabilities. Nor is there a liklihood that the foreign exchange earned from the direct licensing fees, technical data, packages, or knock-down assembly kits and associated support services will diminish for the major industrialized producers. Licensing, coproduction, and joint venture agreements still require large-scale assistance from the supplier, e.g. tooling equipment, and the inevitable servicing and up-grading of that equipment;[1] training in manufacturing and operating procedures; refitting to upgrade weapon platforms already in service; and in some instances the provision of complete turnkey factories, often including managerial and technical personnel from the seller country.[2] The growth of these service and production industries promise to more than compensate for any decline in the number of jobs or loss of exports due to the manufacture of other defense items in industrializing countries.[3] Therefore, given the high

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[1] Complex tooling technology often changes more rapidly than the item it produces. Newer, more efficient manufacturing techniques are constantly introduced in order to keep manufacturing costs down and remain competititve. (Interview with State Department official, January 1983.)

[2] The Soviet Union, for instance, has offered to train personnel and set up fully operative plants for the production of the latest model MiGs in India. ("Soviet Union Says Its Eager to Help India Produce Arms," The New York Times, March 20, 1982.) A French industrial group has been discussing with the Argentine government the possibility of building a factory in Buenos Aires for the production of French armored vehicles under license. (Aviation Week and Space Technology, September 1982.) The Chinese have already provided Pakistan with a complete factory for assembly and overhaul, see above, p. 48.

[3] The typical cost for a jet aircraft, for example, generally breaks down into one-third for the air frame, one-third for the engine, and one-third for the avionics. Most developing countries are dependent on major suppliers for the latter two items, or at least two-thirds the cost of the plane. Brazil serves as a good illustration. Although Brazil has stopped buying fly-away military jet aircraft from the U.S. (because of domestic production), it continues to purchase components, transportation and commercial aircraft. Therefore, U.S. aeronautical exports to Brazil totalled $192.8 million in 1981. Of this $115 million was for Piper kits and other parts and components. Another $41 million was for commercial transports and $636 thousand was for piston engine aircraft. ("Brazilian Export Policy Sparks Criticism," Aviation Week and Space Technology, June 21, 1982, pp. 60-1.)

cost of modern weapons, for the industrialized North the constant dollar value of the flow of military technology to the South gives every indication of not only maintaining itself but rising.

Obviously, some LICs have and will become successful producers and exporters of one or more of the major weapon systems; but for every LIC which becomes a net exporter of planes, or ships, or armored fighting vehicles, the more industrialized countries, by specializing in high technologies and investing generously in R&D, will have little difficulty finding new areas of competitive advantage. Seen from this perspective, the structure of the global arms production system gives little hint of change. The picture is one of a growing pie, not a zero sum pie, with third world industries advancing and integrating into the established system rather than sustaining a challenge to it.

## Summing Up

The predictions and conclusions advanced here, grew like Topsy, out of the present writer's observation of the world arms trade. They are presented here with some miscellaneous evidence to support them. But the future envisioned in this paper is based on a gradualist model of industrial development. It assumes that over time, the embryonic beginnings observed today will develop into predictable maturity tomorrow. However, new, unanticipated factors are bound to appear. No crystal ball can be expected to project the full panoply of new and unforeseen circumstances. And therein lies the danger of prediction. Nevertheless, with this caveat in mind, a vision of the future international arms trade and production is offered here for further scrutiny and investigation. Ultimately, its relevance will be tested by the future itself.


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