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APPENDIX I

Key Defense-Industrial and Arms Trade–Related Terms

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ACQUISITION AND CROSS-SERVICING AGREEMENT

This is an agreement signed between the United States and another country that provides for the exchange of military support by their armed forces. Acquisition and cross-servicing agreements can cover the provision of equipment and logistical support. These agreements set out the terms of support, including how this is to be reimbursed by the receiving state. This type of agreement is intended to cover contingencies where requirements cannot be adequately addressed through national means. Acquisition and cross-servicing agreements supplement the out-of-area logistic capabilities of the United States, thereby enabling it to function more effectively in operations abroad, and provide a mechanism for the expeditious supply of arms and provision of logistical support to other countries in times of conflict or heightened tension. This type of agreement is a product of interest in more effectively supporting equipment in emerging operational environments, the requirements of which are proving more difficult with the introduction of each new product generation.

ACQUISITION ROADMAP

Procurement authorities in many states develop what are called roadmaps (keep) to help guide their arms development and procurement efforts. Acquisition roadmaps set out desired future capabilities and equipment requirements in a specific area, such as tactical air defense, and outline a long-term strategy for meeting these requirements. An example of this approach is the American Conventional Engagement Capability Roadmap. Acquisition roadmaps may include an assessment of current capabilities that identifies capability shortfalls and areas of excess capability, as well as setting general targets for future capability acquisition through the development or importation of future generations of equipment. In
some cases, acquisition roadmaps are updated on an annual basis. The use of acquisition roadmaps is growing as equipment requirements become more complex and the resources required to meet them increase, which force procurement authorities to consider carefully how they can most efficiently meet their requirements. As well as providing an important planning document for procurement authorities, acquisition roadmaps provide industry with an indication of potential future procurement programs, for which they can then better prepare to bid.

ADVANCED CONCEPT TECHNOLOGY DEMONSTRATION (ACTD)

Advanced Concept Technology Demonstration is an American program designed to expedite the process of fielding cutting-edge technologies by bypassing the standard acquisition process. ACTDs are near-term activities intended to identify equipment requirements, evaluate mature technologies, and help to determine potentially useful technologies, with the intention of moving the latter quickly to the point where they can be fielded should they prove sufficiently promising. Reducing the costs associated with developing advanced arms is a secondary objective of ACTDs. For this reason, they include assessments of affordability. ACTDs generally run for two to four years, and in many cases are open to participation by other states with similar equipment requirements. They define equipment requirements by procuring prototypes that are then subjected to extensive field testing by military personnel.

ACTD programs often lead to the deployment of operational systems, either through the fielding of limited quantities of prototype equipment as an interim measure, or by developing designs to the point where they can enter the standard acquisition process at an appropriate stage, possibly as late as the stage of low-rate initial production. ACTDs constitute a significant example of agile acquisition, and this is likely to remain an important defense-industrial mechanism in the United States given trends in equipment requirements and the difficulties experienced in meeting these through mainstream procurement channels. ACTDs are distinct from advanced technology demonstrations (ATDs), which are intended to prove the feasibility and maturity of specific technologies and reduce the risk associated with their development, though in some cases successful ATDs mature into ACTDs.

AGILE ACQUISITION

This is a general approach that developed in response to the escalating costs and increasingly protracted processes of the development and production of advanced arms. Agile acquisition initiatives are intended to reduce costs and shorten the time required to move promising designs through the development cycle and on to full-rate production. Agile acquisition encompasses a range of initiatives, including greater a reliance on commercial off-the-shelf components and technologies and support for the development of dual-use technologies, but is most notable for developing simplified and expedited procurement processes that serve to erode the distinction between what formerly constituted distinct phases of development and production. Agile acquisition initiatives often feature mechanisms for bridging the gap between developers and operators and generally involve more flexible arrangements with reduced formal reporting requirements. These initiatives are most evident on the part
of states with high qualitative equipment requirements, such as the United States and the United Kingdom. The U.K.'s urgent operational requirement provision represents an effort to circumvent lengthy procurement processes and quickly field equipment that is regarded as crucial in light of emerging operational requirements. In the United States, this approach is manifest in the advanced concept technology demonstration process. While agile acquisition has considerable potential to overcome the limitations of mainstream procurement processes, this comes at the cost of the increased danger that expedited developmental processes may result in the deployment of equipment designs that are insufficiently mature or robust, or that display poor interoperability with other equipment that is in service or under development. It is noteworthy that despite the obvious benefits of this approach, in no country have agile acquisition initiatives entirely replaced established procurement mechanisms.

**ARMS EMBARGOES**

An arms embargo refers to the prohibition of sale, transfer, lease, provision of financing and/or technical assistance of weaponry, and, in some cases, dual-use goods and their associated technology to a government, group, or individual in a certain country. The aim of putting an arms embargo in place is to signal disapproval of the behavior of the targeted country's government, a group, or an individual; to remain neutral in a conflict; and to lessen a party's capability to engage in conflict, in a way that avoids a great peril to the country's people. An arms embargo is considered as smart, focused kind of embargo to be used alongside travel bans, financial or aviation-related embargoes, and many more.

Although the mechanism to use arms embargoes had existed under chapter 7 of the United Nations' Charter since 1945, since the cold war ended, this political tool has increasingly been in use. During the cold war period, hostility between the USSR and United States, along with their allies, made it difficult to deliver an effective embargo, since the two great powers tended to undermine each other's political efforts. The UN arms embargo of the apartheid regime in South Africa in 1977 was the first embargo imposed on a UN member country. Since 1990, the UN has imposed at least 27 embargoes. Among the countries that have experienced an arms embargo are South Africa, Afghanistan, Iraq, Haiti, Liberia, Libya, Sierra Leone, Somalia, Rwanda, and Yugoslavia. Not only applicable to states, UN also placed embargoes on individuals and groups like Osama bin Laden and al Qaeda due to their terrorism activities. UN arms embargoes, however, have been criticized as merely a last resort, used when the situation is already deteriorating, hence making it difficult to meet the objective of the arms embargo. UN arms embargoes can be either mandatory or voluntary. It is also known that member countries often violate UN arms embargoes even if they are mandatory.

The EU (European Union) also implements the embargoes issued by the UN. Within the framework of the Common Foreign and Security Policy (CFSP), the EU applies restrictive measures in pursuit of the specific CFSP objectives set out in the EU treaty. The EU supports UN embargoes because their implementation essentially relies on the political willingness of the member states to employ their national law to criminalize violators. However, sometimes EU member countries have different interest in the embargo, for example in the
case of the arms embargo to China. France and Germany have supported the view that the embargo should be lifted, while the Scandinavian countries persistently use human rights violation as a rationale to maintain the embargo.

The United States, the biggest exporter of arms in the world, also has its own mechanism of arms embargo. Not only following UN arms embargoes, the United States also applies a unilateral arms embargo. This mechanism is regulated under the Arms Export Control Acts (AECA) and International Traffic in Arms Regulation (ITAR). ITAR stated that a nation may lose U.S. foreign military financing (FMF), loans, or the rights to purchase and have sales agreements related to defense articles or services if it commits a "substantial violation," subject to the interpretation of the U.S. authority. At least 26 countries have been banned from receiving U.S. arms, including China, Cuba, Iran, Lebanon, and Venezuela. U.S. arms embargo has been criticized as a worn-out and double-standard policy, with an unclear end result. Indeed, the U.S. arms embargoes used against the United Kingdom, France, and Israel, who attacked Egypt due to its effort to nationalize the Suez Canal, effectively stopped the 1956 Suez War. However, the U.S.'s unilateral arms embargo for Indonesia (1999–2005) simply led Jakarta to seek weapons from Russia.

Even though the effectiveness of the arms embargo is in question, it is still a popular initiative. A study by the Stockholm International Peace Research Institute (SIPRI) on the effectiveness of 27 UN embargoes since 1990 led to the conclusion that only 25 percent of all arms embargoes can be considered effective. Some achieved the desired effect while, others just worsened the situation or were counterproductive. Arms embargoes of Israel, China, and South Africa have led the three countries to build their own defense-industrial base in order to lessen dependency on foreign suppliers and strengthen the self-reliance. Arms embargo during the Yugoslavian war in the 1990s arguably worsened the conflict because it secured the military superiority of the Serbian forces.

AUTARKY

Autarky, derived from Greek word autarkies, means self-sufficiency or being economically independent. Every state wants to be self-sufficient in defense for obvious reasons. Autarky, as opposed to dependency, seeks to guarantee full sovereignty of the state in both domestic and foreign policy. Being dependent on foreign suppliers implies a great danger: either this dependency can be used as political leverage to interfere in domestic situation or, worse, a weapons transfer cut-off or embargo may undermine a country's defense capabilities in a critical time. Example of countries that see autarky as inevitable are Sweden, a non-aligned country during the cold war, and Israel, South Korea, India, and Pakistan, which are facing security threats from their neighbors. The need for self-sufficiency is greater in the absence of reliable suppliers. In addition to security and political reasons, the other reason for self sufficiency policy is to enhance one country's position in the regional or international arena because these countries want to be seen as a new power.

Autarky has been used interchangeably with self-reliance. However, these two terms actually have different meanings. While in self-sufficiency there is no room for dependency, self-reliance implies a more rational option. Self-reliance allows the acquisition of technology from foreign countries for a period of time, but with the intention of reducing this
dependency through incorporation of the technology into the local industrial base or indigenization. Self-reliance, therefore, is merely a cornerstone to be used in obtaining self-sufficiency.

Defense self-sufficiency is achieved through developing and maintaining a defense-industrial base capable of providing all military capability requirements. The degree of a state's sufficiency can be seen from its minimum dependency on arms imports. Judging from this, it can be said that most countries have failed in their efforts. Big arms producing countries like the United Kingdom, France, Germany, and Russia are still importing great amount of weapons. Others, like India and China, have not been able to reduce their dependency on arms imports, despite the fact that they have had massive defense-industrial programs for years.

Nowadays, autarky is considered elusive, except perhaps for United States. Lots of countries give up self-sufficiency because it is too expensive. It is simply impossible to control the whole supply chain of the defense industry. Downsized militaries, reduced defense budgets, and increased unit production costs of new weapons have forced countries to rethink their strategy, and some have eventually given in to globalization. Countries are now being more selective in controlling only critical weapons technology, and tend to collaborate with other states or accept the private sector's involvement to develop other types of weapons. Even though local defense industries are still maintained, following massive cross-border mergers and acquisitions, collaboration and outsourcing supply chains, defense firms are now conducting more business with other countries than they originally did. For example, BAE Systems, the U.K.'s biggest defense firm, is now conducting more business with the U.S. government.

**BATTLE LABORATORY (BATTLE LAB)**

Battle laboratories are facilities intended to accelerate innovation and to expedite the fielding of new generations of equipment by demonstrating the capabilities of emerging technologies. They also play an important role in helping to develop operational doctrine for the employment of the equipment items that result from them. A key feature of battle labs is their effort to bridge the divide between equipment developers and users by incorporating service personnel at a much earlier stage of the procurement process than generally is the case, and by involving industry in developing equipment specifications. Battle labs typically involve a mix of military personnel, scientists, and engineers. They may focus on the development of prototypes of totally new equipment types or on modifying designs that have already entered service. Battle labs often sponsor equipment demonstrations and deploy prototype equipment for military exercises as a means of exhibiting the equipment's capabilities in an operational environment. This approach is best developed in the United States, where the first such facility was established in the early 1990s, and which now boasts a number of battle labs, such as the U.S. Air Force's Air Mobility Battlelab. In some cases, these are termed warfighting laboratories, such as the Marine Corps Warfighting Laboratory. Some American battle labs are open to participation by foreign industry, and can involve observers from other states with similar equipment requirements. Battle labs also have been established by Australia and the United Kingdom. In the United Kingdom, they
are complemented by brainstorming labs, which focus on the development of new operational procedures. As with other recent initiatives to develop more efficient and timely procurement processes, battle labs do so at the cost of the increased risk resulting from reduced oversight.

BUYERS GROUP

This is a group of states that collaborate in the procurement of equipment where there is sufficient overlap in their requirements to justify the procurement of a common design. Buyers groups generally include countries that share close political relationships, and have been a feature of the international arms market for some time. The most prominent example is the four-nation group within the North Atlantic Treaty Organization (NATO) that selected the F-16 Fighting Falcon as their next-generation fighter in the 1970s. Buyers groups are useful in that they can potentially negotiate more favorable purchase terms through the economy of scale that they offer, including in terms of offsets, and have better prospects for viable local production or coproduction for the same reason. A buyers group also provides a basis for ongoing collaboration in supporting the equipment procured throughout its service life. Despite their many advantages, buyers groups remain more the exception than the norm. It often proves difficult in practice to harmonize requirements sufficiently to provide for a joint procurement, as the disappointing record of collaborative arms development projects by NATO members demonstrates.

CASCADE (OR CASCADING) OF ARMS

Cascading of arms is a process whereby surplus arms are transferred to another state that is less well equipped, where this equipment can replace or supplement its existing fleet. This practice has been around for some time, but the term came into prominence around the end of the cold war, when the changing security environment and equipment cuts mandated by the Conventional Forces in Europe treaty led a number of the members of NATO to reduce their arsenals by passing equipment on to members of the alliance that were not as well equipped, and to offer arms at concessionary rates to non-NATO states. This resulted in further large-scale arms transfers in a number of cases as the recipients transferred older arms to other states in turn. The cascading of arms continues, albeit on a reduced scale, as states seek to support other states and offset the costs associated with the introduction of new equipment.

CENTER OF EXCELLENCE (COE)

A center of excellence is a facility that provides critical expertise for a particular type of equipment or a particular technology. While examples of CoEs can be found in many product areas, they are most common in those that involve advanced technologies. In many cases, CoEs play an important developmental role, and feature prominently in national efforts to develop their defense-industrial capabilities. CoEs are often linked with procurement authorities and with research and development (R&D) facilities as a means of effectively
drawing on their expertise on a sustained basis. Centers of excellence may be firms that have been designated as such by the government, or can be government-operated facilities established with this objective in mind. This approach is proving increasingly popular as the pace of technological progress in many equipment areas accelerates and procurement authorities seek to establish a sustained national basis for staying abreast of developmental trends and for supporting the long-term development of the defense-industrial base.

CIVIL-MILITARY INTEGRATION (CMI)

Civil-military integration (CMI) is the process of merging the defense-industrial base and the larger commercial-industrial base; the common technologies, processes, labor, equipment, material, and facilities can be utilized to meet both defense and commercial needs. Although the idea has already existed for several decades, it was after the end of cold war that this concept gained a major spotlight in the United States. In the United States, CMI has been claimed to be the most essential factor for the transformation of defense acquisition practices and the industrial structure. Conflicting interest between reducing defense resources and maintaining a strong defense-industrial base forced the United States to look to other countries like France, China, and Japan in terms of how to integrate its alienated defense-industrial base with that of civilian development.

According to the U.S. Congressional Office of Technology Assessment, CMI includes: cooperation between government and commercial facilities in research and development (R&D), manufacturing, and/or maintenance operations; combined production of similar military and commercial items, including components and subsystems, side by side on a single production line or within a single firm or facility; and direct use of commercial off-the-shelf (COTS) items within military systems. CMI can occur on three levels: facility, firm, and sector. Facilities can share personnel, equipment, and materials, and even manufacture defense and civilian goods side by side. Firm-level integration involves separate production lines but the joint military-civilian use of corporate resources (management, labor, and equipment). Finally, integrated industrial sectors (such as aerospace or shipbuilding) can draw from a common pool of R&D activities, technologies, and production processes.

CMI offers many potential benefits. First, adapting available commercial technologies to meeting military needs can save money, shorten development and production cycles, and reduce risks in weapons development. CMI can also improve the quality of military equipment and contribute to the more efficient production and acquisition of military systems. Above all, CMI permits arms industries and militaries to leverage critical technological advances in sectors where the civilian side has clearly taken the lead in innovation, particularly in information technologies (IT) such as communications, computing, and microelectronics. However, CMI requires massive changes in the way the government conducts business; the Department of Defense (DoD) is now forced to perceive industry as a partner rather than keeping the commercial sector at arm's length.

There are many factors that favor CMI. First, trends in technology are blurring the differences between commercial and defense technology. Second, overlapping product technology at the lower tiers like composite materials, pumps, valves, and so on can readily serve the military as well as civil sector. Third, the demand in commercial market for lightweight,
rugged, and reliable goods, which is similar to defense requirements. Fourth, the growing gap between worldwide levels of spending for commercial and defense purpose makes it difficult for defense to drive the technology to be used commercially. Implementation of CMI is not without problems, however. The different degrees of complexity between integrated weapon systems and commercial goods makes it difficult to use a common workforce to perform many production functions for military goods. The tortuous change within government acquisition procedure and reluctance of the market to respond to small but highly demanded military requirements are among factors that hamper CMI.

An example of CMI's success in the United States is the mine resistant ambush protected (MRAP) vehicle production to meet critical military needs for ongoing military operations in Iraq and Afghanistan. These operations have dramatically increased demand for MRAP vehicles. The U.S. Department of Defense (DoD) and industry have had to speed up production dramatically from fewer than 100 to over 1,200 vehicles per month in less than one year. This spectacular performance is enabled because of two issues. First, MRAP vehicles were designed primarily with components from the commercial heavy truck industry. Second, DoD and industry work together to eliminate production bottlenecks for specialized items like armor steel and military specification tires.

COMMERCIAL OFF THE SHELF (COTS)

The term commercial off the shelf is applied to products, components, and technologies that can meet or be incorporated into equipment that fulfills military requirements, even though they were not developed with this in mind and may not fully meet important military equipment specifications. COTS equipment, components, and technologies have become more attractive in light of spiraling developmental and production costs, and their exploitation features prominently in many initiatives intended to reduce procurement costs and to shorten developmental timeframes. This is true of developed as well as developing states, but COTS items are particularly important in the latter due to their relatively less well-developed industrial capabilities, particularly in terms of research and development (R&D). The disadvantage of this approach stems from the differences between equipment developed for the defense and commercial markets. COTS equipment is often designed to less demanding standards, particularly in terms of ruggedness and survivability. This means that procurement authorities may either be forced to lower their requirements or devote the time and resources necessary to militarize COTS items, which detracts from their attractiveness. The term non-developmental item (NDI) is applied by some states to civil-grade equipment or components that are capable of fulfilling military requirements.

COMMERCIAL SALE

A commercial sale is a form of interstate arms transfer where the government of the exporting state does not serve as a middleman, though it still plays an important role in approving the transfer as this will still be subject to export controls. This type of arms transfer also is referred to as a direct sale, direct commercial sale (DCS), or company-country agreement. Commercial sales have an important advantage in that they are generally much easier to
negotiate; however, they expose both the vendor and the customer to a higher degree of risk should the product fail to meet required specifications or the customer fail to make a full or timely payment. For this reason, authorities in developing states may prefer to procure arms through the official arms export agencies maintained by some governments or through channels such as that provided by the foreign military sales (FMS) process in the United States, where one of the military services handles the sale, and firms may prefer to export through these mechanisms. Despite this, commercial sales continue to account for the majority of international arms transfers.

CONVERSION

Conversion refers to efforts to reconfigure defense industries to meet commercial requirements. It often is associated with the privatization of government-owned production facilities, where this occurs. Though industrial conversion is a common post-conflict phenomenon, this issue attracted particular attention following the end of the cold war when defense-industrial overcapacity and the contracted defense market in many states encouraged political authorities to consider how they might best avoid serious economic dislocation and substantial job losses. The conversion of defense industries is a complex issue due to the need to determine which defense-industrial research and development (R&D) and production capabilities are crucial, and how these can effectively be maintained in the changed procurement environment. National conversion initiatives can take various forms, but often involve support for the updating of industrial plants in an effort to render enterprises more commercially competitive, and support for commercially oriented R&D and marketing efforts. Interest in placing enterprises on a sounder commercial base also can encourage support for mergers with or acquisition by foreign firms, which may have been resisted prior to this by political authorities intent on maintaining the integrity of the national defense-industrial base.

COPRODUCTION

Coproduction involves the partial production under license of arms developed elsewhere, with the significant and ongoing assistance of the developer of the arms. This is a common feature of arms production in developing states due to local industrial capabilities that are often limited, where it is often approached as a means of defense-industrial and even general industrial development. Coproduction can involve varying levels of local input, ranging from the mere assembly of imported components to the production of significant portions of the equipment in question, but often features local assembly with local production of the less technologically advanced components involved. As a defense-industrial strategy, coproduction offers very limited advantages. While it can help to develop local defense-industrial capabilities and provide a useful general industrial stimulus, it often does little to advance the technological level of local industry and does not provide any significant degree of national autonomy, which is one of the key objectives of defense-industrial development in many states. Where coproduction does serve to promote the objective of national defense-industrial autonomy, it involves a growing local contribution in both
qualitative and quantitative terms as experience is gained and local industry develops. Despite its limitations, the coproduction of arms remains widespread, as it is the only viable option for many developing states.

COUNTER-TRADE

This is the practice of paying for arms imports through means other than money, while supporting the local economy. This can involve the supply of manufactured goods (including arms), or commodities such as agricultural goods or minerals. Counter-trade is resorted to by states that lack the necessary financial resources, and thus constitutes an important mechanism for some developing states to meet their arms requirements. Counter-trade for arms is most common during economic downturns or in cases where pressing security concerns generate arms requirements that cannot be met in a timely manner by any other means. This is not a favored type of arrangement from the perspective of arms suppliers due to the requirement for them to then sell the item with which they have been paid, but some firms and even governments are prepared to provide arms on this basis, recognizing that this may be the only way to secure a sale.

CRITICAL TECHNOLOGY

The term critical technology refers to defense-related technologies that are regarded as crucial. The determination as to which technologies are critical varies greatly between states, and is includes factors such as the organization and doctrine of the defense establishment, the sophistication of its arms requirements, and the state of local industrial capabilities. Authorities may approach critical technology in terms of the capabilities of arms (particularly advanced arms), the production of arms, or both. The common feature of considerations of critical technology is their impact on defense-industrial policy. Policy in many states reflects efforts to encourage and support the development of local capabilities in critical technological areas. There is particular attention to the capacity to develop and apply critical technologies independently of other states. This technological sovereignty is often even pursued in terms of states that are not politico-military rivals. Similarly, national technology control efforts are generally influenced by considerations of which technologies are critical, with these serving as the focus of the most stringent national controls. The issue of how best to promote and protect critical technology is being complicated by recent industrial trends, which are seeing a deepening transnational integration of processes of technological development and application, and accelerated transnational technological diffusion. This potentially encourages political authorities in different states to approach the issue collaboratively, but national security concerns continue to impede this.

DEMONSTRATION PROGRAM

Demonstration programs go by various titles, but generally feature mechanisms for showing that an equipment item is producible, affordable, and that the risks involved in its development have been reduced to the point where full-scale development can be initiated with
minimal risk. Demonstration programs often constitute a distinct stage in the procurement process, and constitute an important oversight mechanism. One form is the demonstration and validation program (dem/val, DEMVAL, D&V), which constitutes a key phase of the American acquisition process. Dem/val programs provide for the production and trialing of developmental models of equipment. Often it is the case that rival firms or industry teams participate in these programs, so that they also serve as an important means of selecting between competing designs for further development. As well as producing equipment under contract for demonstration programs, many firms produce demonstrators on their own initiative to demonstrate capabilities to prospective customers.

DE-RATED EQUIPMENT

The term de-rated equipment is applied to equipment of deliberately downgraded performance for the export market. The term sanitization is also applied in this context. The de-rating of equipment is undertaken in some cases to meet the less demanding needs of some export customers, but more often reflects a desire to control the diffusion of advanced technologies and to help maintain the qualitative edge of the armed forces of the supplier state. Developing a sanitized export version may be required as a condition of export approval. Often it is only particular parts of an equipment item that are subject to de-rating, such as aircraft avionics or engines. This approach surfaced as a deliberate strategy during the cold war, and was practiced by both the United States and the Soviet Union, but is less common now due to the fact that many customers are more discriminating in their requirements and wish to avoid the stigma associated with purchasing de-rated equipment models. The potential impact of this was demonstrated of the failure of the de-rated but still very capable F-16/79 export version of the Fighting Falcon to secure even a single order.

DE-RISKING

De-risking refers to efforts to minimize the degree of risk involved in developing and applying advanced technologies. This risk has increased as technological frontiers have advanced and the resources and time required to bring technologies to the point where they can be fielded have increased. De-risking strategies vary greatly, but generally involve some manner of determining relatively early in a program whether or not technologies are likely to prove viable, and prove affordable in terms of their development and application. De-risking strategies may involve measures such as technology demonstrations, risk-reduction studies, or demonstration and validation programs, which provide the basis for efforts to address identified aspects of risk in a program. It is important to note that de-risking activities may be undertaken by industry on its own initiative, as well as by procurement authorities in the context of defense research and development (R&D) programs.

DESIGN AUTHORITY

The design authority is the firm or the facility that is considered the overall authority for a particular equipment design. Design authorities are officially responsible for designing
hardware changes and developing any necessary production procedures. This role is generally played by the firm that launched the development of the item in question, but may be delegated to a subsidiary, which may be based abroad, particularly once the equipment has been in production for some time. The design authority for a particular equipment item may even be sold on once the original authority sees no further value in continuing to develop or support the design. The globalization of high-technology industry has seen considerable devolution of responsibility for research and development (R&D) to foreign subsidiaries and offshore capability partners, with the result that design authority may no longer lie in an industrial actor that is under the effective control of the government under which the design originated. This represents a problem for political authorities intent on maintaining the integrity of the national defense-industrial base and ensuring that key R&D and production capabilities remain under sovereign control. It is important to note that design changes may be and often are undertaken by firms other than the design authority, particularly where an equipment item has been in service for some time and is widely disseminated as a result. In cases where this does not involve the support of the design authority, however, this may come at considerable cost in terms of the effectiveness or even the safety of the resulting equipment model.

**DESIGN HOUSE**

This is a relatively recent phenomenon in the defense-industrial landscape. A design house is a firm that specializes in undertaking research and development (R&D) in its particular area of expertise under contract to other firms or to government entities, and that itself possesses no production facilities and has no interest in undertaking production. The importance of design houses has increased as technological frontiers have advanced and even large firms may experience difficulties in undertaking specialized R&D. The outsourcing of R&D to design houses is one way in which firms have sought to offset spiraling developmental costs, and this enables them to concentrate their resources on their core areas of expertise. While design houses occupy an importance niche in the defense-industrial market, they raise concerns from the perspective of authorities intent on maintaining the integrity of their national defense-industrial bases, and constitute a major issue in terms of national technology controls.

**DUAL/MULTIPLE SOURCING**

Dual or multiple sourcing is an approach employed in an effort to ensure the continuity of supply of crucial equipment items, protecting against potential supply disruptions. By expanding the production capacity through providing for multiple suppliers, governments reduce their dependence on individual firms and help to insulate themselves from industrial developments such as firms going out of business or deciding to exit particular product areas. The interfirm competition that this encourages also provides a useful means of leveraging favorable procurement terms and enhances the basis for a production surge in periods of conflict or tension. At the same time, however, it tends to be more difficult to manage procurement processes involving dual or multiple sources. Because of its disadvantages of being more complex and slower to implement, this approach is generally not employed in
cases where time is an issue. Dual and multiple sourcing tend to be very unpopular with industry due to its profit implications.

DUAL-USE TECHNOLOGY

This also is referred to as *dual-application technology*. This term is applied to technologies that have important civil and military applications, and entered usage during the cold war, when it was recognized just how much scope there was for technologies to meet important defense and commercial requirements. The overlapping nature of technological development in the defense and civil spheres, and the potential military applications of many technologies developed with commercial requirements in mind, means that this term remains important, if redundant. Dual-use technology may provide opportunities or challenges to political authorities. It can be a great benefit due to its potential to save governments from having to support and pay for the development of desired defense technologies. This is the case for developed as well as developing states, but is particularly important in the case of the latter due to their generally greater difficulties in mustering the financial and other resources required for technological development. At the same time, however, the potential for dual-use technologies to contribute to foreign defense-industrial programs generates heightened technology control requirements. This is particularly true of the developed industrial states, which tend to be most concerned over technological diffusion and its implications. These requirements are growing in concert with deepening transnational industrial integration, which is generating growing support for multilateral technology control mechanisms such as the Wassenaar Arrangement.

END-USE/END-USER AGREEMENT

An end-use/end-user agreement is an agreement signed between a supplier and a recipient state under which the latter guarantees that an equipment item it intends to procure is in fact for its own use. This also often commits the recipient to forego transferring the equipment at any point in the future without the approval of the supplier. End-use/end-user agreements can apply to key components such as engines as well as to complete systems. Many arms exporters require end-use/end-user agreements, but they are most vigorously promoted and policed by the United States. The diligence with which U.S. authorities apply this requirement in arms sales leads some offshore arms producers to avoid using U.S.-sourced or U.S.-designed components in the arms they develop and produce for export, in order to increase their potential customer base. Though it has long been recognized that the end-use/end-user agreement system is open to abuse as a result of corruption and a lack of adherence by recipients following changes of government, this remains an important arms and technology control mechanism.

EXPORT RELEASE

Export release refers to the point where an equipment item is made available for supply to export customers. Many arms producers are prepared to export even advanced arms as soon as possible, but political authorities in some states intervene to delay this in order to
ensure that their armed services maintain a substantial technological lead. This also is referred to as export clearance. Export release may be highly selective, in which case its timing in particular cases generally reflects the closeness of political ties between the supplier and recipient and the importance attached on the part of the former to transferring the equipment in question.

FULL-RATE PRODUCTION (FRP)

Full-rate production (FRP) is the stage where production of an equipment item is accelerated to the rate considered economically viable and operationally desirable in terms of the maturity of the design and the capacity of the operating service to field the item. Waiting until design maturity has been attained is a useful way of ensuring that equipment is operationally ready, and provides important leverage in dealing with industry as FRP is generally not approved until after the equipment is cleared for full operational service. This point may now be reached well after the introduction into service of the equipment item, however, due to a desire to determine an appropriate production-ready standard while getting the equipment into the hands of the user as quickly as possible, and due to the costs involved in full-rate production. This also is referred to as full-scale production (FSP), full-scale series production, serial production, and series production.

FULL-SCALE DEVELOPMENT (FSD)

The term full-scale development (FSD) applies to the point where the relevant authorities are confident enough in a general design and its affordability, and with the set of requirements it is designed to meet, that they are prepared to commit themselves fully to the developmental process. It often remains the case, however, that there is provision for target milestones and formal progress reviews to ensure that development remains on track and on cost, particularly given the increasing tendency of equipment requirements to evolve while development is underway. FSD increasingly overlaps with production due to the changing nature of defense-related research and development (R&D), which now often involves continually evolving equipment specifications and efforts to incorporate newly emerging technologies in order to ensure that designs are not already dated when they enter production. Full-scale development plans may even provide for the manufacture of preproduction or early-operational examples of equipment. The U.S.'s system development and demonstration (SDD) phase of the procurement process is basically similar to this.

GENERATIONS OF FIGHTER AIRCRAFT

There is no single definition of generations of fighter aircraft, but approaches toward this issue have involved differentiating stages of design, performance capabilities, and technology innovation. Fighter aircraft refers to an aircraft that was designated primarily for, although is not limited to, air-to-air combat. During World War I, fighter referred to a two-seater aircraft that can carry guns. In World War II, fighter referred to a piston-engine powered aircraft; some of these aircraft were fitted with radar, capable of performing as bombers
to provide air support. In time, fighter aircraft were developed into more specific categories according to their primary duty, namely interceptor, fighter bomber, or air superiority. Modern fighters are now able to perform multi-missions duty.

Late in World War II, the first jet engine–powered fighter was created. First-generation jet fighters, therefore, generally referred to turbojet engine–powered aircraft. Their primary weapons were machine guns, cannon, dumb bombs, and later air-to-air missiles. Some variants were capable of cruising beyond the speed of sound (supersonic), and some were equipped with radar to be able to operate at night (interceptor). An example from this generation is the U.S. F-86 Sabre, which was highly praised with regard to its air superiority during the Korean War, against the Soviet MiG-15. However, the first generation fighter did not have good endurance and could not sustain a supersonic flight level.

Second-generation fighter referred to a more powerful jet aircraft that was capable of maintaining supersonic speed in level flight. With the invention of the guided missile, air-to-air missile became its primary weapon, replacing the old cannon and machine gun. Innovation in technology enabled this type of aircraft to be fitted with onboard radar, making it possible to track down enemy beyond visual range. As a consequence, emphasis was no longer put on dogfight capability, but on the bigger payload of missile and better radar. An example of this generation of fighter is the Mig-21, which was used extensively in Vietnam and Middle East conflict.

The third generation of fighters was marked with the production of the multi-mission role jet aircraft, which was capable of conducting both ground attack and air defense. New technologies like vertical/short take-off and landing (V/STOL) and thrust vectoring (the ability of the aircraft to direct the thrust from its main engines in a direction other than parallel to the vehicle’s longitudinal axis) were tested and fitted into aircraft, enabling them to use shorter runways and perform better maneuver. Improved ground attack capability was supported by the air-to-surface missile and laser-guided bomb. An example from this generation is the McDonnell F-4 Phantom, a multirole aircraft that could perform as interceptor and bomber as well as fighter for air combat.

Fourth-generation fighters were those designed for network-centric battlefields and performed multi-mission tasks. They emphasized maneuverability rather than speed, which proved to be more effective in winning a dogfight. This type of aircraft was fitted with multimode avionics that can change from air to ground modes, making it easier to perform both ground attack and air superiority tasks. Stealth coating technology, which can absorb radar, was beginning to be introduced, for example in the Boeing F-117 Nighthawk and the General Dynamics F-16 Fighting Falcon.

The term fourth-and-a-half generation fighter was coined as a reference to aircraft with more advanced technology compared to those of fourth generation fighters, but that cannot be designated as fifth generation. Some fighters were made of lighter composite material with stealth coating, having high-altitude supercruise ability, and were fitted with digital avionics and more sophisticated weapons like beyond visual range air-to-air missile, global positioning system (GPS)-guided missile, and helmet-mounted display. Examples of this generation are the Eurofighter Typhoon and Dassault Rafale.

The term fifth-generation fighter referred to aircraft fitted with advanced very low observable (VLO) stealth, integrated information and sensor fusion, along with air-to-air and
air-to-ground capabilities, thus resulting in new fighting agility, reliability, maintainability, and deployability. This kind of fighter equipped pilots with 360 degrees of situational awareness and network-centric capability. Currently, there are only two kinds or fifth-generation fighters being produced: the F-35 Lightening II and the F-22 Raptor, both made by the United States. However, Russia is now trying to develop the MiG MFI and the Sukhoi Su-47 as competitors in this generation.

GLOBALIZATION OF DEFENSE INDUSTRIES

Globalization generally refers to a free flow of goods, services, and ideas, as a result of the increasing integration among countries worldwide. Defense, like public goods, cannot escape from this trend. Globalization in arms production is a shift away from traditional, single country patterns of weapons manufacturing in favor of 'internationalizing' the development, production, and marketing of arms. This also marks the shift from techno-nationalism to techno-globalism, which is manifested in the increasing amount of arms collaboration and the emergence of transnational defense-industrial and military technology bases. There are at least seven types of globalization of arms production: licensed production, coproduction, codevelopment, families of weapons, international strategic alliances, joint ventures, and transnational mergers and acquisitions (M&As).

Globalization in arms production has taken place as a result of several factors: first, the end of cold war, which forced countries to change the way they conduct business with industries. Countries want to retain control over national production of some strategic weapons (self-sufficiency) for modernization purposes, while needing to scale down defense industries' excessive capacity and the steep increase of weapons production costs. International collaborations and mergers are also seen as an alternative strategy to ensure that a particular defense program survives. Joint ventures are created among western European defense industries, as well as with Russia and developing countries like India. Second, the adoption of commercial best practices (lean manufacturing processes) in the defense sector aims to increase cost efficiency. This is manifested in the defense supply chain, within which the need to incorporate leading-edge commercial technology into defense systems stimulates the internationalization process. Commercial off-the-shelf (COTS) procurement is seen as an alternative to reducing development time and the cost of production of major defense systems.

The benefits of globalization for defense industries are mainly considered from an economic perspective. First, globalization permit research and development costs and risks to be shared, hence reducing the military burden on the state's budget. Second, through globalization, defense industries can exploit access to new technology, financial resources, and bigger economies of scale.

GOLDEN SHARE

This is referred to in some countries as a special share. A golden share is where the government retains an interest in a private sector firm in order to support its defense-industrial requirements, often in a manner that gives the government extra voting rights or enables
it to retain special powers over a firm, such as in enabling it to exercise a veto over production issues and forcing foreign owners to divest if their shareholding exceeds certain levels. Golden shares serve to safeguard key firms from becoming foreign owned or from being subject to unacceptable foreign influence. This approach is being driven by post-cold war industrial trends that are seeing increasing numbers of key high-technology firms entering into industrial alliances with offshore capability partners or experiencing significantly increased foreign control in an effort to remain viable. This practice is most evident on the part of European states such as France and the United Kingdom.

**GOVERNMENT-FURNISHED EQUIPMENT (GFE)**

Government-furnished equipment involves components that are supplied by a government to industry for incorporation into arms being produced for that government. This may involve components that are sourced from government-operated production facilities or that are taken from equipment already in government service, such as earlier models of the equipment item in question. The provision of government-furnished equipment is stipulated by contract where this occurs. This is one approach to offsetting rising procurement costs, but may require the operator to withdraw equipment from service in advance of the availability of its replacement in order to fulfill the contract.

**HOT PRODUCTION LINE**

A hot production line is available to produce arms, even if it is not currently doing so. This also is referred to as keeping a production line warm. This term can be applied to production facilities that are geared to civil requirements, or can refer to production lines maintained in a standby mode in order to ensure their ready availability in times of conflict or tension when there is a need for increased arms production. This consideration is growing in importance as the lead times for many advanced components increase, and has been compounded by the contracted post-cold war defense-industrial base in many states. A production line can be kept warm by adjusting production rates so as to spread production out until there is a need to produce the next generation of equipment.

**HOT TRANSFER**

A hot transfer refers to the supply of arms directly from the inventory of one state to another. Often, this is done in order to meet a pressing requirement on the part of the recipient, particularly in a conflict situation, when standard arms transfer arrangements are far too cumbersome and slow. Arms also can be hot transferred in order to minimize the period during which they are in storage. This is an important consideration in cases where equipment is being taken out of service by the supplier and the longer that it is inactive the more likely it is to degrade or require refurbishment before it can enter service with an export customer. This is an important consideration where strictly commercial considerations underlie arms transfers and the increased costs resulting from their being placed in storage may render the equipment difficult to sell at all.
INCREMENTAL ACQUISITION/INCREMENTAL MODERNIZATION

Incremental acquisition/incremental modernization involves adding or retrofitting components and capabilities that are unavailable or unaffordable at the onset of the procurement program or when the equipment is initially fielded. Recognition of the accelerating pace of technological progress and the desire to incorporate technological developments as seamlessly as possible are encouraging procurement authorities to plan for incremental acquisition and modernization from an early stage in developmental processes, including through preplanned product improvements (P3I) and incremental technology insertion and upgrades. In some states, these are referred to as spiral upgrades. Equipment designed with this in mind from the outset is more readily and more economically modernized, potentially extending its service life. At the same time, however, it complicates the task of procurement authorities by forcing them to carefully consider which capabilities to include and when. It can also result in a situation where there is never any single standard of an equipment model, with resulting logistical and training difficulties.

INDUSTRIAL ALLIANCE

An industrial alliance is a short- or long-term interfirm arrangement where the partners rely on each other for significant research and development (R&D), production, or marketing capabilities. This approach is increasingly popular among high-technology firms due to the difficulties involved in meeting all of their requirements through their own resources as a result of the increasing cost and complexity of technological development and application. Industrial alliances can take a wide variety of forms, such as joint development, technology exchanges, cross-licensing agreements, testing agreements, cross-servicing arrangements, and standards coordination. Industrial alliances constitute a major issue of concern to national authorities where offshore capability partners are involved, due to the defense-industrial base and technology control implications, but are difficult to deal with in practice, particularly where the arrangements involved are recognized as crucial for the long-term economic viability of key firms.

INDUSTRIAL COOPERATION AGREEMENT/INDUSTRIAL PARTICIPATION AGREEMENT (IPA)

This type of agreement is signed by states for the development or production of arms. Industrial cooperation/participation agreements typically set out the terms of collaboration, including work-share arrangements, cost sharing, and any restrictions on the application and diffusion of technologies provided by partner states. Agreements of this nature are crucial to the success of interstate arms development and production programs, particularly where these involve advanced technologies with the potential to support the long-term development and success of offshore commercial rivals.

INITIAL OPERATING/OPERATIONAL CAPABILITY (IOC)

Initial operating/operational capability refers to the point where a type or model of equipment is considered to be fully in service. This may involve a series of stages or milestones.
as experience with the equipment item is gained, its operational capabilities are established, and the numbers of the type available to the operator increase. The point at which IOC is attained is increasingly blurred as efforts are made to introduce equipment into service as soon as possible, such as through agile acquisition processes, and as processes of development and production overlap. Despite this, the scheduled IOC serves as an important procurement planning device in many countries and constitutes the point at which equipment is considered generally available for use.

INTEGRATED LOGISTICS SUPPORT (ILS)

Integrated logistics support, according to the U.S. Army, is the process that facilitates development and integration of all the logistics support elements to acquire, test, field, and support army systems. According to U.K. Ministry of Defence (MoD), integrated logistic support is a group of practices, processes, and standards that ensure supportability is considered early in the acquisition lifecycle, with the aim of optimizing the whole life cost (WLC). The U.S. Army coined the term in its effort to ensure that, from the earliest stage possible, the supportability of an equipment item is considered. The technique was then adopted by the U.K. MoD in 1993. Now, ILS has been integrated widely into acquisition strategy. For example, recent U.K. procurement of Singapore's Bronco all-terrain vehicles requires the supplier countries to provide integrated logistic support of the platforms.

The purpose of ILS is to introduce and sustain fully supportable materiel systems in current and projected environments that meet operational and system readiness objectives (SROs) at minimum life cycle cost, right-size demand for logistics, reduce life cycle cost and cycle times, and reduce the duplication of efforts. It addresses three aspects of supportability during the acquisition and whole lifecycle of the equipment: first, influence on design, within which the supportability aspect (maintenance and routine servicing) has been considered from the design process; second, design of the support solution, which ensures that the solution considers and integrates the elements of ILS; third, initial support package, which includes calculation of requirements for spares, special tools, and documentation for a specific period of time.

There are 10 elements of ILS: maintenance planning; manpower and personnel; supply support; support equipment; technical data; training and training support; computer resources support; facilities; packaging, handling, storage and transportation (PHST); and design influence/interface. All ILS elements have to be developed as part of integral system engineering practice. Not all of the elements need to be fulfilled, as the system allows trade-offs to take place when affordability, operability, supportability, sustainability, transportability, and environmental soundness are being considered within the limits of resources.

INTEGRATED PRODUCT TEAM (IPT)

The integrated product team is an initiative employed in the United States that seeks to improve the management of procurement programs. Increasing numbers of U.S. defense procurement programs are led by IPTs. They involve personnel from the interested stakeholders, and by removing what are regarded as redundant layers of program oversight, IPTs allow more decisions to be made in a timely manner at the working level. This can
significantly speed up the developmental process and facilitates efforts to efficiently address issues that arise.

INTEGRATED PROJECT TEAM (IPT)

This is a U.K. approach designed to improve procurement processes by rendering them more efficient and by providing for input from industry into decision making at a much earlier point in the developmental process. IPTs are responsible for particular procurement programs, and are also intended to improve the support of the equipment developed under this process. A number of IPTs have been established to address the maintenance of equipment that is already in service. British IPTs include industry partners, officials of the appropriate arm of service, and procurement officials from the Ministry of Defence. This is proving a popular approach to meeting important defense-industrial objectives.

INTEROPERABILITY

This is one of the considerations that may influence equipment development. Interoperability can be applied in an interstate or interservice context within a particular state. Interoperability is a desirable objective because it facilitates multiservice and multinational military operations and is often valued by export customers. Interoperability can apply to a wide range of equipment design parameters. This potentially encourages the design of equipment around common technical standards, such as those promoted by NATO. Efforts to promote interoperability are facilitated by interest within industry in developing products that meet generally accepted technical standards, though in some cases there are drawn-out disputes over what these standards should be.

JOINT VENTURE

A joint venture is a long-term commitment by two or more parties to conduct joint economic activity through the creation of a new entity. These parties contribute funds, facilities, and services and share revenues, expenses, and control of the enterprise. Companies have various motives to create joint ventures, such as gaining access to new technologies and customers, strengthening a company's power, exploiting the larger economies of scale and size that joint venture offers, and gaining access to new technology, financial resources, and customers, as well as good managerial practices. The durations of joint ventures vary; a joint venture can be entered into either for a specific project or a perpetual business relationship. Joint ventures can materialize in a number of forms, such as corporations, limited liability companies, and other legal institutions.

In defense, the joint venture has become a defense globalization trend. It is an international subsidiary owned and operated by defense firms in two or more countries for the purposes of codeveloping or to study future possible coproduction or codevelopment. Some joint ventures, like Matra-BAE Dynamics, in which the missile production of British Aerospace and Matra are combined, has managed to create the largest missile production venture in Europe. Within many of European joint ventures, the companies agree to retain
their original weapon production and to cooperate only for developing future weapons. Other examples of joint ventures are Eurocopter (France's Aerospatiale and Germany's DASA), Matra Marconi Space (Anglo-French subsidiary of Matra and the space system division of GEC Marconi), BrahMos (Defense Research and Development Organization of India and NPO Mashinostroyenia of Russia). A 50–50 joint venture plan has been signed between Germany EADS and Russian Irkut to convert Airbus A320 passenger planes into freighters, starting from 2010. Under the terms of the agreement, Airbus, EFW, and Irkut would design and manufacture the conversion kits, perform the conversion of single-aisle passenger aircraft into cargo aircraft, and market and sell conversion services.

Joint venture has become a popular choice for European countries, Russia, and other developing countries. Throughout 1986–1995, the majority of joint venture took place among western European countries, and only around one-fourth took place in the form of transatlantic joint venture. The reason for this trend is the overcapacity of western European defense industries and the increasing unit production cost of weapon systems, which makes national industry too expensive; hence, it needs to be supplemented by a regional defense-industrial base. This trend has been seen as the reflection of a regionalized arms production system in Europe.

LADDER OF PRODUCTION

Ladder of production is basically a tool to explain the evolutionary road of what are called the new arms producing countries, in their effort to change their status from being dependent on foreign suppliers to becoming self-sufficient in weapons provision. It explains the linear steps that every country needs to take in order to have full-fledged defense-industrial base. The steps are defined by the level of industrial capability (maintenance, assembly, production, research and development [R&D], etc.) and independence of production. Although there is no agreement as to what this ladder consists of, it has generally been agreed that this process reflects a defense industrialization evolution that cannot be bypassed. Also, it is not easy to move to a higher step on ladder once a country kick-starts its defense industry.

Political scientist Keith Krause's ladder of production basically tries to explain the evolution and growth of third-tier arms production as an internally driven process that leads from being an arms importer to a fully indigenous and autonomous arms producer. The term third-tier arms producer refers to countries that are capable of producing one or two weapon systems of which the sophistication is still below that of the technological frontier, and that are still dependent on critical subsystems and transfer of technology to go beyond copying or reproduction. The third-tier arms ladder of production consists of eleven steps: (1) simple maintenance performance capability; (2) overhaul, refurbishment, and rudimentary modification capabilities; (3) assembly of imported components, simple licensed production; (4) local production of components or raw materials; (5) final assembly of less sophisticated weapons, some local components production; (6) coproduction or complete licensed production of less sophisticated weapons; (7) limited research and development (R&D) improvement for local license-produced arms; (8) limited independent production of less sophisticated weapons, and limited production of more sophisticated weapons; (9) independent R&D and production of less sophisticated weapons; (10) independent R&D
and production of more sophisticated weapons; (II) completely independent R&D and production. Krause used this ladder of production to assess the level of sophistication of the third-tier arms industries. He concluded that the highest stage ever reached by third-tier arms producer was between stage eight and nine of the ladder. The biggest problem that he could identify was limited R&D, which mostly takes place in the first-tier countries, namely the United States and Russia.1

Bitzinger, calling the group that Krause referred to second-tier arms producers, concluded that most of these countries start on the ladder by assembling weapon systems from imported parts (knock-down kits), then license produce the complete systems with a gradual increase in using local components. Countries begin to climb the ladder by developing limited indigenous weapons with simple technology like small arms or patrol boats, followed by partnering with advanced foreign producers to develop a more sophisticated weapon. With the development of indigenous R&D, countries will try to indigenously develop more complex systems such as armored vehicles or training aircraft. Soon after they reach a sufficient level of R&D capacity, these countries will be able to develop their own advanced weapon systems like fighter aircraft and submarines.2

LEGACY EQUIPMENT

The term legacy equipment applies to equipment of an earlier generation that remains in service. This term is finding wide acceptance as a method of referring to equipment that, while not necessarily obsolescent or obsolete, is likely to be significantly less capable than is currently required. There is particular attention within the defense-industrial policy of many states over legacy models of equipment and how they can be affordably upgraded or replaced. The requirements of dealing with legacy equipment often constitute a serious drain on national resources. The term block obsolescence is often associated with legacy equipment. Block obsolescence applies to a situation where it is recognized that a substantial quantity of equipment has reached the point where it requires upgrading or replacement. This can constitute a major problem, as it may be necessary to replace a large quantity of equipment within as short a time frame as possible. This is referred to as block aging in some states.

LETTER OF INTENT (LOI)

A letter of intent is a type of document that is often drafted during arms sales. An LOI is signed by the customer and the firm or government supplying the arms it intends to purchase. Letters of intent are most commonly encountered in export sales. A document of this type precedes and paves the way for the formal placing of an order. While an LOI only indicates a customer's intention to place an order, these documents are important as they provide a basis for the manufacturer to proceed with the long-lead activities required to fulfill the contract. This is an important consideration, as it helps to speed up the acquisition process in cases where the formalities of export approval may take some time. A letter of interest or declaration of intent (DoI) fulfills a similar purpose to a letter of intent.
LICENSED PRODUCTION

Licensed production refers to the local production under license of arms developed elsewhere. This is a common feature of the defense-industrial landscape, and is found in developed and developing states alike. This is particularly important to the latter, which often approach licensed arms production as a vehicle for industrial development as well as a method of meeting the material requirements of their military establishments. While the licensed production of arms can provide an important stimulus for the developmental and production capacity of local defense industries in developing states, it often fails to achieve this due to the continued reliance on foreign support. Licensed production in many cases fails to rise above coproduction. Nonetheless, it remains an important vehicle for arms transfers.

LIFE-EXTENSION PROGRAM

This is referred to in some cases as a life extension and capability improvement program, life-of-type extension, service life extension program (SLEP), or capability life extension. Life-extension programs are undertaken in order to maintain the operational viability of equipment that has been in service for some time, until it can be replaced. Programs of this nature are assuming greater importance as the costs of high-technology arms increase and procurement authorities turn to this as a more affordable alternative. Such efforts are being facilitated by the potential for incremental acquisition and incremental modernization, which includes the prospect for less complex upgrading where this has been built into equipment designs from the outset. A related concept is the mid-life update or mid-life upgrade (MLU), which refers to a program to update an item of equipment when it is well into its service life, with the intention of keeping it viable for some time to come. This often involves the replacement of key systems or components or their upgrading through technology insertions. The terms mid-life improvement, mid-life modernization, and mid-term modernization also apply to this activity. While not necessarily undertaken at the midpoint of the planned service life of an equipment item, MLUs are generally approached in terms of a significant, one-time-only upgrading of the capabilities of the item. For this reason, the growing popularity of incremental acquisition and incremental modernization programs potentially comes at the expense of this approach.

LONG-LEAD ITEM

Long-lead items are components that need to be ordered well in advance of the production of the arms into which they are incorporated. These are typically components involving advanced technologies that cannot be provided by the prime contractor and systems integrator, but that must be ordered from specialist firms. These also are referred to as long-lead time items, long-lead material (LLM), and long-lead supplies. The need to incorporate long-lead items greatly complicates production programs, and makes it particularly difficult to introduce a production surge in times of conflict or heightened tension. This encourages procurement authorities to develop multiyear procurement programs for key equipment items.
LOW-RATE INITIAL PRODUCTION (LRIP)

The low-rate initial production of arms may be undertaken in order to speed up the introduction of arms into service, enabling the early attainment of initial operational capability, and precedes full-rate production. This term can be applied to the delivery of equipment that has gone through an upgrade or conversion program as well. This approach has best been developed by the United States, where operational requirements encourage the fielding of newer models and generations of equipment as early as possible, even if the quantities concerned are relatively modest.

MILITARY OFF THE SHELF (MOTS)

The term military off the shelf refers to components or equipment that have been designed to military requirements and that are available without further development. The advantage of buying MOTS items is that they are already technologically mature and generally can be obtained much more quickly and much more affordably than arms that are still being developed or that require further work to adapt them to local requirements. This approach can involve equipment procured from industry or that is available from another operator. This often is referred to as an off the shelf purchase. While it has many benefits, this approach may have implications for the economic viability and sustainability of the progress of the national defense-industrial base, as too great a reliance on MOTS may erode the capacity of defense firms to undertake advanced research and development (R&D).

MODULAR SHIPBUILDING

Modular shipbuilding is a process of building ships in which a complete ship is designed using a computer-aided design (CAD) program, allowing the ship to be built in several huge blocks, to be assembled in a dry dock during the final construction before it is eventually launched into the water. This process is different from the traditional way of making ships, where the complete hull had to be made before the technicians could install all the equipment necessary for the cabin such as engines, electronics, miles of cables, and the armory. The modular technique requires the standardization of cabins, and therefore has some advantages. First, it can speed up the shipbuilding process because different parts of the ship can be made at the same time at different places. Second, it reduces the cost because it uses assembly line methods. Third, it creates safer working conditions for the engineers.

The technique of inverted modular construction was developed during World War II, referring to the process in which entire sections of the ship would be built to be assembled and installed on land prior to completing the hull. The technique was then adopted by the Ingalls shipyard in the late 1960s; the USS Ramage was one of the first U.S. warships constructed using the modular technique in the 1970s. The ship was built in three separate hull and superstructure modules. Piping, duct work, and electrical cabling, as well as machinery and propulsion equipment, had been installed earlier in each of hulls, which were then
assembled into a complete hull. The superstructure or deckhouse was fitted into the mid-body module. Despite the advantages, a modular shipbuilding technique is not easy to adopt. It requires considerable space, and creating new workshops is costly. The technique also necessitates a huge crane to help mate the different superblocks.

Later on, modular shipbuilding started to make use of CAD and laser trackers. Through the use of laser trackers, these modules can be held to high tolerances of quality in production, avoiding the removal of traditional excess material, and thus helping to achieve a consistently higher and more uniform level of finish. During the assembly process, the use of multiple robotic total stations can track the real time of the module and speed up the alignment to the existing structure. Today, modular shipbuilding has been used widely in the world.

MULTIYEAR PROCUREMENT

This is a procurement approach involving contracting for the delivery of equipment over an extended period of time. Multiyear procurement contracts are beneficial to industry through their effect of providing considerable stability, and often benefit the customer by enabling it to obtain equipment at the lower unit price that can result from economies of scale. Multiyear procurement also features as a policy response to the requirement for long-lead items, which encourages procurement authorities to contract for these well in advance. This also facilitates planning by the operating military service, as the yearly numbers of an equipment item to be received are known well in advance.

OFFSETS

Offsets refers to economic or other concessions that are granted to foreign governments as part of their purchase of military equipment. This is where a portion of the agreed purchase price is offset by some form of economic activity on the part of the purchasing state. Offsets are usually specified as a condition of the sale, and commonly are expressed in terms of a percentage of the value of the cost of the purchase. They are intended to provide economic benefits while reducing the net balance of payment costs of purchases. There are both direct and indirect offsets. Direct offsets are those benefits received by a customer that are directly related to the equipment being purchased, particularly the purchase or the production in the purchasing country of components, subcomponents, and services to be incorporated into or provided for the equipment item as it is being produced or after it enters service, either for itself or for another purchaser of the equipment. The coproduction of the arms being purchased is a common form of direct offset. Indirect offsets are those benefits received by a customer as conditions of a sale that are not directly related to the product purchased. This may involve the purchase by the supplier of goods, services, or supplies. These may benefit local industrial and technological development, such as technology transfers, by involving industry in research and development (R&D), or establishing an unrelated production facility in the purchasing country. Arms suppliers can use offsets to advance their own interests, such as by establishing foreign subsidiaries for R&D or production.
OPERATIONAL EVALUATION (OPEVAL, OPEVAL)

Operational evaluations (or field evaluations, operational assessments, or operational demonstrations) are conducted on new equipment times prior to their service entry in many states. It is often the case that operational evaluations involve pre- or early production equipment examples, and it may be the case that full-rate production will not be approved until operations have been successfully concluded and it has been confirmed that the equipment is likely to meet operational requirements. Operational evaluations are also often undertaken to ensure that production-standard equipment is fit for service, at which point it can be declared fully operational.

ORIGINAL EQUIPMENT MANUFACTURER (OEM)

There is no single definition of original equipment manufacturer (OEM). The term can be used to refer to: first, a company that supplies equipment/products to another firm to be resold or merged into the second firm's product, which then will be sold under the reseller's brand name. In other words, OEM refers to the supplier of components. Second, OEM can refer to a company that accepts other companies' components/products and incorporate or resell them under its own brand name. The second definition refers to the reseller firm, and this is the most common definition of OEM at the moment. Other terminology with similar definition to OEM is value-added reseller (VAR). OEM is commonly used in the electronics and computer industries. In defense, forced by the need to be cost effective, a company can subcontract parts of its weapons production to other defense companies or civilian sector firms. Some small defense firms fill the niche in the very competitive sector as value-added resellers. For example, Singapore's ST Engineering imports the Indonesian Penta's ammunitions to be repackaged and resold at a higher quality, thus resulting in a different price.

PRIVATE FINANCE INITIATIVE (PFI)

The private finance initiative is an innovative approach employed by some governments to procure equipment where there is insufficient funding for traditional procurement processes, and emerged in the 1990s. Some, if not all of the funding required is provided by private sector partners. This can take a variety of forms, including leasing or having equipment operated by private firms, and can run for an extended period of time. This approach has been best developed in the United Kingdom, but is found elsewhere as well. A public-private partnership (PPP) is broadly similar. This involves collaboration between a government entity and the private sector in the development or production of arms. Public-private partnerships are employed in a number of countries as a means of developing local defense-industrial capabilities. In many of the countries where this approach is found, the private sector participant is the subordinate partner. This constitutes a means of allowing the government to retain overall control of the program, which is an important consideration in cases where political authorities are reluctant to depend too heavily on the private sector. A public-private initiative (PPI) involves a similar concept.
PRODUCTION GAP

The term production gap refers to a situation that arises when there is a significant break between the end of the production of one equipment item and the entry into production of another. This is an important issue in terms of the sustainability of the national production base, both because of the economic viability of industry, and because of the need to maintain a critical mass of expertise. The latter concern is particularly acute in high-technology industrial sectors. Concern over production gaps in some cases leads procurement authorities to stretch out production programs so as to cover any potential gap. Concerns over production gaps and maintaining a hot production line capability are thus highly complementary.

PRODUCTIONIZATION

Productionization involves adapting an equipment design so that it is suitable for volume production. While this can be factored into equipment designs from the outset, in many cases productionization is undertaken at a relatively late stage of equipment development. This potentially results in increased costs and delayed service entry. The importance attached to this is growing as concern increases over the capacity to initiate a production surge. This is encouraging attention to the issue of productionization at much earlier stages of the development cycle in many states.

PRODUCTION SURGE

The term production surge refers to the capacity to increase production rates on relatively short notice. This capacity is highly desirable in times of conflict or heightened interstate tension. Accelerating arms production in this manner is complicated by the requirement for long-lead items, particularly for more technology-intensive advanced arms, and by deepening transnational industrial integration, which in many cases is leading to the offshore migration of important sections of the defense-industrial base. This encourages efforts to maintain hot production lines in some countries, and in some cases forces procurement authorities to carefully consider the composition of the domestic defense-industrial landscape, including in terms of mergers and acquisitions involving foreign firms.

REQUEST FOR INFORMATION (RFI)

This is a relatively informal mechanism employed in procurement programs. A request for information is issued to industry by a prospective customer in advance of a procurement program in order to ascertain what equipment might be available to meet its requirements and what firms are potentially interested in bidding. In some cases, RFIs are issued generally; they can also be issued to selected firms. Sometimes, requests for information are issued to a foreign government, where this is a more efficient approach to dealing with its national defense industry. This can also be used to help define equipment requirements and to identify promising technologies that can be incorporated into this or future equipment items. RFIs generally outline potential equipment requirements and solicit feedback on the
potential capacity of firms to meet the requirement, including in terms of candidate systems and the timeframe in which they can supply them. Procurement authorities in many states use the responses from requests for information to inform their requests for proposals, enabling them to target particular firms in issuing these.

REQUEST FOR PROPOSALS (RFP)

An RFP is more formal than a request for information, and invites firms to bid to meet a procurement requirement by submitting details of their products. In some cases, these bids serve as the basis for a contract award, and sometimes this constitutes an intermediate stage where the field of potential bidders is narrowed. The request for quotes or quotations (RfQ) and the request for tenders (RfT) used by some states to solicit bids from industry are broadly similar.

SMART ACQUISITION/PROCUREMENT

Smart acquisition/procurement is an approach that can include increased competition for contracts, public-private partnerships, private finance initiatives, and other strategies to support greater synergy between the private and public sectors. This objective is to ensure that procurement programs are on time and on budget, as well as to reduce through-life support costs. In the case of the United Kingdom, this includes greater efforts early in a procurement program to ensure that projects will proceed smoothly. A closely related term is rapid acquisition. This applies to initiatives designed to shorten the time involved in developing arms, particularly where pressing operational requirements are involved. Rapid acquisition strategies often involve efforts to bypass normal acquisition processes. Examples include the Rapid Fielding Initiative (RFI) of the United States and the urgent operation requirement (UOR) process used by procurement authorities in the United Kingdom to quickly deploy new or upgraded equipment in order to meet pressing operational needs. The importance attached to smart acquisition and procurement has increased as developmental costs and timeframes have increased and governments have found themselves hard pressed to meet their procurement objectives. In a number of cases, this is driving renewed attention to collaborative arms development and production with other states, and is encouraging procurement authorities to redefine their approach to dealing with industry.

SPECIAL ACCESS PROGRAM (SAP)

The term special access program is applied to programs in the United States that are not subject to the usual level of Department of Defense (DoD) and congressional oversight because of their sensitivity. These are commonly referred to as black programs, though this label is only relevant in cases of unacknowledged SAPs that are considered so sensitive that even their existence is not made public. SAPs are referred to by unclassified nicknames. Details of SAPs are provided to DoD and Congress by means that involve as few individuals and bodies as possible. The form of SAP that is of interest here is the acquisition SAP (AQ-SAP), which concerns the development and procurement of equipment. Procurement programs
can be converted into SAPs, including through the stage of a prospective SAP, while they are being formally considered for this status, and SAPs can be fully or partially declassified after development is complete or in order to make some of the technologies available to other procurement programs. This approach provides an enhanced level of security for important research and development (R&D) and production programs, but comes at some cost in terms of the cross-fertilization of research efforts. This approach particularly restricts the scope for multinational collaboration in R&D, though in selected cases trusted foreign partners such as the United Kingdom have been involved in such programs.3

STRATEGIC ALLIANCE

A strategic alliance is a form of relationship between two or more independent firms to coordinate their resources for a specific business project, without having to merge into or create a new single entity. It is somewhere between conducting the companies' own business and merging their operations. Different from a joint venture, the relationship among parties being involved in strategic alliances is non-equity, less formal, and formed through a written contract with a termination period. A strategic alliance can materialize in many forms, like a technology transfer agreement, joint development of product, marketing and promotional collaboration, and so on. The alliance can be for a one-off activity, or concentrate on one issue in business, or to develop a new product jointly. The basic reason for creating a strategic alliance is to acquire a competitive advantage for the firms. Even competing firms would create a strategic alliance to gain the benefit it offers. One company can have several strategic alliances with different firms.

In defense, international strategic alliance can be defined as a loose industrial arrangement between defense firms in two or more countries to share information or to study future possible coproduction or codevelopment. The example of strategic alliance is a strategic alliance between Britain's BAE Systems and France's Dassault on a joint defense study for a future attack aircraft. In 1996, the U.K. and French governments inked a memorandum of understanding, in which the two parties agreed to a $58 million joint feasibility study of a future offensive air system. This alliance is preceded by competition between the U.K.-German-Italian-Spanish Eurofighter 2000 and French Rafale, which undermined the export potential of both aircrafts. The competition brings new consciousness that Europe needs a single aircraft collaboration for the future attack aircraft because it cannot afford to continue to have two or more competing fighter programs.

SUPPLIER TIERS

Supplier tiers represent a widely used approach to conceptualizing the structure of the global defense industry. States are categorized on the basis of their capabilities in relation to the development and production of arms and their capacity to supply these to other states. This structure often is expressed in terms of first-tier suppliers, which, as well as having comprehensive production capabilities, are a site of advanced innovation; second-tier suppliers, which can produce advanced arms, but are limited to adapting designs to their own requirements; and third-tier suppliers, which have much more limited production capabilities, and
do not engage in innovation. This is a relatively crude mechanism for examining defense industrialization and analyzing arms transfer trends, but has considerable utility given the need to analyze important differences in the manner in which different states contribute to the global defense-industrial landscape.4

TECHNOLOGY DEMONSTRATION (OR DEMONSTRATOR) (TD)

A technology demonstration is a demonstration of new technological capabilities in support of a procurement program. Procurement authorities in many states use technology demonstrations as means of helping to determine equipment requirements, particularly in terms of advanced arms, and as a means of reducing the risks associated with developing these arms. The equipment models in question, which are referred to as technology demonstrators, are subjected to extensive testing to test capabilities and to indicate areas for further development. In some cases, technology demonstrations are employed as a vehicle for selecting among competing designs for further development. Many firms also use technology demonstrations as a means of demonstrating their capabilities to prospective customers, including export customers. Many firms fund company demonstrators for this reason.

TECHNOLOGY SAFEGUARDS

Sometimes referred to as a Chinese Wall, technology safeguards are designed to prevent the onward, uncontrolled diffusion of technology that is made available to a collaborative industrial partner. This issue has increased in importance as interfirm industrial linkages have expanded and firms have sought to collaborate with offshore capability partners in developing and producing advanced arms through industrial alliances. Technology safeguards can take the form of restricting access to technologies provided under collaborative agreements, including restricting physical access to the facilities where these technologies are used and requiring firms to implement internal firewalls that limit the scope for different facilities and subsidiaries to work with each other.

TECHNO-NATIONALISM

Technological nationalism, or techno-nationalism, refers to the idea that state should retain, control, and support strategic technology industries through a set of policies, namely government procurement policies, that prioritize products with a high content of local technology, import restriction, subsidized export, research and development (R&D), provision of credits, protection of intellectual property rights, control of foreign direct investments, and so on. On behalf of this ideology, government gives excessive supports to domestic enterprises that are considered strategic to develop and strengthen the infant strategic enterprises' competitiveness before they face the fierce competition of the global market independently.

Techno-nationalism has been incorporated into a state's industrial development policy, usually a developing country that aims to be self-sufficient. It serves as a function of national pride and as a promised method of transforming a country into a more sophisticated, high-technology society or to achieve the same technological sophistication as advanced.
countries. Techno-nationalism is the impetus to kick-start the incorporation of high technology and boost one country's competitiveness. However, as ideology, techno-nationalism has been criticized as rhetorical and misleading. In addition, techno-nationalism serves as an ideology that justifies the use of massive resources in the strategic sector, which does not always serve the interest of the majority of people in the country.

In defense, techno-nationalism has been the main ideology for developing countries that wish to be self-sufficient in weapons provision. With the increasing phenomenon of defense globalization, however, it is very difficult for the state to retain control over the technology. Techno-globalism, which is defined as the idea that all nations should join hands and cooperate to develop crucial technology, is eroding techno-nationalism. Nowadays, another term has been coined to provide a third way to deal with this problem: neo-techno-nationalism. This refers to the idea of expanding the state's commitment to promoting local technological innovation through engaging private and foreign institutions and support for international coordination.

**THROUGH-LIFE SUPPORT**

Also known as through-life customer support and whole-life support, this is a comprehensive approach to the support of in-service equipment. It considers support requirements over the long term, including what is sometimes termed the lifecycle cost that encompasses future modifications and upgrades and the expected cost of maintenance over the service life of the equipment, as well as the procurement cost of the equipment. This provides a more realistic, though still necessarily tentative basis for estimating costs, and encourages procurement authorities and equipment operators to consider the long-term requirements of successfully operating equipment. This approach is being encouraged by rising procurement costs, which means that states are generally retaining equipment in service longer than was previously the case, and in many cases far longer than the original design life of equipment.

**TURNKEY PROJECT**

A turnkey project involves the establishment of a production facility on behalf of a state that can then operate it. This is largely a feature of international arms transfers to less well-developed states, and represents one of the means by which they seek to develop their defense-industrial capabilities. While this can provide a relatively rapid manner of acquiring defense-industrial capabilities, this often comes at the expense of long-term sustainability, as the facilities are sourced from external suppliers, and often lack a sufficient domestic-industrial basis to support them in the absence of foreign support. As a result, such facilities may obsolesce rapidly or cease operations entirely without continued external support, and do little to prevent foreign governments from exerting leverage through arms transfers.

**USER COMMUNITY GROUP**

User community groups are formed by states that operate a particular equipment type. These groups provide a cooperative forum for discussing common operational and technical
interests, disseminating operational experiences, and suggesting ways in which they can better support or modify the equipment. This is recognized as a valuable means of supporting equipment. An example of this approach is the Gripen user’s group, which include Hungary, South Africa, and Sweden, all of which operate the Swedish-produced Gripen fighter. As well as supporting the Gripen in service, the Gripen user’s group is intended to encourage feedback from the operators of this aircraft that will be useful to the manufacturer.

WEAPONIZATION

The process by which commercial-pattern equipment is adapted to the requirements of defense operators. Weaponization might involve measures ranging from ruggedizing equipment to withstand the stresses of deployment under field conditions to installing armor and military-standard communications systems. Weaponization is often necessary to successfully exploit the potential of commercial off-the-shelf (COTS) equipment, and is a process that can be undertaken by governments with this in mind, or by firms themselves as they seek to develop products that meet the needs of potential customers.

NOTES