

Chapter 5

**Israel% Defense Industry:
Evolution and Prospects**

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Israel's Defense Industry: Evolution and Prospects

INTRODUCTION AND OVERVIEW

The origins of Israel's defense industry can be traced to the small clandestine arms manufacturing facilities of the Jewish Yishuv in Palestine. After gaining independence in 1948, the newly born state absorbed these facilities within the Israel Defense Forces (IDF) and the Ministry of Defense (MOD). It gradually expanded and upgraded these state-owned facilities to meet the state's security requirements and modest industrial capabilities of the time. By 1967, Israel possessed an impressive indigenous capability (for a developing country) for arms maintenance, retrofit, licensed-production, and in some cases, weapons development as well.

Following the French arms embargo against Israel in 1967, Israel embarked on a highly ambitious course of expanding, diversifying, and modernizing its defense industry. The goal was to develop an industrial capability to meet most, and in certain areas all, of the state's weapons requirements. To meet this self-sufficiency goal, a massive investment of human and financial resources was made in the defense sector. Consequently, by the early 1970s the Israeli defense industry, which by this time consisted of many private as well as public corporations, was able to develop and produce domestically a range of advanced weapons systems. In addition to a main battle tank, a self-propelled howitzer, a jet fighter, missile fast patrol boats, and mini-remotely piloted vehicles (RPVS), these weapon systems included a broad spectrum of ammunition and firearms, missiles, avionics, communications, and electronic warfare systems. Some of these systems nonetheless continued to contain foreign (especially U. S.) components, most prominently tank and jet engines.

Although domestic arms requirements have been the principal driving force behind the industry's growth, its surplus capacity was increasingly directed at foreign markets, especially in Latin America, Southeast Asia, South Africa, Iran, and Western Europe. By the middle 1980s, Israel was exporting approximately \$.5 billion in arms per year. This level of exports was achieved largely due to the reputation of the industry's products, a reputation that owes much to the IDF's combat experience and

the uniquely intimate cooperation between the weapons developers and users in Israel. These sales advantages more than offset several severe limitations of the Israeli defense industry, most prominently formidable foreign and domestic political barriers to Israeli defense sales, as well as scarce financial resources to support exports through provision of easy long-term credit.

Despite the industry's export gains, its growth and diversification peaked in the early 1980s, and has since 1984 been partially reversed. The industry was severely hit by a combination of global as well as Israeli-specific factors. These consisted of increasingly intense global competition for shrinking procurement funds, loss of several lucrative foreign clients (initially Iran and ultimately the Republic of South Africa as well), and sustained severe cutbacks in the Israeli defense budget, in particular for domestic arms procurement. Consequently, since 1985 the industry has been forced to undergo a painful readjustment to the new market realities, which has profoundly transformed the industry. The total workforce was cut significantly, sounder financial management techniques were introduced, marketing was increasingly reoriented toward the export (most prominently U. S.) market, specialization and concentration in several military product areas were emphasized, and modest diversification into civilian products was introduced (see tables 5-1 and 5-2).

The readjustment of the Israeli defense industry has met with considerable short-term success, and by 1990 the industry had accumulated an unprecedented backlog of orders. Yet current market realities still cast doubt over the industry's long-term prospects. Further restructuring seems absolutely necessary for the survival of many Israeli defense firms. Privatisation of certain state-owned defense

**Table 5-1—Israel's Defense Industries:
Main Developments**

	1985	1987	1989
Total sales (index 1985 = 100)	100	99.9	95
Exports as a percent of sales	47	55	59
Number of workers	62,600	61,600	46,500
Sales per worker (dollars)	55,000	56,000	70,000

SOURCE: Economic Advisor to Israeli Ministry of Defense.

Table 5-2—Basic Data on Principal Israeli Defense Firms, 1989

Company	Turnover (millions of \$)	Employees (as (thousands)	Exports a percent of sales)
IAI	1,248	16.1	75
IMI	525	12.1	63
Tadiran	654	7.1	41
Rafael	355	5.8	25
Elbit	158	1.8	62
El-Op	104	1.2	28
Elisra	104	0.9	41
Ordain... ..	67	0.5	55
Rada	22	0.2	82
Ziklon	20	0.2	61

SOURCE: Economic Advisor to Israeli Ministry of Defense.

corporations is under discussion, although its prospects seem slim given the diminishing attractiveness of defense business. Thus, the most likely future course of development for the industry is further acceleration of earlier trends toward diversification, domestic consolidation, product specialization, and cooperative international ventures, especially with U.S. corporations.

CAUSES OF THE CURRENT PREDICAMENT OF THE INDUSTRY

The Israeli defense industry has experienced considerable turbulence since the early 1980s. The performance of the industry has been adversely affected by a combination of broad international as well as unique Israeli developments.

Impact of General and Universal Developments

Over the past two decades, the international arms market has changed from an oligopolistic sellers' market to a highly competitive buyers' market. This transformation has come about as a result of several interrelated developments affecting both the supply and demand for defense equipment.

One supply-side development has been the emergence of many new weapons producers (especially in Southern Europe and the developing countries), as well as the growth in size, diversity, and sophistication of already established defense industrial producers (e.g., Brazil, India, and Israel). Another important development has been the liberalization and commercialization of arms export policies of

most traditional weapon manufacturers (notably the Soviet Union and the United States, the People's Republic of China, Germany, and even Switzerland and Sweden as well). These have come about on top of the already lenient weapon export policies of other traditional Western arms producing nations (e.g., France and the United Kingdom).

The impact of these supply-side developments on the structure of the market was enhanced considerably in the 1980s by a decline in the global demand for conventional arms. This decline was caused by a combination of economic constraints on arms procurement and diminishing defense requirements. The economic constraints are attributable in part to lower oil revenues, higher social welfare expenditures, and the diminishing purchasing power of defense budgets caused by the rapidly escalating costs of modern weapons systems. The lower requirements for weapons may be traced to easing of interstate tensions in several prominent global and regional contexts.

The transformation of the international arms market has had a profound impact on the patterns and terms of weapons trade. Specifically, upgrading existing platforms and purchase of defense technology (through licensed production and other business arrangements) occurs in place of much new procurement. In addition, extensive countertrade (barter and offsets) provisions and generous long-term financing have become the norm in procurement of defense equipment, especially by developing countries. Finally, bilateral and multilateral international joint ventures for development and production of defense products have grown significantly in both number and importance. They are commonly sought as a means to diminish the rapidly mounting risks and costs inherent in new weapons development and to secure access to both technology and foreign markets. This process has been made possible by a lower degree of product differentiation as well as the growing potential for customization through modification of software and sub-systems rather than substantial alteration of basic platform design.

These developments have exerted significant and adverse influences on the Israeli defense industry. The overall decline in demand for arms came about precisely at the time that the indigenous Israeli arms industry had become increasingly dependent on exports (see table 5-3). Moreover, by virtue of its

Table 5-3-Ratio of Exports to Sales for Leading Israeli Defense Companies (percent)

	1985	1989
Israel Aircraft Industry (IAI)	60	75
Israel Military Industries (IMI)	81	63
Elbit	55	62
Radar	49	61
Rafael	40	25

SOURCE: Economic Advisor to Israeli Ministry of Defense.

small size, limited resources, and minuscule civilian market, Israel found it exceptionally difficult to provide long-term financing and countertrade opportunities to support the export drive of its defense corporations. Joint ventures and technology transfer have also proven especially problematic for Israeli defense-firms due to the combination of Israel's political isolation and its tight secrecy requirements on defense technology.

From an Israeli perspective, the only positive aspect of these trends has been the ascendancy of defense systems modernization and upgrading. Here, rather than in the production of main combat platforms, Israeli defense corporations have a relative advantage over their foreign competitors, an advantage stemming largely from the extensive operational and combat experience available to the industry through the IDF.

Impact of Israeli Specific Factors

The growth of the Israeli indigenous arms industry has always been constrained by severe structural limitations on the size of both the domestic and foreign markets for its products. The domestic constraints result from the limited size of the local arms market, whereas the foreign market constraints are grounded in Israel's political isolation.

Israeli companies and products are politically barred from entering a sizable segment of the global arms market-the Arab nations and most of the Islamic world. In addition, other potential markets in Europe and the Far East are strictly off-limits for any defense product bearing a clear Israeli identity or are easily traceable to Israel. Similar if slightly less severe inhibitions also apply in these regions to joint ventures involving Israeli companies. Moreover, Israeli defense corporations are prohibited from selling many products (and to several prominent potential foreign clients), due either to Israeli

political sensitivities or U.S. pressures (e.g., South Africa and Iran). Sales restrictions on transfer to third parties of defense products containing U.S. components (e.g., Israeli-made jet fighters or tanks using American-made engines) also apply.

Operational and security requirements constitute a further barrier to Israeli companies seeking to export some of their more advanced indigenous products to certain lucrative but politically unreliable foreign customers. Finally, Israeli companies face broad protectionist tendencies prevailing in some of the world's largest arms markets (the United States, Western Europe, and Japan).

The cumulative effect of these factors is to restrict severely the share of the arms market accessible to the Israeli defense industry, even before economic and industrial considerations are introduced. These, in turn, further complicate the picture for the industry.

Some of the more salient features of the Israeli arms industry that affect its export prospects are its size and complexity. The tremendous post-1967 growth in size, diversity, and sophistication of Israel's defense industry has been driven almost exclusively by domestic defense requirements. Still, this growth was initially beneficial to the industry's export potential as well, enhancing its appeal as a viable alternative supplier to the major powers who had originally dominated the market.

By the mid-1980s, however, the industry's size and sophistication began to dampen its export potential. By this time Israel was sinking much of its energy and resources into the production of main combat platforms, which it could not export due to political restrictions. Moreover, by virtue of their sophistication, many of the industry's products no longer appeared suited to Israel's traditional customers in the lower end of the market, whereas the potential customers for the more advanced products seemed to lie in politically problematic markets for Israel (western Europe and the United States). Furthermore, Israeli defense corporations would no longer vie for small but profitable specialized niches in the market, but choose to compete for the big contracts, which inevitably pitted Israeli defense corporations against some of the industry giants, severely curtailing profit margins in the process. Finally, entry of many new suppliers into the lower end of the market, many of which enjoy the benefit

of cheap labor, have largely displaced Israeli companies from some of their more profitable traditional export product lines (e.g., mortar, tank, and artillery ammunition).

All of these export-related problems of the Israeli defense industry deepened in the 1980s. This has been the result of the overall developments on the international arms market, continuation and exacerbation of the Israeli industry's specific structural constraints, and finally the loss (due to political factors) of two of its most highly valued clients (initially Iran and then, gradually, South Africa as well). The "peace dividend" of recent developments in Europe looms on the horizon as another major setback to the Israeli defense industry. The Federal Republic of Germany, in particular, was the largest Western client of the Israeli defense industry. In the wake of reunification of Germany and the conclusion of the Conventional Forces in Europe (CFE) talks, this market may deteriorate as well.

The adverse developments on the export front have coincided with bleak economic conditions in Israel. Since the early 1980s, the industry has increasingly depended on foreign sales for its prosperity, in some cases even for the survival of firms. The economic situation in Israel has not only undermined the defense industry's domestic sales but has also, in many cases, deprived the industry of one of its leading export leverages—the so called "IDF stamp of approval" for its products attained through prior sales to the IDF.

Rising government deficits, inflation, and foreign debt coupled with heavy cumulative investment in modernizing and expanding the ranks of the IDF in the post-1973 Yom Kippur War period have forced successive Israeli governments since 1983 to cut and then freeze the local component of the Israeli defense budget. The budget was cut from an annual average of roughly \$3.2 billion from 1973 until 1983 to roughly \$2.6 billion per year since. During the same period the second component of the Israeli defense budget—U.S. military aid—has remained largely stagnant, frozen at the level of approximately \$1.8 billion per year. In real terms, it has declined significantly particularly in comparison to the rapidly escalating costs (above and beyond inflation) of defense products.

The decline in both components of the defense budget took place at a time when the defense

establishment was engaging in unusually heavy operational activity, initially in the context of the war in Lebanon (1982-85) and the Palestinian uprising in the occupied territories (since 1987). Although the operational costs in each case amounted to several billion U.S. dollars, the Israeli defense establishment was forced to absorb some of the costs within its already depressed budget. But despite the severe defense budgetary crisis since the early 1980s, the IDF order of battle was only cut back slowly and modestly during this period. Consequently, it was defense procurement that absorbed the cost of the defense budget crisis.

Two factors contributed to the financial crisis of the Israeli defense industry. One is the diminished buying power of the depressed Israeli currency. Most of it is naturally spent on salaries, infrastructure, operations, and the like. The other is the U.S. stipulation that most of its aid to Israel (all but \$400-\$450 million in offshore procurement funds) be spent on procurement of American goods. Israeli defense procurement thus had to be increasingly reoriented toward U.S. sources. Recently, budgetary constraints have tightened to the point that the Israeli MOD finds it necessary to divert to U.S. suppliers' purchases of certain items it has traditionally bought locally. This diversion has been deepened by the government's economic policy, which has held constant the rate of exchange between the Israeli currency and the U.S. dollar for extended periods while inflation and labor costs have been steadily rising at an average rate of roughly 15 percent. The adverse impact of this policy on the indigenous industry's competitive edge in general, and on competition with U.S. suppliers in particular, is clear.

The burden of the defense budget crisis of the 1980s was not allocated evenly within the indigenous defense industry. Certain government-owned corporations (Israel Aircraft Industries (IAI) and to a lesser extent Rafael) were spared some of the cuts and/or compensated for much of their losses. IAI, in particular, enjoyed preferential treatment due to its strong domestic political clout. It has been receiving by far the greatest share of the offshore procurement component of U.S. military aid to Israel, initially for the Lavi jet fighter project, and since cancellation of the Lavi in 1987 for some of its substitutes. Most public and private defense companies were, conse-

quently, quite severely hit; many of their contracts were stretched, scaled back, or terminated outright.

READJUSTMENT OF THE ISRAELI DEFENSE INDUSTRY: 1984-90

Signs of the crisis awaiting the Israeli defense industry were evident in the early 1980s. Yet its magnitude and severity, its underlying causes, and most importantly, its enduring nature, were not initially understood. Defense budget cuts were widely believed to be transient; many defense industrialists expected to be compensated for them within a year or two. Moreover, hefty financing profits (facilitated by an inflation rate of 600 to 800 percent) permitted many defense firms to gloss over operating losses. Thus, it was not until at least 1984 that tight defense budgets were seen as a permanent condition. The successful introduction, at that time, of a government economic plan to curb inflation eliminated almost overnight the paper financing profits of the industry, adding a sense of urgency to the need to readjust quickly.

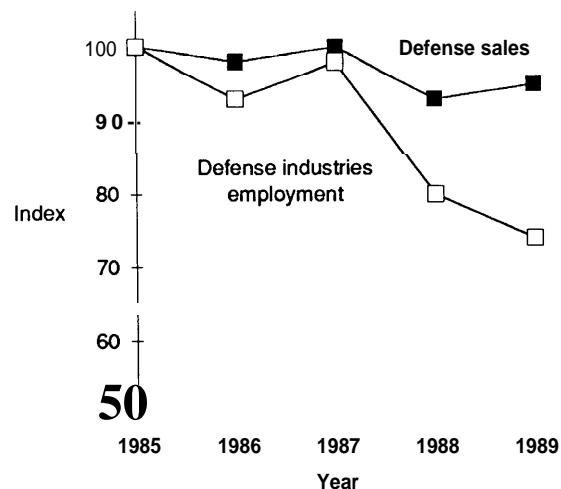
One major factor affecting the adjustment strategy of Israeli defense firms was the widespread perception that global arms markets would provide ample business opportunities. The frost reaction to the domestic sales crisis consequently was an intense arms export drive. This drive was undertaken by individual firms with strong encouragement and backing by the Ministry of Defense. The Minister of Defense at the time, Itzhak Rabin, made it clear to the defense industry leaders that he thought the "industry was oversized for Israel's needs" and that "only those who would export would survive." Even Rafael, the Israeli company that most closely resembles an American national laboratory, was forced to go beyond R&D to full-scale production and ultimately to exports as well.

To improve the industry's export prospects, the Ministry launched an intense diplomatic drive to promote sales to and industrial cooperation with the United States through a series of Memoranda of Agreement (MOAs) and Memoranda of Understanding (MOUs). Similar, though less intense efforts were directed at West Germany and (according to foreign press reports) South Africa. The arms export drive met with considerable short-term success, at least in terms of the volume of sales. From 1984

through 1987 Israeli defense exports exceeded \$0.5 billion, and the industry had accumulated an unprecedented backlog of orders exceeding \$3.5 billion. Furthermore, between 1985 and 1989 the industry's exports rose sharply from 47 percent to roughly 60 percent of total sales. Yet the profitability of much of the arms exports was at best marginal. The industry, primarily state-owned, had put on fat during the years in which it operated mostly in the sheltered environment of the captive domestic market. But the new budget realities precluded continued government subsidization of domestic arms manufacturers and forced significant decreases in government R&D support.

Facing intense competition in the global defense marketplace, the defense industry was forced to accompany its export drive with intense efforts to reduce costs and increase efficiency. For example, industry cut back dramatically on investments and corporate-financed R&D budgets. The former have declined by roughly two-thirds between 1985 and 1989, while the latter dropped on average by roughly 40 percent. In addition, over the 1985 to 1989 period, the defense industry has reduced its workforce by approximately 25 percent (from a total of 62,600 to 46,500) while only experiencing a 5-percent drop in total sales (see figure 5-1). Average annual sales per employee in the industry have consequently risen during the period from \$55,000 to a somewhat more acceptable level of \$70,000. This figure fails to

Figure 5-1-Change in Israeli Defense Sales and Employment, 1985-89



SOURCE: Economic Advisor to Israeli Ministry of Defense.

reveal considerable variance in efficiency between the individual firms in the industry, which ranges from below \$50,000 to over \$120,000 in sales per employee. Finally, in order to overcome cash flow problems, many Israeli defense corporations have increased their presence in foreign financial markets, and, in isolated cases, in the U.S. stock market as well.

For its part, the Ministry of Defense has assisted the industrial readjustment process by exercising leverage (as client, and in certain prominent cases owner as well, of defense manufacturers) in order to streamline the industry. Seeking to eliminate wasteful domestic competition, it has applied pressure on individual corporations to sell out, merge, and/or form joint ventures with other Israeli companies operating in the same areas. These efforts have met with partial success, the most prominent case being the merger of the mini-RPV operations of Tadiran and IAI into one company, Mazlat, which was initially jointly owned and ultimately completely taken over by IAI. The MOD has also labored to capitalize on Israel's political clout in the United States and the IDF's appeal as a sizable and prestigious client in order to secure valuable industrial offsets for, and joint ventures with, Israeli companies. These efforts, however, have attained only a modest degree of success, mainly due to Israel's dependence on U.S. grant-in-aid for the bulk of its military procurement.

As for the impact of the readjustment process on the industry's product lines, two developments are apparent in the post-1984 era: specialization and diversification. The industry has been forced to abandon the domestic production of main combat platforms, a dramatic reversal of the pattern established since 1967 of intensive cultivation in Israel of self-reliance in development and production of all major weapons systems. The process, which had culminated in indigenous production of a modern jet fighter (the Kfir) and a light utility transport (Arava), missile boats (Sa'ar 4 and 4.5), tanks (Merkava Mark 1, 2, and 3), and a self-propelled howitzer, has come to an abrupt end. With the cancellation of the Lavi jet fighter program in 1987, the Merkava tank remained the sole locally produced combat platform, and even its production was significantly scaled back. In the future, industry will likely concentrate on development and production of diverse military

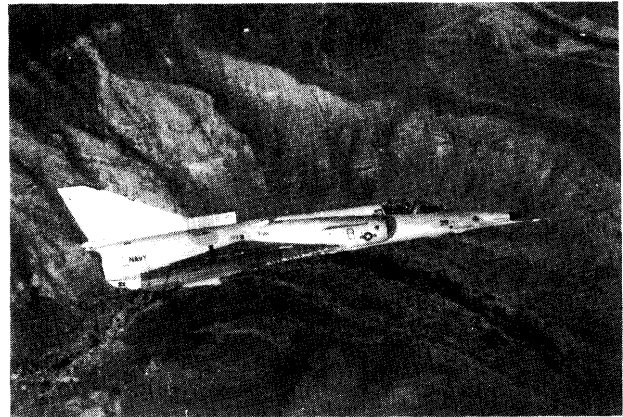


Photo credit: U.S. Navy

The Israeli Aircraft Industries (IAI) Kfir delta-wing tactical fighter was developed from the French Mirage V airframe after the French arms embargo of Israel in 1987. The aircraft began flying in 1974, and 212 have been produced. From 1985 to 1989, the U.S. Navy and Marine Corps leased two squadrons for use as aggressor aircraft in training, and flew them under the designation F-21A. In 1989, France agreed to sell to IAI five SNECMA engines, to be used in place of the airplane's General Electric J79 engines. This was part of a renewed effort to market Kfirs without U.S. export restrictions.

components and subsystems, as well as a comprehensive upgrade and modernization capability.

The second major product related development in the 1985 to 1990 period pertains to the industry's experimentation with diversification to civilian product lines. These range from card-operated public phones (Israel Military Industries (IMI)), to diagnostic medical instrumentation (Rafael), civilian aerospace (IAI), and computer accessories (Elbit). This course of action has been pursued with little enthusiasm and considerable apprehension. The Israeli Government's civilian R&D support budget is small. In addition, most Israeli arms manufacturers lack prior experience in a truly competitive environment, much less in dealing with the civilian marketplace. Some defense companies are still recovering from misguided, half-hearted past endeavors in the civilian market (e.g., Rafael in electro-optics, IAI in executive jets, and Soltam in pots and pans). There is widespread concern among defense industrialists that when it comes to marketing civilian products, Israeli companies do not enjoy the same reputational advantage that they have acquired in the defense area.

OUTLOOK FOR THE FUTURE

Meeting the IDF's Procurement Requirements

If a comprehensive Middle East peace settlement cannot be reached, Israel's arms requirements in the 1990s are unlikely to fall below the level of the preceding decade. Despite the United States' leading role in the Persian Gulf War, Israel will continue to rely on the IDF as its ultimate guarantor of security. And the IDF, in turn, will seek to acquire an uninterrupted supply of diverse state-of-the-art military hardware in order to preform its missions. This leaves open the question of how the IDF will meet its future hardware requirements.

Many analysts expect that most future weapons systems procured by the IDF will come from the United States. This expectation, however, is predicated on several critical assumptions. First, it is assumed that the IDF will adhere to its traditional doctrine ascribing a critical role to mobility. This seems a reasonable assumption given the IDF's reluctance to introduce anything but moderate changes in its doctrine to accommodate the ascendancy of firepower over mobility on the battlefield. While firepower requirements could conceivably be satisfied by indigenous sources, the same no longer holds true for main air, sea, and to a lesser extent land combat systems. These, with the exception of a main battle tank, are no longer produced domestically, and will therefore have to be imported in the future.

Assuming further that the nature of U.S.-Israeli political and security ties will not be fundamentally altered, Israel will continue to import almost all of its foreign weapons systems from the United States. Israel, for its part, is unlikely to seek any fundamental change in its intimate security cooperation with the United States. The United States might conceivably do so, however, for a combination of domestic and foreign policy reasons. Short of a profound change in U.S. policy toward Israel, affecting either the magnitude of military aid and/or the willingness to sell arms, a significant reorientation of Israel's defense procurement is highly improbable.

Two additional aspects of the IDF's weapons requirements will affect Israeli procurement. First, the impact of resource constraints, and second, the strong emphasis on operational autonomy and a

qualitative edge against its opponents. Severe domestic resource constraints coupled with the rapidly escalating cost of new weapons systems mandate that the IDF stretch to the limit the operational life of existing systems. The actual implication of this requirement is that the IDF, like many of its counterparts around the world, would be spending in the future considerable and growing resources on maintenance, modernization, and upgrading of its existing weapons systems. This is where the second requirement comes in. In order for the IDF to enjoy operational autonomy, overcome foreign export restrictions on supply of state-of-the-art military equipment to Israel, and still maintain a qualitative edge, Israel will likely expand its capacity to carry out maintenance and upgrade work locally.

Alternative Futures for the Defense Industry

Many of the original Israeli rationales for the development of a comprehensive and sophisticated indigenous arms industry still pertain today. However, two factors that have influenced the shape of the industry have changed significantly over the past decade. First, domestic demand for its products has both declined and undergone a profound change in nature. And second, the global arms market has also been markedly transformed. The future of the indigenous arms industry lies in systematic readjustment to the new market conditions. The Israeli defense industry today is significantly leaner and more efficient than it ever has been. Its successful foreign marketing effort in recent years has left it with a backlog of orders that could serve to cushion its restructuring process (see figure 5-2). Yet without more drastic restructuring of the industry, its future may still look bleak. As the Director General of the Israeli MOD, Maj. Gen. (ret.) David Ivri, has recently observed, the industry must complete its transformation over the next 3 years, since by that time it will have largely exhausted its current backlog of orders. This leaves the industry with little time in which to maneuver.

Given these constraints, the Israeli defense industry might embark on a number of different courses. Several involve extension and intensification of the readjustment efforts already underway. These include tighter financial and risk management, improved efficiency and productivity, more conservative corporate R&D policies, continued emphasis on exports, specialization in specific market niches, and

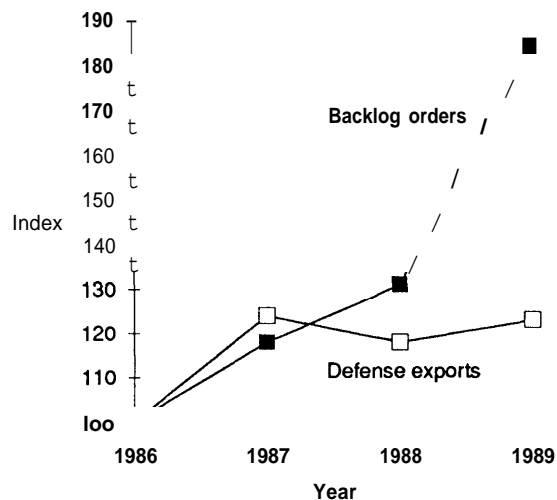
diversification into civilian product lines. For most Israeli defense firms, decreasing the share of military business in their overall activity will be critical to long-term survival. Israeli aerospace manufacturers (e.g., IAI and Elbit), who have long maintained a presence in the civilian market, are finding the transition to civilian products easier to make, despite the formidable political barriers to Israeli participation in collaborative (especially European), nondefense, projects. Elbit has already attained a 50:50 civilian to military sales ratio (up from a 30:70 ratio several years ago), while the much larger IAI is struggling to increase civilian sales from 12 to 20 percent of its business.

Other Israeli defense firms, especially those in military electronics, are finding it more difficult to make the transition, but they are also less pressed to do so. Indigenous R&D and production capability in their area is considered essential not only for Israel's security but also for the country's long-term industrial growth. Moreover, demand for their products is unlikely to fall. Still, rising R&D costs and risks associated with the global arms market enhance the importance of economies of scale. Consequently, even Israeli companies in defense electronics are experiencing growing pressures to consolidate their operations. Elbit's much-publicized negotiations for Tadiran's electro-optics subsidiary El-Op is a case in point. Such transactions, however, have proven difficult to make in the heavily unionized parts of Israel's economy, as the abortive merger of Elisra and Tadiran's Systems Division has clearly demonstrated.

Israeli firms in the traditional and specialized military areas such as armor casting (Urdan), mortar, artillery, and ammunition production (Soltam and IMI), and military R&D (Rafael) face the most daunting challenges. They experience far more difficulty in making the transition to civilian products. For them, selling out, scaling back operations, or, in extreme circumstances, even closing down parts or all of their military production lines may well be the only way to go.

Privatization of the key state-owned defense companies is unlikely given the combination of secrecy requirements and the unattractiveness of defense business in the current market conditions. In these cases, changes in the legal status of certain parts of the state-owned arms industry may lead to

Figure 5-2—Israeli Defense Exports and Backlog Orders, 1986-89



SOURCE: Economic Advisor to Israeli Ministry of Defense.

a more competitive spirit, as well as greater financial and operational autonomy. A change in the status of IMI from direct MOD ownership to government-owned corporation (similar to IAI) has long been expected, and only delayed by last minute technical problems. Rafael may well follow suit before long.

Ultimately, however, the future of the entire Israeli defense industry hinges on specialization and joint ventures. Specialization in market niches such as missiles, defense electronics, unmanned aerial vehicles, and upgrade and retrofit work is necessary to capitalize on the industry's strength without taxing its resources. The industry will have to concentrate on these areas in order to meet the country's security requirements, as well as to take advantage of its exceptionally skilled engineering capability, the extensive combat experience of the IDF, and the intimate relationship in Israel between weapons designers and users. On the other hand, the industry will have to forego activity in many other areas, especially those that are highly capital intensive and therefore certain to strain Israel's limited financial resources. Furthermore, in the future, the Israeli defense industry will have to stay clear of products whose clear political identification with Israel renders their foreign sale impossible.

Joint ventures are increasingly common in the contemporary global arms market. Until recently, however, Israeli defense firms have taken part in

only a handful of such business ventures. Joint ventures between Israeli and European companies are rare and will, in all likelihood, remain uncommon in the foreseeable future. But joint ventures in the defense field between Israeli and American firms are growing in number and importance. For Israeli companies they have proven essential in order to penetrate the U.S. arms market, and in some cases to acquire technology as well. Their principal appeal for American companies, on the other hand, seems to lie in their potential for enhancing market clout through access to off-the-shelf products, specialized Israeli military technology, and invaluable IDF operational and combat experience, although this last factor will become less important in view of U.S. experience in the Persian Gulf War. The cooperation between Mazlat and AAI (mini-RPVs), Tadiran and General Dynamics Electronic Systems (SINCGARS), Rafael and Martin Marietta (air-to-ground missiles and reactive armor), IAI and Lockheed (advanced tactical ballistic missiles or ATBMs) as well as TRW (UAVs) are just a few examples.

Finally, a word regarding the impact of the Gulf crisis and war on the Israeli defense industry. It has led to a significant short-term increase in the local component of the defense budget as well as in the foreign military aid to Israel from both the United States and Germany. These funds have aided several existing procurement programs and the addition of several new ones. Moreover, some of the lessons learned about key weapons systems in the course of Operation Desert Storm are also likely to trigger new orders of both indigenous and foreign weapons. The appeal of several Israeli systems already under evaluation by the U.S. military (e.g., UAVs and mine clearing equipment) might be enhanced in view of the lessons likely to be learned from Operation Desert Storm.

Yet, side by side with these largely positive developments for the Israeli defense industry, several adverse consequences are also anticipated. These include an inevitable medium-term decline in the local defense budget now that the Iraqi threat to Israel has diminished considerably, at least for several years. The defense budget is also likely to be the target of growing demands for resources from other parts of the economy, particularly those associated with absorption of massive immigration to Israel. But the most important setback to the Israeli defense industry will come from the loss of its

competitive edge tied to combat experience. Because few Israeli systems were deployed in the Persian Gulf War, their effectiveness in combat could not be evaluated. At the same time, many American, British, and French systems were tested in the war and, consequently, might be further refined. The enhanced appeal of these foreign weapons deployed in the 1991 war is likely to make marketing of Israeli-made weapons more difficult in the future. This constitutes a significant setback in an era of declining defense procurement budgets worldwide.

EVOLUTION OF ISRAEL'S DEFENSE INDUSTRIES

From 1948 to 1967

The roots of the Israeli defense industry predate the founding of the state, with the "Haganah" weapons producing facilities of the early 1940s. These underground facilities gained legal status in 1948 and formed the nucleus of Israel's modern day defense industries. After Israel gained independence, and well into the 1950s, its first Prime Minister and Minister of Defense David Ben-Gurion was instrumental in creating the infrastructure for the expansion of these facilities and the creation of new defense industries.

In his budget message to the Knesset in August 1949, Ben-Gurion spoke of the need to promote domestic production of weapons to avoid dependence on outside sources. During the early 1950s, regional and international conditions contributed to a growing sense of the imperative to expand Israel's defense industries, and the Tripartite Agreement played a central role in this respect. Ben-Gurion faced opposition to the idea of an indigenous defense industry, which was based on economic considerations. By 1953 Ben-Gurion made a number of key decisions that pushed Israel toward greater self-reliance in the area of weapons production:

- The expansion of TAAS (Israel Military Industry), principally a light arms and ammunition
- Reorganization of R&D component of the IDF and Defense Ministry. Ben-Gurion removed the Science Corps from the IDF and placed it (greatly expanded and modified) under the jurisdiction of the Defense Ministry, as Emet.

This research and planning division later evolved into Rafael.

- Approval of the establishment of an airplane maintenance plant, Bedek, which later became the Israel Aircraft Industries (IAI).
- Approval of Defense Ministry's creation of Tadiran, the Israeli Electronics Industry.

The establishment of Bedek and Tadiran and the expansion of IMI in the early 1950s occurred without either significant foreign sources of capital or technological cooperation between Israel and any developed industrial nation. The expansion of these industries and the establishment of new industries, however, were facilitated by West German reparations, as well as by Israel's collaboration with France in coproducing weapons and technology, which began in 1956.

Between 1956 and 1967 the IAI increased the maintenance and repair service that characterized its early years and also began development of the Gabriel sea-to-sea missile. In 1957 IAI decided to produce the first jet training plane, the Fouga Magister, under license from France. Tadiran and IAI also began development of communications and control systems for the IDF, as the existing systems were found to be deficient following the 1956 war. Along with IAI and IMI, Rafael developed a series of air-to-air missiles (Shafir), a meteorological rocket (Shavit II), and the Luz air-to-ground missile series. The systems developed were tailored to Israel's needs and contributed to reducing dependence on external powers.

There was constant tension, which began in the 1950s and increased during the 1960s, between the MOD and the IDF in arms production. While the IDF preferred to purchase foreign weapon systems that were less expensive, tested and proven, and had a shorter delivery schedule, the MOD maintained that Israel had to pay the price for arms independence. This same controversy was reflected within the government itself: the tendency within Ben-Gurion's political camp, Rafi, was to advocate expanding domestic industries, while members of a competing faction, Mapai, favored greater reliance on foreign purchases. Nevertheless, the defense industries became firmly entrenched during these years.

From 1967 to 1984

A major push forward in the direction of autonomous weapons and aerospace industries came with the gradual deterioration of French-Israeli relations in the early to mid- 1960s and finally the French weapons embargo in 1967 and 1968. The French embargo came at a time when Israel had attained a development capability which could be carried over into production. In response to the French decision to halt the delivery of 50 Mirage V fighter airplanes, Israel decided to proceed with the development and production of the Kfir jet fighter. Similarly, when five already-paid-for Sa'ar missile boats were prevented from leaving Cherbourg in France (although they were later brought to Israel in a special undercover mission), Israel recognized the need to build its own missile boat, and decided to build the Reshef class fast attack crafts Sa'ar 4 and 4.5.

The British Government's decision in 1969 to cancel an almost completely negotiated agreement for the supply of British Chieftain tanks, and U.S. refusal to supply Israel with modern M-60 tanks prompted the decision to build the Merkava, designed for the IDF by General Israel Tal, with crew safety a paramount concern (development and production plans became operational only after 1973). However, all engines were either exported to Israel principally from the United States reproduced locally under license.

Israel's defense industry was initially concerned with more modest undertakings such as maintenance, repair, upgrades, modifications, and licensed production. But after 1967, on the basis of experience gained in these areas, Israel initiated indigenous design of major weapons. The principal industries as well as many smaller companies initiated new projects and expanded production of weapon systems.

Israel increased investments in R&D funds by 300 percent between 1967 and 1972, and the number of employees in the defense sector almost doubled. After 1973, the defense industries continued to expand production, and began to export arms at a profit. Israel became a major supplier of military electronics and communications equipment and advances in missile technology, which included IAI's Gabriel Mark III antiship missile and a number

of air-to-air missiles, placed its electronics industries at the forefront of the field.

During this period Israel and the United States increasingly cooperated in producing technologically advanced weapon systems. Following the 1973 War, Israel became aware of the growing importance of sophisticated weapon systems, yet the high cost, complexity, and rapid rate of technological change in these systems made it difficult to develop and produce all systems locally. Cooperation with the United States in this area was formalized in a number of Memoranda of Agreement. The first significant defense production MOA was signed in 1979. It enabled Israeli firms to participate in U.S. Government contract bidding without the hindrance of Buy American legislation; this MOA also provided for cooperation in military R&D.

While the foundations of an indigenous defense industry were laid during the 1948 to 1967 period, the years until the mid-1980s were characterized by expansion and increased production in the defense industries, which has helped Israel realize partial independence in this field; this includes the ability to produce those weapons most susceptible to embargoes and boycotts, the ability to incorporate incremental technological innovations in large-scale weapons systems, and the ability to produce weapons designed particularly for local requirements.

1985 to Present

This period is perhaps best characterized as the defense industry's retrenchment and restructuring. The most salient aspect has been the cancellation, or cutback of several indigenous R&D and production programs for major combat platforms. These include cancellation of the financially overambitious Lavi jet fighter project by IAI in 1987, cutbacks in production of the Merkava tank, cancellation of local production of missile boats and submarines, and termination of development of an indigenously designed 155mm self-propelled howitzer, Sholef.

The state of the industry during this period is best reflected in a statement made in June 1987 by then Israeli Defense Minister Yitzhak Rabin, who warned the defense industries that the days of indigenous production were over; they would have to reduce their size, develop new markets for export of domestic production, and become more efficient. As for the Ministry of Defense, it would have to reduce

its orders from its own industry and reduce R&D in order to keep within the defense budget.

THE CURRENT STRUCTURE OF THE INDUSTRY

The relationship between the defense industries and the Ministry of Defense is historically close, and the four largest firms today—IAI, IMI, Rafael, and MASHA (Renovation and Maintenance Centers-IDF)—are still closely tied to the Israeli Government. Nevertheless, there are nuances of ownership within these government-owned firms, and today's Israeli defense industries also include public and private sector corporations. What follows is a breakdown of the defense industries according to ownership, as well as a brief profile of some of the larger industries.

Inhouse Military Organizations

MASHA-the Renovation and Maintenance Centers within the IDF Logistics Branch—is a prime example of military defense industrial production. One of these Centers has specialized since the 1950s in renovation of armored combat vehicles (World War II halftracks and Sherman tanks). The manufacture of the Merkava was assigned to units within this Center, and since 1978 MASHA has concentrated on production of the Merkava main battle tank. While manufacture of most of the tank's parts was subcontracted, MASHA is in charge of the assembly.

Ministry of Defense Companies

This category includes those companies under the direct jurisdiction of the Defense Ministry. Today, the only company left with this standing is Rafael, as IMI had its status changed in late 1990. Rafael is Israel's weapons development authority, whose traditional task has been to develop state-of-the-art weapon systems. Rafael develops and manufactures missiles, guided and unguided weaponry, electronic warfare equipment, C³I systems, simulators, thermal imaging devices, and add-on armor for main battle tanks and armored personnel carriers. Rafael has developed over 100 different weapon systems for the IDF since 1967.

Rafael has been among the companies hardest hit by lowered defense budgets in the 1980s. Rafael has traditionally turned over production of its products to IMI and IAI, but in the 1980s Rafael was

increasingly forced into production, exports, and to a lesser degree a search for civilian markets in order to sustain its workforce. With a highly sophisticated and highly paid workforce, Rafael has found the transition difficult. The company's cumulative losses until 1988 were \$150 million, and in 1989 alone its losses rose by \$85 million.

As a consequence, Rafael cut its workforce from 7,500 to 6,000 and experienced severe union problems as a result of these layoffs. The State Comptroller's Report of July 1990 found **that** Rafael was not measuring up as a viable business enterprise, having failed to formulate and implement a long-term rehabilitation **strategy**. Domestic sales for 1990 stand at \$265 million, defense exports were \$110 million, and commercial sales were \$5 million. Rafael's current order backlog is \$450 million. Projections for 1994 place domestic sales at \$290 million, defense exports at \$210 million, and commercial sales at \$50 million. In mid-March 1991, Rafael's General Manager Moshe Peled claimed that in order to remain competitive, Rafael will require yearly sales of \$550 million. Moreover, in light of the company's difficulties, he added that if Rafael does not succeed in laying off an additional 800 employees, it will face a difficult future.

Government-owned Corporations

This category includes firms such as IMI, IAI, Israel Shipyards Ltd., and Bet Shemesh Engines Ltd.

IMI is Israel's most veteran defense industry, with its roots in the prestate years. Its mission is to keep the IDF as independent as possible of external weapons supply sources. It manufactures light arms, ammunition, tank guns, military bridging equipment, air fuel tanks, artillery rockets and launchers, chaff/flare and aerial decoys, and other materiel. Among the weapons produced are the Uzi machine gun and the Galil rifle. Because of the nature of IMI production (emphasis on ammunition and light arms), the company has been extremely sensitive to regional conflicts and wars, with production peaks during periods of war.

The crisis that hit the Israeli defense industries in the mid- 1980s led to a reduction of IMI's workforce from the February 1985 peak of 14,615 employees, to 11,500 in late 1990. From 1986 to 1989, IMI suffered losses in the range of millions of dollars—\$100 million in 1988 alone. It has also suffered from

a marked decrease in foreign orders due **to the fact that other countries** have entered its market. The MOD spokesman in early 1989 confirmed **that** between 1986 and 1988 IMI's revenues were cut as a cumulative result of three factors: the rise in cost of local material (in dollars), the reduction of MOD orders, and the slump in international markets, which caused a reduction in export demand, production over capacity, and lowered prices.

In February 1991, IMI formulated a plan for additional personnel cutbacks of approximately 1,000 employees over the next few months (roughly 9 percent of the total workforce), due to the continuous decline in activity and the slump in exports. While exports for 1990 reached \$450 million, the expected amount for 1991 is a mere \$300 million, a decrease of 33 percent. IMI will most likely record losses for 1991.

Israel's largest corporate employer, IAI, was established as Bedek Aviation in the early 1950s to maintain Israel's Air Force aircraft, but gradually evolved into a full-fledged aerospace industry. An important milestone was the licensed production of the French Fouga Magister **jet trainer in the** late 1950s and early 1960s, which provided it with essential production experience, setting the stage for an autonomous aircraft design and production capability. Today IMI concentrates on aerospace, electronics, and naval systems, and is comprised of over a dozen separate plants, including the Engineering Division, Aircraft Production Division, Elta, MBT, and Bedek Aviation.

Cancellation of the Lavi and earlier defense budget cuts resulted in major cutbacks at IAI in the second half of the 1980s. The total workforce was reduced from 22,500 employees in 1986 to 17,500 in mid-1988 (3,300 as a direct result of the Lavi), and by early 1989 the workforce was further reduced to 16,000 employees. Yet despite the difficulties, IAI has been relatively sound financially, primarily due to foreign military export opportunities and the transition to space-oriented and civilian markets, which currently account for roughly 15 percent of its business. IAI hopes to raise this to 20 percent by 1995. In the wake of the Lavi cancellation, IAI continues to be active in the new combat aircraft business; moreover, the company turned its efforts to modernization and upgrade, unmanned aerial

vehicles, and continued development of electronics and avionics, missiles, and space technology.

Total sales for 1990 reached \$1.6 billion, with exports of \$1.4 billion. Orders for 1991 stand at \$3 billion, and a projected 80 percent of total sales are expected to be exported. While the IAI seems to be recuperating well, the company's program for the development of an executive aircraft, Astra, has been critical. IAI has been accused of unrealistic forecasts concerning the market value of the jet.

Israel Shipyards Ltd. is Israel's shipbuilding firm, and it deals in ship construction and repairs (Sa'ar 4 and 4.5 missile boats). Israel Shipyards has built naval products both for Israel and for export. The company faced financial difficulties in the late 1980s, following the termination of all major naval production contracts, and the absence of new civilian construction activity. It nonetheless proceeded to develop the Shaldag attack craft, which it was hoped would improve its fortunes. The Israeli Navy, however, refused to buy the Shaldag without even testing it and continued to prefer the IAI-produced Super Dvora. In mid-1990, Chief-of-Staff Shomron promised to appoint a team to test the patrol boat, and in early 1991 it was tested, although the IDF still refused to purchase it. The U.S. Coast Guard, however, is considering buying 50 Shaldags to use in its war on drugs. Toward the close of the decade Israel Shipyards' financial situation stabilized thanks to extensive cost-cutting measures, as well as an infusion of much maintenance and overhaul work (including work for the U.S. Navy 6th Fleet).

Bet Shemesh Engines, devoted to developing, manufacturing, and repairing jet engines, originally manufactured and assembled Marbore VI turbojets for the Israeli Air Force's Tzokit version of the French-made Fouga Magister trainer, and later manufactured portions of the General Electric J79 engine-power, which powers the Israeli Kfir fighter. Bet Shemesh Engines is currently owned 58 percent by the Government, 40 percent by United Technologies, and 2 percent by the Education Fund. Between 1985 and 1987 the company had problems with Pratt & Whitney over the licensed-production of the PW 1120 engine destined for the now-defunct Lavi jet fighter project.

In the early 1980s, Bet Shemesh suffered heavy losses and the board of directors claimed that the government was not investing the promised funds to

help the company expand its capacity to produce the PW 1120 engines. In January 1985, **Pratt&Whitney** acquired 40 percent control of the company (58 percent remained in the hands of the MOD, and 2 percent was owned by the late French industrialist J. Shidlovsky), but Bet Shemesh Engines still faced financial difficulties. Senior officials threatened to resign and place the company in receivership unless unions representing the 1,300 employees agreed to a plan to fire 400 to 500 workers. Bet Shemesh's losses reached \$55 million by the end of 1985, and its cumulative debt reached \$65 million in 1987.

Consequently, in early January 1987 the Israeli Government appointed a receiver to run the company (an arrangement similar to Chapter 11 in the United States). Following the cancellation of the Lavi project, Pratt & Whitney, which originally invested \$10 million in the company, considered pulling out but ultimately decided to stay in. Since 1987, Bet Shemesh Engines' workforce, level of activity, and operating losses have decreased, but the company's future remains uncertain.

Public-Sector Corporations

This group of defense industries highlights a unique aspect of the Israeli economy in general: these are firms owned by the major trade union, Histadrut, and are controlled directly by Koor, the industrial holding company owned by Histadrut. Here one finds Soltam, Tadiran, and Telkoor.

Soltarn is a weapons and ammunitions factory specializing in mortars and artillery weapons. A recent agreement between its two principal shareholders, the Zeldowitz family (which held 26 percent of the company's stocks) and Koor, has resulted in the transfer of Soltarn to full Koor ownership. Soltam is one of the companies that suffered from the smaller defense budgets in the second half of the previous decade. Soltam had its best year in 1978 with exports of mortars, artillery weapons, and shells reaching \$94 million (mainly to the Shah of Iran). Khomeini's rise to power reduced demand from the world market and increased competition created difficulties for the company, and while in the early 1980s it recovered somewhat, since 1984 there has been a drastic decrease in sales.

In 1987, Soltam's deficits increased due to a change in the IDF procurement policy. In an attempt to save the company massive cutbacks were pro-

posed, which led to severe tensions between management and the nearly 2,400 workers. These labor disputes reached a peak in August 1987, and since then 1,800 employees have been fired. The most recent labor dispute broke out in late July 1990 following plans to fire a further 180 employees from the remaining 580. Nevertheless, in late 1990 Soltam had orders of \$30 million, a large portion of which were already in the factory's stock, and this growth in orders may help the company reach operational balance.

Tadiran, traditionally Israel's largest producer of electronics, specializes in both civilian and military communications equipment. Tadiran deals in three areas of military production: communications, electronic warfare systems for the Air Force, Navy, and Intelligence Corps that are developed and produced in Tadiran's subsidiary Elisra, and electro-optical systems produced through El-Op. The civilian sector of Tadiran is comprised mainly of consumer electronics and telecommunications. As a result of defense budget cuts, Tadiran's defense section has been losing money, while the civilian sector—which comprises more than 50 percent of total activity—is registering hefty profits.

In the mid-1980s, Tadiran experienced financial difficulties in its defense sector due to a slowdown in its traditional export market, and cutbacks in orders from the Israeli Signal Corps. In 1988, Tadiran in conjunction with General Dynamics Electronics Division was selected to supply Single Channel Ground and Airborne Radio System (SINCGARS) equipment to the U.S. Army. The selection nonetheless entailed complications for Tadiran, as the company was required to make heavy outlays both in preparation for production in the United States and in anticipation of future contracts. Other Tadiran military projects include battle management simulators, work on Strategic Defense Initiative projects, and ground stations for UAVs.

Data on Tadiran from 1986 and 1991 show that the workforce has been cut from 13,000 to 6,500. Total sales registered for 1986 were \$620 million, while projections for 1991 reach \$700 million. The division between defense and civilian sales shows that while in 1986 more was directed to the defense market (\$360 million v. \$260 million), in 1991 expectations are that \$380 million will be civilian and only \$320 million defense-oriented. While

traditionally the ratio of defense exports to sales to the Ministry of Defense stood at 50:50, projections for 1991 show that \$200 million will be directed to export and only \$120 million will be sold to the IDF, about a 60:40 split.

Another variant of the public sector corporations are those run by a kibbutz, a collective settlement; an example of this type of corporation is the Nezer-Sereni Metal Works, which produces vehicle chassis.

Private-Sector Corporations

This category includes privately owned firms that produce military materiel for the defense establishment. Examples include Elbit, Urdan, El-Op, and Rada. Funding for private sector corporations often comes from the Israeli and American stock market as well as from the large banks. Some of these firms are owned by Klal—an industrial conglomerate owned by Israeli banks (more than half of Urdan's stock, for example, is owned by Klal).

Elbit is Israel's largest computer systems house and exporter of computer-based products and systems; its shares are traded on the Tel Aviv Stock Exchange and over-the-counter in the United States. Elbit deals in airborne, ground, and naval systems, and advanced battlefield systems. For example, an innovative sensor for the detection of chemical warfare material produced by Elbit was used for the first time during the Persian Gulf War. Elbit also develops, manufactures, and markets a variety of civilian systems and products ranging from imaging radiometer systems to computer products and services.

Elbit is one of the few defense companies not to have had a crisis in the mid-1980s, mainly due to its high proportion of civilian sales. Elbit formulated three strategic goals: acquisition of companies that complement Elbit's activity in the military sector, such as the proposed takeover of El-Op, joint ventures with American and European companies, and investments in the civilian sector. Elbit's 1990 takeover of 70 percent of the stock of Elscint, a producer of medical equipment, was a major step in the direction of greater civilian production.

Data from the past 3 years illustrate Elbit's financial soundness. Total revenues for 1988 were \$158 million with a backlog of orders of \$316 million; sales outside Israel came to \$98 million and

domestic sales reached \$60 million. Elbit recorded a record-high profit of \$22 million for 1990, as compared to \$13 million in 1989; moreover, Elbit's income from the civilian market made up 57 percent of the company's total income (as compared to 23 percent in 1989). Elbit derived 45 percent of its 1990 revenues from Elscint, and over 80 percent of the revenues came from export and international sales. Elbit is currently taking steps to further strengthen its position in the U.S. market.

Urduan, comprised of several autonomous operations, produces items principally in metal and steel: armored steel castings, tank and armored vehicles suspension parts, tank upgrading kits, mine clearing systems, ammunition trailers, and various spare parts. Urduan suffered heavy losses in the past 4 years, about \$7.5 million in 1990 alone; a large portion of the losses are related to the shutdown of its American subsidiary Lebanon Steel Corp. in September 1990. Moreover, Urduan sells mainly to the Israeli MOD and the U.S. Army, but the MOD has not committed itself beyond April 1992 and hasn't specified a minimum of Merkava tanks that it will buy from Urduan. Long-term sales contracts with the U.S. Army end in late 1991, and additional contracts are uncertain at this point. The chassis that Urduan produced for the Patriot missile were sold at what turned out to be a significant loss; while a technical success, it was a financial failure.

Urduan, one of the defense industries most in need of a transition to civilian markets, has few resources with which to do so. Urduan will undoubtedly find it difficult both to expand its clientele for existing products and to find the resources to develop products with which to enter new civilian markets.

E1-Op, half owned by Tadiran, specializes in optical products, night vision technology, and laser technology (including tank fire control systems, thermal imaging and image intensification sights and systems, aerial and marine systems, and sights and optomechanical products). One of the smaller defense firms, with a total of 952 employees as of early 1991, E1-Op's sales from 1986 to 1990 have been on the rise, from a recorded \$83 million in 1986 to \$129 million in 1990. The proportion of export versus local sales has changed quite significantly over the past 5 years: while in 1986 \$37 million was directed to export and \$47 million was local, in 1990

over \$82 million went **to export and \$40 million was local.**

Rada focuses on air force ground support equipment, avionics, computers constructed to military specifications, automatic test equipment, and computerized control systems. Rada is one of the few industries to gain from the worldwide defense budget cuts, as it produces test and maintenance equipment; Rada participates in avionics upgrades in most of the avionics industries in the world.

Another private defense industry that has recently been successful is Eagle Military Gear Overseas. This company produces and markets different types of armored vests, battle vests for infantry units, armored corps, demolition squads, medical corps, naval commandos, etc., nuclear biological and chemical warfare (NBC) equipment, and various accessories. For the 6 months preceding November 1990, Eagle recorded earnings of just under \$1 million, as opposed to losses of roughly \$1 million for the 14-month period ending on May 31, 1990. Eagle presently has orders that reach roughly \$80 million and has more than 500 employees in its 1 U.S. and 2 Israeli plants. Following the Gulf War, there has been increased interest in Eagle's NBC protective gear in both the United States and Israel.

Thus, the largest Israeli defense firms (IAI, IMI, and Rafael) are still closely tied to the government. The privately owned defense industries are much smaller, although they are relatively successful despite the constraints and competition posed by the larger state-owned companies.

The past 5 years have been characterized by defense budget cuts and a decrease in MOD orders from local defense industries, which have resulted in serious economic difficulties for most of these companies. While 5 years ago the defense firms together employed a total of 60,000, today less than 45,000 remain. These difficulties have pushed the defense industries toward increased exports and redirection of production to the civilian market. Not all industries have been able to deal with the transition successfully, and in addition to personnel cutbacks, a number of plants have been forced to shut down. Paradoxically, those companies that needed most to shift to civilian and export markets are also those with the fewest resources with which to do so—for example, Soltam and Urduan.

Other companies, such as IAI and Elbit, have found the transition much easier. In spite of the difficulties, on the whole the defense industries have adapted themselves to changing realities. Export figures, for example, show that while in 1984, 70 percent of defense industry products were sold to the IDF and only 30 percent directed to export, toward the close of the decade the situation was reversed.

DOMESTIC AND FOREIGN SALES

Domestic arms requirements provided the original rationale for development of an indigenous defense industry in Israel. Consequently, the industry's products and output have traditionally been oriented toward the IDF. Senior IDF officials have been reluctant to rely on domestic procurement, especially for those products that could be obtained elsewhere either sooner or with more certainty regarding performance and ultimate cost. But their reluctance was frequently overruled by a powerful combination of high-level political support for the development of an indigenous defense industry, and foreign restrictions on arms sales to Israel. Furthermore, over time some of the military's opposition to domestic procurement has also dissipated, due to several impressive indigenous weapons developments.

Thus, after a modest beginning in the 1950s, the industry has increasingly become the most important source of defense products and services for the IDF. Early on, the indigenous industry assumed most maintenance and retrofit services for the IDF and embarked on the domestic production of ammunition, light arms, and automotive parts as well. These were initially supplemented with World War II British and Korean War-era U.S. surpluses as well as new French materiel. Gradually, the Israeli industry also made inroads into additional and more sophisticated areas. It has embarked on licensed production and ultimately development as well, for the IDF, of communications gear, electronic warfare, radars, avionics, missiles and rockets, as well as self-propelled artillery, mortars, tanks, jet trainers and fighters, and naval craft. Its products have entered the IDF ranks in increasing numbers in the 1970s and 1980s, side by side with new U.S.-made arms that began to flow to Israel in the mid-1960s. As a result of the development of the indigenous defense industry and the severance of defense ties with France, Israel attained in the post-1967 era an

extremely high degree of self-sufficiency in certain key areas of military procurement.

Most products of the Israeli defense industry originally developed for domestic consumption are also sold abroad, the two principle exceptions being Merkava tanks (as distinguished from certain tank components) for which there have been no foreign buyers, and certain sensitive systems that are often exported in somewhat downgraded versions. An important export item of the industry has been the Gabriel surface-to-surface missile, several models of which have been sold abroad. Other Israeli developed products that have met with significant export success include several types of missiles, sophisticated tank and artillery ammunition, fire control, radio communication, and electronic warfare systems, mini-remotely piloted vehicles (RPVs), and light arms (see table 5-4).

The most important foreign markets for the Israeli defense industry have traditionally been in Latin America and Southeast Asia. They were partially displaced by Iran (under the Shah), South Africa, and certain West European customers in the 1970s and early 1980s. This pattern changed course again in the 1980s with the loss of the Iranian market (in the early 1980s), the imposition of a ban on new arms sales to South Africa (since 1987), and the tightening defense cooperation between Israel and the United States. Consequently, in the latter part of the 1980s the United States emerged as the single most important foreign customer of the Israeli defense industry.

THE U.S. CONNECTION

The relationship between the Israeli and U.S. defense industries in the 1980s (especially the latter half of the decade) was characterized by increased cooperation on common projects (U.S. firms teamed with Israeli firms or used them as subcontractors) and by growing defense exports from Israel to the United States. Since February 1987, Israel has been permitted to compete for Pentagon contracts as a major U.S. non-NATO ally; moreover, Israeli companies have entered the American market also through direct contacts with branches of the U.S. Armed Forces.

Israel has benefited from the dollars or barter products obtained in return for defense exports, as

Table 5-4-Selected Arms Orders, Deliveries and Licensed Production of Israeli Weapon Systems, 1986-88

Arms transfers from Israel							
Recipient	Number ordered	Weapon name	Type	Year ordered	Year delivered	Number	
United States	37	Kfir-C1	Fighter	1984-86	1985-87	25	
		Popeye	Antiship missile	1986	1987	6	
		Have Nap	Antitank guided missile	1986-88	1987-88	14	
Argentina	1	B-707-320C	Transport	1985	1987	1	
		120	Shafir	Air-to-air missile	1986	1988	60
Chile	13	Kfir-C7	Fighter	1988			
		30	M-4 Sherman	Main battle tank	1987	1987	30
Colombia	14	Kfir-C2	Fighter	1981			
Ecuador	12	Kfir-C7	Fighter	1986	1986-87	12	
		2	Barak launcher	Ship-to-air missile launcher	1984		
		16	Barak	Ship-to-air/surface-to-air/ point defense missile	1984		
	96	Shafir-2	Air-to-air missile	1986	1987	96	
Paraguay		IA1-201 Arava	Transport	1985			
Lebanon	36	BTR-60P	Armored personnel carrier	1987	1987	18	
		18	M-1944 100mm	Towed gun	1987	1987	18
		18	T-54	Main battle tank	1987	1987	18
Liberia	3	IAI-201 Arava	Transport	1984	1985	3	
Cameroon	4	IAI-202 Arava	Transport	1985			
		10	Kfir-C7	Fighter	1985		
Sri Lanka	18	Dvora Class	Fast attack craft	1985-87	1987-88	12	
China		Mapats	Portable antitank missile	1986			
Thailand	12	Bariel-2	Ship-to-ship missile	1987	1988	12	
Fiji	3	IAI-202 Arava	Transport	1986			
Papua New Guinea	3	IAI-201 Arava	Transport	1984	1984	1	
					1985		2
Licensed production of Israeli weapon systems							
Licensee	Number ordered	Weapon name	Type	Year ordered	Year delivered	Number	
United States		EL/2106	Point defense radar	1983			
		Popeye	Antiship missile	1987			
South Africa	96	Gabriel-2	Ship-to-ship/surface-to-ship missile	1984	1986-88	36	
		12	Reshef Class	Fast attack craft	1974	1978-88	9
Taiwan		Gabriel	Ship-to-ship/surface-to-ship missile launcher	1978	1980-88	48	
		Gabriel-2	Ship-to-ship/surface-to-ship missile	1978	1980-88	375	

NOTE: Blank spaces denote information not publicly known.

SOURCES: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1986 through 1989, *World Armaments and Disarmament*.

well as from the closeness of the military relationship (Israel became a major partner in the Strategic Defense Initiative). The United States has benefited from Israel's ability to fill essential technological gaps at short notice, and to provide off-the-shelf weapons, as well as from the fact that IDF weapons systems are battle proven. According to Brig. Gen. (ret.) Uzi Eilam, current head of the Israeli MOD's

Weapons and Infrastructure Development Authority, a factor that pushed Israel to cooperate was the growing cost and complexity of technologically sophisticated weapons systems, epitomized by cancellation of the Lavi fighter. A drawback of Israel's penetration into the U.S. market is that it is usually in partnership with U.S. companies, with production usually carried out in the United States; thus, while

these projects are lucrative to the Israeli companies, they do not necessarily create more jobs in Israel.

The formal aspect of the U.S.-Israeli cooperation in defense production finds expression in a series of Memoranda of Agreement and Memoranda of Understanding signed by the governments of the two countries. These MOAs and MOUs provide the legal authority for U.S.-Israeli cooperation in R&D, for Israeli companies' attempts to secure U.S. defense contracts, and for Israeli participation in large-scale defense projects, most notably SDI. The following is a brief review of the important MOUs and MOAs in cooperative defense research and production.

U.S.-Israeli military technological cooperation began in 1971 with an agreement between the two countries for the United States to provide technical information and assistance for arms production; this did not lead to agreements for coproduction. In fact, under the Carter Administration, Israel regularly received compensation for having been denied coproduction agreements. Cooperation with Israel was opposed in Congress because of concern that the United States might be aiding potential competitors to U.S. industries. The Reagan Administration was much less reluctant in this regard, and the most significant defense MOAs and MOUs were signed during the Reagan Presidency.

The first significant defense MOA between the United States and Israel was signed in 1979, during the Carter Administration, and may be seen as a reward to Israel for having concluded a peace treaty with Egypt. As mentioned above, this MOA enabled Israeli defense firms to participate in U.S. Government contract bidding, and also provided for cooperation in R&D. But, unlike the MOUs signed between the United States and NATO countries, the U.S.-Israeli MOA was not comprehensive. Only a specified number of defense items (initially 500) were not to be subject to Buy America restrictions. Moreover, actual implementation of the 1979 MOA was problematic in terms of the domestic sensitivities to non-American procurement.

In early 1984, this MOA on security matters was renewed and expanded. It aimed to facilitate Israeli military exports to the United States, allowed for freer Israeli access to the U.S. market by increasing the number of categories open for Israeli bids, and prevented U.S. officials from vetoing deals with

Israel once the bidding process has been completed, if an Israeli firm had been identified as the lowest bidder. Israeli sales to the U.S. Defense Department rose significantly under the new MOA, and an independent defense industrial relationship was established between the two countries.

A special MOA was signed in May 1986 to provide a comprehensive basis for participation of laboratories, research centers, defense industries, and other entities in Israel in SDI research. This MOA was followed by several more, as well as actual contracts involving more than \$200 million (programs include the Arrow ballistic missile defense system, the Israeli Test Bed, and work on the architecture of such a system). In February 1987 Israel was declared a major non-NATO ally, and in December of that year an MOU was signed that covered R&D, logistics support, and additional SDI work, and brought Israel's status on cooperation in line with NATO countries. It generally enabled Israel to compete on an equal footing with U.S. and NATO companies for U.S. contracts, gave Israel more latitude to sell weapons to the United States, and elevated Israel to a trade status previously granted to only two other non-NATO allies—Sweden and Australia.

Beyond Israel's participation in SDI, which has primarily been between IAI and the Strategic Defense Initiative Organization, Israel's most intimate relationship with the U.S. Armed Services has been cooperation on Navy and Marine Corps projects. This includes the leasing of two Kfir (F-21) squadrons for aggressor squadrons, the sale of mini-RPVs and mobile bridging equipment, IMI's Portable Mine Neutralization System (POMINS) II, and laser range finders for U.S. Marine Corps AH-1W Cobra helicopters (El Op, IAI with Kollsman). Israel's relationship with the U.S. Army has also been close, and has consisted of sales of mortars, radio communication (including SINGARS), tank launch bridging equipment, and a plow bulldozer system for BMV's Counter Obstacle Vehicle. The least amount of cooperation has been with the U.S. Air Force. To date it includes only the Have-Nap (AGM 132) air-to-ground missile deal with the Strategic Air Command (Rafael with Martin Marietta), although the Tactical Air Command is also currently evaluating the procurement of the same missile.

Recent cooperation between U.S. and Israeli defense firms includes a \$200 million contract for IAI to improve F-5 jets produced by Northrop, the Adams Mobile Defense System jointly produced by General Dynamics and Rafael, and data-transfer equipment for F-16 jets that Rada Electronics Industries produced for General Dynamics. The U.S. Congress recently awarded \$53 million for the continued development and purchase of IAI laser systems for U.S. Marine Corps' super-Cobra helicopter (for 1991). A subsidiary of Eagle in the United States has received an order for protective coveralls and tents (against nuclear biological and chemical warfare) for \$14 million.

Elbit has received a \$10 million order from General Dynamics for the supply of avionics systems until 1992; this deal was concluded as part of General Dynamics' commitment to offsets in Israel in the framework of the agreement to supply F-16s to the Israeli Air Force. Rafael and Martin Marietta are jointly contenders for a large contract for reactive armor for the new Bradley Armored Fighting Vehicles. If Rafael and Martin Marietta win, 50 percent of production will be carried out in Israel.

Finally, IAI, in a joint venture with TRW, is conducting test flights of the future unmanned aerial vehicle (UAV) that it wants to sell to all branches of the U.S. military. Following the successful employment of IAI's Pioneer UAV in the Gulf War aboard U.S. Navy battleships, procurement of additional Pioneer mini-RPVs is being seriously evaluated by the U.S. Navy.

Thus, the main features of the cooperation between U.S. and Israeli defense industries are the following:

1. Outright procurement from Israeli defense industries has risen over the years; yet in most cases it is done in collaboration with U.S. companies, with the actual production carried out in the United States.
2. A significant amount of activity has resulted either from direct or indirect offset agreements incorporated in the major IDF contracts with U.S. companies.
3. To date there have been relatively few **joint ventures in R&D**, although there are early signs that joint activity in this realm is on the rise.