



*Contributions of and Issues Concerning
Small- and Medium-Sized Manufacturers
in the Defense Industrial Base*

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Contributions of and Issues Concerning Small- and Medium-Sized Manufacturers in the Defense Industrial Base

Introduction

The defense industrial base in the United States underwent a period of intense transformation during the 1990s. The end of the Cold War and the subsequent change in defense spending patterns by the U.S. Government prompted a radical restructuring through closure, diversification, and consolidation. Consolidation of the major prime contractors has captured much of the attention, but the health and well-being of the small- and medium-sized businesses that supply and manufacture defense systems and products is of great importance.

As defense spending fell, many feared that the specialized base of small- and medium-sized manufacturing enterprises (SMEs) would erode with the drop in direct contracting by the Defense Department (DOD) and decline in subcontracting activity by the primes, resulting in the loss of critical capacity and increased dependence on foreign suppliers. Despite the fears, there has been little focused attention on strengthening the SMEs in the defense industrial base and the potential for erosion has grown. The erosion of capacity produces shortages of parts and equipment, may increase reliance on foreign sources, and increases the propensity for cost overruns.

Is the nation's small- and medium-sized manufacturing base prepared to meet the needs of national defense? This paper examines available data on SMEs in the defense industrial base, DOD contracting trends, and key issues affecting the SME base to shed light on that critical question. The evidence suggests that the base of SME suppliers remains an important feature of the defense industry and that the firms that have weathered the transition to a post-Cold War industrial base continue to face significant challenges.

Key findings include:

- A healthy SME base is an important component of defense production capabilities.
- Small businesses are a critical element of the production and knowledge base supporting the defense industrial base. In nine leading defense manufacturing sectors, firms employing less than 500 people represent 90% of firms.
- Small businesses are responsible for a significant share of defense contracting activity. They receive 21% of prime contracts and 41% of the subcontracts awarded to businesses by or on behalf of the Department of Defense.

- Other analyses of weapon systems' costs reveal that subcontractors account for a considerable portion of defense-related manufacturing. Studies suggest that subcontractors account for two-thirds of prime contractors' costs and supply 80% of the value to defense systems.
- The defense industry is spread throughout the United States, but is concentrated in a handful of states. Ten states received 63% of all FY 2001 DOD prime contracts and the top-ten states secured 68% of all defense subcontracts in 2000. Seven states appear on both lists. Even though much of the contracting activity occurs in a select group of states, the sheer size of defense contracting activity supports significant effort across the United States.
- Five key challenges confront the defense industrial base today and highlight the need for renewed focus on defense SME supplier base.
 - **Critical shortages of spare part and component production capacity for aging weapon systems.** For example, spare parts of Navy and Air Force aircraft and engines are frequently unavailable and manufacturing issues are cited as a direct reason for these shortages about one-third of the time. There are over 11,000 products used by DOD for which there is no known source of supply and, furthermore, for 227 of these products there is an immediate need for resupply. Changes in the SME production base is one cause and changes to the SME production base may provide solutions to these challenges.
 - **Maintaining sufficient surge production capacity to meet unanticipated national defense needs.** The ability to rapidly expand production of platform systems, components, and munitions is constrained not only by the surge capacity of the prime contractor, but also by the capabilities of the supplier base. Given that the SME base diversified its customer base in the 1990s in response to the downturn in the federal defense budget, these firms may have greater resistance to working with DOD's cumbersome acquisition process. New demands on the defense industrial base to meet urgent needs for weapon systems, components, or spare parts may have a more difficult time being filled as a result.
 - **Modernizing SME techniques and manufacturing systems.** Outdated and aging manufacturing systems and processes are present in the production processes of major weapon systems. Moreover, with increased requirements for quality and technological improvements coupled with improved productivity and cost reduction, this situation is aggravated. With current plans calling for key aircraft, ground, and naval systems to be in service for many years to come, the shortage of capable SMEs will only become more acute.
 - **Increasing the productivity of the SME supplier base.** The desire to surge production is constrained by the capacity and productivity of the

prime and SME supplier base. The largest defense companies have the ability and resources to make investments in productivity and efficiency improvements. SMEs frequently lack the necessary technical knowledge, staff, and resources to take advantage of new techniques and technology.

- **Adapting commercial production practices and techniques in the defense SME base.** Small manufacturers do not have the staff or technical expertise to identify potentially beneficial practices and may lack the knowledge needed to successfully implement them expeditiously. Overcoming this challenge is a necessary step to integrate civilian and military production, where possible, and achieve affordability and technology goals associated with expanded use of commercial technology.

Summary

Key factors that must be overcome before a viable SME supplier development strategy for the Defense Department can emerge, include:

- Lack of adequate attention and programs by DOD policymakers to address SME issues;
- Acquisition practices that treat SMEs unfairly, especially new entrants;
- Adapting to new technologies that complicate supply chain management, SME communication, and integration of technology and techniques;
- Dual pressure on SMEs of cost reduction and quality improvement typical of defense procurement;
- Unique requirements for approaches to increase productivity and quality in a low-volume production environment are required by SMEs; and an
- Aging workforce at key junctures in the supply base that threatens to exacerbate existing challenges through the loss of skilled personnel and tacit knowledge.

Background:

Structure and Trends in the Defense Industrial Base

Small businesses are a critical element of the production and knowledge base supporting the defense industrial base.¹ These businesses may work directly for the Defense Department or indirectly through subcontracting arrangements. In 9 leading defense manufacturing sectors,² firms employing less than 500 people represent 90% of firms, but employ only 10% of the workforce. The employment statistics belies their importance in the defense industry. These firms produce specialty components for prime contractors, sell spare parts directly to the Defense Department, and are a source of innovation and productivity in the weapon system production process.

	Firms				Employment (in thousands)			
	Employment Size				Employment Size			
	Total	<20	<500	500+	Total	<20	<500	500+
Ammunition (except small arms) Mfg (NAIC 332993)	46	19	34	12	8,876	77	1,410	7,466
Aircraft Mfg (NAIC 336411)	193	120	167	26	215,746	565	4,646	211,100
Aircraft Engine and Engine Parts Mfg (NAIC 336412)	272	108	233	39	88,284	636	13,421	74,863
Other Aircraft Parts & Auxiliary Equipment Mfg (NAIC 336413)	1,033	656	961	72	130,163	3,909	24,061	106,102
Guided Missile & Space Vehicle Mfg (NAIC 336414)	12	3	5	7	50,398	n/a	180	50,218
Guided Missile & Space Vehicle Propulsion Unit & Parts Mfg (NAIC 336415)	20	3	8	12	18,533	n/a	169	18,364
Other Guided Missile & Space Vehicle Parts & Auxiliary Equipment Mfg (NAIC 336419)	47	22	36	11	6,447	n/a	761	5,686
Ship Building & Repairing (NAIC 336611)	631	411	595	36	96,374	2,294	19,101	77,273
Military Armored Vehicle, Tank, & Tank Component Mfg (NAIC 336992)	43	22	37	6	5,840	144	1,222	4,618

Source: Data from Small Business Administration and U.S. Census Bureau

The nine sectors arrayed in the table represent the most germane elements of the defense industrial base. Not listed above are a larger group of suppliers of defense-related material, such as firms that supply advanced electronics components, communications and search & navigation equipment, machine tools, and other products. Firms in these industry sectors typically are commercially oriented; making it difficult to determine how much activity in these sectors is defense-oriented.

Nevertheless, firms in these sectors are important contributors to the defense industry. As an example, the largest single input into the Guided Missiles and Space Vehicles sector is search and navigation equipment (see following table). Other electronic components, communication equipment, and semiconductors also ranked quite high as key elements of the supply chain for the missile sector.³

Surveys of the broad SME community in the defense industrial base show that the major shakeout expected by many analysts never occurred. One survey of 600 defense companies, with dependencies on defense business ranging from total sales dependence to less than 5% of sales, showed “considerable stability” in the number of firms and employment from the period 1989-1993.⁴ A similar effort that evaluated changes in the subcontracting base in California found a small business failure rate of only 3% between 1992 and 1995.⁵ The pace of consolidation in the defense sector increased considerably in the latter half of the 1990s. That trend was joined by a prevailing attitude of large defense companies to reduce the number of companies in their supply chains during the mid-to-late 1990s.⁶ The implication of these trends and the extent to which the SME base was affected by them remains to be studied systematically.

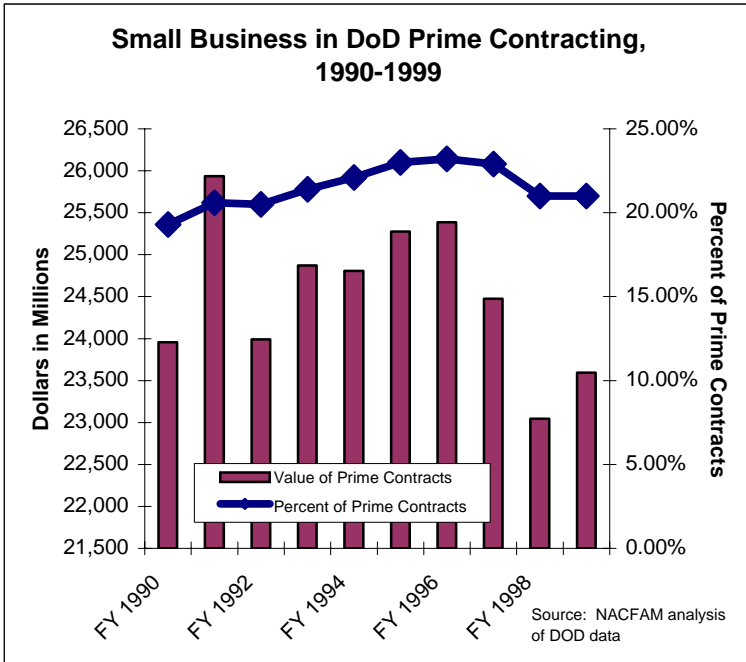
Supply Chain of the Guided Missiles and Space Vehicles Sector

Commodity/Product Consumed	Amount Used by this Sector (\$ in millions)	Percent of Total National Use of this Commodity by this Sector
Search and navigation equipment	\$981.6	3.249%
Aircraft and missile engines and engine parts	\$883.5	3.753%
Other electronic components	\$779.5	1.256%
Aircraft and missile equipment, n.e.c.	\$582.0	2.116%
Communication equipment	\$366.7	0.949%
Wholesale trade	\$287.1	0.036%
Semiconductors and related devices	\$165.0	0.215%
Computer and data processing services	\$158.0	0.052%
Guided missiles and space vehicles	\$149.7	1.236%
Miscellaneous plastics products, n.e.c.	\$145.8	0.124%
Real estate agents, managers, operators, and lessors	\$134.1	0.021%
Carbon and graphite products	\$130.8	6.127%
Banking	\$97.8	0.027%
Air transportation	\$92.7	0.068%
Electric services (utilities)	\$91.5	0.039%
Other repair and maintenance construction	\$82.2	0.045%
Special industry machinery, n.e.c.	\$77.2	0.352%
Services to dwellings and other buildings	\$62.8	0.169%
Personnel supply services	\$55.3	0.066%
Mechanical measuring devices	\$54.9	0.319%
Relays and industrial controls	\$53.2	0.483%
Other business services	\$51.6	0.044%
Telephone, telegraph communications, and communications services n.e.c.	\$51.3	0.019%
Industrial and commercial machinery and equipment, n.e.c.	\$46.8	0.164%
Metal stampings, n.e.c.	\$45.3	0.345%
Eating and drinking places	\$42.1	0.012%
Detective and protective services; including own-account software	\$41.6	0.199%
Hotels	\$41.2	0.059%
Management and public relations services	\$39.1	0.031%
Trucking and courier services, except air	\$29.2	0.015%
Legal services	\$26.6	0.019%
Advertising	\$26.1	0.014%
Landscape and horticultural services	\$26.0	0.107%
Insurance carriers	\$24.9	0.010%
Nitrogenous and phosphatic fertilizers	\$23.2	0.176%
Industrial inorganic and organic chemicals	\$21.6	0.018%
Wiring devices	\$21.2	0.209%
Metal foil and leaf	\$18.6	0.587%
Pipe, valves, and pipe fittings	\$18.6	0.092%
Miscellaneous equipment rental and leasing	\$18.6	0.042%
Miscellaneous repair shops	\$18.4	0.044%
Electron tubes	\$16.6	0.378%
Broadwoven fabric mills and fabric finishing plants	\$15.6	0.050%
Screw machine products, bolts, etc.	\$15.3	0.096%
Fabricated rubber products, n.e.c.	\$13.9	0.093%
Automotive rental and leasing, without drivers	\$13.7	0.016%
Engineering, architectural, and surveying services	\$13.0	0.011%
Petroleum refining	\$13.0	0.008%
Fluid power equipment	\$12.8	0.252%
Local and suburban transit and interurban highway passenger transportation	\$12.4	0.034%
Automotive repair shops and services	\$12.4	0.008%
Plating and polishing	\$10.1	0.162%
Business associations and professional membership organizations	\$9.2	0.053%
Aluminum rolling and drawing	\$8.6	0.045%
Iron and steel foundries	\$8.3	0.049%
Natural gas distribution	\$7.9	0.008%
Aluminum castings	\$7.2	0.065%
Nonferrous forgings	\$7.1	0.343%
Laundry, cleaning, garment services, and shoe repair	\$6.2	0.025%
Electrical repair shops	\$6.2	0.023%
Electrical machinery, equipment, and supplies, n.e.c.	\$5.9	0.097%
Special dies and tools and machine tool accessories	\$5.7	0.027%
Metal heat treating	\$5.6	0.162%
Coating, engraving, and allied services, n.e.c.	\$4.7	0.051%
Sanitary services, steam supply, and irrigation systems	\$4.7	0.014%
Abrasive products	\$4.3	0.099%
Rolling, drawing, and extruding of copper	\$4.0	0.053%
Accounting, auditing and bookkeeping, and miscellaneous services, n.e.c.	\$4.0	0.005%
Royalties	\$3.9	0.004%
Railroads and related services	\$3.7	0.009%
Research, development, and testing services, except noncommercial	\$3.6	0.008%
Security and commodity brokers	\$3.6	0.002%
Paints and allied products	\$3.4	0.019%
U.S. Postal Service	\$3.4	0.005%
Professional sports clubs and promoters	\$3.2	0.020%
Physical fitness facilities and membership sports and recreation clubs	\$3.0	0.016%
Photographic equipment and supplies	\$2.9	0.015%
Theatrical producers (except motion picture), bands, orchestras and entertainers	\$2.2	0.009%
Ball and roller bearings	\$1.9	0.031%
Other State and local government enterprises	\$1.8	0.004%
Retail trade, except eating and drinking	\$1.4	0.000%
Chemicals and chemical preparations, n.e.c.	\$1.3	0.011%
Coal	\$1.3	0.006%
Periodicals	\$1.2	0.008%
Water supply and sewerage systems	\$1.0	0.003%
Iron and steel forgings	\$0.9	0.018%
Warehousing and storage	\$0.9	0.005%
Motor vehicle parts and accessories	\$0.9	0.001%
Other membership organizations	\$0.8	0.003%
Paperboard containers and boxes	\$0.8	0.002%
Paper and paperboard mills	\$0.8	0.002%
Newspapers	\$0.7	0.007%
Arrangement of passenger transportation	\$0.7	0.004%
Pipelines, except natural gas	\$0.1	0.001%
Water transportation	\$0.1	0.000%

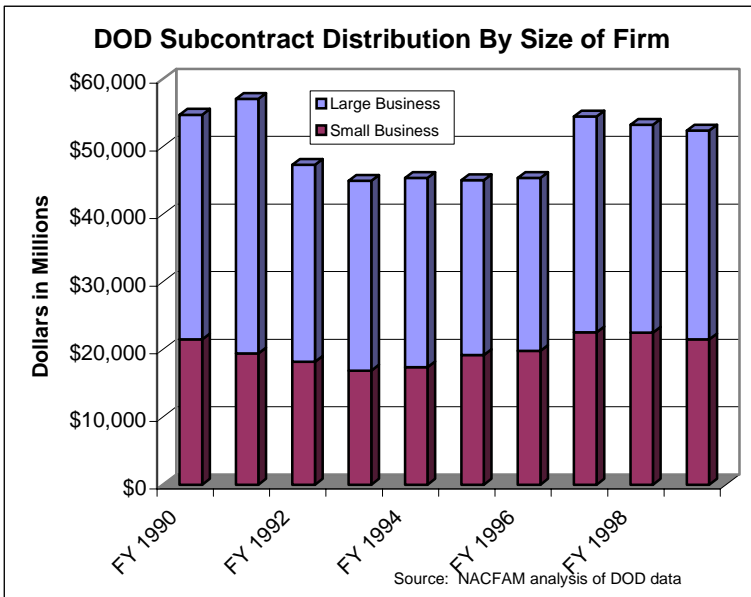
Source: NACFAM Analysis using National Input-Output Data from the Bureau of Economic Analysis, DOC

Defense Department Prime and Subcontracting Trends

Small businesses are a critical component of the defense supply chain. According to Defense Department data, small firms account for 21% of the value of prime contracts awarded to businesses in FY 1999 and 41% of the value of subcontracting activity performed by business on behalf of the Department of Defense.^{7, 8}

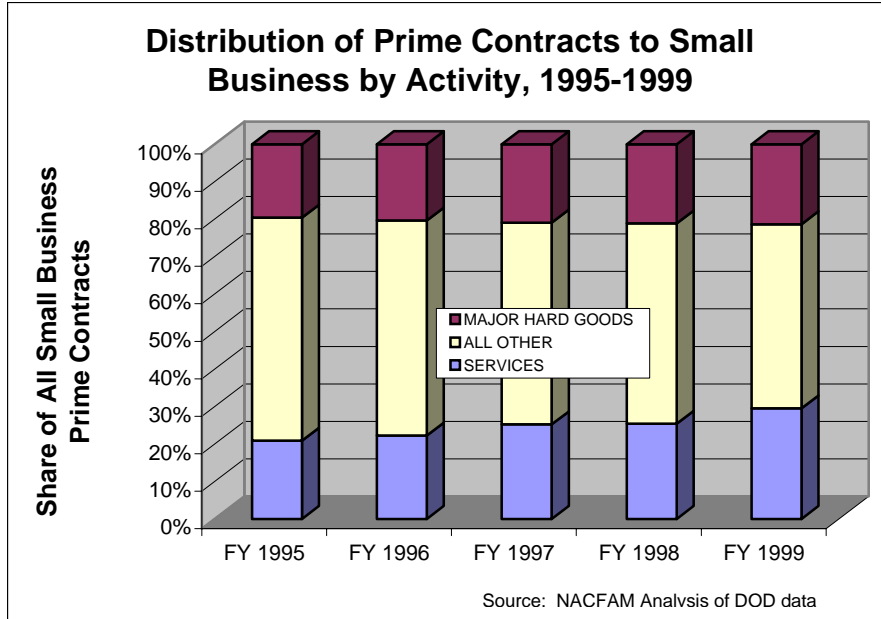


Prime contracting trends to small businesses were quite stable over the decade of the 1990s.⁹ Small firms consistently secured 20% of all prime contracts awarded by DOD. The value of those awards fluctuated within a range of \$3 billion, from a low of \$23 billion to a high of \$26 billion. In FY 1999, small businesses secured \$23.5 billion in prime contracts, slightly below where they started the decade. Over the same period, prime contracts to large businesses fell \$11 billion, from \$99 billion in FY 1990 to \$88 billion in FY 1999.



Subcontracting trends show similar stability. DOD subcontracts fluctuated in a band of about \$10 billion over the period, from a high of \$54.7 billion to a low of \$44.9 billion. During that time, small businesses retained at least 34% of the value of all subcontracts. Since 1995, small businesses have secured consistently over 40% of the value of the subcontracts.

Looking at the distribution of prime contracts by activity provides a glimpse of the types of products the small business community provides the Defense Department. Major Hard



DOD Prime Contracts to Small Business, FY 1995-1999

(Dollars in Thousands)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
SMALL BUSINESS TOTAL	25,274,222	25,387,141	24,476,485	23,045,938	23,592,862
MAJOR HARD GOODS	4,948,453	5,174,151	5,123,944	4,869,792	5,035,831
Aircraft	895,753	1,027,173	1,074,086	1,108,898	1,206,491
Missile and Space Systems	759,092	856,529	840,668	726,633	759,125
Ships	804,967	653,051	793,323	650,325	753,599
Tank-Automotive	311,307	342,693	342,488	334,662	305,378
Weapons	147,635	136,112	130,995	203,191	199,823
Ammunition	189,022	315,548	204,742	209,261	235,925
Electronics and Communications Equip.	1,840,677	1,843,045	1,737,642	1,636,823	1,575,490
SERVICES	5,275,832	5,642,358	6,176,730	5,849,644	6,958,950
ALL OTHER	15,049,937	14,570,632	13,175,811	12,326,501	11,598,081
Subsistence	401,095	316,413	316,652	410,648	364,680
Textiles, Clothing, and Equipage	390,733	492,873	511,860	363,033	410,622
Fuels and Lubricants	730,912	992,199	793,320	734,586	572,850
Miscellaneous Hard Goods	2,409,382	2,619,998	2,390,548	2,236,750	2,326,495
Construction	4,824,954	4,959,920	4,344,509	4,361,879	4,266,355
All Actions of \$25,000 or Less	6,292,863	5,189,228	4,818,921	4,219,606	3,657,079

Source: DOD Directorate for Information Operations and Reports, Prime Contract Awards - FY 1999

Goods, defined by the DOD as weapon system platforms, provided by small manufacturers grew slightly between FY 1995-1999, from just under \$5 billion to just over \$5 billion. The slight growth in this area came from contracts for aircraft-related work (up \$310 million) and ammunition (up \$46.9 million).

Other analyses of weapon systems' costs reveal that subcontractors account for a considerable portion of defense-related manufacturing. One study of prime contractors shows that "the dependence on subcontractors ranges from 60% to more than 70% of prime contractors' costs."¹⁰ Another review suggests that "over 80 percent of the value of some weapons systems is supplied, and the percentage is nearly that for most subsystems."¹¹ While large businesses are undoubtedly a significant part of these calculations, the roles of small- and medium-sized businesses should not be overlooked. As the Deputy Under Secretary of Defense for Industrial Policy emphasized in her March 2002 testimony before the U.S. House of Representatives, "innovation and small firms have always had an important place in our defense industrial base."¹²

Services represent another growth area, up \$1.7 billion. The largest drop, in the All Other category, of \$3.5 billion is a result of major reduction in the ambiguous "Actions of \$25,000 or less" category.

The defense industry is spread throughout the United States. While every state has some element of defense work, the geographic patterns of DOD contracting suggest the defense industry is concentrated in a handful of states.¹³ Ten states received 63% of all FY 2001 DOD prime contracts and the top-ten states secured 68% of all defense subcontracts in 2000. Seven states – California, Massachusetts, Virginia, Texas, Florida, Maryland, and Connecticut – appear on both lists. Two others – Pennsylvania and Georgia – fall just outside of one list while appearing on the other.

Even though much of the activity occurs in a select group of states, the sheer size of defense contracting activity supports significant effort across the United States. For instance, in FY 2001, 31 states received DOD prime contracts worth more than \$1 billion and 18 states reached the same threshold for subcontracting activity. In terms of the relative shares of DOD contracts, states roughly possess the same percentage of subcontracts as they do prime contracts. That is expected given that many firms receiving prime contract awards are also subcontractors on other projects.

Distribution of Prime and Subcontracts by State

State	Prime Contracts (\$000)	Share of Prime Contracts, 2001	Subcontracts (\$000)	Share of Subcontracts, 2000
Alabama	\$3,424,969	2.5%	\$1,284,456	2.3%
Alaska	\$836,664	0.6%	\$43,198	0.1%
Arizona	\$4,904,858	3.6%	\$717,502	1.3%
Arkansas	\$382,437	0.3%	\$126,063	0.2%
California	\$19,939,088	14.7%	\$7,388,044	13.5%
Colorado	\$2,302,817	1.7%	\$826,487	1.5%
Connecticut	\$4,269,536	3.2%	\$1,733,281	3.2%
Delaware	\$84,241	0.1%	\$15,859	0.0%
District of Columbia	\$1,459,519	1.1%	\$76,668	0.1%
Florida	\$6,712,819	5.0%	\$2,252,699	4.1%
Georgia	\$5,999,682	4.4%	\$1,461,796	2.7%
Hawaii	\$1,307,386	1.0%	\$312,355	0.6%
Idaho	\$147,837	0.1%	\$35,569	0.1%
Illinois	\$1,727,695	1.3%	\$3,262,543	6.0%
Indiana	\$1,824,030	1.3%	\$1,702,250	3.1%
Iowa	\$503,120	0.4%	\$263,086	0.5%
Kansas	\$930,042	0.7%	\$184,827	0.3%
Kentucky	\$1,180,261	0.9%	\$140,608	0.3%
Louisiana	\$1,487,320	1.1%	\$251,330	0.5%
Maine	\$496,525	0.4%	\$405,260	0.7%
Maryland	\$4,970,015	3.7%	\$2,396,713	4.4%
Massachusetts	\$5,247,752	3.9%	\$6,072,881	11.1%
Michigan	\$2,281,812	1.7%	\$1,454,093	2.7%
Minnesota	\$1,386,777	1.0%	\$582,725	1.1%
Mississippi	\$1,425,561	1.1%	\$568,379	1.0%
Missouri	\$5,186,822	3.8%	\$351,267	0.6%
Montana	\$127,442	0.1%	\$8,143	0.0%
Nebraska	\$190,861	0.1%	\$77,606	0.1%
Nevada	\$323,633	0.2%	\$32,565	0.1%
New Hampshire	\$488,969	0.4%	\$348,278	0.6%
New Jersey	\$2,807,748	2.1%	\$1,384,126	2.5%
New Mexico	\$763,065	0.6%	\$121,184	0.2%
New York	\$3,405,165	2.5%	\$1,393,183	2.5%
North Carolina	\$1,477,799	1.1%	\$594,637	1.1%
North Dakota	\$159,179	0.1%	\$5,651	0.0%
Ohio	\$3,302,983	2.4%	\$1,096,411	2.0%
Oklahoma	\$1,594,898	1.2%	\$144,719	0.3%
Oregon	\$393,771	0.3%	\$45,416	0.1%
Pennsylvania	\$4,244,938	3.1%	\$1,932,912	3.5%
Rhode Island	\$283,475	0.2%	\$13,311	0.0%
South Carolina	\$1,029,638	0.8%	\$317,360	0.6%
South Dakota	\$118,175	0.1%	\$4,563	0.0%
Tennessee	\$1,028,116	0.8%	\$110,986	0.2%
Texas	\$9,538,770	7.1%	\$3,144,303	5.7%
Utah	\$1,250,523	0.9%	\$405,018	0.7%
Vermont	\$307,653	0.2%	\$246,873	0.5%
Virginia	\$18,411,792	13.6%	\$3,215,409	5.9%
Washington	\$2,446,151	1.8%	\$5,860,283	10.7%
West Virginia	\$106,966	0.1%	\$61,435	0.1%
Wisconsin	\$911,227	0.7%	\$324,001	0.6%
Wyoming	\$92,230	0.1%	\$1,135	0.0%
	\$135,224,752	100.0%	\$54,799,448	100.0%

Source: Directorate for Information Operations and Reports, DOD

Discussion:

Issues Affecting SMEs in the Defense Industrial Base

Despite the evidence of stability, there are signs of concern. Bottlenecks in the defense supply chain exist in terms of limited production capacity, diminished manufacturing sources, single sources of supply, and foreign sources – all of which could impede the sustainment of current forces or hinder production surges necessitated by wartime requirements.

Serious questions exist concerning whether today's (and tomorrow's) weapons systems can be effectively sustained over unprecedented service lives. Recent experience indicates that even in-production systems or to-be-produced systems experience such problems as components that abruptly (and often unexpectedly) go out of production (often due to technical obsolescence) or if a key lower tier supplier goes out of business, changes business lines, or loses critical internal assets.

Current designs will have to be sustained for a long time. In 2025, over 65% of the in service weapons systems (naval, ground, and air) will be those that are in service in 2002. For example, under current plans the B-52 will stay in service until 2040—or beyond.

Examples of potential strategic issues that can have an effect on the sustainment and production of U.S weapons systems include:

- Lack of Suppliers for Spare Parts or Components. Existing suppliers of spare parts or components for weapon systems may go out of business, decide to abandon a line of business, or discontinue a product (insufficient return on investment, old technology, change in plans, etc.) or cannot (in turn) obtain needed components to manufacture their products. This problem is particularly acute for weapon system platforms that are as old as the B-52. Recent studies by the U.S. General Accounting Office (GAO) and the Defense Logistics Agency (DLA) have begun to document the extent of the problem. According to the GAO, critical spare parts of Navy and Air Force aircraft and engines were frequently unavailable and manufacturing issues were cited as a direct reason for the shortage about one-third of the time.¹⁴ An at-risk study by the DLA revealed that there are over 11,000 products for which there is no known source of supply and, furthermore, for 227 of these products there is an immediate need for resupply.¹⁵

In filling these needs, sometimes the only “responsive” bidders will be foreign sources. Relying on foreign sources (even friendly ones) for vital spare parts and materials for U.S. weapons systems entails risk. An even the worse situation is that the lack of potential sources may not be known (even by the original manufacturer of the system or the entity with configuration management and/or sustainment responsibility) until a new procurement is initiated—which could be just when the need for the part is the most acute.

- Outdated/Inefficient Manufacturing Methods and Processes. Weapon systems designed in the 1950s and 1960 often employed manufacturing methods and

processes that are no longer in widespread use. Sometimes the only sources interested in bidding to manufacture such items (electronic or structural) are foreign or “mom and pop” shops whose true competence to accomplish the work in a timely and quality fashion and ability to remain in business is in doubt.

- Surge Production Capacity. The ability to rapidly expand production of platform systems, components, and munitions is constrained not only by the surge capacity of the prime contractor, but also by the capabilities of the supplier base.¹⁶ Improving the efficiency of the DOD supply chain has the potential to produce a dramatic reduction in the time needed to move product from order-to-the-warfighter. For example, current stocks of air-launched cruise missiles are limited, yet it would take 30 months to reconstitute their production line. In contrast, best commercial practices preserve a surge capacity by negotiating long term contracts with suppliers of critical parts and through continual product improvement that keep important elements of the production base warm. The recognized challenge is determining what elements of commercial supply chain management are appropriate for the defense environment and then designing effective ways to educate the defense industrial community about them and working with them to institute the appropriate practice.
- Incorporating Commercial Practices for the Production of New Systems. The Pentagon is presently exploring “less-traditional defense solutions” and the supplier base necessary to support those solutions.¹⁷ In particular, one ongoing study is evaluating the financial incentives needed to attract a new set of firms to the defense sector and ways to improve the financial attractiveness of the existing defense base. While the most direct application of the work is the expansion of commercial buying practices and efforts to facilitate the introduction of commercial technologies into new and existing defense systems, other opportunities to incorporate commercial production practices clearly exist. If the Pentagon is serious about moving in this direction, it will require a decidedly different perspective on how to interact with the commercial base than presently exists as evidenced by the general perception that many of the nation’s most innovative and advanced firms refuse to work under DOD contracting rules and procedures.

Compounding this situation are a number of factors that inhibit the development of an efficient industrial base response to these challenges.

Lack of Attention to SME Issues – Despite this general situation, there is lack of dedicated focus on SME issues at the Defense Department. Under Secretary Aldridge claims “small businesses play a critical role in DOD’s accomplishment of its mission and the overall strength of the U.S. industrial base”¹⁸ and the Bush Administration set in place a number of programs focused exclusively on SME needs.¹⁹ The Diminished Manufacturing Sources and Materiel Shortages (DMSMS) program sheds light on the problem, but is limited in its ability to devise a comprehensive solution. Much of its effort to this point has focused on critical supply problems in the electronics sector. Nevertheless, interviews with leading officials, associations, and academics reveal a lack of attention to the small- and medium-sized manufacturing community among decision makers. The absence of substantive analysis in the Industrial Base reviews conducted by

the Department of Defense,²⁰ the Defense Science Board's review of the industrial base,²¹ and the Commerce Department's Bureau of Export Administration²² lends credibility to the claim that DOD decision makers are not focusing on issues facing the defense supply chain.²³

Demand for greater affordability coupled with the desire to improve capability and maximize sustainment leads inevitably to expanded roles for the SME base. Improving the efficiency and productivity of the SME base, and by extension, the operation of the supply chain and the prime contractors, will help reduce costs and improve capability. Yet, in the commercial sector, it is well known that SMEs face stiff challenges when making those improvements. By not focusing on these or related issues, the DOD unnecessarily delays the adoption of actions designed to improve the productivity of its SME base.

Biased Acquisition Practices – Even with efforts to streamline and simplify the acquisition and procurement process and growth of programs to assist small business, claims that the system remains biased toward large companies persist. For example, attendees of the 5th annual Army Small Business Conference point out that the Army's emphasis on past performance criteria in awarding contracts effectively limits opportunities for most small businesses.²⁴ This preference extends to follow-on projects, as well, making it more difficult for new entrants to win future contracts if an established relationship exists. Furthermore, programs designed to assist SMEs in improving the quality of their operations in order to increase their chances in the acquisition process show mixed results. For example, the Mentor-Protégé program, which matches prime contractors with small, disadvantaged businesses to provide training on how to do business with the Pentagon, show little evidence of benefiting the protégés.²⁵

Reform of the acquisition process is an ongoing and difficult challenge. Setting aside wholesale changes in the system, efforts to improve the productivity and quality of the SME base through dedicated supplier development programs could dramatically improve the competitiveness of SMEs in the contracting environment. A White Paper by the U.S. Air Force suggests that defense primes offer few training programs designed to improve the function, operation, efficiency, and performance of their supplier base.²⁶ Government business practices are to blame for this lack of interaction because of the failure to emphasize “deep, continuous cost reduction by the primes and subsystem suppliers.”²⁷ The analysis concludes that supplier development programs can weaken the bias against SMEs in acquisition business practices.

Communication Through the Supply Chain – The speed of technological change puts increased pressure on prime-supplier relationships.²⁸ Design teams can keep pace with this change by incorporating new technology into design revisions, but because production processes evolve more slowly, the challenges faced by manufacturing divisions at larger companies (Tier 2 or 3 suppliers) or subcontractor SMEs can be daunting. Similarly, constant changes in requirements brought on by schedule changes or uncertainty in the procurement environment strains relationships as well. Simply communicating changes efficiently up-and-down the supply chain is one challenge facing defense primes and their supply chain. Another is the reliability of the resulting product.

Many manufacturers that outsource or subcontract have found that they must now greatly expand their reliability and inspection procedures to ensure design changes were met. Interacting with the supplier base during the design process and establishing communication channels through the production process is one way to confront this situation. Improving the ability of the supplier base to handle uncertainty in the production environment represents another approach.

Cost and Quality – Demands by the Defense Department to reduce costs of major systems invariably trickle through the defense supply chain. Prime contractors pressure their suppliers to reduce costs. Depending on the structure and distribution of market power, which is determined by the presence of alternative suppliers/substitutes, individual suppliers will be more or less capable of resisting these pressures. Regardless, cost reduction, without quality degradation, will be a persistent demand on the defense industry for years to come.

One strategy adopted by the DOD to achieve cost reduction is to slow build-rates.²⁹ Shifting to low-volume production may produce the desired cost savings, but has different effects on the supply chain. At the prime contractor level, the effects can be quite pronounced. These firms oftentimes do not maintain a diversified product or customer base and are not able to withstand sustained sluggishness in demand.

Below the level of the primes, the advent of low volume production produced a number of responses. Depending on the type of product produced by a firm, diversification of business and customer bases may be a viable option. Successful diversification allows firms to avoid the problem of managing fixed costs when production volume drops. For defense dependent SMEs, the only available option is to find a way to hold costs level or suppress them further without forcing the loss of critical capacity or exiting the market. The growth of foreign competition is a related cost and quality issue. Driven in part by the expanded use of production offsets, the U.S. SME base faces a more competitive marketplace while at the same time facing declining production volumes domestically.³⁰

Improving productivity is the most effective strategy for these firms to meet the twin demands of decreased cost and quality improvement while maintaining their own desire for profitability. Unfortunately, the relationships between the primes and the supplier base do not lend themselves to supplier development and only a few federal options address the situation.

Aging Workforce – The graying of the workforce is cited by some as a major problem faced by specialized, defense-dependent small businesses.³¹ In this class of companies, the workforce tends to be relatively small, as shown by the statistics at the beginning of this paper, and with the company for many years. As this workforce nears retirement, these companies face the prospect of a loss of tacit and craft-like knowledge. To the extent that these firms may represent sole suppliers of critical parts, the loss of this tacit knowledge could seriously undermine the performance and quality of those companies.³²

Conclusions

The small- and medium-sized manufacturer (SME) is a vibrant component of the defense industrial base. SMEs are responsible for large portions of manufacturing and production activity, perform a considerable share of DOD prime and subcontracting activity, and provide key spare parts and components needed to sustain existing weapon system platforms.

In many cases, the SME base survived the downturn in defense spending in the 1990s and has adapted to the new business climate through a strategy of diversification, where appropriate, or limited growth. Yet, concerns are emerging about the ability of the SMEs as a whole to meet expected demands on the industrial base.

It is imperative that the business community and the federal government begin exploring strategies for supporting the SME base to ensure that critical capacity for production, maintenance, and innovation is not lost.

Endnotes

¹ Small Businesses. A small business is defined by the Small Business Administration in the Federal Register (Title 13, Chapter 1, Part 121). The definition also appears in the Federal Acquisition Regulation (19.101). Generally, a small business is one that is independently owned and operated, is not dominant in its field of operations, and, with its affiliates, does not employ more than a specified number of employees (usually not more than 500, 750, or 1,000, depending on the type of product called for by the contract). For construction and some service industries, the criterion is a specified annual dollar volume of sales or receipts rather than the number of employees.

² The nine sectors were selected by NACFAM as illustrative of the defense industries.

³ The analysis of the Guided Missile and Space Vehicles sector is derived from the 2001 National Input-Output tables developed by the U.S. Department of Commerce, Bureau of Economic Analysis. The tables identify which inputs are used by individual industries and to what degree.

⁴ Oden, Michael. "Restructuring the Defense Industrial Base." In Arming the Future: A Defense Industry for the 21st Century. Ann Markuson and Sean Costigan, ed. Council on Foreign Relations: New York, 1999.

⁵ Vernez, Georges. California's Shrinking Defense Contractors: Effects on Small Suppliers. (MR-687-OSD), RAND Corp: Santa Monica, CA, 1996.

⁶ Interview with former defense industry executive by NACFAM staff.

⁷ Aversion to imposing added reporting requirements on prime contractors limits the DOD's ability to collect accurate subcontract data. Several interviewees commented on background that the contracting data substantially erodes in quality past the point of the initial prime-subcontract relationship. In other words, if a subcontractor, in turn, contracts with another company to do work that data is not likely to appear in the official statistics.

⁸ A letter between Sen. Christopher Bond and Under Secretary Aldridge, dated September 4, 2001, sheds additional light on the matter. The letter asks for the DOD's commitment to improving the measurement of small business contracting activity, based on a study by the U.S. General Accounting Office.

⁹ FY 1999 contract data are the most recent available and analyzed data from the DOD's Directorate for Information Operations and Reports.

¹⁰ Kelley, Maryellen, and Todd Watkins. "Are Defense and Non-Defense Manufacturing Practices All That Different." In The Defense Industry in the Post-Cold War Era. Gerald Susman and Sean O'Keefe, eds. Pergamon: Amsterdam, 1998.

¹¹ Air Force Manufacturing Technology Program. "White Paper: Initiative for Small and Medium Enterprises." <http://www.nwlean.net/sme.htm>

¹² Patrick, Suzanne. Deputy Under Secretary of Defense (Industrial Policy). Statement before the House Armed Services Committee, Subcommittee on Military Procurement, March 19, 2002.

¹³ According to the DOD's Directorate for Information Operations and Reports – "Contract work is not necessarily performed in the state where the contract is awarded. Most manufacturing contracts have been attributed to the contractor's location where the product will be processed and assembled. When contract work has been performed at more than one plant, the contract has been attributed to the location where the largest dollar amount of work was produced. Both construction and service contracts have been attributed to the state where the work is to be performed. Contracts for transportation and communications services have been attributed to the state where the contractor's home office is located. For purchases from wholesale or other distribution firms, the location is the contractor's business address." Prime Contract Awards by State, FY 2001.

¹⁴ U.S. General Accounting Office. Air Force Inventory. GAO-01-487. June 2001. U.S. GAO. Navy Inventory. GAO-01-771. July 2001.

¹⁵ Robinson, David. *Briefing for the Diminished Manufacturing Sources and Materiel Shortages 2002 Conference*.

¹⁶ Patrick, Suzanne. Deputy Under Secretary of Defense (Industrial Policy). "The U.S. Missile Industry: Consolidation And Transformation," Speech at the Strategic & Tactical Missile Systems Conference, January 29, 2002

¹⁷ Patrick, Suzanne. Deputy Under Secretary of Defense (Industrial Policy). Statement before the House Armed Services Committee, Subcommittee on Military Procurement, March 19, 2002.

¹⁸ Aldridge, Pete. Undersecretary of Defense for Acquisition, Technology, and Logistics. Testimony before the Committee on Small Business, U.S. House of Representatives, September 6, 2001.

¹⁹ These include:

- Small business improvement plans for each military department and defense agency
- Increase emphasis on small business subcontracting during annual contractor reviews with prime contractors
- Create small business forum under auspices of the Small and Disadvantaged Business Utilization Office
- Established FedBizOpps, single-point of entry system for DOD procurement opportunities above \$25,000

Other Programs to assist small business

- Pilot Mentor-Protégé Program
- SBIR/STTR
- Woman-Owned Small Business Program
- HBCU/MIs Technical Assistance Program
- Indian Incentive Program
- Comprehensive Subcontracting Plan Test
- Regional Councils for Small Business Education and Advocacy
- Elements of the Supply Chain Integration Office

²⁰ Department of Defense. Annual Industrial Capabilities Report to Congress. January 2001.

²¹ Defense Science Board Task Force. Preserving a Healthy and Competitive U.S. Defense Industry to Ensure our Future National Security. Final Briefing. November 2000.

²² For example, U.S. Department of Commerce, Bureau of Export Administration, Office of Strategic Industries and Economic Security. National Security Assessment of the U.S. Shipbuilding and Repair Industry. May 2001.

²³ One off the record interview suggested there is even a lack of appreciation of obvious supply chain issues associated with established weapon system platforms within DOD.

²⁴ Kutner, Joshua. "Past Performance Issues Stir Debate at Small Business Conference." *National Defense*. <http://www.nationaldefensemagazine.org/article.cfm?Id=387>.

²⁵ U.S. General Accounting Office. Contract Management: Benefits of the DOD Mentor-Protégé Program are not Conclusive. (GAO-01-767), July 2001.

²⁶ Air Force Manufacturing Technology Program. "White Paper: Initiative for Small and Medium Enterprises." <http://www.nwlean.net/sme.htm>

²⁷ Op cit.

²⁸ Interview with Tier 2 defense contractor official by NACFAM research staff.

²⁹ This trend is particularly evident in the Navy's shipbuilding account.

³⁰ National Research Council. Trends and Challenges in Aerospace Offsets. 1999.

³¹ For example, this issue was raised in Vernez, Georges. California's Shrinking Defense Contractors: Effects on Small Suppliers. (MR-687-OSD), 1996.

³² In general, the aging workforce affects the defense industrial sector more so than other sectors, but outside this small segment of the industry, officials seem to believe it is a manageable problem.