Rethinking Governance of the Army's Arsenals and Ammunition Plants

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This report documents the results of an analysis of the Army's ordnance industrial base. It focuses on arsenals and ammunition plants. Specifically, it analyzes Watervliet and Rock Island arsenals and 14 ammunition plants, 11 of which are operated for the Army by contractors, and it considers alternative forms of governance and management for each class of installation. The work was sponsored by the Army G-8. It should interest those involved with the military industrial base or transferring government activities to the private sector.

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BACKGROUND AND PURPOSE OF THIS STUDY

The Army manages a large industrial base consisting in part of 14 government-owned plants that manufacture ammunition or are laid away to do so following hostilities, and 2 arsenals that manufacture ordnance materiel such as gun tubes, gun mounts, and other weapons-related items. These facilities occupy about 230,000 acres of DoD-owned land, about 1 percent of DoD's 24 million acres. They generate revenues of more than $1 billion a year. The oldest of the 16, Watervliet Arsenal, dates to 1813. The ammunition plants are of more recent vintage; most represent the residual of 77 government-owned, contractor-operated plants and works built or expanded to meet the needs of World War II, although three were opened during the Korean War or since. Three of the ammunition plants and the two arsenals are operated by government employees rather than contractors.

Today, the Army retains more capacity than the nation needs or anticipates that it will need. Furthermore, much of the equipment in these facilities is old, and, partly as a result of this obsolescence, they are expensive to operate.

The Army has long recognized these problems, and it has asked RAND Arroyo Center to assess options for managing this part of its industrial base. Initially, the research focused on reducing excess capacity at the two arsenals. That research suggested that downsizing through elimination of excess equipment and manufacturing space, while worthwhile, leaves the facilities with certain disadvantages that are inherent in continued government ownership of these manufacturing activities, which are peripheral to the Army's primary missions and functions. Hence, the research led to the more central issue of governance and ownership.

Later, during the conduct of the research, the Army initiated a review of its entire industrial base and folded this research into the new effort, called the Industrial Base Program Review (IBPR). The IBPR has as its mission to identify
logistics infrastructure the Army can divest of without jeopardizing its ability to accomplish its national security missions. Hence, prudent divestiture and reliance on private manufacturing became an important objective of the assessment.

PROBLEMS WITH THE ORDNANCE INDUSTRIAL BASE

The research suggests the following problems with the ordnance base:

- It lacks a strategic vision and plan.
- Army ownership is a peripheral function that diverts managers' attention from more essential tasks.
- Reduced workload contributes to high unit costs.
- In the government-operated facilities, it is difficult to relate costs to outputs, and prices are distorted.
- It has difficulty competing for capital investment funds in the Army budget process.
- Ammunition receives low priority for funding, which has detrimental effects on the base.
- Extended time is required to dispose of excess facilities.
- Ammunition replenishment policy is in flux.

The Army has attempted to address the issues of the ordnance industrial base for a number of years; it has developed ideas, written plans, and reorganized. But it has not produced and adopted an overarching vision and plan for the base. The requirements determination process is faulty. Manufacturing is not a core competency for the Army. Army ownership of the manufacturing capability requires Army leaders, particularly logistics leaders, to attend to this peripheral function. However, doing so diverts them from their primary responsibilities, and it requires them to make decisions in areas that fall outside their primary areas of expertise. It has taken nearly a decade to dispense with excess plants. In the arsenals, workload associated with their principal products has declined to less than 10 percent of peak levels. Fixed costs spread over less output drives prices higher. Reductions in employment levels and elimination of excess equipment help but are insufficient to solve the problem. In the government-operated facilities, funding rules and budgeting methods distort prices and make it difficult to relate costs to outputs. In the contractor-operated ammunition plants, the problems, which are less severe than in the government-operated facilities, derive from the inability of capital investment to compete for resources against current expenditures in the Army's operating
budget, leading to obsolescence and inefficiency in the base. Further, government ownership of plants sometimes leads to inefficient sourcing decisions. Ammunition does not enjoy a high priority in the budget. Army funds allocated to ammunition have been level and declining as a fraction of the Army’s total budget. The level funding masks the fact that within ammunition categories, procurement varies significantly, reducing the efficiency of production. Finally, the policy under which the Army replenishes ammunition is in flux. Because there is no clear policy, the Army does not know how much replenishment capacity to maintain.

In 1997, the Pacific Northwest National Laboratories (PNNL) issued a report on the ammunition industrial base. The report urged the Army to convert its government-owned assets to commercial activities, apply acquisition reform measures, focus government activities on accurately expressing the need for munitions, use the competitive marketplace, and establish a program executive office (PEO) for this important program. The Army has established the PEO but has not implemented the other recommendations.

STRATEGY TO RESOLVE ORDNANCE BASE PROBLEMS

Many of the problems with the ordnance base could be solved by transferring functions to the private sector, and such a step would be consistent with national policy. However, some risk exists that transferring functions to the private sector might result in a loss of a critical capability, and whatever plan is adopted needs to hedge against that risk. Taking into account the problems of the ordnance base and the national policy for the government to take greater advantage of the private sector, we believe that the following strategic vision for the ordnance base will help the Army chart a course for management:

Convert the organic base to a responsive, innovative, efficient manufacturing base, capable of meeting national security requirements while relying to the maximum practical extent on the inherent advantages of competition and private ownership of capital.

Given this vision, the next question becomes how to achieve it. We considered the following four options:

- Privatize facilities
- Create a federal government corporation
- Consolidate facilities and declare unneeded plants excess
- Recapitalize on multifunction posts
Privatize

Under this option, the plants would be sold as going concerns to ordnance manufacturers, who would agree to maintain a specific capability for a specific number of years. This method of privatization would be accomplished by declaring the property "excess to ownership but not excess to need." Unlike consolidations and closures that render property excess to need, this excess-to-ownership but not excess-to-need method includes no legal requirement to offer excess property first to other government agencies, some of which may acquire it without paying compensation to the Army. Unlike excess-to-need transfers that require remediation to be completed before the property is sold, excess-to-ownership transactions permit transfer while remediation is ongoing. Further, environmental remediation may be conducted at the programmed rates, and to the maximum extent possible, the buyer performs remediation in exchange for a reduced purchase price. This frees Army funds programmed for remediation to be applied to other Army priorities. Both the Air Force and the Navy have employed excess-to-ownership divestitures. Purchase would be accompanied by a production and replenishment contract for a set number of years, probably five, after which the Army would select sources on the basis of full and open competition. Privatization under excess to ownership but not excess to need retains current capacity; it only changes the ownership of that capacity.

Create a Federal Government Corporation

The federal government corporation (FGC) option was conceived as a compromise between the privatization option, which would leave capability in private hands, and the consolidation and recapitalization options, which would leave it in Army hands. An FGC would combine the safety and stability of a government agency with many of the incentives and freedoms of private firms. FGCs operate at the boundary between the public and private sectors and possess some of the characteristics of both classes of organizations. Federal government corporations are relatively common; the Congress has created about one a year since World War II.

Federal government corporations have many of the characteristics of a private firm: they operate as commercial organizations but receive some government subsidies; have boards of directors; can raise capital by borrowing or issuing debt; have the right to sue (and be sued); are not bound by federal procurement regulations; and their employees are not necessarily subject to civil service rules.

For the ordnance activities at hand, an FGC might be chartered first to meet DoD's ordnance requirements but also to use the existing underused capacity.
to manufacture commercial products. This dual authority would provide the greatest benefit at the arsenals, whose manufacturing equipment is suitable to commercial production in a number of markets, most notably machine shop, oil and gas machinery, industrial valves, and structural steel. Dual use of productive capacity would have the potential to greatly improve the efficiency of the arsenals by spreading the overhead burden across commercial products as well as Army products and converting indirect labor to direct. Both the spreading of the overhead and the labor conversion would reduce the cost to the Army of the ordnance materiel it would continue to procure from the FGC. The option would have the added benefit of stabilizing or even potentially increasing the levels of employment at the arsenals, where the workforces have suffered through repetitive employment reductions for a decade or more, destroying morale and causing a continuing hemorrhage of talent. For reasons explained in detail in the report, the FGC appears to be a less attractive option for the ammunition plants, particularly the contractor-operated ones.

Consolidate

This option would leave the ordnance base under the control of the Army. It would consolidate the needed capacity on fewer installations, declare the unneeded plants excess, and dispose of them under government procedures. The equipment would either move to the new site or be replaced. Employees would either move to the new site, transfer to other facilities, or be terminated. Consolidation could reduce overhead costs and result in more efficient operations, particularly if old equipment is replaced. While the capabilities at the various facilities are highly specialized and in some cases unique to each plant, in some cases it may be possible to combine similar processes at two plants onto a single line, achieving economies of scale. Consolidation would incur front-loaded costs to move capabilities and personnel, to build facilities at receiving locations, and often to conduct environmental remediation before transfer of property declared excess to need. Because it would involve the transfer of jobs, consolidation would incur political costs as well. Finally, consolidation of the government-operated facilities would require base realignment and closure (BRAC) legislative authority.

Recapitalize and Unify

This option envisions a long-term strategy of relocating the organic base entirely on multifunctional installations of the Army or the other services. Ideally it would be part of a broader Army or DoD base realignment strategy to eliminate the many single-function installations that today house such activities as headquarters, training, and industrial operations. It would share some of the
same benefits as consolidation in terms of reducing overhead costs. BRAC legislation would be required for the government-operated facilities.

ASSESSMENT OF OPTIONS

The status of the facilities needs to be taken into account in assessing the options. They fall into three categories: arsenals; government-owned and operated (GOGO) ammunition plants; and government-owned, contractor-operated (GOCO) plants. An installation's category affects the attractiveness of options, because each category is subject to different statutes and rules.

The recapitalize-and-unify option is set aside for two reasons. First, it depends on two problematic events: the implementation of a fifth round of BRAC, which has been authorized for FY05 but may still be uncertain, and, within a broad BRAC strategy, the adoption of this option. The other options may be implemented, at least for part of the base, without BRAC legislation or similar broader authority. Second, the option does nothing to move the base in the direction of increasing private-sector reliance, an objective that, after analysis, appears appropriate.

Turning to the remaining three options, consolidation is not without merit, but it does not offer many advantages. It would help address the problem of expensive overhead, and it could meet the Army's demands. But it does not solve other problems. It still leaves the facilities under the control of the Army, which thus will continue to expend management attention. Installations declared excess to need risk divestiture without compensation to the Army. The history of BRAC indicates that the service does not realize much revenue from the sale (about 10 cents on the dollar of fair market value). Also, the Army may be required to clean up environmental hazards before the installation can be turned over for alternative uses, and the turnover process can be quite lengthy, on average about nine years. Furthermore, the Army would incur the front-loaded relocation and construction costs associated with consolidation with little prospect of achieving economies of scale in manufacturing.

On the other hand, the privatization and federal government corporation options offer many benefits that consolidation lacks, and both can meet mission requirements. The former gets both the DoD and the Army out of the business of managing a peripheral function for which they have no special expertise and places the function in the hands of those who do. It improves access to capital and provides incentives for the owners to raise capital and invest in the plants. It also generates revenue from the sale of the plants. Because the plant does not close, workforce issues are less of a problem. Nor does the Army have to pay any construction costs as it would under consolidation, and increased competition creates incentives to reduce overhead costs.
Table S.1

Legal Constraints on Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Category of Facility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GOCO Plants</td>
</tr>
<tr>
<td>Privatize</td>
<td>No enabling authority exists.</td>
</tr>
<tr>
<td></td>
<td>Protective legislation in place(^a)</td>
</tr>
<tr>
<td>FGC</td>
<td>Requires authorizing legislation</td>
</tr>
<tr>
<td>Consolidate</td>
<td>Protective legislation in place for Crane and McAlester</td>
</tr>
</tbody>
</table>

\(^a\) An A-76 competition could be conducted for Pine Bluff.
\(^b\) An A-76 competition could be conducted.

The federal government corporation offers most of the benefits of privatization, except that it does not completely divest the government of ownership of the plants in that they remain under a quasi-government corporation (although the Army would not own them).

As mentioned, each option faces different legal constraints. Table S.1 depicts these for the three types of facilities by option. A blank cell indicates no constraint.

The GOCO plants face the fewest constraints. The federal government corporation would require authorizing legislation. However, Congress has passed many of these, so, assuming that political leaders in the affected locations supported the proposal, passing the legislation should not prove overly difficult. The same point would apply to creating a federal government corporation for the arsenals. Privatizing the arsenals would prove more problematic because no authority exists to do that directly. Consolidating the arsenals would require BRAC legislation, which the Congress has authorized for FY05 but which it could also reconsider between now and then. The GOGO plants face the most constraints because two (Crane and McAlester) operate under protective legislation that prevents the conversion of work there to contract. At the third, Pine Bluff, the provisions of Office of Management and Budget Circular A-76 could permit the conversion of some workload to contract.

**WHAT WE RECOMMEND**

We recommend the Army adopt a mixed strategy. Specifically, we recommend that the Army:
Sequentially privatize 10 of the 11 GOCO ammunition plants, retaining Mississippi AAP.

Retain the three GOGO ammunition plants as government facilities, providing a hedge of government-owned capacity.

Create a federal government corporation for the two arsenals. After five years of operation, privatize the FGC unless overriding considerations dictate continuance as an FGC.

Withhold all further facility-use contract competitions pending decisions on this study.

The GOCO Plants

We recommend privatization of the GOCO plants, except for Mississippi AAP, which the Army does not own. Declare the plants excess to ownership but not excess to need, so that capability is retained, plants are sold as going concerns, and likelihood of sale revenue is enhanced. Use legal authorities to transfer property before environmental cleanup is completed, and trade sale revenue for agreement of buyers to conduct cleanup. Sell the plants in packages that maximize sale value. Sequence the sales so that early lessons learned can be applied to subsequent sales. In the meantime, we recommend deferring any further long-term commitments to facility-use contractors.

The GOGO Plants

We recommend that the Army retain the three GOGO ammunition plants along with Mississippi AAP as a hedge against unforeseen need for Army-owned facilities. Retaining these four installations retains more than half of the current government-owned acreage devoted to ammunition plants.

The Arsenals

For the arsenals, because there appears to be no authority for direct privatization, we recommend that the government create a federal government corporation to own and run them. The corporation will be chartered not only to meet DoD needs for ordnance materiel, but also to use its substantial capabilities and capacities to manufacture commercial products. The corporation may be chartered either as a permanent entity or with a provision for its board of directors to recommend at the end of a five-year period whether to continue the corporation or to privatize it. We favor an assumption of subsequent privatization, but experience could indicate continuance of the FGC as the preferred long-term option.
FALBACK STRATEGIES

Many pitfalls dot the path of these recommendations, and it is quite possible that the Army may not be able to carry out all the recommendations for one reason or another. Should one of the primary strategies fail, the Army still has options.

If a particular GOCO plant does not generate a fair price, the Army still has both a short- and a medium-term option. In the short term, the Army could sell property and perhaps buildings while retaining land, which it would lease for a very long term to provide incentives for lessees to invest as if they owned the land. While falling short of complete privatization, such a fallback would bring some of the benefits of complete privatization. Manufacturing capital would be in the hands of a firm with access to capital and incentives to modernize. As simply a landowner, demands decline for Army management attention. But retaining the land forgoes the revenues from sale.

In the medium term, the Army might consolidate some of these facilities to achieve overhead savings. But, as pointed out above, consolidations entail large front-end costs. Further, they incur the human and political costs associated with moving the workload of hundreds of employees to new locations. Finally, the consolidation leaves the remaining assets in government hands, doing nothing to move toward the vision of private-sector reliance and forgoing the other benefits of private-sector reliance. Consolidation, while potentially worthwhile, represents an inferior solution.

Turning to the arsenals, if either the Army or DoD rejects the proposal to create an FGC to own and operate the arsenals or if the Congress looks unfavorably on an administration proposal to create one, there are alternatives to consider. An option available outside of BRAC authority would be to convert one or both of the arsenals to GOCO operation, but the small and uncertain anticipated demand makes this prospect unlikely. That leaves only consolidation or divestiture under a possible future BRAC as an option. As noted earlier, this is an inferior option. One other possibility for the arsenals would require a willing buyer, perhaps a consortium of local interests, with a proposal to buy one or both of the arsenals, maintain Army-required capability, and employ the available capacity to manufacture commercial products. If the proposal met with Army approval and could provide reasonable expectation of commercial success and employment, then the Army might submit a request for special privatizing legislation, meeting the congressional reporting and notification requirements of 10 USC 2687. The likelihood of this set of events occurring, however, seems small.
HOW DOES THE GOVERNMENT BENEFIT?

What benefits does the strategy offer the government? They are of two types: intangible and tangible. The intangible but very real benefits include those of freeing the Army from managing manufacturing operations and placing the responsibility in the hands of those who know more about it. Senior Army leaders no longer have to operate outside their primary area of expertise, and the arsenals and ammunition plants now operate under market forces, which should encourage innovation and efficiency.

The tangible benefits are cost savings, and they could be substantial, both over the POM years and over a 20-year projection. Tables S.2 and S.3 show the estimated net present value of savings from privatizing the 10 GOCO ammunition plants and creating an FGC for the arsenals. Table S.2 shows the figures for the budget and POM through FY09; Table S.3 shows the same figures for a 20-year time horizon, through FY22.

Savings from privatization of the 10 GOCO ammunition plants result principally from reduced ammunition costs due to improved productivity and greater competition; revenue from sale of property; reduced government staff; and savings from ARMS appropriations net of increased tenant revenues. While the unit price contractors charge may actually rise, total costs to the Army should fall as the costs associated with the government’s ownership of facilities are eliminated. The three cases, pessimistic, base, and optimistic, vary assumptions concerning sale revenue, product prices, Armament Retooling and Manufacturing Support Initiative (ARMS) costs and benefits, contract termination costs, employee termination costs, and discount rates.

Savings from the creation of the FGC for arsenals result principally from the restructuring of the labor force to industry-standard ratios of direct to indirect labor and the sharing of overhead with commercial production. The three

<table>
<thead>
<tr>
<th>Table S.2</th>
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<tr>
<td>Net Present Values of Savings to the Army from Privatization of GOCO Ammunition Plants and Creation of FGC for Arsenals: FY03–09 ($ millions)</td>
</tr>
<tr>
<td>3% Interest Rate</td>
</tr>
<tr>
<td>Pessimistic</td>
</tr>
<tr>
<td>Privatization</td>
</tr>
<tr>
<td>FGC</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
cases vary assumptions concerning rate of conversion of commercial workload, employee retraining costs, transition costs, and initial working capital infusion.

A word of caution is in order. In privatizing the GOCO plants, there is substantial uncertainty in estimates both of sale revenue and future ammunition prices. While revenues are estimated here using conservative assumptions, one cannot know for sure what a competitive or negotiated sale will bring. But the risk is not great. In selling property, the Congress oversees GSA and will approve only sales that generate a reasonable market value. The Army can withdraw from transactions that fail to produce reasonable bids. Similarly, to the extent that competitive pressures fail to generate reasonable offers on concurrent agreements for future ammunition prices, the Army need not agree. Hence, while the uncertainty is substantial, the financial risk is small.

With regard to the creation of the FGC, the financial risk to the Army is similarly small. To the extent that the FGC is unable to fully restructure to commercial standards, even a partial movement in that direction will serve to reduce the prices the Army pays for its ordnance materiel. Even if the FGC is able to bring in only a fraction of the commercial work hypothesized in the business plan, the Army is still better off financially. Hence, the financial risk to the Army from creating the FGC is modest.

Thus, both the intangible and tangible benefits to the Army are considerable. This is not to minimize the difficulties of carrying out the recommendations. The history of the Army and its ordnance manufacturing base is long, and it has served the needs of the nation well. The changes proposed here are sweeping. Many involved with the base will be reluctant to make dramatic changes in institutions that have served their purpose well. However, the problems described above are real, and it will take major changes to resolve them. The vision and recommendations proposed here chart a feasible path for the Army to follow.

### Table S.3
Net Present Values of Savings to the Army from Privatization of GOCO Ammunition Plants and Creation of FGC for Arsenals: FY03–22 ($ millions)

<table>
<thead>
<tr>
<th></th>
<th>3.5% Interest Rate</th>
<th>7% Interest Rate</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Pessimistic</td>
<td>Base</td>
</tr>
<tr>
<td>Privatization</td>
<td>–64</td>
<td>1,062</td>
</tr>
<tr>
<td>FGC</td>
<td>1,177</td>
<td>1,732</td>
</tr>
<tr>
<td>Total</td>
<td>1,113</td>
<td>2,794</td>
</tr>
</tbody>
</table>
A final word. The proposed strategy will not solve all the problems identified in the base. Regardless of who owns the manufacturing assets, the Army should resource ammunition procurement in ways that enhance the stability and efficiency of its base.
The authors are grateful to the many government and contractor staff at the arsenals, ammunition plants, and private facilities who hosted our visits and provided information and data for this study. In addition, the various staffs at the Army Materiel Command and in the Pentagon, in particular our study advisory group, merit special recognition. While there are too many persons to thank individually, the authors wish to acknowledge the special efforts of the following personnel:

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Mr. John Kelly  
Mr. Tony Kress  
Mr. Tom Lanyi  
Mr. Fritz Larsen  
Mr. Dave Lunasco  

Mr. Jim Ball  
Mr. Al Beuster  
MG Bill Bond  
LTC Tim Burke  
Mr. Don Chrans  
Mr. Bob Conley  
Ms. Patty Felth  
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Mr. Walt Hollis  
Mr. Kevin Knotts  
Ms. Gail Lankford  
LTC Bob Larsen  
Mr. Steve Linke  
Mr. John McDonald
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>A-76</td>
<td>OMB Circular A-76</td>
</tr>
<tr>
<td>AAA</td>
<td>Army ammunition activity</td>
</tr>
<tr>
<td>AAP</td>
<td>Army ammunition plant</td>
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<tr>
<td>AFB</td>
<td>Air Force Base</td>
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<tr>
<td>AMC</td>
<td>Army Materiel Command</td>
</tr>
<tr>
<td>ANAD</td>
<td>Anniston Army Depot</td>
</tr>
<tr>
<td>AOR</td>
<td>Accumulated Operating Results</td>
</tr>
<tr>
<td>APFSDS</td>
<td>Armor Piercing, Fin Stabilized, Discarding Sabot</td>
</tr>
<tr>
<td>ARMS</td>
<td>Armament Retooling and Manufacturing Support</td>
</tr>
<tr>
<td>ASPI</td>
<td>Arsenal Support Program Initiative</td>
</tr>
<tr>
<td>ATACMS</td>
<td>Army Tactical Missile System</td>
</tr>
<tr>
<td>ATK</td>
<td>Alliant Techsystems, Inc.</td>
</tr>
<tr>
<td>AWCF</td>
<td>Army Working Capital Fund</td>
</tr>
<tr>
<td>BDM</td>
<td>Bunker Defeat Munition</td>
</tr>
<tr>
<td>BLS</td>
<td>Bureau of Labor Statistics</td>
</tr>
<tr>
<td>BOD</td>
<td>Board of directors</td>
</tr>
<tr>
<td>BRAC</td>
<td>Base realignment and closure</td>
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<tr>
<td>CAPM</td>
<td>Capital Asset Pricing Model</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>CNC</td>
<td>Computer numerically controlled</td>
</tr>
<tr>
<td>COCO</td>
<td>Contractor-owned, contractor-operated</td>
</tr>
<tr>
<td>COR</td>
<td>Contracting officer’s representative</td>
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</tbody>
</table>
D&Z  Day & Zimmerman  
DA  Department of the Army  
DCAA  Defense Contract Audit Agency  
DCF  Discounted cash flow  
DCSOPS  Deputy Chief of Staff for Operations  
DLH  Direct labor hours  
DoD  Department of Defense  
DP  Dual purpose  
EBIT  Earnings Before Interest and Taxation  
EBITDA  Earnings Before Interest, Taxation, Depreciation, and Amortization  
EPA  Environmental Protection Agency  
ETO  Excess to ownership  
EV  Expected value  
FCF  Free cash flow  
FGC  Federal government corporation  
FMR  Financial management regulation  
FMS  Foreign military sales  
FY  Fiscal year  
GAAP  General accepted accounting principles  
GAO  General Accounting Office  
GD  General Dynamics  
GD-OTS  General Dynamics Ordnance and Tactical Systems  
GE  General Electric  
GOCO  Government-owned, contractor-operated  
GOGO  Government-owned, government-operated  
GSA  General Services Administration  
GSE  Government sponsored enterprise  
HAAP  Holston AAP  
HMMWV  High mobility multipurpose wheeled vehicle  
HMX  High Melting Explosive
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>HQDA</td>
<td>Headquarters, Department of the Army</td>
</tr>
<tr>
<td>IAV</td>
<td>Interim armored vehicle</td>
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<tr>
<td>IBPR</td>
<td>Industrial base program review</td>
</tr>
<tr>
<td>ICM</td>
<td>Improved conventional munition</td>
</tr>
<tr>
<td>IF</td>
<td>Industrial facilities</td>
</tr>
<tr>
<td>IMC</td>
<td>Industrial mobilization capacity</td>
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<tr>
<td>JDAM</td>
<td>Joint direct attack munition</td>
</tr>
<tr>
<td>JSOW</td>
<td>Joint stand-off weapons</td>
</tr>
<tr>
<td>LAAAP</td>
<td>Louisiana AAP</td>
</tr>
<tr>
<td>LAP</td>
<td>Load, assemble, pack</td>
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<tr>
<td>LCAAP</td>
<td>Lake City Army Ammunition Plant</td>
</tr>
<tr>
<td>LIF</td>
<td>Layaway of Industrial Facilities</td>
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<tr>
<td>LOSAT</td>
<td>Line of sight anti-tank</td>
</tr>
<tr>
<td>MACS</td>
<td>Modular Artillery Charge System</td>
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<tr>
<td>MIIF</td>
<td>Maintenance of Inactive Industrial Facilities</td>
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<tr>
<td>MLRS</td>
<td>Multiple Launch Rocket System</td>
</tr>
<tr>
<td>MTW</td>
<td>Major theater war</td>
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<tr>
<td>NASA</td>
<td>Naval Air Station</td>
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<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
</tr>
<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
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<tr>
<td>NPL</td>
<td>National priorities list</td>
</tr>
<tr>
<td>NPV</td>
<td>Net present value</td>
</tr>
<tr>
<td>OMB</td>
<td>Office of Management and Budget</td>
</tr>
<tr>
<td>OPFOR</td>
<td>Opposing force</td>
</tr>
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<td>OSC</td>
<td>Operations Support Command</td>
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<tr>
<td>OSD</td>
<td>Office of the Secretary of the Defense</td>
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<tr>
<td>PBD</td>
<td>Program Budget Decision</td>
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<tr>
<td>PBP</td>
<td>Production base plan</td>
</tr>
<tr>
<td>PEO</td>
<td>Program Executive Office</td>
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<tr>
<td>PEP</td>
<td>Plant equipment packages</td>
</tr>
<tr>
<td>PL</td>
<td>Public Law</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>PNNL</td>
<td>Pacific Northwest National Laboratories</td>
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<tr>
<td>POM</td>
<td>Program Objective Memorandum</td>
</tr>
<tr>
<td>PP&amp;E</td>
<td>Property, plant, and equipment</td>
</tr>
<tr>
<td>PV</td>
<td>Present value</td>
</tr>
<tr>
<td>QDR</td>
<td>Quadrennial Defense Review</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and development</td>
</tr>
<tr>
<td>RCRA</td>
<td>Resource Conservation and Recovery Act</td>
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<tr>
<td>RDX</td>
<td>Royal Demolition Explosive</td>
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<tr>
<td>RIA</td>
<td>Rock Island Arsenal</td>
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<tr>
<td>RIF</td>
<td>Reduction in Force</td>
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<tr>
<td>RRAD</td>
<td>Red River Army Depot</td>
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<tr>
<td>SADARM</td>
<td>Sense and destroy armor</td>
</tr>
<tr>
<td>SAG</td>
<td>Study Advisory Group</td>
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<tr>
<td>SIC</td>
<td>Standard Industrial Classification</td>
</tr>
<tr>
<td>SLAP</td>
<td>Saboted Light Armor Piercing</td>
</tr>
<tr>
<td>SRAW/ MIPM</td>
<td>Short Range Assault Weapon/Multipurpose Individual Munition</td>
</tr>
<tr>
<td>TAA</td>
<td>Total Army Analysis</td>
</tr>
<tr>
<td>TACOM</td>
<td>Tank-Automotive and Armaments Command</td>
</tr>
<tr>
<td>TNT</td>
<td>Trinitrotoluene</td>
</tr>
<tr>
<td>TOW</td>
<td>Tube Launched, Optically Tracked, Wire Guided</td>
</tr>
<tr>
<td>TOWF&amp;F</td>
<td>TOW fire and forget</td>
</tr>
<tr>
<td>TPCSDS-T</td>
<td>Target practice cone-stabilized discarding sabot with tracer</td>
</tr>
<tr>
<td>TSDF</td>
<td>Treatment, storage, and disposal facilities</td>
</tr>
<tr>
<td>U.S.H.R.</td>
<td>U.S. House of Representatives</td>
</tr>
<tr>
<td>USC</td>
<td>United States Code</td>
</tr>
<tr>
<td>USDA</td>
<td>U.S. Department of Agriculture</td>
</tr>
<tr>
<td>USEC</td>
<td>U.S. Enrichment Corporation</td>
</tr>
<tr>
<td>USF</td>
<td>United States facilities</td>
</tr>
<tr>
<td>USOC</td>
<td>U.S. Ordnance Corporation</td>
</tr>
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</table>
Abbreviations

VSIP  Voluntary Separation Incentive Payment
WACC  Weighted average cost of capital
WVA   Watervliet Arsenal
Chapter Five

THE PRIVATIZATION OPTION

The previous chapter proposed a strategic vision of the Army's industrial ordnance base and described four ways the Army might move toward achieving that vision. This chapter discusses one of those options—privatization—in more detail. It describes how privatization would be accomplished. It then lays out and discusses the arguments against privatizing: market conditions, cost, and risk of mission accomplishment.

Since the GOCO ammunition plants employ relatively few government civilian workers, a sale of these facilities would be relatively straightforward. For the reasons laid out in Chapter Four, direct privatization of the GOCO ammunition plants and arsenals is infeasible, but eventual privatization of the arsenals could be possible after a transition stage as a federal government corporation. This chapter therefore concentrates on the privatization of the GOCO ammunition plants, but it also includes examples from the arsenals.

As discussed in the Phase 2 report (Hix et al., 2003) and in Chapters Three and Four, our assessment takes as an underlying principle the imperative to rely on the private sector for the provision of ordnance materiel unless overriding considerations dictate to the contrary. In principle, privatization could resolve many of the problems described in Chapter Three. Its benefits include:

- Removal of management distractions by divesting the Army of the organic industrial base, freeing military and civilian personnel to focus on issues more central to the Army's mission.
- Ability of private-sector owners to bring in additional workload or to redeploy assets not currently used for ordnance production.
- Increased visibility of the full costs of ordnance production by removing restrictions on competition associated with the Arsenal Act, under which the

---

1As one reviewer pointed out, privatization offers only the potential for achieving the benefits listed below. Outcomes depend on the actual relationship between the government and the contractor.
out-of-pocket costs of GOCOs and GOGOs can be compared with the full costs of COCOs (contractor-owned and -operated), and subsidies to GOCO and GOGO ordnance prices such as Military Construction funds and government-provided insurance.

- The potential to disentangle production and replenishment costs using contracting mechanisms and thereby make more informed decisions about the costs and benefits of holding idle replenishment capacity.
- Private-sector access to capital markets, which creates the potential to modernize facilities and make cost-saving investments.

However, some issues would remain for the Army to resolve internally. These include:

- Developing a strategic vision for the industrial base, by recognizing that procurement decisions affect the structure and financial health of private-sector ordnance producers.
- Employing contracting policies that promote competition and innovation, such as best-value source selection, system-level contracting, performance incentives, and relaxing military specifications or using commercial equivalents where feasible.
- Providing more stable funding for ammunition procurement.
- Creating a coherent and cost-effective replenishment policy.

In addition, as described in earlier chapters, there are circumstances under which government-run production or government ownership of the means of production may be preferable to reliance on the private sector. These exceptions include the following:

- Unresponsive markets, i.e., private-sector firms are unwilling to produce needed ordnance materiel in a timely fashion.
- Government-owned facilities can produce ordnance materiel at a lower cost than the private sector.
- Mitigation of the risk that private-sector producers will not have the capability or the capacity to produce ordnance materiel in sufficient quantities, particularly in time of crisis.
- Activities defined as inherently governmental.\(^2\)

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\(^2\)Inherently governmental activities are those that involve the discretionary application of governmental authority (such as criminal investigations, judicial functions, and management and direc-
The fourth exception, inherently governmental activities, is relatively easily dismissed in the case of ordnance materiel. OMB Circular A-76 specifically cites the manufacture of ordnance equipment as a commercial rather than an inherently governmental activity (U.S. Executive Office of the President, 1983, p. 2 and Attachment A).

In the remainder of this chapter, we discuss the applicability of the remaining three exceptions to private-sector production of ordnance materiel, supporting our arguments with empirical examples and analytical models. In the first section, we discuss the characteristics of the market for ordnance materiel and whether commercial firms are unresponsive. In the second section, we discuss whether private-sector production of ordnance materiel is likely to be more or less expensive than GOGO or GOCO production. The third section addresses whether private-sector production is likely to lead to an unacceptable risk that ordnance materiel will not be available in sufficient quantities in times of crisis. In the final section, we discuss the Economic Regeneration Model, an AMC-proposed alternative to immediate privatization.

ARE COMMERCIAL PRODUCERS UNRESPONSIVE?

This section first describes the characteristics of the market for ordnance materiel that differ from typical competitive markets for goods and services and that may result in the unwillingness of commercial producers to respond to Army demands for ordnance materiel. It then discusses whether these characteristics are sufficient to drive private-sector firms out of the market, thus requiring government ownership of facilities and equipment or government control of production processes.

Characteristics of the Market for Ordnance Materiel

A number of factors that differ from typical competitive markets characterize the market for ordnance materiel in the United States. Among these are uneven demand histories for components and end items; a requirement for a significant production increase during or after periods of military conflict; geographical semi-isolation of some ammunition production for safety reasons; a single buyer for the vast majority of products; a concentrated supplier market; and Army ownership of a substantial fraction of ordnance production facilities and equipment. Understanding these characteristics is essential before evaluating arguments that unresponsive markets require continued government ownership of the Army's organic industrial base.

Executive Correspondence
DCN 5435
The uneven demand for ammunition is particularly noteworthy for those types and components associated with warfighting ammunition, as opposed to those items used exclusively or partially for training. Ammunition used principally for warfighting is produced and stored against the day it is needed. As mentioned earlier, in balancing the demands on its limited resources, the Army never funds its full requirement. Production also tends to be compressed to achieve adequate stockage levels rapidly. As a result, the production demand history is very uneven for warfighting rounds. Production of the types of ammunition used in training tends to be more prolonged and regular, as existing stocks are constantly used up in training.

The demand for other ordnance items, such as cannon, recoilless rifles, and mortars produced at Watervliet Arsenal and gun mounts produced at Rock Island Arsenal, has also been volatile, though the change in quantity has been primarily negative. In the last fifteen years, production of cannons, recoilless rifles, and mortars at Watervliet Arsenal has fallen from approximately 3,500 per year to 300 to 400 per year (see Figure 3.1). Likewise, production of gun mounts at Rock Island Arsenal has decreased more than 90 percent in the last decade.

The market for ordnance materiel is also noteworthy in that most products have only one buyer: the U.S. government, primarily the Department of Defense. As in any monopsonistic (i.e., one-buyer) market, the buyer has substantial flexibility to set the rules that govern the relationship between the seller and buyer. In the ordnance market, the role of the monopsonistic buyer is further

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3 For example, Olin Corporation produced approximately half a million M903, Saboted, Light Armor Piercing (SLAP), .50 caliber rounds between 1996 and 1998. After this production, the SLAP lines at Winchester’s East Alton, Illinois, facility shut down for three years. In late FY01, a new contract was awarded for the production of SLAP rounds, and the line is being restarted at this writing. (Contract number DAAE30-01-C-1114, posted in CBNet on September 27, 2001.)

4 For example, the M865 Target Practice Cone-Stabilized Discarding Sabot with Tracer (TPCSDS-T) is a tank training round. It has been produced every year since the introduction of the 120mm tank cannon in the U.S. Army in the mid-1980s. Between 1995 and 2001, production averaged 175,000 per year, though annual quantities varied substantially. (See U.S. Department of the Army, Procurement Programs, 1998, 1999, 2000, 2001.) Ammunition used in both training and combat, such as the M107, 155mm high-explosive round, also has more stable production.

5 Production of various gun mounts and towed howitzers fell from 981 in 1990 to 70 in 1999. Future production is based primarily on residual demand for legacy systems. Of planned new systems, neither the Mobile Gun System nor the Lightweight Towed Howitzer will have its gun mounts produced at Rock Island. Rock Island did win a competitive subcontract to produce a component of the Lightweight Towed Howitzer, but that decision was contingent on reducing its overhead rate. There was some hope that the Crusader self-propelled artillery system gun mount would be produced at Rock Island, but that system has been cancelled. Thus, the prospects for gun mount and towed artillery production at Rock Island Arsenal are bleak.

6 The U.S. government does not always act as one, and in fact, a number of distinct organizations within the Department of Defense are responsible for purchasing ammunition and ordnance items. Nevertheless, the government retains most characteristics of a monopsonistic buyer. There are some foreign military sales (FMS), but the quantities are typically small compared to the U.S. market. Most FMS sales must also be approved by the U.S. government.
distorted from classic market mechanisms in that the buyer owns a substantial portion of the production capital in the form of facilities and equipment, particularly as associated with final assembly of ammunition. As one might expect in such a market, competition is considerably constrained. To spread the overhead cost of owning and maintaining large production facilities, the government tends to favor the producers that run or use the government's facilities when it awards production contracts. In some cases, competitions are constructed in a manner that virtually guarantees the continued use of government facilities.

In addition to the existence of a monopsonistic buyer, the supply side of the ordnance market is highly concentrated. First, we consider the market for ammunition. Three firms, Alliant Techsystems, General Dynamics, and Day & Zimmerman, account for 55 percent of the ammunition end items identified by the 1999 Production Base Plan (PBP). The Army's GOGO facilities account for another 30 percent of the end items in the PBP. The concentrated supplier market is partly the result of the general decline in ammunition procurement since the end of the Cold War. DoD ammunition procurement budgets have been halved in real terms (2001 dollars), from $4.2 billion in 1991 to $2.1 billion in 1996 (U.S. Government, 1992, and U.S. House of Representatives, 1995). Total ammunition and ordnance sales (including commercial sales) declined by about 50 percent in real terms from a peak of $13.2 billion in 1988 to $6.7 billion in 1999. As Figure 5.1 indicates, much of the decline in sales since 1988 is in large-caliber (greater than 30mm) ammunition, which is primarily a military market. However, as shown in Chapter One, recent DoD budgets show a real increase in ammunition procurement, one that has not yet appeared in the Department of Commerce annual sales, shown in Figure 5.1.

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7The Arsenal Act of 1920 (10 USC 4532) requires the Secretary of the Army to use factories or arsenals owned by the United States when they are less expensive than the private sector. This requirement has been interpreted to mean that the out-of-pocket, or marginal, cost of production in Army-owned facilities must be less than the full cost proposed by privately owned firms. Thus, workload could be awarded to government facilities even if their full costs are higher than the private sector. The government also provides other subsidies for GOGO ammunition producers by covering insurance costs and exempting them from property taxes, for example.

More recently, a briefing from the U.S. Army Materiel Command Deputy Chief of Staff for Ammunition (DCS-AMMO) recommends that the organic industrial base be taken into account when making weapon system procurement decisions. See U.S. Army Materiel Command Deputy Chief of Staff for Ammunition (2002), slide 2.

8For example, the competition to produce the majority of the Army's small-arms ammunition was conducted in a way that tied the running of Lake City AAP, the Army's small-arms ammunition production facility, to the production of small-arms ammunition.

9The Production Base Plan is a biannual report that assesses the capability of the U.S. munitions industrial base to replenish ammunition that would be expended in the event of war. See Appendix B for a more detailed description.
Rethinking Governance of the Army's Arsenals and Ammunition Plants

The decline in the ammunition budget since the end of the Cold War, as in so many other defense procurement areas, has forced substantial consolidation in the ammunition industrial base. Some of the consolidation is also a result of government ownership of much of the base. The largest survivors in the ammunition market consolidation are those involved in running the government's facilities. As mentioned earlier, these firms enjoy some competitive advantages in winning production contracts, and this has helped them weather the downturn in the ammunition budget. Finally, the high level of market concentration is exacerbated by the fact that the major market players have entered into partnerships or joint ventures with each other to manage the government's facilities. In addition to the corporate-level relationships, these firms often work together in prime contractor-subcontractor relationships.


Figure 5.1—Value of Ammunition and Ordnance Shipments, 2001 Dollars

For example, General Dynamics and Day & Zimmerman have partnered to form American Ordnance, which manages both the Iowa and Milan AAPs. General Dynamics and Alliant Techsystems formed American Powder as a joint entity to run Radford AAP, but this enterprise was abandoned in the face of antitrust scrutiny.

Examples include tank ammunition, where Alliant Techsystems and General Dynamics are the prime contractors, but American Ordnance (joint venture between General Dynamics and Day & Zimmerman) holds the subcontract to load, assemble, and pack rounds at the Iowa AAP. Alliant
For other ordnance materiel (e.g., large-caliber cannon, mortars, and gun mounts), the U.S. supplier base is even more concentrated than in the ammunition market. Other than the Army-owned Watervliet Arsenal, only United Defense has a current capability to produce large-caliber cannon. As for gun mounts, other than the capability at Rock Island Arsenal, only General Dynamics and United Defense produce gun mounts, for the Abrams tank and naval applications, respectively.

The ordnance market is also notable for its need to be able to increase production substantially during or after conflicts. This requirement has probably shaped the current market more than almost any other factor, by providing a rationale for continued Army ownership. The need to maintain replenishment/surge capability appears to require the retention of large amounts of production capital in either an idle or underutilized capacity. The prevailing argument for government retention of this capital is that absent explicit contractual agreements, the private sector will not allow such large amounts of capital to remain so underutilized. By retaining this capital in the government, it is argued, the Army can better manage its upkeep and can remain assured of its availability during times of replenishment or surge. However, this argument requires careful examination, because much of DoD’s ammunition production, as well as other weapon system and component production and repair, which would also need surge or replenishment strategies, is currently conducted in the private sector. Issues involved with replenishment are discussed in more detail below in the section on risk and in Appendix B.

Responsiveness of Markets

Uneven demand for ordnance materiel, the need to maintain a replenishment or surge capability, and the presumed unprofitability of the ordnance business cause concern that a complete absence of market responsiveness is prevented only by continued government ownership of much of the production capital and extensive, detailed management of the market. These concerns are high-

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12 United Defense produces cannon for the Navy at its Louisville, Kentucky, facility. This was a Navy owned and operated facility until it was privatized in the mid-1990s.

13 For example, the M864, 155mm Dual Purpose, Improved Conventional Munition (DP-ICM) is not currently in production. This is a major warfighting round that has a replenishment requirement to produce over 700,000 rounds during the replenishment period. The bill of materials for this round includes items such as submunitions grenades, shell body, fuze, explosive, and propellant. Each of these components must also be produced at an accelerated rate to meet replenishment requirements. While some of the components are in production for other end items, many are not and require the restart of lines that either have been laid away or are producing other types of components.

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lighted by recent trends, such as an exodus of companies from the ammunition market,\textsuperscript{14} consolidation of existing companies,\textsuperscript{15} and a lack of entry by new firms.

But some of the presumptions that underpin the fear of an unresponsive ordnance market need closer examination. A couple of points are particularly relevant. The first is that over half the current ammunition budget is spent outside of the organic base. Much of this production is for items that have commercial analogues,\textsuperscript{16} but much is also for militarily unique ammunition items and components.\textsuperscript{17} Second, newer munitions, such as guided missiles, are not produced in Army-owned facilities. Nor does replenishment or surge production planning for these items include Army-owned facilities.\textsuperscript{18} Significantly, even for very advanced conventional munitions the trend is to plan for replenishment or surge more and more in the private sector.\textsuperscript{19}

It is difficult to make direct comparisons between GOCO and COCO ammunition facilities, because most are operated as subunits of larger, defense-oriented conglomerates such as General Dynamics, Alliant Techsystems Inc. (ATK), Olin, and BAE Systems, or by privately held corporations such as Day & Zimmerman, Chamberlain, and Norris Industries. Some broad comparisons between various sectors of the ordnance industry and other comparable defense and non-defense industries are possible using data collected by the U.S. Department of Commerce in the Economic Census and the Annual Survey of Manufactures. These data are collected at the "establishment" level, so each operating location

\textsuperscript{14}Between 1992 and 1997, the number of firms in the market for large-caliber (greater than 30mm) ammunition fell from 56 to 45, while the number of establishments (separate plants) fell from 70 to 53 (U.S. Department of Commerce, 1995b and 1999a). In the 1980s, up to eight companies were involved in the production of submunition grenade bodies. Today, only one company, Amron, continues production, and the replenishment capacity is retained through laid-away production lines on Army-owned facilities.

\textsuperscript{15}The ammunition base continues to consolidate. Recent examples include General Dynamics’ acquisition of HiTech and Primex and Alliant’s acquisition of Thiokol.

\textsuperscript{16}For example, General Dynamics produces most of the propellant used in small- and medium-caliber ammunition in a private facility at St. Marks, Florida. This production is mingled with production of propellant for commercial small-arms ammunition. Intercontinental Manufacturing, Wyman Gordon, and National Forge all produce bomb bodies. Bomb bodies are large, cylindrical, hollow bodies that are forged in a manner similar to some commercial products.

\textsuperscript{17}Fuzes are a good example. These are critical for bombs; artillery, tank, and mortar projectiles; rockets; and missiles, yet all are produced in privately owned facilities. As another example, General Dynamics’ (formerly HiTech’s) facility in Camden, Arkansas, is included in surge/replenishment planning for a number of warheads.

\textsuperscript{18}A few components for guided missiles, e.g., Patriot warheads, are included in replenishment planning for Army facilities, but not the assembly of end items.

\textsuperscript{19}Load, assemble, and pack of the SADARM was planned for Aerojet’s Azusa, California, facility. Load, assemble, and pack of the M829A3 is planned for an Alliant Techsystems facility in West Virginia.
within a company is represented separately and can more easily be classified into a specific industry.

Table 5.1 shows some descriptive statistics from the 1997 Economic Census for the ammunition and ordnance industries, plus selected defense and commercial industries for purposes of comparison. Although comparisons of profitability between industries are problematic because of differences in capital structures and in industry risk, the ordnance industries do not appear to be noticeably less profitable than other comparable industries. Gross margins (sales minus the cost of materials and labor as a percentage of sales) in the ammunition and ordnance industries tend to be higher than in other comparable defense and commercial industries. Alliant Techsystems Inc., a large diversified ordnance materiel producer (and the installation manager for the Radford and Lake City AAPs), earned common shareholders a return of approximately 100 percent in calendar year 2001, most of which occurred before the terrorist attacks on September 11. Its gross profits for 2001 were 25 percent, and net profits were 4.4 percent. General Dynamics' gross and net profits were 21.4 percent and 8.1 percent for the same period. Another indication of the sector's profitability is that solicitations for ammunition products usually draw a number of proposals from different companies.

Finally, uneven demand for ordnance products is another potential reason for unresponsive markets. The fear is that few companies would be willing to make the capital investments required to produce ordnance materiel when the likely production run is short, uneven, or unpredictable. In the ammunition market, however, these fears appear to have less to do with actual ammunition requirements than with the method by which, or the perception of how, the government funds and buys ammunition. As Table 1.3 in Chapter One indicates, production of military ammunition in the United States has been funded at $2–2.5 billion per year in real terms in recent years, and it is growing substantially in FY02 and FY03. Although emphasis may, in the long term, shift away from

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20 This is the latest available census. The U.S. Census Bureau conducts an economic census for years ending in 2 and 7. Statistics for interim years are estimated based on a representative sample of manufacturing establishments canvassed in the Annual Survey of Manufactures (U.S. Department of Commerce, 2001).


22 For comparison, the gross and net profits of some commercially oriented companies over the same period were: Dupont (chemical manufacture) 32.6 percent and 3.5 percent; Varco (oil drilling equipment) 34.9 percent and 6.0 percent; Olin (commercial ammunition, copper-based metals, and chemicals) 18.4 percent and 1.6 percent. See Hoover's On-Line, http://hoovers.com.

23 PM Mortars is the best example. Several years ago it successfully moved some of its products out of a workloaded government facility and instituted "best-value" competitions for mortar ammunition. These competitions draw a number of proposals, and according to PM personnel, have lowered price, increased quality, and improved the production base.
Table 5.1
Descriptive Statistics for Ordnance and Selected Defense and Commercial Industries

<table>
<thead>
<tr>
<th>Industry</th>
<th>Number of Companies</th>
<th>Number of Employees</th>
<th>Sales³ (Thousands of 2001 Dollars)</th>
<th>Gross Marginb</th>
<th>Capital-Sales Ratio⁹</th>
<th>Capital Replacement Ratio⁸</th>
<th>Annual Sales Growth (1992–1997)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small-arms ammunition manufacturing</td>
<td>108</td>
<td>6,863</td>
<td>76%</td>
<td>$1,032,700</td>
<td>36%</td>
<td>0.56</td>
<td>0.77</td>
</tr>
<tr>
<td>Ammunition (except small arms) manufacturing</td>
<td>45</td>
<td>9,427</td>
<td>53</td>
<td>1,646,750</td>
<td>33</td>
<td>0.44</td>
<td>0.72</td>
</tr>
<tr>
<td>Explosives manufacturing</td>
<td>65</td>
<td>7,770</td>
<td>71</td>
<td>1,450,244</td>
<td>38</td>
<td>0.35</td>
<td>0.85</td>
</tr>
<tr>
<td>Small arms manufacturing</td>
<td>191</td>
<td>9,907</td>
<td>76</td>
<td>1,376,971</td>
<td>46</td>
<td>0.39</td>
<td>1.03</td>
</tr>
<tr>
<td>Other ordnance and accessories manufacturing</td>
<td>67</td>
<td>12,285</td>
<td>39</td>
<td>1,925,534</td>
<td>48</td>
<td>0.17</td>
<td>1.08</td>
</tr>
<tr>
<td>Military armored vehicle, tank, and tank component manufacturing</td>
<td>39</td>
<td>5,982</td>
<td>49</td>
<td>1,204,964</td>
<td>33</td>
<td>0.31</td>
<td>0.84</td>
</tr>
<tr>
<td>Guided missile and space vehicle manufacturing</td>
<td>15</td>
<td>52,158</td>
<td>36</td>
<td>16,270,613</td>
<td>41</td>
<td>0.36</td>
<td>1.69</td>
</tr>
<tr>
<td>Guided missile and space vehicle propulsion unit and propulsion unit parts</td>
<td>19</td>
<td>18,540</td>
<td>45</td>
<td>3,562,936</td>
<td>32</td>
<td>0.41</td>
<td>0.87</td>
</tr>
<tr>
<td>Other guided missile and space vehicle parts and equipment</td>
<td>47</td>
<td>6,110</td>
<td>68</td>
<td>986,634</td>
<td>28</td>
<td>0.22</td>
<td>1.87</td>
</tr>
<tr>
<td>Machine shops</td>
<td>23,438</td>
<td>290,849</td>
<td>78</td>
<td>29,844,695</td>
<td>33</td>
<td>0.49</td>
<td>1.46</td>
</tr>
<tr>
<td>Iron and steel forging</td>
<td>392</td>
<td>26,243</td>
<td>76</td>
<td>5,370,258</td>
<td>27</td>
<td>0.54</td>
<td>1.44</td>
</tr>
<tr>
<td>Industry</td>
<td>Number of Companies</td>
<td>Number of Employees</td>
<td>Production Workers as % of Employees</td>
<td>Sales(^a) (Thousands of 2001 Dollars)</td>
<td>Gross Margin(^b)</td>
<td>Capital Sales Ratio(^c)</td>
<td>Capital Replacement Ratio(^d)</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>---------------------</td>
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<td>--------------------------------------</td>
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<td>-------------------------------</td>
</tr>
<tr>
<td>Fabricated structural metal manufacturing</td>
<td>2,867</td>
<td>92,512</td>
<td>72%</td>
<td>$17,737,117</td>
<td>26%</td>
<td>0.21</td>
<td>1.53</td>
</tr>
<tr>
<td>Oil and gas field machinery &amp; equipment</td>
<td>497</td>
<td>29,452</td>
<td>66</td>
<td>6,864,039</td>
<td>36</td>
<td>0.37</td>
<td>1.97</td>
</tr>
<tr>
<td>Iron and steel pipes and tubes manufacturing</td>
<td>169</td>
<td>27,723</td>
<td>78</td>
<td>8,321,915</td>
<td>25</td>
<td>0.33</td>
<td>1.68</td>
</tr>
<tr>
<td>Industrial valve manufacturing</td>
<td>427</td>
<td>53,264</td>
<td>65</td>
<td>9,539,641</td>
<td>37</td>
<td>0.41</td>
<td>1.21</td>
</tr>
<tr>
<td>Automobile manufacturing</td>
<td>174</td>
<td>114,060</td>
<td>86</td>
<td>104,924,119</td>
<td>24</td>
<td>0.25</td>
<td>2.24</td>
</tr>
<tr>
<td>Motor vehicle body manufacturing</td>
<td>749</td>
<td>42,674</td>
<td>76</td>
<td>9,828,326</td>
<td>19</td>
<td>0.14</td>
<td>2.97</td>
</tr>
</tbody>
</table>


\(^a\) Value of shipments.
\(^b\) (Value of shipments – cost of materials – payroll)/value of shipments.
\(^c\) Gross book value of total assets at end of year/value of shipments.
\(^d\) Total capital expenditures/total depreciation during year.
\(^e\) Comparable 1992 sales figures are not available for some industries because the industrial classification system used by the U.S. Census Bureau switched from the Standard Industrial Classification (SIC) system in 1992 to the North American Industry Classification System (NAICS) in 1997.
legacy conventional munitions to smarter conventional munitions and missiles, the shift should be gradual, leaving a large demand for conventional ammunition for the foreseeable future. This volume should be sufficient to attract significant competition if the government acts as a good customer. Strategies that stretch out or smooth production schedules, combine similar types of ammunition production onto single contracts, make greater use of multiyear and options contracting, and tie replenishment/surge requirements to peacetime production can all help make ammunition production more attractive.  

These types of recommendations are neither new nor unique to ordnance production. For example, Gansler (1980) recommended that DoD recognize, in industrial sectors where it is the primary or the only buyer, that its procurement decisions will influence the structure and financial health of the industry and the costs of production. More predictable and stable procurement allows firms to make long-range plans and investment decisions and ultimately lowers the prices paid by DoD. Gansler also recommended that DoD do less micro-management of industry through regulations, profit policy, and military specifications, and pay more attention to "macro"-level issues, such as maintaining competition and a robust industrial base, in its planning, programming, and budgeting processes.

Recent events also indicate that low-volume buys of other ordnance materiel have not deterred competition in that market. The U.S. Marine Corps and Army are in the process of buying a new towed howitzer system. As a part of that program, the government decided to procure the cannon for the system separately from the rest of the system and provide it as government-furnished equipment. United Defense emerged as a viable competitor to Watervliet Arsenal for production of the cannon. Likewise, BAE Systems, the prime contractor for the new towed howitzer, competed production of the other system components. Significantly, a large number of companies and government facilities, including Rock Island Arsenal, bid on the opportunity to manufacture various components of the new howitzer.

Examples of "Unresponsiveness"

If private-sector firms are unable or unwilling to produce particular ordnance items, Army ownership of arsenals and ammunition plants may provide the

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24As described in Chapter Three, a 1997 study of the Army's ammunition industrial base by the Pacific Northwest National Laboratory (Doherty and Rhoads, 1997) recommended commercializing the organic base but also, as a necessary corollary, creating a Program Executive Office for Ammunition to consolidate management responsibility and financial resources. The influence this newly created office should possess could create the more stable and predictable funding and procurement policies necessary to enhance the viability of the commercial base.
Army a capability to manufacture those items. To justify retention of this capability requires an examination of the frequency and criticality of private-sector unresponsiveness and the reasons why it occurs. To address this question, project team members investigated the three anecdotes most frequently cited to us as examples of private-sector inability to produce some goods economically and in response to military requirements: small-arms headspace and timing gages, links for automatic-fire ammunition, and bridge wires. In all three cases, we found that production problems were not due to an inherent inability or unwillingness by private-sector producers to meet demands, but had other causes.

Production of small-arms headspace and timing gages was brought into Rock Island Arsenal after several contractors failed to deliver gages that conformed to required specifications. Winning bidders underestimated the difficulty of meeting the extremely tight tolerances that make sure the gages can verify critical weapon parameters. These bidders, however, were selected primarily on the basis of bid price. Rather than indicating an inability of private-sector producers to make headspace and timing gages, this anecdote suggests that source selection based primarily on price is flawed. A "best-value" approach to source selection would be much more likely to identify contractors capable of meeting specifications.25

The case of links for automatic-fire ammunition is somewhat more complex,26 but again offered us no compelling reason to conclude that private ownership of production facilities and equipment led to the production problems. Instead, the problem appears to be related to a change in the way links were accepted by the Army. Our discussions with Army personnel indicate that, for a variety of legal and economic reasons, the production base for links entered a period of turmoil during the FY00 and FY01 timeframe. This turmoil eventually led to relocating links production to Lake City Army Ammunition Plant (LCAAP) in FY01. That move, as well as the production base turmoil, resulted in heightened technical scrutiny of links production.27 In addition to having their functionality tested, links were physically measured to test compliance with their

25Alternatively, a source selection based on performance specifications could have produced a better product at a lower price in the case of .50 caliber machinegun gages. Use of newer materials that were not available when the original specifications were written (in 1943 and last updated in 1966) would greatly simplify production and significantly lower the price of these gages. A performance specification approach could also be used for other small-arms gages.

26The complexity of the story is related to a number of factors, including: a complete turnover in the contractor base, the move of production facilities onto a GOCO facility, a mix of government-owned and contractor-owned equipment, and somewhat confused government-to-contractor relationships.

27For example, the move to a new links production facility required first article testing (FAT) of the links once production was restarted.
technical specifications. The failure to meet these technical requirements has caused most of the production problems. Army personnel implied that the technical conformance inspection of links before the move of production to LCAAP was rare, and no data were presented to indicate that compliance with the technical specifications actually declined in recent years. Since the same equipment was used before and after the move, it is probable that the quality of links produced before and after the move to LCAAP are similar. Whether moving the 50-year old links manufacturing equipment onto LCAAP was the best way to solve the production problems is an open question. We conclude more clearly, though, that the perceived problems with links production were not fundamentally related to private-sector capabilities. Ammunition links are not technically difficult to produce. The processes include metal cutting, rolling, bending, plating, spot welding, and riveting. All these processes are well within the capability of commercial industry. Also, these items have been successfully produced for decades in the private sector, indicating that recent problems are not due to an inherent unresponsiveness on the part of private producers. Finally, some government personnel note that private producers will be unwilling to produce links at the price the government is willing to pay. Such comments must be taken in light of the millions of dollars and the substantial time taken to move links production onto LCAAP.

A third example frequently cited as a failure to perform by the private sector is the production of bridge wires. Bridge wires and associated detonators are common in the commercial sector, although Army detonators are typically smaller and more rugged. As with the links example above, the industrial base for bridge wires has recently turned over. During the transition to new bridge wire producers, the prime contractors for fuze production experienced difficulty in obtaining quality components containing bridge wires. These difficulties resulted in delayed fuze production. As a result, the Army, along with some of its contractors, devoted considerable resources to improving the bridge wire industrial base. This effort has been successful, and several commercial companies are now producing these critical items. As stated at the beginning of this section, these three examples (headspace and timing gages, ammunition

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28 This equipment is both government and contractor owned, is of 1950s vintage, and relied on worn-out dies that are now being replaced.

29 It is unclear whether the rate at which links fail in functional testing has changed over the last few years.

30 A bridge wire is a thin wire that explodes in a controlled fashion when a high-energy electrical pulse is passed through it. It is typically the first link in a detonator's explosive chain. Detonators are used in bomb, artillery, and explosive charge fuzes. Bridge wires have been in use since the 1880s for both military and commercial applications.

31 In the mid-1990s the two principal producers of military bridge wires, ICI Americas and Dyno-Nobel, decided to exit the market.
links, and bridge wires) have been cited most frequently as cases that demonstrate the unwillingness or unresponsiveness of commercial industry to respond rapidly to the military's needs. In each instance, we found this not to be the case. The example of the headspace and timing gages merely demonstrated that awarding contracts solely on the basis of price is flawed contracting policy. The use of links and bridge wires as examples demonstrates Army discomfort with the natural dynamism of the private sector more than it illustrates production failings in that sector. This point is made especially clear because the proposed solution, establishing production capability for these items on government facilities, has its own examples of production failure.32

WOULD IT COST MORE TO PRODUCE ORDNANCE MATERIEL IN PRIVATIZED PLANTS?

Given the unusual characteristics of the market for ordnance materiel—high initial demands when a weapon system is built and fielded or when war reserves are stockpiled, followed by little or no demand while production capacity is held in reserve for surge or replenishment—the capital investment required is likely to be higher than if demands were more consistent and stable. As a result, there are a number of reasons why GOGO or GOCO production might be less expensive than private-sector production. First, if the government makes efficient investment and production decisions (i.e., chooses the cost-minimizing combination of capital, labor, and materials to produce a given amount of ammunition and maintain the required replenishment capacity), the government's lower cost of capital could give it a cost advantage over the private sector.33 Second, except for annual capital investment costs, government-owned land and facilities are a sunk cost, whereas contractors would have to buy privatized arsenals or ammunition plants, and charge higher prices for ordnance materiel to recover the costs of buying the assets. Third, since contractors can compete to operate GOCO facilities, it is not necessary for them to duplicate investment in their own facilities to compete for ordnance production contracts. The existence of government facilities thus could lower entry barriers and increase competition. We examine each of these arguments in the remainder of this section.

32 For example, in the late 1990s, load, assemble, and pack of mortar ammunition was moved from Milan Army Ammunition Plant to the private sector because Milan had been unable to produce mortar ammunition to specification for several years.

33 Although the government can borrow at a lower interest rate than most firms, any individual investment project in an arsenal or ammunition plant would have similar risks whether it was carried out in the public or private sector. Thus, it can be argued that the government does not truly have a lower cost of capital than the private sector. Taxpayers simply are not compensated for this additional risk as they would be if they were lending to a private-sector firm.
Government Investment and Production Decisions

Although the government’s cost of borrowing is nominally lower than the private-sector cost of capital because of lower default risk, there is evidence to indicate that the Army does not make efficient investment decisions for its arsenals and ammunition plants nor efficient production decisions for its GOGO facilities.

Government capital investment is tied to the annual budgeting process, because investment funds must be budgeted in the year they are obligated. As a result, investment decisions may depend more on the availability of funds than on net present value or cost/benefit analysis. Based on visits by project team members to Army-owned and COCO ammunition plants, much of the equipment at GOGO plants appears to be antiquated, indicating a tendency toward underinvestment. The Army also raids the budget for ammunition plant investments when funding falls short in other areas. In July 2002, for example, the Army proposed to defer $9.9 million in electrical and equipment upgrades (out of a total investment budget of $57.3 million) to cover military pay, contingency operations, and a surge in training requirements (Winograd, 2002).34

Overinvestment could also occur if excess funds are available. For example, the decision to invest in the “Tank Line of the Future” at Iowa Army Ammunition Plant appears to have been based on congressional mandate rather than net present value analysis. Based on the 1997 Economic Census data in Table 5.1, capital intensity35 (as measured by the capital/sales ratio) of the ordnance industry varies from .56 in small-arms ammunition manufacturing to .17 in other ordnance and accessories, a range that is similar to other industries reported in the table. However, the capital replacement ratios (capital expenditures divided by depreciation) for the ordnance industries tend to be lower than other industries in the table, including other defense industries that saw similar declines in sales between 1992 and 1997.

In contrast, private-sector owners have access to capital markets and can borrow or raise equity to finance investments that have a positive net present value at the firm’s cost of capital. Provided that there is competition to produce ord-

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34 In addition, the AMC Office of General Counsel has indicated that the Army uses the investment budget to pay for plant and equipment losses due to fires and explosions, since the Army self-insures the plants. Since these losses are not specifically budgeted, other investment projects must be deferred.

35 An industry is said to be more capital intensive if it employs relatively more capital than labor or other inputs. Capital-intensive industries tend to require higher investment and have higher fixed costs than other industries.
nance materiel, and contracting approaches create appropriate incentives.\footnote{\textsuperscript{36}} Private-sector owners also are likely to make investment decisions that result in a more efficient mix of capital, labor, and material inputs. Thus, privatization can help overcome the shortcomings associated with government capital budgeting, and it smooths capital investment spikes in government budgets by paying for capital investment as part of the cost of ammunition.

The government also appears to make inefficient production decisions in its GOGO ordnance facilities. In the Army’s arsenals, factors of production have fallen at a much slower rate than output, leading to higher prices, further loss of business, and working capital fund losses.\footnote{\textsuperscript{37}} For example, as described in Chapter Three, production of core products at Watervliet Arsenal has fallen to 4 percent of its 1976 peak, whereas workyears have fallen to about a third, equipment has fallen by half, and building space occupied has remained essentially the same. (See Figure 3.1.) Recall also from Chapter Three that the ratios of indirect to total labor are high. Indirect employees comprise 69 percent of the total staff at Watervliet and 77 percent at Rock Island Arsenal, compared with 28 percent in the commercial structural steel industry and 22 percent in the machine shop industry.\footnote{\textsuperscript{38}}

Estimated FY01 revenues per direct labor hour were $331 at Watervliet and $201 at Rock Island.\footnote{\textsuperscript{39}} In contrast, fully burdened labor rates averaged approximately $130 per direct labor hour in the commercial structural steel industry and $70 per direct labor hour in the commercial machine shop industry. However, in spite of higher direct labor rates, revenues per employee (including both direct and indirect personnel) were $163,000 per employee at Watervliet and $129,000 per employee at Rock Island,\footnote{\textsuperscript{40}} in comparison to $193,000 per employee in the structural steel industry and $104,000 per employee in the machine shop.

\footnote{\textsuperscript{36}}For example, firm-fixed-price contracts create stronger incentives for efficient input decisions than cost-based contracts.

\footnote{\textsuperscript{37}}The Army's arsenals are financed by the Army Working Capital Fund (AWCF), a transfer-pricing system under which customer organizations buy goods and services from support organizations. Support organizations are required to set their prices to cover their full costs and to break even over the two-year budget cycle. Costs per unit at the arsenals have risen as workload has declined faster than total costs. The arsenals have also received cash infusions, not recovered in customer rates, to stabilize the prices charged to customers.


\footnote{\textsuperscript{39}}These estimates are derived by dividing total FY01 budgeted revenues by the number of direct employees times 2,080 labor hours per year. For example, the figures for Rock Island are $152 million / (364 x 2,080) = $201. They differ from the stabilized hourly rates charged to customers under AWCF rules ($197.11 at Watervliet and $267.45 at Rock Island) due to carry-in and nonstabilized orders at different hourly rates, cash subsidies, and adjustments for prior-year gains and losses.

\footnote{\textsuperscript{40}}These figures are derived by dividing total FY01 budgeted revenues by the total number of employees. For example, the figure for Rock Island is calculated as $152 million / 1,179 = $129,000.
industry. In practice, the arsenals have converted direct employees into indirect employees rather than lay them off as workload has fallen. Based on this evidence, private-sector firms in comparable competitive industries appear to be more likely to redeploy excess labor, but the actual practices in defense industries are likely to depend heavily on the relationship between the government and its suppliers.

Based on the available evidence about the employment of capital and labor at GOCO and GOGO ordnance producers, it seems unlikely that any government advantage in the cost of borrowing could overcome the offsetting inefficiencies in government investment and production decisions. Private-sector ammunition firms also seem to be able to manage their environmental liabilities at a lower cost than the Army’s facilities. Six currently operating AAPs (Iowa, Lake City, Lone Star, Louisiana, Milan, and Riverbank) and a number of facilities previously declared excess are on the National Priorities List (NPL) for environmental cleanup. In contrast, COCO facilities recently acquired by General Dynamics (St. Marks Powder, producing ball propellant, and the former HiTech in Camden, Arkansas, producing warheads and rocket motors) have negligible environmental liabilities. Likewise, Olin Corporation’s Winchester small-arms ammunition manufacturing facility in East Alton, Illinois, appears to have manageable environmental liabilities and is not on the NPL.

In the economics literature, there is little cost-based theoretical justification for government ownership of firms in competitive markets or in markets that could readily become competitive. Even in the case of “market failure,” such as monopolies or externalities (e.g., pollution), government ownership has important weaknesses, such as difficulties defining the goals of the firm and monitoring managerial behavior, easier intervention in the firm’s production decisions, and “soft budget constraints,” which protect government-owned firms from the threat of bankruptcy and the financial discipline imposed by private-sector capital markets (Megginson and Netter, 2001, pp. 7–10).

Megginson and Netter (2001) survey recent empirical comparisons of the relative performance of government-owned and privately owned firms. Virtually all of the studies cited find that private ownership is associated with better measures of performance, including higher productivity, lower costs, higher profits, lower debt, and fewer labor-intensive production processes. Some studies also find that these performance improvements are not affected by the degree of market competition or regulation.

Although the market analysis in this report and in Hix et al. (2003) indicates that most markets for ordnance items have either current or potential competitors,

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there may be some end items or components where GOCO or GOGO producers have a monopoly. The Army's contracting approach, including the size and stability of buys, technical specifications, and source-selection criteria, can help to ensure that multiple contractors are willing to bid on ordnance contracts. Even in sole-source situations, contracting approaches can induce incentives for more efficient, lower-cost production after divestiture. The economic literature on privatization of monopolies (primarily utilities such as telecommunications, electricity, natural gas, and water), suggests that price-cap or "RPI-X" regulation, under which the prices of the firm's products are held constant between regulatory reviews or allowed to adjust at a fixed rate relative to inflation, is effective in creating incentives for cost reduction, if regulatory reviews are held relatively infrequently, e.g., every five years. (See, for example, Armstrong et al., 1994; Jenkinson and Mayer, 1996; or Pint, 1992.) In the context of defense procurement, firm fixed price or fixed price with economic adjustment contracts that capped prices over a five-year period would provide similar incentives. However, it should be noted that under these contracting/regulatory schemes, some of the benefits of cost reduction will accrue to the firm rather than the Army. If all the benefits of cost reduction accrue to the Army, the firm would have no incentive to reduce costs.  

Recovery of Capital Costs

If the Army's arsenals and ammunition plants were privatized, private-sector ordnance producers would have to recover the costs of buying the privatized assets through the prices they charge for ordnance items and ammunition. Some might argue that this will cause the Army's cost of ordnance materiel to rise relative to the status quo. However, this will not necessarily be the case, for two reasons.

First, all of the Army's costs of ordnance, including capital investments and the opportunity cost of holding excess capacity, should be compared with the

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42It has also been possible to introduce competition in some of these industries as technology has changed (in telecommunications) or as production has been separated from distribution (in natural gas and electricity).

43Armstrong et al. (1994, pp. 39–44) describe pricing policies as a continuum from firm fixed prices, under which the firm has strong incentives to minimize costs, but the government may pay more than actual costs (i.e., the firm earns above-normal profits), to cost reimbursement, under which price equals actual cost and the firm earns no abnormal profits, but the firm has no incentive to reduce costs. Intermediate schemes, under which the firm may be paid more than the target price if costs are unusually high, or the government gets a share of the savings if costs are unusually low, have incentive and efficiency effects that lie between these two extremes. The optimal amount of cost passthrough depends on tradeoffs between allocative efficiency (price equals cost, no abnormal profits) and productive efficiency (optimal cost-reducing effort), which are affected by the responsiveness of demand to changes in price and the relative risk aversion of the government and the firm, among other factors.
private-sector cost of ordnance. For example, at the 10 GOCO ammunition plants considered for privatization, the Army spent a total of approximately $617 million in FY01 for the production of ammunition. It also spent $7 million on layaway and maintenance of inactive facilities and $11 million on offices of the Contracting Officer’s Representative at each plant (including 160 government employees located at the plants). Capital investment costs for production facilities and environmental compliance totaled $37 million. Approximately $14 million was spent under the ARMS program to refurbish unused building space and attract tenants. In return, the facility-use contractors at the plants received approximately $33 million in ARMS revenues, some of which was used to offset the government costs of overhead, maintenance of inactive facilities, and capital improvements. The Army also received $4 million from agriculture and forestry leases. Thus, the Army spent approximately $649 million (net of rental income) on the plants in FY01, not counting the time spent by military and civilian personnel at higher headquarters managing operations at the plants or the opportunity costs of holding idle facilities. The fraction of these additional costs that would no longer be incurred by the Army after divestiture could be more than enough to offset any capital cost recovery by the owner of the privatized facilities.

Second, the existence of competitors who could produce the same ordnance materiel in their own facilities or potential competitors who have the technological expertise and the resources to build their own facilities limits the maximum price that the owners of a privatized arsenal or ammunition plant could charge. To examine this argument, we construct a simple example in which the operator of a government-owned facility competes with two actual or potential competitors using contractor-owned, contractor-operated facilities. We then compare the GOCO example with the case where one of the competitors has bought the privatized facility.

Suppose the operator of Iowa AAP can load, assemble, and pack (LAP) 100,000 artillery shells per year at a cost of $100 per shell, but it would cost $120 per shell for either of the other two contractors to perform the same work, because they would need to invest in their own facilities. If all three competitors know each others’ costs, and the government awards a competitive contract to LAP

44Mississippi AAP is excluded, since the Army is a tenant on a NASA facility.
45This $617 million includes both directly observable prime contract costs for ammunition production and estimated costs for ammunition subcontracts held by the GOCO contractors.
46This example is intended to illustrate the effects of privatization on the competition for production contracts and the resulting price of ammunition, not to be a model of the entire privatization process.
47This example is loosely based on the prices and quantities of M795 155mm artillery shells in U.S. Department of the Army, Procurement Programs (2000).
artillery shells, the operator of Iowa AAP only has to bid a price that undercuts its competitors' costs by a small amount to win the contract. At a price of $119 per shell, the operator of Iowa AAP would win the competition and earn an annual profit of $(119 - 100) \times 100,000$, or $1.9$ million per year.

The government also holds periodic competitions to operate Iowa AAP that are open to all three firms. If a facility-use contract lasts five years, any of the three contractors should be willing to bid up to the net present value of $1.9$ million per year for 5 years, or $7.1$ million at an interest rate of 10.69 percent. If a facility-use contract lasts 25 years, the maximum bid would be the net present value of $1.9$ million per year for 25 years, or $16.4$ million at the same interest rate. Whether the Army could obtain this maximum valuation through a competition for the facility use contract would depend on the design of the competition process and the potential for collusion, since firms could earn above-normal profits by paying less than the net present value of future profits. However, assuming that the winning bidder does not pay more than the net present value of future profits, it will be able to recover the capital costs of its bid through the price it charges for ammunition.

Now, if we consider the privatization of Iowa AAP, the winning bidder obtains the right to operate Iowa AAP in perpetuity (or as long as the Army continues to buy the same type of ammunition). If the number and costs of the competitors stay the same, the winning bidder will still charge a price of $119 per shell and earn profits of $1.9$ million per year. Therefore, the maximum that the new owner of Iowa AAP should be willing to pay is the net present value of a perpet-

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48 In practice, GOCO contractors have additional advantages in ammunition production competitions that may enable them to win even if their full costs per shell are higher than COCO competitors. Under the Arsenal Act, "out-of-pocket," or marginal, costs at the GOCO can be compared with full costs at the COCO. Under "best-value" contracting, the Army may weight the use of organic facilities favorably in its source-selection decision.

49 This is the weighted average cost of capital for the explosives and volatile chemicals industry (Ibbotson Associates, 2001, pp. 2-45 to 2-46).

50 According to Klemperer (2002), the important factors in designing auctions and similar forms of competition are discouraging collusive, entry-deterring, and predatory behavior, and attracting potential bidders. The best auction design depends on the assets being sold and the number of incumbent producers and potential new bidders. Open-bid, ascending auctions reveal information about bidders' valuations and are more likely to allocate assets to the bidders who value them most, but they are prone to collusion and may discourage potential entrants. Sealed-bid auctions make collusion more difficult and are more attractive to entrants, but they may not allocate assets to the bidders who value them most, because bidders have an incentive to bid less than their full valuation of the asset in order to earn above-normal profits. In some cases, a hybrid auction, which begins with an ascending auction until two bidders are left, who then each make final sealed-bid offers, can yield the best results.

51 In practice, GOCO contractors do not pay rent to the Army for use of the ammunition plants. However, when production contracts are competed at the same time as facility use contracts, bidders may offer concessions on ammunition prices, overhead rates, or payments for inactive facilities in exchange for the right to operate the facility.
Rethinking Governance of the Army's Arsenals and Ammunition Plants

A profitability of $1.9 million per year, or $17.8 million at an interest rate of 10.69 percent, to buy the plant. Assuming that the owner of a privatized Iowa AAP does not pay more than this maximum value, it will be able to recover its cost of capital through the price of ammunition, but the price of ammunition depends on its competitors' costs, not whether Iowa AAP is GOCO or privatized.

More complex versions of this simple model that take more “real-world” conditions into account are possible but do not change the basic result that privatization does not increase the price of ammunition. For example, suppose the operator of Iowa AAP knows that it can LAP 100,000 artillery shells for $100 each, but is unsure of its competitors’ costs. It thinks its competitors’ costs are uniformly distributed between $110 and $130 per shell, i.e., any value between $110 and $130 is equally likely. When the operator of Iowa AAP makes its bid to LAP shells, it must trade off higher potential profits against an increased probability that it could lose the contract as its bid increases above $110. If there is only one competitor, the operator of Iowa AAP maximizes expected profits at a bid of $115, but if there are two or more competitors, it should reduce its bid to $110.52 The net present value of expected annual profits determines the maximum that contractors are willing to bid to operate Iowa AAP as a GOCO or a privatized facility, but it is the number of potential competitors and what is known about their costs that drives the price of ammunition, which remains the same whether Iowa AAP is GOCO or COCO.

Competition for Ordnance Production

Another possible cost-based argument in favor of government ownership of arsenals and ammunition plants is that it lowers entry barriers by providing facilities to contractors, who then do not have to incur the costs of investing in their own facilities. However, as the theoretical example above illustrates, the price of ordnance materiel is not determined by the availability of low-cost government facilities, but rather by the existence of actual and potential competitors who could make the same products in their own facilities.

Under the current rules for ordnance competition, as defined by the Arsenal Act of 1920 (10 USC 4532), government ownership appears to tilt the competitive playing field for ammunition and ordnance items. The Arsenal Act requires the Secretary of the Army to "have supplies needed for the Department of the Army made in factories or arsenals owned by the United States, so far as those factories or arsenals can make those supplies on an economical basis."53

52 Mathematical calculations are given in Appendix C.
53 However, the statute also gives the Secretary of the Army the power to "abolish any United States arsenal that he considers unnecessary."
"Economical basis" has been interpreted to mean that the out-of-pocket, or marginal, cost of the government-owned producer can be compared with the full cost proposed by privately owned firms. However, the full costs of production, including overhead, are charged to the Army or DoD agency that is the customer for the ordnance materiel.54

Although this type of cost comparison may be appropriate for short-term decisionmaking, when the existence of Army-owned facilities is taken as given and overhead costs would be incurred whether government-owned facilities win contracts or not, it is not appropriate for long-term decisionmaking, when the Army considers whether it is cost-effective to continue to own these facilities. One can cite a number of cases where the full cost of production in COCO facilities is less than the full cost of production in GOCO or GOGO facilities.

For example, in 1995, the Talon Manufacturing Company protested the award of a contract to produce .50 caliber blank ammunition to the Olin Corporation, the operator of Lake City Army Ammunition Plant at the time. Talon’s bid was lower than the historical GOCO full cost per round of $0.95, but the contract was awarded to Olin because its out-of-pocket costs were 40 percent lower than the historic fully funded cost. The protest was denied by the Comptroller General of the United States on the basis of the Arsenal Act (Comptroller General, 1995).55

The other armed services are not bound by the restrictions of the Arsenal Act and have increasingly turned to commercial competitors to produce ordnance items. For example, the 155mm Lightweight Howitzer, a joint Army–Marine Corps development program that is currently being managed by the Marine Corps, will use cannon barrels produced by Watervliet Arsenal, but Rock Island Arsenal had to compete with COCO facilities for a share of the production subcontracts. The prime contractor, BAE Systems, is obligated to stay within ceiling option prices for the first 190 howitzers, so any subcontracted work must

54Although the Army is shifting toward more competitive production contracting approaches, such as system-level contracting for ammunition rounds instead of separate contracts for multiple components, other aspects of the procurement process and ownership structure still favor GOCOs. These include technical specifications tailored to current GOCO processes, large and variable quantities, requirements to hold excess capacity for replenishment, short notice of competitions, Army indemnification of insurance costs, and exemption from local property taxes.

55The Comptroller General’s 1995 decision cites the following precedents: "‘Economical basis’ means a cost to the government which is equal to or less than the cost of such supplies to the government if produced in privately-owned facilities, and government plant production costs are to be computed on the basis of actual out-of-pocket cost to the government. Olin Corp., 57 Comp. Gen. 289 (1978), 78-1 CPD P 45; Action Mfg. Co., B-220013, Nov. 12, 1985, 85-2 CPD P 537. ‘Out-of-pocket’ costs for a GOCO include all costs incurred by the government directly as a result of producing an article at a GOCO plant and excludes those costs which would be incurred by the GOCO regardless of whether a particular contract were awarded to the GOCO firm. Id.”
meet cost targets to keep the full cost of the howitzers within the ceiling.\textsuperscript{56} Rock Island was able to win a subcontract for the breach operating load tray system, contingent on reducing its overhead rate to bring its bid within the competitive price range, but subcontracts for stabilizers, spades, and trails, for body assembly, and for final assembly, test, and delivery were awarded to private-sector competitors. (See U.S. Marine Corps and U.S. Army, 1999, and U.S. GAO, 2000, 2001, and 2002.)

If the Army divested its arsenals and ammunition plants, it could treat all ordnance materiel producers on an equal footing and have greater assurance of awarding contracts that are cost-effective from a long-term as well as a short-term perspective.

\textbf{DOES PRIVATE-SECTOR PRODUCTION INVOLVE UNACCEPTABLE RISK?}

Another potential reason for government ownership of arsenals and ammunition plants is that private ownership could involve unacceptable risks that ordnance materiel will not be available in sufficient quantities in times of crisis or that the Army will lose critical production assets. These risks could take a number of forms, including the risks that private-sector owners will

- not retain sufficient replenishment capacity,
- be subject to greater physical security risks,
- exit the market and allow irreplaceable land, facilities, and environmental permits to be lost,
- go bankrupt, or
- not be responsive to emergency demands in times of crisis.

In the remainder of this section, we examine each of these potential risks.

\textbf{Replenishment}

A common justification for maintaining government ownership of ammunition production facilities is tied to a requirement to maintain a replenishment production capability for ammunition and ordnance items.\textsuperscript{57} We provide a de-

\textsuperscript{56}This ceiling does not apply to the cost of the cannon barrels, which are being provided to the contractor as government-furnished material.

\textsuperscript{57}Missiles, which are analogous to conventional ammunition in many ways, provide an interesting counterpoint. They are primarily produced in the private sector, and no formal replenishment production planning is required for them. The Army leadership appears to accept that the next missile is always on the way and hence there is no need to be prepared to increase or restart production of current models. Missile production is discussed in greater detail in Appendix B.
tailed assessment of replenishment issues in Appendix B (Replenishment), but note the three major issues here.

The first issue is whether private firms can be relied upon to maintain sufficient underutilized and laid-away equipment to ensure an adequate ammunition replenishment capability. This is not so much a concern about the actual ability of private firms to hold reserve capacity. Rather, the concern is whether adequate incentives, primarily monetary ones, are available to induce them to do so. These concerns are quite manageable. Importantly, the Army already relies to a large degree on the private sector for replenishment capability. In addition, resources used to maintain government-owned replenishment capability would be freed up with privatization. Most important, though, reliance on the private sector for replenishment capability would demand explicit decisions about required replenishment capability as each contract was written or renewed. This decision process would further call for a well-thought-out ammunition replenishment policy that prioritized ammunition requirements on an ongoing basis. Enhancing the visibility of such decisions and making them more explicit is likely to improve the Army’s overall ammunition readiness.

A second issue relates to the near-term budget effect of privatizing government-owned, replenishment-required facilities and the perception that government ownership of the organic industrial base has only a small cost associated with it. This particular issue has little to do with the merit of privatizing the replenishment of ammunition. Instead the concern is focused on finding the funding to effect privatization. The near-term budget impacts of privatizing the organic industrial base can be made acceptable with a sound divestiture strategy, as provided in Chapter Eight. As for the costs associated with current and continued government ownership of an organic industrial base, these are substantial and are detailed elsewhere in this report.

The last of the three issues is not specifically one of “replenishment,” but is related strongly to it. Here the question is whether private facilities are as able as government-owned ones to support “surge production” or other emergency requirements. As with the first of these three issues, this one has little to do with suspicions concerning the actual ability of the private sector to hold reserve capability and exercise that capability responsively, at least in comparison to the government’s organic base. Again, the concern is that there are no incentives for the private sector to maintain a reserve industrial capability. This concern may be overstated, however, since there is no official requirement or policy to surge production. To the extent that production-surge remains an

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58 Much of this perspective is the result of the Army's experience in divesting itself of excess facilities, industrial and others.
"informal" policy, resource allocation decisions are still required, especially since surge requires an enhanced industrial readiness to an even greater extent than replenishment capability requirements. Like replenishment capability, privatization enhances the explicit nature of the decisions, thus improving the probability that such decisions will support overall Army requirements.

To the extent that the Army retains the three GOGO plants as a hedge, these plants may be assigned replenishment or emergency production missions that the private sector is unable to accomplish. By assigning the GOGO the replenishment missions that are large compared with peacetime production, the Army permits commercial contractors to concentrate in peacetime on the more profitable workload.

**Homeland Security**

Since September 11, 2001, there is reason to be concerned about the physical security of domestic defense-related industrial facilities, both commercial and government-owned. At issue is whether privatization of government-owned facilities would increase or decrease the risk of terrorist attack.

Regardless of whether the government or private firms own defense-related industrial facilities, threats to their physical security (sabotage and terrorism) require the government to address the following options:

- Many distributed capabilities.
- Few consolidated production facilities.
- Government ownership.

One policy decision is whether to maintain the current set of widely distributed industrial facilities, both commercial and organic. Such dispersion limits the damage of a single attack but complicates and multiplies security requirements. The alternative, to consolidate onto fewer production facilities, risks greater damage from any single attack but simplifies and eases the security problem. From the standpoint of a terrorist attacker, the rural locations of the facilities under study here, regardless of the concentration of activities on them, limit their attractiveness as targets. Terrorists seek to create fear in as much of the population as they can reasonably affect.

The Army can maintain adequate physical security regardless of whether these plants are government- or contractor-owned. Co-locating industrial facilities on multifunctional installations with troops would provide an extra measure of protection. On the other hand, the services have a good record of protecting sensitive and dangerous manufacturing facilities in the private sector. Both private firms and government agencies have industrial security requirements and
means of meeting them. The extent of physical and personnel security measures may need to be upgraded regardless of ownership, but it is not clear that government ownership is necessary to ensure security. More than two-thirds of ammunition dollars already go into about 70 completely commercial facilities; the Army needs to validate its security measures as well. Neither the commercial nor the organic base can meet the Army's ammunition requirements if the other is destroyed.

While in many cases some comparable commercial capability could substitute for any destroyed organic capacity, the extent of this backup capacity varies considerably across products. If the Army were to become very concerned about the physical security of these places, it could split capabilities into two or more installations. For example, metal parts contracts now executed entirely at Scranton could be split between Scranton and Riverbank or even Iowa—or, more broadly, between Scranton and White Sands or Yuma, which do not now produce ammunition. While the Army would lose the benefit of any economies of scale it now enjoys, the split might generate other benefits through increased competition. To justify the large front-loaded cost of making such substantial changes, however, one would want a plausible threat.59

Finally, while terrorist attacks on current production facilities would hinder the Army's long-term sustainability, they would not provide the dramatic fear effects that terrorists seek. So far, the terrorists have not tried to physically destroy U.S. warfighting capabilities; instead, terrorists exploit the fear created by their acts. They did not hit the Pentagon to disable the military; they hit it and the World Trade Center to kill some but, more importantly, to scare the rest of us. The Army's industrial facilities are likely to be low-priority terrorist targets because they tend to be in rural areas that lack the potential to produce mass casualties. Further, they are not symbolic targets that would have widespread psychological effects on the population at large. That said, the Army ought to make sure the plants are secure. In particular, the Army should take care to secure any facilities that may store weapons, such as chemical or nuclear devices, whose destruction or loss would cause substantial fear in the population apart from any loss in military capability.

If the nation begins to face the more traditional military threats—sabotage, subversion, espionage—intended to destroy our military capability rather than create mass fear, then the industrial base could be expected to be a higher-priority target. But such threats tend to come from more traditional foes, not terrorist organizations.

59The recently announced creation of U.S. Northern Command may signal an elevated concern for U.S. security. Such concern could lead to consideration of such broad changes and on a joint, rather than a service-specific, basis.
That said, no one now feels comfortable predicting what may happen tomorrow, next month, or next year. Few would be astounded to learn tomorrow that an organic Army ammunition plant or a commercial Raytheon plant had been attacked. But such an attack would probably not create the enormous fear that terrorists have gained in attacking the more important symbolic targets.

If the Army perceives that the threat to these installations has intensified, security measures should be (and in some ways already have been) intensified, regardless of any divestiture options the Army may elect to implement. Security most likely can be achieved under either government or private ownership.

**Loss of Irreplaceable Assets**

A third type of risk that might be associated with divestiture of the Army’s arsenals and ammunition plants is that the new owners may exit the market and allow irreplaceable land, facilities, workforces, and environmental permits to be lost. To the extent that excess capacity still exists in the organic production base, it would be neither unexpected nor undesirable for some of the divested facilities to exit the market. However, there may be some minimum level of capacity currently in the organic industrial base that the Army would like to retain in the event of divestiture.

To examine this question, the Army must first consider how “unique” or “irreplaceable” these assets are. If COCO producers of ammunition and ordnance items can set up similar facilities and get the required environmental permits quickly and easily enough to meet the Army’s needs for peacetime production and replenishment, then the exit of particular facilities from the current organic industrial base should not be of great concern. If the Army’s ordnance facilities truly are unique and difficult to replace, the Army must take a proactive approach to ensure that private-sector owners have an incentive to maintain these assets. Appendix B offers a detailed assessment of these issues.

This suggests a two-step approach to preserving critical assets in the private sector. First, the Army should identify critical assets that cannot easily be reconstituted if needed. For those assets deemed critical, the Army must provide a steady peacetime demand for ordnance materiel and be willing to pay the cost of maintaining its desired level of replenishment capacity. Under this approach, if one particular producer decides to exit the market, the most likely buyer of these critical facilities would be another ordnance producer, rather than a buyer who would put the facilities to some alternative use. Hence, applying this approach would eliminate this concern about privatization. Note that current Army replenishment planning is based on startup times of one year or more for organic, laid-away facilities. Plausibly, such facilities could be built from scratch in comparable lengths of time.
Environmental Issues

As mentioned above, it could be claimed that GOCO ammunition plants have unique, preexisting environmental permits for ammunition production that would be difficult for COCO producers to obtain. However, private-sector producers indicate that the permitting process for ammunition is similar to that for industrial chemical production. In other cases, such as TNT production at Radford AAP (which may need to be restarted in the near future unless substitutes are found), the permit for disposal of red water, a toxic by-product of TNT, is held by an independent disposal facility, which could presumably also be used by a COCO producer of TNT. Our review of environmental laws and regulations did not find any clear advantages for GOCO facilities relative to COCOs in obtaining necessary permits. In the remainder of this subsection, we briefly discuss the permitting processes for hazardous wastes, air pollution, and water pollution.

Industrial facilities that generate hazardous wastes are not required to obtain Resource Conservation and Recovery Act (RCRA) environmental permits unless they are considered to be Treatment, Storage, and Disposal Facilities (TSDFs). Arsenals or ammunition plants will be classified as TSDFs if they store hazardous wastes for more than 90 days or if they perform extensive treatment, incineration, or open burning of hazardous waste. Changes in the ownership or operational control of a facility may be made as a Class 1 (routine) modification of a RCRA permit with the prior written approval of the director of the permitting agency. The U.S. EPA has authorized all states except Iowa and Alaska to run their own hazardous waste programs. Owners and operators of new TSDFs must submit a permit application at least 180 days before the date on which physical construction is expected to begin. RCRA permits are effective for a fixed term of a maximum of 10 years, or 5 years for land disposal of hazardous waste, at which time the operator must submit an application for reissuance (U.S. EPA, 1998a). Facilities that generate hazardous waste but are not classified as TSDFs are required to obtain an EPA identification number.

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60Totally enclosed treatment units that are directly connected to industrial production processes, elementary neutralization units used to handle corrosive wastes, and wastewater treatment units that treat and discharge hazardous wastewater pursuant to the Clean Water Act are exempt from TSDF standards. See U.S. EPA (1998a), pp. III-61 to III-63.

61The new owner or operator must submit a revised permit application no later than 90 days prior to the scheduled change. A written agreement containing a specific date for transfer of permit responsibility between the current and new permittees must also be submitted to the director. The old owner or operator must continue to provide financial assurance that it can cover the costs of closure and postclosure care of the facility until the new owner or operator can demonstrate financial assurance, which must occur within six months of the date of the change of ownership or operational control. See 40 CFR, Chapter I, Part 270.40-42 and Part 264.142-146.

62Information obtained from RCRA Call Center, 1-800-424-9346, February 28, 2002.
identify, label, and measure the amount of waste generated; comply with accumulation and storage requirements; prepare the waste for transportation; track the shipment and receipt of waste; and meet record-keeping and reporting requirements.

Operating permits are required for all major stationary sources of certain air pollutants, such as carbon monoxide, particulates, volatile organics, sulfur dioxide, and nitrogen oxides. Construction permits, also known as New Source Review permits, are required for all new stationary sources and all existing stationary sources that are adding new emissions units (i.e., pieces of equipment that generate pollutants) or modifying existing emissions units. EPA has established operating permit programs in every state as well as 60 local programs to manage the permitting process. The permits are legally binding documents that establish limits on the types and amounts of air pollution allowed, operating requirements for pollution-control devices or pollution-prevention activities, and monitoring and record-keeping requirements. Operating permits must be renewed every five years, and if laws change or additional requirements under the Clean Air Act become applicable to a source, the permit must be revised (U.S. EPA, 1998b and 2002a).

Industrial facilities are potentially subject to three separate water permitting processes under the National Pollutant Discharge Elimination System (NPDES). Industrial facilities that discharge wastewater directly to surface waters are required to obtain an NPDES permit. Permits consist of effluent limits, monitoring and reporting requirements, any special conditions, and standard legal, administrative, and procedural requirements. Effluent limits are calculated based on best-available treatment technologies and on the impact of the discharge on the quality of the receiving water; the more stringent limit is applied. Stricter technology-based limits, known as new source performance standards (NSPS) are applied to new sources.

Industrial facilities that discharge wastewater to a municipal sewer system are covered by the NPDES pretreatment program. The pretreatment program includes both national standards for prohibited discharges and limits on pollutant discharges for particular industrial categories, and local limits developed to reflect specific needs and treatment capabilities at individual publicly owned treatment works. Facilities subject to these limits are required to show initial compliance, file periodic compliance reports at least every six months, and

63 Generally, a source is considered "major" if it emits 100 tons or more per year of a regulated air pollutant. Smaller sources are considered "major" in areas that are not meeting the national air quality standards for a particular pollutant. Large coal-burning utility boilers and industrial boilers subject to the Acid Rain Program must also have an acid rain permit as part of the air quality operating permit.
notify the treatment facility of any changes in discharges, noncompliance, or potential problems. New sources also face higher pretreatment standards than do existing sources.

Storm water that runs off the property of an industrial facility or a construction site into a municipal storm sewer system or directly to surface water may require an NPDES permit under the storm water program. Facilities with manufacturing operations or effluent limitations under other programs must obtain a permit unless they can show that their industrial materials and operations are not exposed to storm water.

The U.S. EPA also delegates authority to states and territories to administer the NPDES program. As of March 2002, EPA had authorized 44 states and one territory to administer individual permits for industrial and municipal facilities, but only 39 states had authority to regulate federal facilities, and 33 had authority to administer the pretreatment program (U.S. EPA, 1999 and 2002b).

Thus, although existing GOCO and COCO plants may be subject to somewhat less strict water quality regulations than new COCO sources, and some GOCO plants may be subject to U.S. EPA jurisdiction rather than state jurisdiction, it does not appear that GOCO facilities have a significant advantage over COCO facilities in obtaining environmental permits for ammunition production. Existing permits are subject to renewals and must be revised if new environmental requirements come into effect.

**Bankruptcy**

Another possible risk is that one or more of the new owners of the Army’s divested organic industrial base could go bankrupt. Perhaps the most important fact to consider with regard to the privatization of the current GOCO plants is that the firms that now operate these plants are large, stable, and profitable. General Dynamics, BAE Systems, Alliant Techsystems, and Day & Zimmerman operate 8 of the 11 plants. Collectively, they represent the robust part of the market.

More generally, the purpose of Chapter 11 bankruptcy is to restructure the firm’s finances by passing control from equity holders to debt holders so that fiduciary responsibilities can be maintained, and the company reorganized. Production of goods and services typically continues, often under the supervision of court-appointed management, although unprofitable activities can be suspended.

When forecasted cash flows indicate that required payments to debt holders are at risk, and therefore bankruptcy is imminent, two types of market failures
could ensue. First, attractive investment opportunities could be forgone if the firm cannot induce the capital markets to lend to it. Potential investors are unwilling to finance new projects, because the firm's value will be reallocated to debt holders in order of seniority under Chapter 11 reorganization, regardless of the success of the particular project they invested in.

Second, when a firm is threatened with bankruptcy, its management (selected by equity holders) has an incentive to make very risky investments, because equity holders (and probably management themselves) have very little to lose and much to gain if they pull off a successful risky investment. To circumvent these types of market failures, U.S. bankruptcy laws allow debt holders to negotiate or sue the firm into foreclosure so that its finances can be reorganized while it continues to operate. As a result, firms emerging from Chapter 11 bankruptcy are often stronger and more innovative, because new management can be brought in, and the experience causes stakeholders, such as middle management and unions, to renegotiate the way the firm operates to make it more innovative and competitive.

In the short term, an imminent bankruptcy could cause supply disruptions. If a firm has corrupt management or becomes financially unsound, it might have trouble accessing financial markets to obtain or maintain sufficient capital funding to complete an Army contract. This phenomenon is sometimes called the “present value of financial distress.” Bankruptcy typically alleviates these short-term problems by giving the firm temporary protection from its creditors while it reorganizes its finances. The Army has a number of strategies to reduce the risk of financial distress and help it through any short-term supply disruptions.

First, DoD monitors the finances of defense contractors through the Defense Contract Audit Agency (DCAA), which examines not only the cost structure of all defense firms that bid on DoD contracts, but also the financial health of these firms, to ensure that they have the financial resources to execute their commitments. (See, for example, Ratnam, 2002.) Second, the Army plans to execute the national military strategy with existing stocks and replenish during peacetime, so sufficient ordnance stocks should be available in times of emergency. As mentioned earlier, there is a risk that underfunding of war reserves may, by default, change the strategy to one of surge during an actual operation. Third, stockpiles could be increased to mitigate any additional risk from potential bankruptcies, although this risk should be minor if the Army exercises financial due diligence in the source-selection process. As a last resort, if a firm

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64 For example, it was reported on CBS’s 60 Minutes that when his television station WTBS was under a cash flow crunch in the 1970s, Ted Turner financed its payroll by playing roulette.
facing bankruptcy threatened national security in wartime by refusing to produce ordnance, the President could seize control of its assets and assume liabilities for financing its operations. Finally, it should be kept in mind that these strategies are felt to be adequate to handle the threat of bankruptcy for the vast majority of ammunition production. Two-thirds of DoD ammunition requirements are already produced in COCO facilities, and most of the remainder is produced by contractors in GOCO facilities, all of whom are already subject to the risk of bankruptcy.

An example of a recent bankruptcy that affected DoD is the Iridium satellite telephone system. The Iridium consortium raised $5.5 billion during the 1990s to put a constellation of 66 satellites into low earth orbit. In November 1998, the system began providing global service, including oceans, airways, and the polar regions. However, it was never able to attract enough customers to finance the initial investment because its handsets were relatively large and expensive and could only work in direct line with a satellite (i.e., they did not operate inside buildings or cars). The company’s bondholder group filed an involuntary Chapter 11 petition, which was followed by a voluntary petition from Iridium, in August 1999. Although it was rumored that Iridium would have to cease operation and destroy its satellites, Iridium’s assets (the satellite constellation, terrestrial network, real property, and intellectual capital) were sold to Iridium Satellite LLC for $25 million in November 2000.

Iridium Satellite’s first customer for its relaunched service was the Defense Information Systems Agency, which awarded a $72 million, two-year contract for mobile phones and paging. The contract, which includes options to extend the deal through 2007 at $252 million, gives unlimited airtime to 20,000 government workers. Iridium Satellite resumed commercial voice services in March 2001, and it introduced data and Internet services in June 2001. The system appeals primarily to users who operate in remote areas where terrestrial telephone services are not available. More recently, Iridium Satellite has proposed that its system could be used by the FAA to provide real-time monitoring capability of cockpit voice and flight data.65

As this example illustrates, a firm’s physical assets do not disappear, or even necessarily go out of service (or out of production), if it enters Chapter 11.

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bankruptcy. The bankruptcy process is intended to revalue those assets to a level that can be supported by the firm’s revenues and operating margin. In the case of ordnance materiel, the firm’s physical assets would not go out of ordnance production unless its revenues did not cover its operating costs, or the assets could be put to a more productive alternative use. As discussed in the previous subsection, if these assets are unique or irreplaceable, the Army must take a proactive approach to ensure that ammunition producers have adequate financial incentive to keep them in production.

**Responsiveness to Emergency Demands**

Earlier in this chapter, we discussed the general problem of private-sector responsiveness to Army demands for ordnance during peacetime. During periods of crisis, the Army faces the additional problem that it needs to obtain ammunition or ordnance items quickly to meet emergency needs. It is sometimes argued that only GOGO facilities can offer the responsiveness needed in a crisis, citing a recent example from the conflict in Bosnia. The commander in Bosnia identified an urgent requirement for metal plating to protect occupants of HMMWVs from mines. Rock Island Arsenal received the requirement to design and fabricate the items in a matter of days and did so. No contracting was required; the federal employees at the arsenal simply went to work without bureaucratic or contractual delay. Although this anecdote conveys an important attribute of GOGO governance at Rock Island, it is not clear that it is unique to GOGO facilities.

On a recent trip to McAlester AAP, two project team members were briefed on a crisis that occurred in July 2000, when all the joint standoff weapons (JSOWs) of the Pacific fleet were found to have a flaw in their payload dispenser rails that required immediate correction. DoD turned to a Raytheon element, which happens to be located at McAlester but could just as easily have been located at a commercial facility, to refit the entire complement of 112 JSOWs. Without bureaucratic or contractual delays, the Raytheon team turned to the task immediately. Upon receiving the weapons on July 10, the team worked around the clock and refitted the entire stock of missiles. Eighteen days later, the missiles were back at Port Hadlock ready for transport back onboard the aircraft carriers. The Raytheon team points proudly to the congratulatory letter from Admiral Jack Chenevey commending the team for their responsiveness and dedication.65

Since the beginning of Operation Enduring Freedom in Afghanistan, Boeing has doubled the production rate of the Joint Direct Attack Munition (JDAM), a

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65We are indebted to Mike Chitwood of the McAlester Raytheon team for this information.
$20,000 precision-guidance kit that is attached to 1,000-pound and 2,000-pound "dumb bombs," from 700–800 a month to 1,500 a month by adding a second production shift. Production rates are expected to nearly double again to 2,800 a month by August 2003. The JDAM program manager is facilitating the production rate increases by funding additional capacity at Boeing and its critical suppliers. Boeing’s production facility is also a model of lean manufacturing, where fewer than 30 workers are needed to produce 1,500 kits per month. Only a handful of additional workers are expected to be needed to further increase production rates, since Boeing plans to reduce assembly time by simplifying parts designs (Weinberger, 2002; Wallace, 2002; and Selinger, 2002).

In sum, both GOGOs and contractors can be responsive when called upon to satisfy emergency demands. Interviews with contracting and procurement authorities lead us to the conclusion that smart contracting and the maintenance of healthy relationships with contractors can ensure responsiveness.

ECONOMIC REGENERATION MODEL

An alternative proposal for long-term management of the GOCO plants that has received some attention is the Economic Regeneration Model (U.S. Army Materiel Command Deputy Chief of Staff for Ammunition, 2002). Under this model, the Army would continue to invest in upgrading building space at the ammunition plants to attract commercial tenants through the ARMS program. ARMS tenant revenues could then be used to pay off the costs of environmental remediation and other liabilities, such as unfunded retiree benefits, before the plants were privatized. Its proponents argue that this approach is preferable both to the Army’s past practice of declaring ammunition plants "excess to need" and to the option of privatization.

When installations are declared excess to need, under the Federal Property and Administrative Services Act of 1949, they must first be offered to other military services, then to other federal agencies, and then to state agencies, which in turn can offer the property to any public agency or nonprofit organization. As a result, they typically generate little or no revenue to the Army, whereas the Army must fund environmental remediation and other liabilities before an installation can be turned over to the new owner. Since funding is not usually available to pay off these liabilities immediately, installations declared excess to need tend to remain under Army ownership awaiting disposal for many years. (See Table 4.1.)

67A similar program for the arsenals, the Arsenal Support Program Initiative (ASPI), is being initiated in FY02.
Although the Economic Regeneration Model may be preferable to declaring ammunition plants excess to need, it does not appear to be preferable to privatization. Under the privatization option, the ammunition plants would be sold as “going concerns,” so they would be considered excess-to-ownership, but not excess-to-need. On this basis, they could be sold to the current GOCO operators or to other ammunition producers. Privatization revenues could then be used to offset environmental remediation and other liabilities. In most cases, the estimated sales values of the ammunition plants exceed their liabilities, so the Army could be freed from most of these liabilities. (See Appendix E, Table E.2.) Additional gains could potentially be made by selling the plants in groups that combined high-liability, low-value plants with low-liability, high-value plants. Furthermore, the privatization option has the advantage of giving the new owners access to capital markets to fund modernization of ammunition production facilities. Since the ammunition plants would remain under government ownership in the Economic Regeneration Model, they would continue to face the problems associated with constrained investment resources in the DoD budget. And they would continue to distract the Army leadership from its core functions.

There are also problems associated with evaluating the true costs and benefits of the ARMS program, as noted by Hix et al. (2003), Appendix A. First, some ARMS investments, such as upgrading buildings to modern safety and access standards, demolition of excess buildings, or environmental remediation, may represent costs the Army would eventually have incurred in the absence of ARMS. Second, ARMS tenants pay rent to the facilities contractors, not to the government. Contractors then provide in-kind benefits to the Army, such as reductions in ammunition prices or payments for maintenance of inactive facilities, or making an investment in the plant that has been approved by the Army. In some cases, however, it is difficult to determine whether the Army would have incurred these expenses in the absence of ARMS. Third, real estate development is not a core competence of the Army or of ammunition producers, so the ARMS program most likely is not making the same investments that a profit-maximizing private-sector owner would make.

A final objection to the Economic Regeneration Model is that if a facility is truly excess to the Army’s ownership requirements, it is probably not appropriate for the Army to retain ownership simply to generate revenues to pay off environmental and other liabilities. Generation of revenues from real estate operations to fund other functions is not an Army mission.
CONCLUSIONS

In sum, three arguments are typically made as reasons for not privatizing the ordnance base:

- The markets will not respond to the Army's needs.
- It will cost more to produce ordnance in private plants.
- It is too risky to transfer a key capability to the private sector.

Our reading of the economic literature, analysis of the arsenals and ammunition plants, and examination of comparable examples suggest that these rationales are not persuasive. To the limited extent they do apply, the issues they raise can be addressed by careful contracting and monitoring of performance. Indeed, the greater cost and risk to the Army may well lie in the status quo. It is not difficult to imagine a scenario in which the Army finds itself with obsolete facilities that either cannot respond to critical needs or can do so only slowly and at far greater cost than establishing new ones.