Acquisition Research Program:
Creating Synergy for Informed Change

An Empirical Analysis of the Patterns in Defense Industry Consolidation and Their Subsequent Impact

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Purpose

- "*Almost a decade of consolidation in the defense industry has failed to deliver the benefits of lower costs for the Pentagon. And the mergers of the '90s that were supposed to produce stronger and more innovative defense contractors have more often caused corporate indigestion."* (Los Angeles Times, Oct. 17, 1999)

- Have defense mergers reduced weapons system costs for DoD?

Table 1: Annual Growth Rates in Merger Activity in the Defense Sector and in the Overall Economy

Time Period	Annual growth rates for merger activity (number of transactions) in the defense sector	Annual growth rates for merger activity (number of transactions) in the overall economy	Annual growth rates for merger activity ($ value) in the defense sector	Annual growth rates for merger activity ($ value) in the overall economy
1992-1993	-44.83%	4.008%	-82.37%	45.41%
1993-1994	-6.25%	12.66%	268.1%	80.63%
1994-1995	-33.00%	17.37%	-94.13%	30.94%
1995-1996	100.0%	66.51%	8571.4%	110.8%
1996-1997	50.00%	33.32%	-46.96%	35.68%
1997-1998	70.00%	0.154%	-59.25%	83.41%
1998-1999	0.00%	18.94%	169.0%	19.16%
1999-2000	-29.4%	3.28%	392.8%	832.9%
2000-2001	-5.5%	-13.37%	-97.03%	-94.72%
2001-2002	26.47%	-12.06%	164.7%	-37.42%
2002-2003	-34.88%	9.573%	-55.97%	15.14%
2003-2004	-10.7%	22.66%	50.50%	48.78%

These annual growth rates were calculated by the author from raw data found in the Mergerstat Review for 2005, the Mergerstat Review for 2002, the Mergerstat Review for 1997, and the Mergerstat Review for 1996. The defense sector, as defined by Mergerstat, encompassed firms in Standard Industry Classification (SIC) codes 3761-3769, 3721-3728, and 3795.

- **Table 2: Is Defense Merger Activity More Linked to the Overall Level of DoD Spending or to the Overall Level of Merger Activity in the Economy?**

Correlation between:	Number of defense merger transactions in a given year	Dollar value of defense merger transactions in a given year
Level of overall DoD outlays in a given year	-0.0269	-0.2058
Level of DoD procurement outlays in a given year	-0.3591	-0.3783
Level of overall DoD outlays in the previous year	-0.1929	-0.2947
Level of DoD procurement outlays in the previous year	-0.6097	-0.3916
Number of mergers in the overall economy in a given year	0.6498	
Dollar value of mergers in the overall economy in a given year		0.9399

The statistical correlations were calculated by the author from raw data found in the Historical Tables (Table 3.2) for the Budget for Fiscal Year 2008, p. 56-50, and from data in the raw data found in the Mergerstat Review for 2005, the Mergerstat Review for 2002, the Mergerstat Review for 1997, and the Mergerstat Review for 1996.

Forces Behind Defense Merger Activity

- Defense mergers are negatively correlated with DoD procurement outlays.
  - The correlations between defense mergers in a given year and DoD procurement outlays in the previous year are stronger than current year measures.
  - Suggests that merger activity is more likely to be a delayed response to previous spending levels than to current spending levels.
- Correlations between defense merger activity and overall merger activity in the economy are strongly positive.
- Correlations between defense merger activity and overall merger activity are stronger than correlations with DoD procurement outlays.
- Conclusion: Defense merger activity was driven less by declines in spending following the Cold War, and more by a stronger economy and a vibrant financial market.

Table 3: Reduction in Prime Contractors in Various Weapons Systems Sectors Between 1990 and 1998

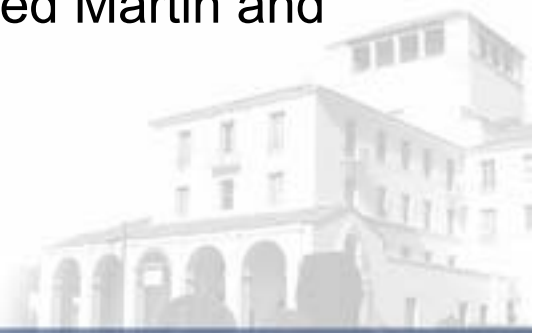
Sector	Number of prime contractors in 1990	Number of prime contractors in 1998	Percentage reduction
Tactical Missiles	13	4	-69.2%
Fixed Wing Aircraft	8	3	-62.5%
Expendable Launch Vehicles	6	2	-66.7%
Satellites	8	5	-37.5%
Surface Ships	8	5	-37.5%
Tactical Wheeled Vehicles	6	4	-33.3%
Tracked Combat Vehicles	3	2	-33.0%
Strategic Missiles	3	2	-33.0%
Torpedoes	3	2	-33.0%
Rotary Wing Aircraft	4	3	-25.0%

Patterns of Defense Consolidation

- Between 1990 and 1998, the percentage reduction in contractors exceeded 60% in 3 of the 10 sectors (tactical missiles, fixed wing aircraft, and expendable launch vehicles), and varied between 25% and 37.5% in the remaining 7 sectors.
- The major giants emerging from the consolidation by 1998:
  - Boeing (prime contractor in 6 of the 10 markets)
  - Lockheed Martin (prime contractor in 5 of the 10 markets)
  - Northrop Grumman (prime contractor in 3 of the 10 markets)
  - Raytheon (prime contractor in 2 of the 10 markets)
  - General Dynamics (prime contractor in 2 of the 10 markets)

Antitrust Concerns

- With the increasing number of defense mergers in the mid to late 1990's, the DOJ and FTC became concerned about reduced competition
  - "*A number of defense mergers proceeded unchallenged over the last 5 years, which rationalized capacity, but, if that rationalization goes too far, it can harm competition*" (Joel Klein, Assistant Attorney General of the Antitrust Division, DOJ, June, 1998)
- 1997-DOJ challenged Raytheon's acquisition of Hughes Aircraft and Raytheon's acquisition of the defense electronics division of Texas Instruments, but allowed them to go through provided that some key divestitures occurred.
- 1998—DOJ blocked the merger between Lockheed Martin and Northrop Grumman.



Antitrust Considerations Regarding the Defense Industry

- Differences between antitrust analyses involving the defense industry vs. other industries
  - Definition of the relevant geographic market and possible competitors can't always include foreign manufacturers for security reasons.
  - Traditional industries have a broad spectrum of consumers, whereas DoD is the primary buyer in this industry.
  - Government contracting process can serve as a BTE to new entrants, the entry of whom would ordinarily serve as a mechanism to reduce the anticompetitive effects of increased concentration.

Analysis and Data

- Used cost data from the summary tables in the Selected Acquisitions Reports (March, 1981-June, 2006)
- Examined 28 weapons systems which were selected because:
  - Primary contractor was involved in a merger with another major defense contractor during the period covered
  - Enough time series data to examine the pre and post-merger period
  - Weapons system was only made for one of the services
  - Weapons system did not have a defense contractor that was not involved in the merger as its primary contractor at any time during the period covered
- Ran the following model for each weapons system
  - (Current year cost estimates in base year dollars)$_l$ = α +β_1 (time trend) + β_2(post-merger indicator variable)

Table 4: Regression Results With the Post-Merger Effect Beginning at the SAR Nearest to the Effective Date of the Merger

Weapons System	Coefficient on post-merger indicator variable	P value on coefficient for post-merger indicator variable	Coefficient on time trend variable	P value on coefficient for time trend variable
AH-64	36.9611	0.763	47.257	0.000
AIM-9X	1554.8	0.000	4.8778	0.568
ASAS	-1419.66	0.000	16.395	0.046
AMRAAM	-2826.00	0.000	183.26	0.000
ATACMS	134.47	0.366	29.903	0.000
AV-8B	-113.64	0.001	6.5453	0.005
ATCCS	179.68	0.046	-12.833	0.003
ATICRM	-49.355	0.899	64.324	0.007
C-17	17687.66	0.000	319.77	0.000
DDG-51	-6357.78	0.001	740.82	0.000
FA-18	-21133.99	0.002	635.6	0.014
F-22	-8867.30	0.151	1074.1	0.000
Javelin	-78.669	0.840	14.043	0.291
JDAM	-669.47	0.032	147.651	0.000
JSOW	542.25	0.609	-9.9954	0.827
JSTARS	-1396.20	0.003	168.99	0.000
LHD-1	251.02	0.210	53.764	0.000
Longbow Apache	-381.75	0.612	149.51	0.000
Longbow Hellfire	-759.73	0.033	36.382	0.008
NAVSTAR User Equipment	-212.399	0.013	29.502	0.000
Titan IV	-9604.985	0.000	504.366	0.000
DMSP	15.714	0.322	6.557	0.000
FBCB2	-422.658	0.180	4.646	0.876
MLRS	-28.854	0.744	28.307	0.000
Strategic Sealift Program	58.530	0.685	20.624	0.029
T45TS	143.59	0.401	47.809	0.000
Trident	-2111.671	0.056	10.3506	0.679
JPATS	744.526	0.047	124.02	0.000

Table 5: Regression Results With the Post-Merger Effect Beginning at the Second Nearest SAR to the Effective Date of the Merger

Lagged	Coefficient on post-merger indicator variable	P value on coefficient for post-merger indicator variable	Coefficient on time trend variable	P value on coefficient for time trend variable
AH-64	87.88	0.48	45.65	0.000
AIM-9X	1279.3	0.000	9.408	0.422
ASAS	-1004.9	0.002	-8.205	0.733
AMRAAM	-2953.6	0.000	184.6	0.000
ATACMS	234.6	0.108	27.20	0.000
AV-8B	-116.95	0.001	7.088	0.004
ATCCS	194.91	0.033	-13.60	0.002
ATICRM	255.64	0.504	49.295	0.031
C-17	17138.7	0.000	336.68	0.000
DDG-51	-7478.1	0.000	761.47	0.000
FA-18	-24329.8	0.000	751.15	0.003
F-22	-11220	0.067	1127.4	0.000
Javelin	1156.99	0.002	-22.196	0.067
JDAM	-698.65	0.028	149.39	0.000
JSOW	1631.28	0.126	-50.687	0.276
JSTARS	-1300.27	0.005	166.48	0.000
LHD-1	144.32	0.476	55.225	0.000
Longbow Apache	-669.24	0.372	158.10	0.000
Longbow Hellfire	-789.56	0.030	38.132	0.007
NAVSTAR User Equipment	-191.89	0.024	28.756	0.000
Titan IV	-10094.5	0.000	513.14	0.000
DMSP	30.865	0.041	5.910	0.000
FBCB2	-606.34	0.056	22.475	0.456
MLRS	-34.901	0.693	28.377	0.000
Strategic Sealift Program	93.856	0.506	19.345	0.028
T45TS	63.6989	0.707	49.373	0.000
Trident	-1489.63	0.178	-2.125	0.933
JPATS	947.42	0.006	118.27	0.000

Table 6: Percentage of Weapons Systems Experiencing a Post-Merger Change in Cost Estimates

	Percentage of systems experiencing a positive and statistically significant change	Percentage of systems experiencing a negative and statistically significant change	Percentage of systems experiencing a statistically significant change
Post -merger effect begins at the SAR closest to the merger effective date	14.3%	39.3%	53.6%
Post-merger effect begins at the second nearest SAR to the merger effective date	21.4%	42.9%	64.3%

Table 7: Percentage of Weapons Systems Experiencing a Post-Merger Change in Cost Estimates by Equipment Type

	Percentage of systems in each category which experienced a statistically significantly higher cost estimate post-merger	Percentage of systems in each category which experienced a statistically significantly lower cost estimate post-merger	Percentage of systems in each category which experienced a statistically significantly different estimate post-merger (higher or lower)
Rotary Aircraft AH-64 Longbow Apache	0%	0%	0%
Tactical Missile AIM-9X AMRAAM ATACMS Javelin JSOW Longbow Hellfire MLRS	28.6%	28.6%	57.1%
Strategic Electronics ASAS NAVSTAR User Equipment FBCB2 ATCCS ATICRM	20%	60%	80%
Fixed Wing Aircraft AV-8B C-17 FA-18 F-22 JSTARS T45TS JPATS	28.6%	57.1%	85.7%
Surface Ships DDG-51 LHD-1 Strategic Sealift Program	0%	33%	33%
Satellite DMSP	100%	0%	100%
Munition JDAM	0%	100%	100%
Strategic Missile Titan IV Trident	0%	50%	50%

Findings by Type of Weapons System

- About 57%-60% of the systems exhibited a statistically significant reduction in cost estimates, controlling for the time trend.
- By sector:
  - Fixed Wing Aircraft: Although the number of prime contractors declined 62.5% (1990-1998), of the 85.7% of the systems that had a statistically significant change, 57.1% experienced cost decreases and 28.6% experienced cost increases.
  - Tactical Missiles: Number of prime contractors declined 69.2% (1990-1998). Of the 57% of the systems exhibiting statistically significant changes, 28.6% of the exhibited significant increases, and 28.6% of them exhibited decreases.
  - Surface Ships: Number of prime contractors declined 37.5% (1990-1998). Of the 33% of the systems exhibited a statistically significant change, all of them experienced cost decreases.
  - Strategic Electronics: Less of an issue of increased concentration. Of the 80% of the systems that experienced a statistically significant change, 60% of them experienced a decrease and 20% of them experienced an increase.

Table 8: Summary of Statistically Significant Cost Changes by Defense Contractor

	Percentage of systems made by each defense contractor which experienced a statistically significantly higher cost estimate post-merger	Percentage of systems made by each defense contractor which experienced a statistically significantly lower cost estimate post-merger	Percentage of systems made by each defense contractor which experienced a statistically significantly different estimate post-merger (higher or lower)
Northrop	0%	40%	40%
Boeing	14.3%	57.1%	71.4%
General Dynamics	0%	50%	50%
Raytheon	60%	20%	80%
Lockheed	25%	50%	75%
McDonnell Douglas	14.3%	42.8%	57.1%

Findings by Primary Contractor

- About 70-80% of the weapons systems made by Boeing, Raytheon, and Lockheed experienced statistically significant changes in their cost estimates following their mergers
- Over half of the weapons system made by Boeing (prime contractor in 6 of 10 markets), Lockheed (prime contractor in 5 of 10 markets) and General Dynamics (prime contractor in 2 of 10 markets) experienced statistically significantly lower post-merger cost estimates.
- Raytheon was the only one of the major contractors which had a higher percentage of weapons systems (60%) that experienced a statistically significant cost increase than the percentage (20%) that experienced a decrease.
- About 40% of McDonnell Douglas' and Northrop's weapons systems had a statistically significantly lower post-merger cost estimate (40-57% of their systems exhibited a statistically significant change)

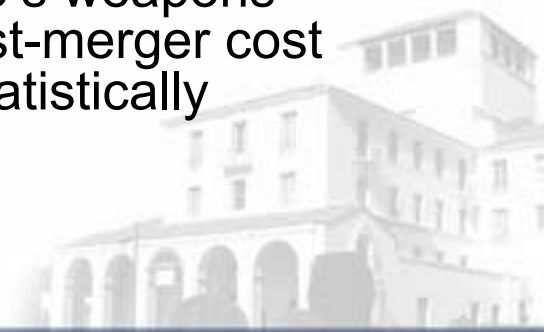


Table 9: Impact of Selected Defense Mergers on Weapons Systems Cost Estimates

	Percentage of systems made by the defense contractors involved in a specific merger which experienced a statistically significantly higher cost estimate post-merger	Percentage of systems made by defense contractors involved in a specific merger which experienced a statistically significantly lower cost estimate post-merger	Percentage of systems made by the defense contractors involved in a specific merger which experienced a statistically significantly different estimate post-merger (higher or lower)
Lockheed / Martin Marietta (March 16, 1995) ASAS F-22 Longbow Hellfire Titan IV DMSP Trident	16.7%	66.7%	83.3%
Boeing / McDonnell Douglas (August 1, 1997) AV-8B C-17 FA-18 JDAM Longbow Apache T45TS	16.7%	50%	66.7%

Findings on Two Major Mergers

- The Lockheed-Martin Marietta Merger (March 16, 1995) impacted over 80% of the weapons systems examined, but 2/3 of them exhibited a statistically significant decline in cost estimates.
- The Boeing-McDonnell Douglas merger impacted 2/3 of the weapons systems, of which 50% of them experienced a statistically significant decline in cost estimates.

Conclusions

- Defense merger activity was driven less by declines in spending following the Cold War, and more by a stronger economy and a vibrant financial market.
- Many weapons systems' cost estimates were unaffected by merger activity.
  - Only 50-65% of the weapons systems examined exhibited a statistically significant post-merger cost change.
- Of those systems, affected, a greater percentage exhibited significantly lower cost estimates than higher cost estimates.
  - About 50% of the systems exhibited a significant decrease in cost estimates, and 15-20% experienced a significant increase.

Conclusions

- Several of the sectors which experienced a dramatic reduction in competition were more likely (or as likely) to have significantly lower cost estimates as higher ones.
  - Within the fixed wing aircraft sector (2/3 reduction in contractors), about 60% of the systems experienced a statistically significantly lower cost estimate during the post-merger period.
  - Within the tactical missile category (2/3 reduction in contractors), 28.6% of the systems surveyed experienced a statistically significantly higher post-merger cost estimate and 28.6% of the systems experienced a statistically significantly lower post-merger cost estimate.

Conclusions

- Increases in market power may not have translated into higher costs for DoD, especially for systems made by Lockheed and Boeing.
  - For Boeing and Lockheed, 50-57% of the systems experienced a statistically significant reduction in cost estimates.
  - Raytheon was the only contractor for whom 60% of the systems experienced a statistically significant increase in their cost estimates.
  - About 2/3 of the systems made by Lockheed and Martin Marietta experienced a statistically significant decline in cost estimates following their merger.
  - Half of the systems made by Boeing and McDonnell Douglas experienced a statistically significant decline in cost estimates following their merger.

Conclusions

- The preliminary evidence suggests that although market concentration levels in certain sectors increased due to the wave of defense mergers, DoD's costs across weapons systems tended to be lower in the post-merger period.

- Although further research on a larger sample of weapons systems distributed across various sectors is necessary to more fully inform the public policy discourse, this study indicates that increases in market power do not necessarily lead to an anticompetitive outcome in pricing.