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DEFENSE INDUSTRY CONSOLIDATION AND WEAPON SYSTEMS COST GROWTH

by

Ioannis A. Stratogiannis
Christos K. Zahos

June 2008

Primary Advisor:	Nayantara Hensel
Associate Advisor:	Don Summers

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DEFENSE INDUSTRY CONSOLIDATION AND WEAPON SYSTEMS COST GROWTH

Ioannis A. Stratogiannis
Lieutenant Commander, Hellenic Navy
B.S., Hellenic Naval Academy, 1991

Christos K. Zahos
Major, Hellenic Air Force
B.S., Electronics Engineering, Hellenic Air Force Academy, 1992
M.S., Electronics & Radio Communications, University of Athens, 1998

Submitted in partial fulfillment of
the requirements for the degree of

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NAVAL POSTGRADUATE SCHOOL
June 2008

Authors: Ioannis A. Stratogiannis

Christos K. Zahos

Approved by: Nayantara Hensel
Primary Advisor

Don Summers
Associate Advisor

Robert N. Beck, Dean
Graduate School of Business and Public Policy

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I. INTRODUCTION

A. BACKGROUND

The end of the Cold War created expectations and hopes among the majority of nations and global institutions and organizations for a more peaceful and prosperous future. It is now a common perception, after 9/11, that these expectations do not reflect today's reality. Expenditures for National Defense have once again reached high levels. At the same time new and extremely complicated global security issues have emerged which demand quick and effective responses. The defense industry can reasonably be considered among the industrial sectors of primary importance for the U.S. economy with an integral contribution to the entire security environment. Furthermore, the U.S. defense industry, as a major international weapon systems provider, is of global importance from both security and economic perspectives.

The evolution of technology, as well as the expectations and needs of the potential user, are some of the major causes, which drive the increase of development and procurement costs of weapon systems. Critical modern weapon systems such as fighter aircrafts are now delivered in smaller quantities, providing more capabilities for multiple missions.

After the end of the Cold War period, the U.S. defense industry underwent a very extensive consolidation phase. The end of this period of intensive mergers and acquisitions activity left only a handful of major defense contractors in the market. One sensible expected outcome of this consolidation was the increase of the efficiency of the defense contractors with subsequent results on the costs of weapon systems, ultimately saving money for the government. Thus, the federal government had actively supported the wave of mergers and acquisitions in the defense industry. Nevertheless, numerous concerns have been expressed and several issues were addressed in studies and surveys by governmental and non-governmental research institutes and organizations.

B. OBJECTIVE OF STUDY

The U.S. defense budget is the highest in the world. Defense expenditures actually represent a very high percentage of the total amount spent for defense on a global basis. This fact alone makes it interesting to survey the possible realized savings due to the acquisitions and mergers, which took place in the defense industrial sector. The primary objective of this project is to survey whether and at what degree the consolidation of the U.S. defense industry led to any significant benefits for the federal government and taxpayers, mainly in terms of the cost growth of the weapon systems acquired by the U.S. Armed Forces. This thesis analyzes the cost growth of the major weapon systems acquisition programs, in an effort to identify trends and/or patterns and additionally draw conclusions concerning the consolidation of the U.S. defense industry. There have been numerous expressions of doubt and questioning whether the consolidation has actually offered significant benefits and whom these benefits serve. It is rather obvious that the conditions, needs, and purposes of the consolidation of the U.S. defense industry reflected the particular period prior to the War on Terror. Consequently, the question raised is whether, under the current circumstances and within the newly shaped global environment, consolidation has been and remains in the best interests of the government and the taxpayers.

The results of this survey can be studied and used in different ways and levels. At the policy level, it is possible that a requirement for a reform of the acquisition system will be identified, at certain aspects, in order to be able to cope with a market environment where competition is limited. In addition, under the expectation of a possible new wave of consolidation, the lessons learned from the previous consolidation can act as one of the guidelines in which to timely form a response policy. The weapon systems cost growth is one of the primary indicators that can reveal the overall picture of the results of the consolidation. Cost growth can also be used as a descriptive tool for the overall situation and effectiveness of the defense market and its rules and institutions, which govern the procurement process. Possible discernible patterns of the cost growth over time and different categories of systems and contractors might indicate necessary policy initiatives for quick and effective response, regardless of the long-term causes and

the possible relationship of the cost growth with the defense industry consolidation. On the other hand, cost growth can be affected by many other different factors. The degree to which each one of these factors actually affects cost growth can be very to estimate accurately.

C. RESEARCH QUESTIONS

The following primary and secondary research questions were created in order to facilitate the analysis of cost growth of the major defense acquisition programs (MDAP), in an effort to identify trends and/or patterns. Additionally these questions are useful for drawing conclusions concerning whether the merger and acquisition activity of the 1990s led to consolidation of the U.S. defense industry competition, and, possibly, costs.

1. Primary Questions

- Is there any obvious impact caused from the consolidation to the cost growth of the major defense acquisition programs (MDAP)?

2. Secondary Questions

- What were the causes that led to U.S. defense industry consolidation?
- Are there any identifiable trends of the weapon systems cost growth based on the information, which are included in the Selected Acquisition Reports (SAR)?
- Are there any obvious consequences of the consolidation for the U.S. and foreign buyers of U.S. weapon systems?

D. SCOPE AND LIMITATIONS

This thesis is limited by design to focus on cost changes of major defense acquisition programs (MDAP). The total defense budget expenditure is not restricted only at the MDAP. At any given time, there are around seven hundred DoD major and minor programs. Because the submission of data is mandatory for major programs, this thesis looks at the 358 of them that are being reported in the Selected Acquisition Reports (SARs). The use of SARs makes accessing data relatively simple. The use of certain selection criteria as discussed in a later chapter reduces the number of programs analyzed

to 113. Although acquisition policy reform is a perpetual activity, this thesis narrowly focuses on those policies that impact consolidation or program cost changes. This thesis investigates whether mergers, and at what degree the consolidation of the U.S. defense industry, led to any significant benefits for the federal government and taxpayers, mainly in terms of the cost growth of the weapon systems acquired by the U.S. Armed Forces.

E. ORGANIZATION OF STUDY

This analysis compares baseline year and current year (reflecting the date, which the respective report was issued) cost estimates (all in base year dollars for each individual program) of defense programs that fall among the largest defense contractors to see if savings are realized post-merger. Chapter II includes the literature review and incorporates a wide narrative of the trends that appeared and influenced policies towards U.S. defense expenditures and weapon systems exports, during and mainly after the Cold War. In addition, a brief description of the theory of merger waves is provided in order to make the reader familiar with the concepts of merger and acquisitions activity as they appeared in the history of U.S. economy. The basic governmental policy, which was implemented and supported the consolidation, is also depicted. Chapter III describes the method applied for the calculations of cost growth of the MDAPs based on the Selected Acquisition Reports (SARs) database. It also contains a brief explanation of the information included in the SAR along with the various difficulties and limitations in the exploitation of these data. Chapter IV describes quantitative statistical analysis and results. Lastly, Chapter V provides the answers to the research questions and the conclusions based on the results and the other qualitative information that was available. These conclusions have to do mostly with the defense industry consolidation, but also touch upon other aspects of the defense acquisition policy. Recommendations for areas of further research are provided to complement these findings.

II. BACKGROUND INFORMATION AND LITERATURE REVIEW

A. THE COURSE TO THE U.S. DEFENSE INDUSTRY CONSOLIDATION

1. Introduction

The U.S. policy towards the issue of defense expenditures has undergone numerous changes throughout the years. There have been periods when the administration chose to follow a more conservative route, expressing concerns that an approach of maintaining high defense budgets on a constant basis could potentially bear devastating consequences for the economy of the country. On the other hand, especially following 9/11 and the ongoing War on Terror, a continuously high level of defense spending can be observed.

2. U.S. Defense Procurement Expenditures

The Cold War constituted a turning point for defense related spending of the U.S. in the sense that it was the first prolonged period of peace when the U.S. maintained such a high level of readiness, work force and equipment for the Armed Forces. The threat of the Communist block was real, regardless of the fact that it did not escalate further than regional conflicts, and the response to this threat from the U.S. had an impact on the level of necessary resources. The peak of the approach of high-level defense spending was reached during the Reagan administration (1981-1989), having already started to increase during the last two years of the Carter administration. The majority of the taxpayers, who perceived the Communist threat as real and imminent, generally supported this. In 1980, military expenditures reached 5% of the Gross Domestic Product (GDP) and rose to 6.2% in 1986, a percentage below the levels reached during the Vietnam War; but this had been a direct conflict with massive mobilization and full-scale military operations.[1] The higher

[1] Robert D. Hormats, The Price of Liberty: Paying for America's Wars (New York: Times Books, 2007), 229.

defense budget was a vital part of a policy to force the Soviet Union to negotiate under financial and military burdens that would eventually surpass the actual Soviet economic capabilities through an extended period.[2]

It is important to note that the U.S. has traditionally been the global leader in defense spending. More specifically, in 2006 the U.S. spent approximately 46% of the global defense-spending total, while the difference with the second largest defense budget is almost 900%.[3] Therefore, it is obvious that even small percentage changes in the U.S. defense budget will reflect in large actual amounts that can have important consequences from a financial and economic point of view for the industry.

The U.S. defense expenditures for procurement, like the whole defense budget, have followed different trends over time, responding to the changes in international conditions and security needs. World Wars and regional conflicts are among the periods with direct and usually high changes on the defense budget. After every period of high increases in demand for procurement in the defense sector, a transitional phase followed to adapt to the peace period and the defense industry had to follow this course. A "cyclical" pattern in this sense is observable on defense procurement expenditures. However, the levels of the differences in procurement spending are different from period to period. The changes in the required industrial capacity can be of a very high scale. At the same time, with the advances in technology and the subsequent sophistication and multitude of the weapon systems that are procured, the complexity of the industry and its variety of activities are increasing.

Based on the official historical data of the U.S. Office of Management and Budget (OMB) we can derive a reliable and descriptive picture of the course of the defense expenditures of the U.S. over time. More specifically, we can observe the procurement expenditures, which can be considered as a clear indication for the level of amounts that are transferred to the defense contractors. The levels are comparable because the amounts

[2] Robert D. Hormats, The Price of Liberty: Paying for America's Wars (New York: Times Books, 2007), 229.

[3] SIPRI (Stockholm International Peace Research Institute), "Recent trends in military expenditure," http://www.sipri.org/contents/milap/milex/mex_trends.html, (accessed April 15, 2008).

are converted in constant dollars of FY 2000, based on the deflation factors provided by the OMB. The procurement expenditures part of the defense budget is of primary interest to the defense contractors, since it constitutes an indication of the anticipated level of major acquisition programs, providing a basis for estimate for the industrial capacity that is actually necessary to support the demand. Furthermore, procurement spending levels can attract new investments in equipment, infrastructure, research and development (R&D), or even bring new entrants into this market, enhancing competition.

Figure 1 depicts the U.S. Defense procurement spending from 1941 to 2009. The peak of the World War II period was beyond comparison with any other period, involving an enormous national effort and commitment, with a full-scale global war, fought in different battlefields and areas concurrently. Therefore, the period after 1949 is more appropriate to estimate and compare the levels for procurement defense expenditures and draw conclusions relevant to the defense industry for "normal" periods. However, one cannot ignore the historical value of the particular period in terms of the conclusions that can be drawn related to the smooth transition and adaptation to a peaceful period. The period that followed World War II, especially from 1947 until 1951, had the lowest levels of procurement spending for the period after 1941 until today.

It is clear that the highest levels of procurement, after the World War II peak, took place during President's Reagan defense buildup period in the 1980s as depicted in Figure 2. By the end of this period, an approximately $92 billion (CY 2000), was budgeted for defense procurement, reaching $143 billion including the R&D spending for defense purposes. After 1989, a gradual reduction of the defense procurement expenditures followed. It is interesting, though, that despite the decreasing trend the actual procurement budget levels remained considerably higher than they had been in the period of the 1970s and the 1950s, after the war in Korea. In addition, the peak in the years of the Vietnam War produced levels far lower than the 1980s. The reduction of the defense procurement expenditures can be assessed with different criteria.

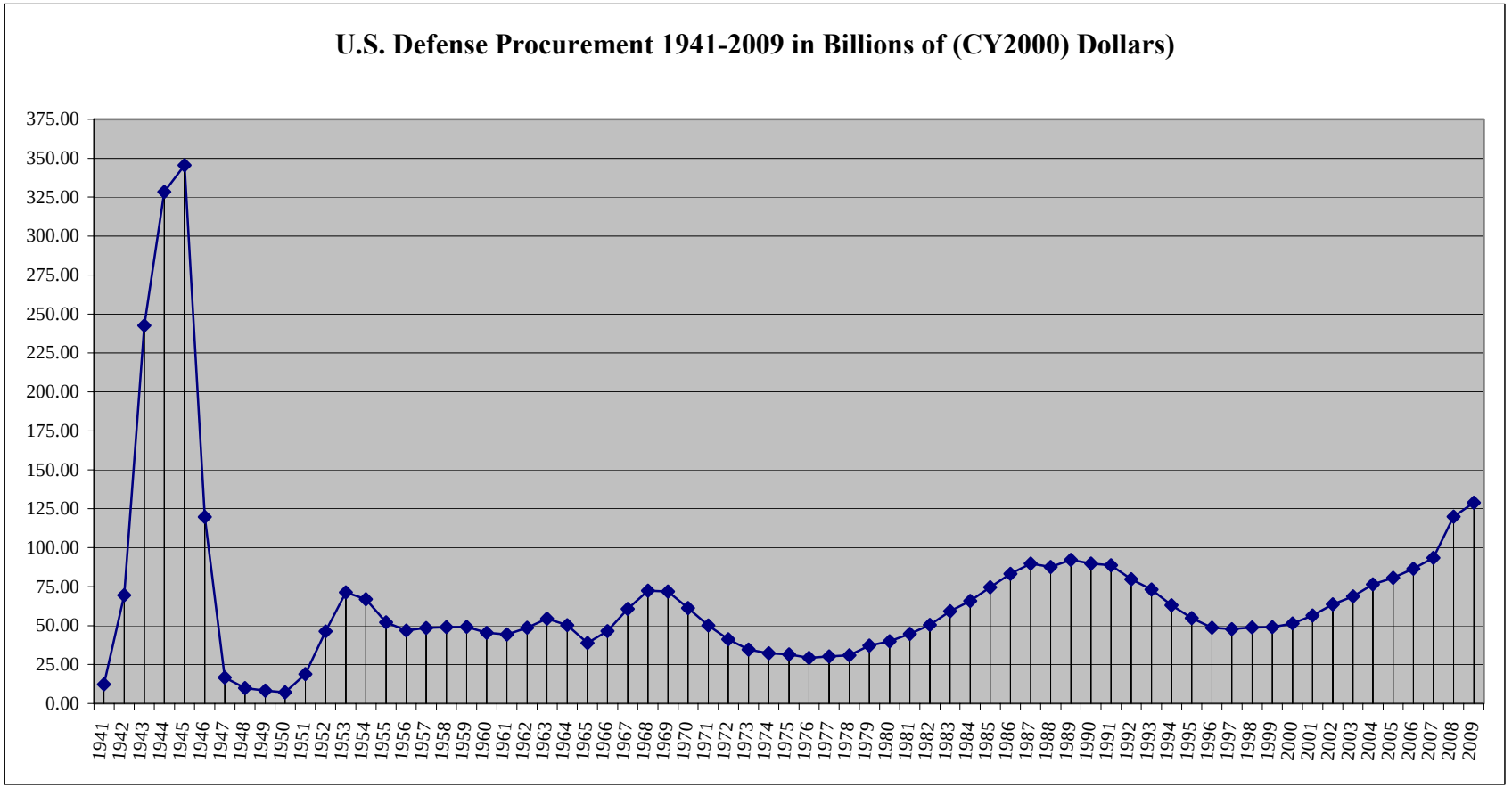

Figure 1. **U.S. Defense Procurement 1941-2009 (After[4])**

[4] Executive Office of the President of the United States, Office of Management and Budget, "Budget of the U.S. Government FY 2009." All amounts in FY 2000 constant dollars. Amounts for FY 08 and FY 09 are estimates.

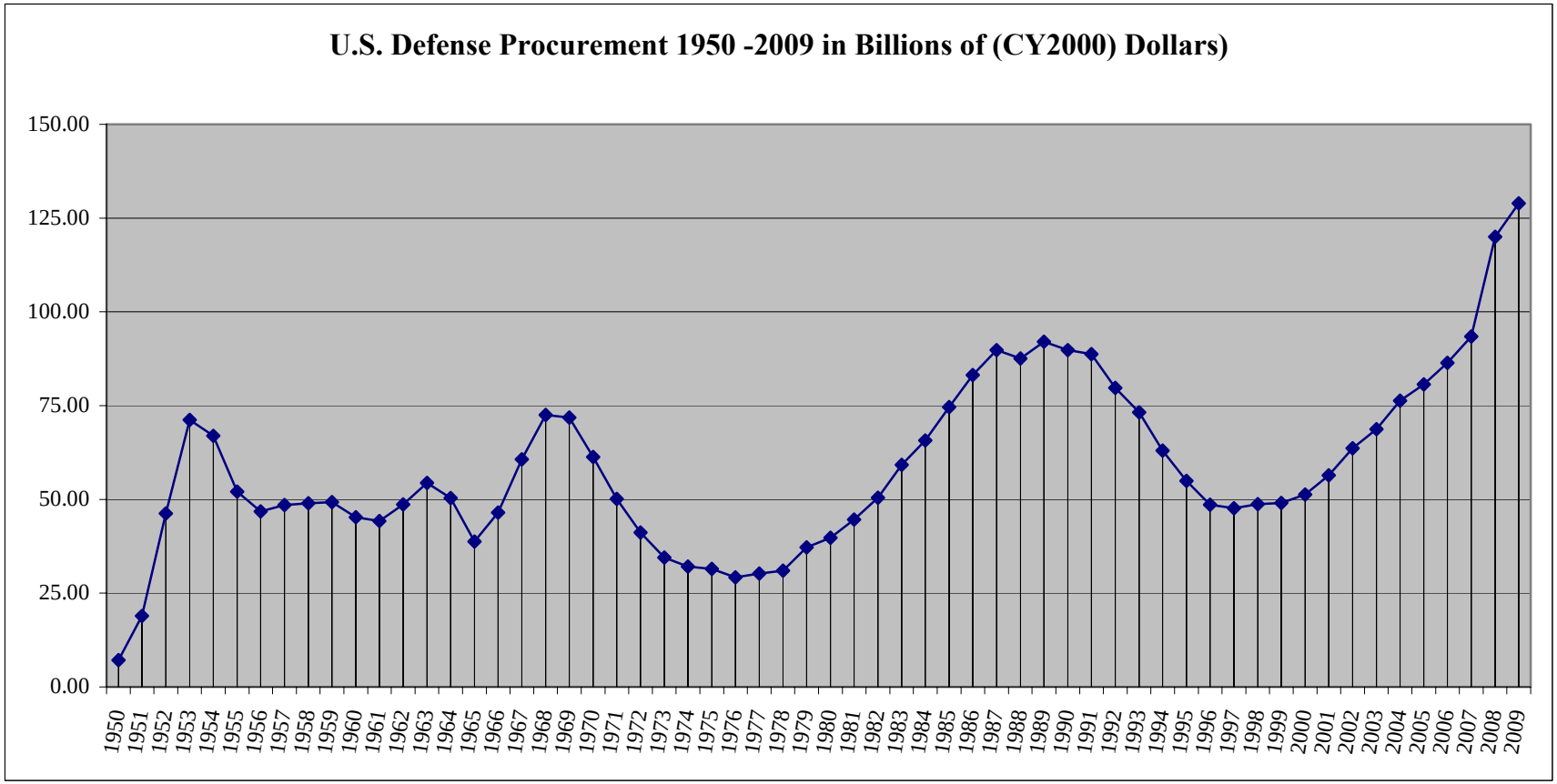

Figure 2. **U.S. Defense Procurement 1950-2009 (After[5])**

[5] Executive Office of the President of the United States, Office of Management and Budget, "Budget of the U.S. Government FY2009." All amounts in FY 2000 constant dollars. Amounts for FY 08 and FY 09 are estimates.

Clearly, if we consider the levels of the 1990s with the period of President Reagan's buildup, the reduction is dramatic (almost 50% from 1989 to 1997, or 40% if we include the R&D expenditures). On the other hand, if we broaden our base of comparison, we can derive that the defense procurement expenditures actually returned to their "normal" levels before this specific period of buildup policy. The levels of the buildup period were only reached again after 2004, with the ongoing Global War on Terror, after 9/11. The R&D expenditures for defense remained high in the 1990s, and their reduction was relatively small as shown in Figure 3.

Conclusively, from a quantitative standpoint, the buildup of the 1980s cannot be considered as the most characteristic period of reference for U.S. defense expenditures. Even during war times, when actual military operations took place, there was not a demand sufficient to support such levels of defense expenditures. The results of this policy are mostly a historical matter, which has been addressed and studied extensively. Today we know that it has been an effective means of pressure against the Communist Block. However, based on the long history of the U.S. defense expenditures, we need to consider the bigger picture in order to draw conclusions.

The basic statistical indicators of the official OMB data (including R&D expenditures) give a median of approximately $90 billion (constant year 2000, hereafter CY 2000) for the period after 1949, including the high estimates for 2008 and 2009 as depicted in Figure 4. For the period of the 1990s, the lowest level of spending was almost equal to the median, and slightly lower than the mean (approximately $92 billion, CY 2000).

Overall, if we look back upon the history of procurement defense expenditures, we can identify different periods of large-scale reductions, following a period of high spending due to a war. These periods are after World War II, after the Korean War and after the Vietnam War.

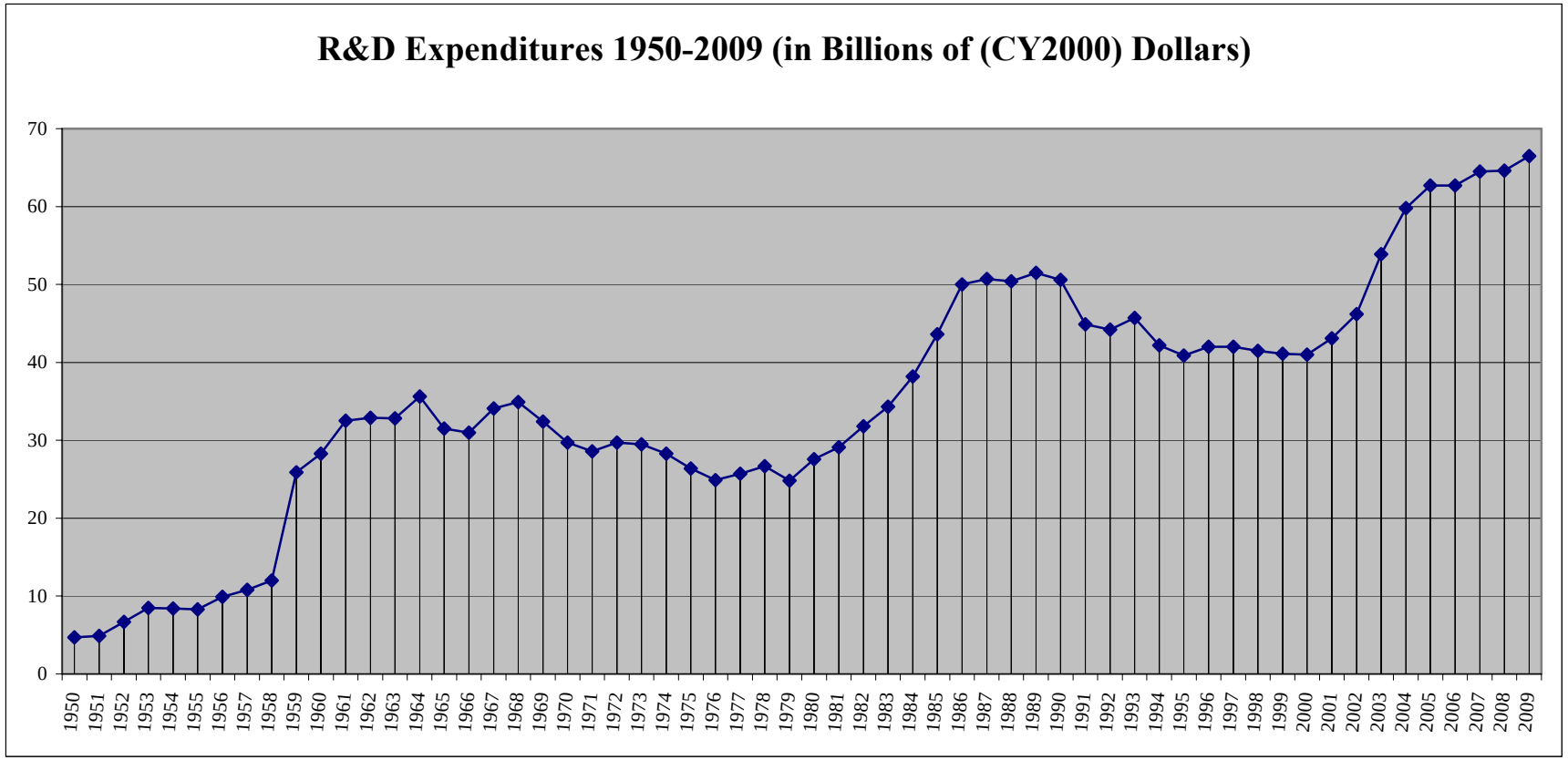

Figure 3. **R&D Expenditures 1950-2009 (After[6])**

6 Executive Office of the President of the U.S., Office of Management and Budget, "Budget of the U.S. Government FY 2009." All amounts in FY 2000 constant dollars. Amounts for FY 08 and FY 09 are estimates.

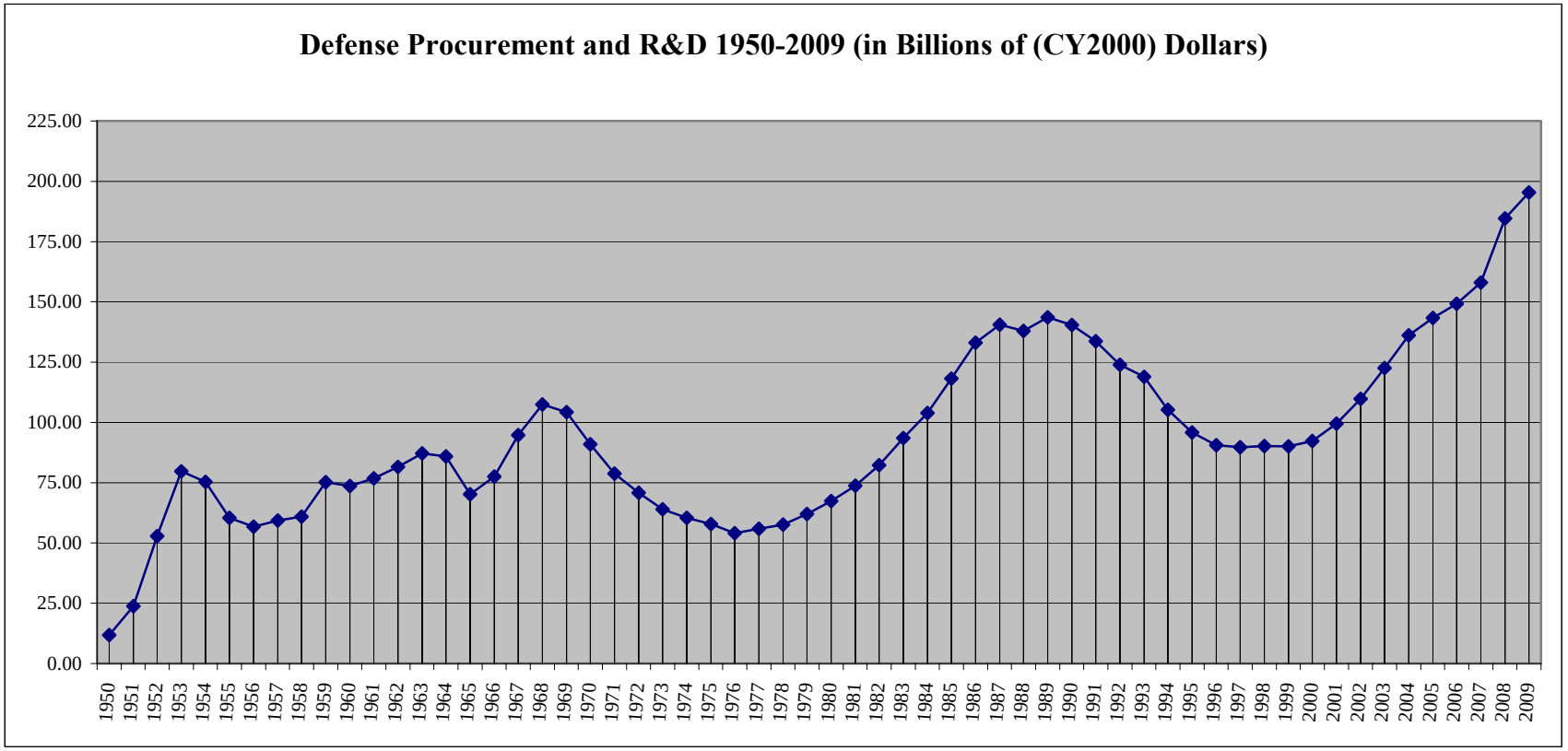

Figure 4. **Defense Procurement and R&D 1950-2009 (After[7])**

[7] Executive Office of the President of the U.S., Office of Management and Budget, "Budget of the U.S. Government FY 2009." All amounts in FY 2000 constant dollars. Amounts for FY 08 and FY 09 are estimates.

As mentioned previously, World War II required a mobilization of a national scale, economically and industrially, along with other areas of activity. In Table 1 is presented the evolution of procurement spending in the period during World War II and in the years that followed. The Roosevelt administration performed detailed planning in order to deal with the demobilization that would follow the end of the War, including the defense industrial base. Legislative measures were taken for returning factories into civilian production, and the transformation of the industry took place successfully.[8] This proactive approach managed to avoid undesired turbulences, directing the economy to the peace needs and exploiting the increased post-war demand for commercial products.[9]

Year	Procurement	Mean	Peak	Max Change	Reduction	Mean Reduction
1941	12.17	199.62	345.54			
1942	69.41					
1943	242.63					
1944	328.36					
1945	345.54					
1946	119.75	32.33	119.75	338.42	-65.34%	-44.51%
1947	16.70				-86.05%	
1948	9.96				-40.40%	
1949	8.14				-18.24%	
1950	7.12				-12.53%	

Table 1. **World War II (After[10])**

The Korean War presented a somewhat different picture as depicted in Table 2. The scale of the mobilization was much lower than the previous one, while the necessary reduction was even smaller, since a large military force was maintained to be able to effectively respond to the Soviet threat.[11]

[8] Jacques S. Gansler, Defense Conversion: Transforming the Arsenal of Democracy (The twentieth century fund, MIT Press, 1995), 7.

[9] Ibid.

[10] Amounts in billions of CY 2000.

[11] Gansler, Defense Conversion, 8.

Year	Procurement	Mean	Peak	Max Change	Reduction	Mean Reduction
1950	7.12					
1951	18.88					
1952	46.22	48.02	71.23			
1953	71.23					
1954	66.96					
1955	52.08				-22.22%	
1956	46.83				-10.08%	
1957	48.52	49.12	52.08	24.40	3.61%	-5.44%
1958	48.93				0.86%	
1959	49.24				0.64%	

Table 2. **Korean War (After[12])**

After the Vietnam War, the situation resembled the one that followed the Cold War, in the sense that the production of military systems had greatly differentiated from the commercial industry as shown in Table 3.

Year	Procurement	Mean	Peak	Max Change	Reduction	Mean Reduction
1965	38.74					
1966	46.52					
1967	60.66					
1968	72.49					
1969	71.84					
1970	61.28	49.17	72.49			
1971	50.17					
1972	41.12					
1973	34.47					
1974	32.11					
1975	31.46					
1976	29.22				-7.13%	
1977	30.23				3.47%	
1978	30.98	33.47	39.78	43.27	2.46%	5.17%
1979	37.16				19.97%	
1980	39.78				7.06%	

Table 3. **Vietnam War(After[13])**

12 Amounts in billions of CY 2000.

13 Ibid.

This posed severe difficulties to the transformation of the defense industrial base, resulting in the loss of many jobs and governmental initiatives to provide some relief to former defense industry employees.[14]

Initially, after the collapse of the Communist Block and the Soviet Union, a wide impression prevailed that the defense expenditures were going to follow a declining trend towards unprecedented low levels, due to the fact that no other kind of threat was perceived as potentially requiring resources as many as needed to effectively confront the former Warsaw Pact.[15] Another approach to depict the intensity of the downward trend of the period after the Cold War is to compare it with the other periods that followed War mobilizations, in terms of the procurement expenditures as illustrated in Table 4.[16]

Tables 1 through 4 can assist in realizing the actual intensity of the reduction of defense procurement expenditures. It is important to note that the amounts do not include R&D expenditures. It is clear that the maximum reduction that took place after the Cold War, meaning the difference between the maximum amount spent within the period of increase during the War and the minimum amount spent during the period of reduction after the War, was $44.39 billion, an amount comparable to the $43.27 billion of the period after the Vietnam War. Furthermore, the mean percentage of the reduction of the post-Cold War era of 5.67% is comparable to the 5.44% after the Korean War.

We can derive from these numbers that the percentages of reduction and the rate of the reduction of the post-Cold War period were not unprecedented from a historical point of view. What is interesting, though, is that the defense industry actually lost a high amount of revenue: during a ten-year period after 1992, the defense industry made approximately $208 billion less than the period of 1982-1991.

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[14] Gansler, Defense Conversion, 8-9.

[15] Ibid, 9.

[16] Eugene Gholz and Harvey M. Sapolsky, “Restructuring the U.S. Defense Industry,” International Security 24, no. 3 (Winter 1999-2000): 5-51.

Another simple quantitative measure in order to assist in understanding the intensity of the changes of procurement spending over time is the ratio of the current to the previous year's value of spending. This measure depicts the degree of smoothness of the changes in procurement spending. As Figure 5 above shows, beginning from the period of World War II, the transitions become smoother over time. The turbulence in defense procurement spending appears to be less intense over time, with the exception of the current period (but we have to take into account that the last values are projected and not actual). More specifically, for the period of 1980-1991 the ratio values are in the range of 0.97 – 1.17, while for the period of 1991 – 2001 the range is 0.86 – 1.1. Although there is a significant difference, we can clearly identify much higher values in previous periods. Therefore, by this additional measure, we can reasonably conclude that the period following the end of the Cold War does not constitute something unique or unprecedented in the historical course of the defense budget's procurement spending.

Year	Procurement	Mean	Peak	Max Change	Reduction	Mean Reduction
1981	44.63					
1982	50.45					
1983	59.21					
1984	65.73					
1985	74.60					
1986	83.12	75.06	92.07			
1987	89.81					
1988	87.56					
1989	92.07					
1990	89.80					
1991	88.72					
1992	79.70				-10.17%	
1993	73.22				-8.13%	
1994	63.02				-13.93%	
1995	54.91				-12.87%	
1996	48.59	57.36	79.7	44.39	-11.51%	-5.67%
1997	47.68				-1.87%	
1998	48.75				2.24%	
1999	49.05				0.62%	
2000	51.29				4.57%	

Table 4. **Cold War(After[17])**

[17] Amounts in billions of CY 2000.

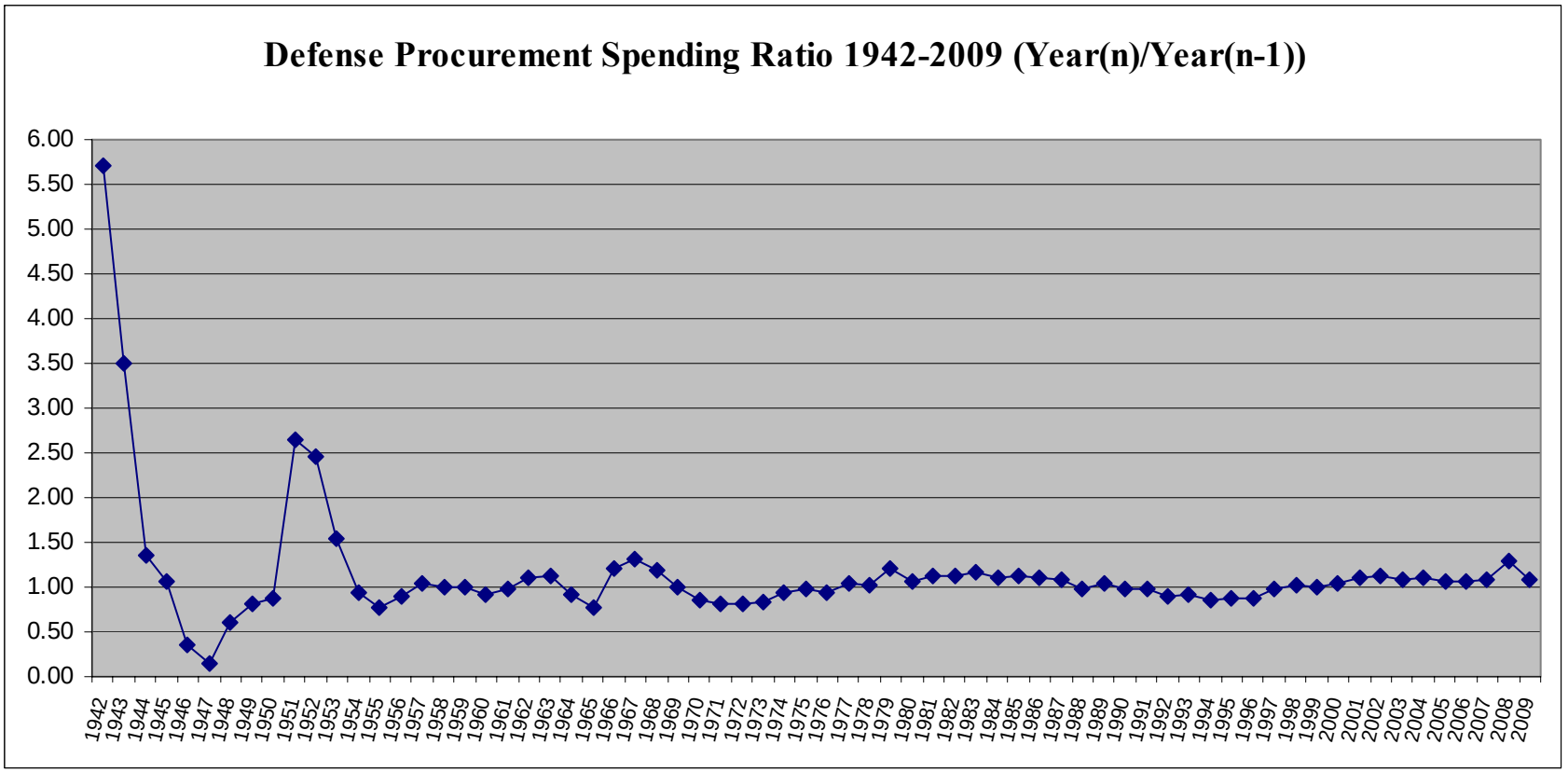

Figure 5. **Defense Procurement Spending Ratio 1942-2009 [Year(n)/Year(n-1)] (After[18])**

[18] Executive Office of the President of the U.S., Office of Management and Budget, "Budget of the U.S. Government FY 2009." All amounts in FY 2000 constant dollars. Amounts for FY 08 and FY 09 are estimates.

Another important factor that needs to be considered is the actual revenue of the U.S. Defense Industry over time in order to identify indications, in terms of changes in revenue, which could have triggered, or at least significantly contributed to, the massive consolidation wave. The revenue of the U.S. Defense Industry comes from multiple sources: weapons systems exports need to be examined, as an important portion of the total revenue. If we consider the sum (approximate) of U.S. Defense Procurement and Weapons Systems exports for the period of 1989-1999, we can identify a decreasing trend, especially after 1991. Despite the increasing contribution of weapons systems exports, the reduction in defense procurement of the U.S. caused a very significant overall decrease to the (approximate) revenue for the U.S. Defense Industry.

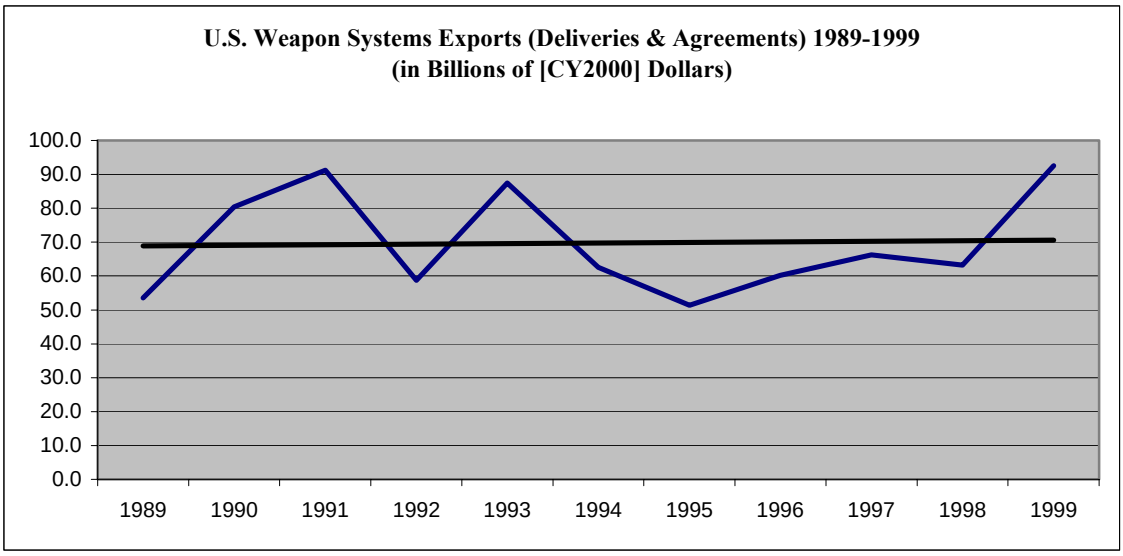

Figure 6. **U.S. Weapon Systems Exports 1989-1999 (After[19])**

For the period of 1989-1999, the weapons systems exports had significant changes, following an increasing path from 1989 until 1991; but after that, a reduction is observed. Figure 6 illustrates this trend. Overall, the trend for the specific period is relatively stable, and the exports did not fall below $50 billion, in constant 2000 dollars. What is also an interesting measure for the course of the defense industry is the role and the importance of the exports of the weapons systems, in comparison with the U.S.

[19] U.S. Department of State, "World Military Expenditures and Arms Transfers" (WMEAT) release of February 6, 2003.

Defense Procurement for the same period. The importance of the exports can be expressed by the ratio of the value of exports (including deliveries and agreements) to the value of the U.S. defense procurement. We can identify that after 1993, the value of exports exceeded the value of DoD procurement (Figure 7), a fact that can clearly be attributed to the reduction of the procurement budget and the increase of exports, even if this was unstable.

Conclusively, there are not any significant indications (Figure 8) that the procurement spending after the end of the Cold War followed a unique pattern, which would require a large-scale unprecedented reaction of the defense industry. At any rate, this does not appear to be the overarching reason behind the turbulences of this industrial sector. Under this perspective other causes, apart from (or in combination with) procurement spending, must be analyzed to identify their relationship with the consolidation of the U.S. Defense Industry.

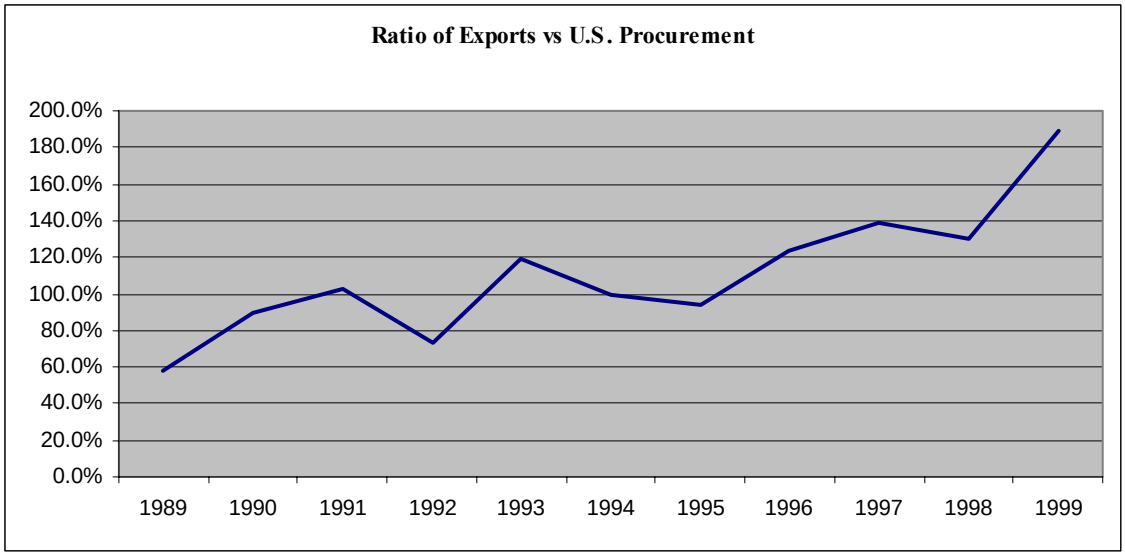

Figure 7. **Ratio of U.S. Exports/U.S. Procurement (After[20])**

20 Executive Office of the President of the U.S., Office of Management and Budget, "Budget of the U.S. Government FY 2009." All amounts in FY 2000 constant dollars. The conversion was done using the deflation factors of the OMB tables.

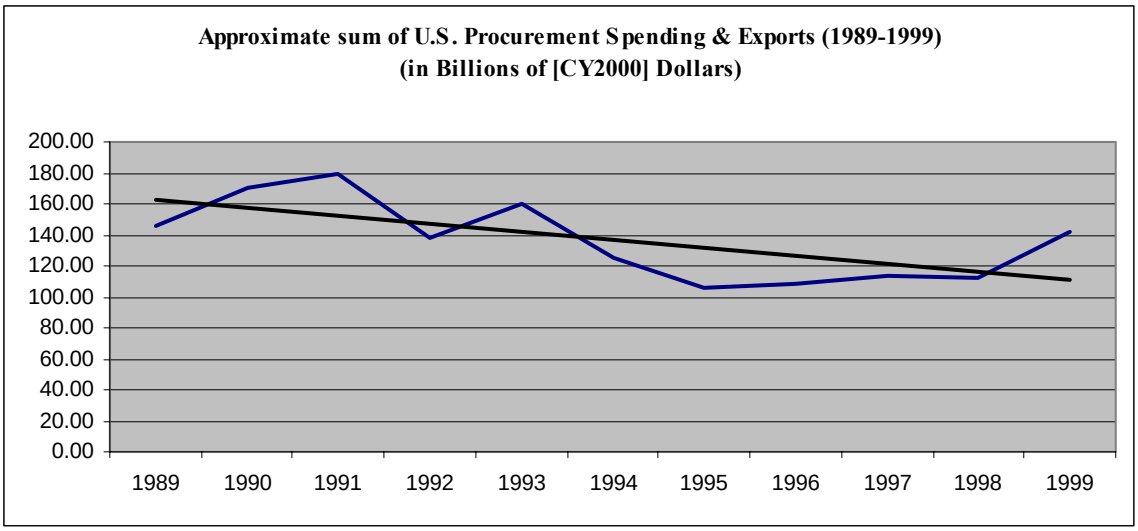

Figure 8. **Sum of U.S. Procurement Spending and Exports (1989-1999)(After[21])**

B. MERGERS AND MERGER WAVES

1. Introduction

Every individual firm might be regarded as an entity, which is continually under the effect of both internal and external influences. The practice of referring to biological analogies to describe the general life cycle of a typical company is no longer considered appropriate for the modern world of business. Although it is well thought-out and old-fashioned, there is still an existing resemblance and one can effectively illustrate the life of a firm applying biological analogies. According to this belief,

> a company is born, struggles to survive, grows through adolescence and then reaches maturity. Eventually, it will die, either through natural causes and a slow deterioration into old age or it may be absorbed into another, more predatory, firm. Merger and acquisition (M&A) activity represents the second of these options and provides a way for company assets to be transferred from one set of owners to another.[22]

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[21] Executive Office of the President of the U.S., Office of Management and Budget, "Budget of the U.S. Government FY 2009." All amounts in FY 2000 constant dollars. The conversion was done using the deflation factors of the OMB tables.

[22] Sian Owen, "The history and mystery of merger waves: A UK and U.S. perspective," (working paper number 2006-02, School of Banking and Finance, The University of New South Wales, 2006), http://wwwdocs.fce.unsw.edu.au/banking/workpap/wp_02_2006.pdf (accessed February 2008).

2. Terms and Definitions

Throughout this thesis, there is a constant repetition of several M&A key terms. Therefore, it is considered beneficial for the reader to provide a list of definitions of those terms in an early stage. This way one can more easily understand the rest of the concepts and analysis presented in the following chapters.

In a strict definition of the term, a *merger*[23] (or *statutory merger*) describes the combination of two corporations in which only the one firm survives and the merged company disappears as a business entity. The acquiring company assumes all assets and liabilities of the acquired firm. In cases of *subsidiary* or *reverse subsidiary mergers*, both the acquiring and the acquired company survive after the merger.

The term *horizontal*[24] depicts a type of merger in which the target firm and the acquirer belong in the same line of business; in simple words, two competitors combine. One typical example of a horizontal merger is the $78.9 billion mega merger of Exxon and Mobil in 1998.

Vertical is the type of merger that occurs between companies that are involved at different stages of production; suppliers merge with buyers or distributors. For example, the acquisition of Medco Containment Services from Merck, the world's largest drug company, enabled the latter to go from being the largest pharmaceutical company to also being the largest integrated producer and distributor of pharmaceuticals.

Finally, *conglomerate merger* is the type of merger that involves companies in unrelated lines of business; the merged companies are not competitors and do not have a buyer-seller relationship. This type of merger was the type that dominated the market in the 1960s and the 1970s but is less popular now. On the contrary, there is enough evidence[25] that the majority of M&A activity in the 1980s and the 1990s came from the

[23] Patrick A. Gaughan, Mergers, Acquisitions and Corporate Restructuring, 4th ed. (New Jersey: John Wiley & Sons, Inc., 2007), 12.

[24] Richard A. Brealey, Stewart C. Myers, and Franklin Allen, Principles of Corporate Finance, 8th ed. (New York: McGraw-Hill/Irwin, 2005), 871.

[25] Ibid.

breaking up of the conglomerates created ten to twenty years earlier. A successful example of a conglomerate would be Phillip Morris, now called Altria. This company, by acquiring General Foods in 1985, Kraft in 1988, and Nabisco in 2000, achieved to diversify and shift from the U.S. tobacco industry that has experienced decline at an average rate of 2% to the food industry.

The term *consolidation*[26] is used to describe any business combination "whereby two or more companies join together to form an entirely new company." [27] In such an activity, the consolidating firms cease their operating activities and the new entity solely continues to operate. The stakeholders of the combining companies become, after consolidation, stakeholders of the new firm. For example, in 1986 the computer manufacturers Burroughs and Sperry combined to form UNISYS.

Although a majority of the time the two terms merger and consolidation are used interchangeably, there is a difference between the two activities. The easiest way to remember the difference is to think of merger with the notation A+B=A which means company B merged into company A, or it was acquired by company A. Similarly, for consolidation the most appropriate notation would be A+B=C, which is translated as the two companies A and B joined to form the entirely new company C.

3. Motives for Mergers

According to existing literature, several different motives attempt to interpret merger and acquisition activity of individual firms or market's industries. The obtainable research has pointed to a number of speculative reasons, but to our understanding, there is no single answer about it. There is still ongoing qualitative and quantitative research that analyzes the potential factors through various perspectives. Following Gaughan's simplified reasoning,[28] we conclude to the following generic internal motives described below.

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[26] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 12.

[27] Ibid, 12.

[28] Ibid, 117.

Growth seems to be the most important among several other reasons. Companies that are trying to expand and evolve in their industry find it easier to accomplish their goals by M&A activity than by internal growth. This practice also tends to prove more convenient, as the total amount of money (premium included), that bidding firms are expected to pay is not necessarily more expensive than the relevant total cost to achieve internal growth. The number of existing exceptions only enforces the hypothesis that "growth through mergers and acquisitions is significantly faster than through internal means. [29]"

The pursuit of synergistic benefits is another common motivation for M&A activity: the two (or more) merging entities are creating a positive synergy by combining the best attributes from each company. Alternatively, the two (or more) combining firms will create value greater than the values of the two independent companies:

$$\text{Value (A+B)} > \text{Value (A)} + \text{Value (B)}.$$

Cost economies and revenue enhancement are two different types of synergistic effects that managers are expecting to achieve. However, synergistic gains are not always obvious to realize. "Possibilities of cost savings may be attributed to synergistic effects such as improved efficiency through organizational restructuring, improvements in technology, or capitalization of particular expertise." [30] Cost economies have a lot to do with the reduction of per-unit cost and are typically easier to understand but not necessarily to achieve. On the other hand, revenue enhancement is even more difficult to predict.

Diversification is another equally important but dubious driver. During the 1960s, businesses' trend to diversify was highly regarded as one of the key drivers of the intense M&A activity. It is assumed that companies, in order to achieve growth, often try to expand outside their current industry category. Such an outward expansion, most of the time, is facilitated "by some creative financial techniques that temporarily cause the

[29] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 12.

[30], Ibid, 126.

acquiring firm's stock price to rise while adding little real value through the exchange."[31] The results of decisions to diversify vary among companies that adopted this tactic. Many have regretted their attempts, where others (e.g., General Electric) claim to have gained significantly.

There is no evidence for one to get restricted to the aforementioned reasons to understand why firms tend to merge. However, given the external factors of the economy pointing in the same direction, we get a brief but adequate explanation why in the history of the United States there were several periods identified that were characterized by increased levels of M&A activity across a wide spectrum of different markets' industries.

4. Merger Waves in the History of U.S. Industry

There is much research available showing that one of the most remarkable characteristics of mergers is that they come in bunches. Whenever there are propitious circumstances such as evolving economy, capital market buoyancy, technological innovations, etc., to ignite the phenomenon of mergers in a certain industry sector, the number of transactions starts to increase rapidly. Soon after, the phenomenon expands outside the market where initially started, affecting a larger number of companies and industries. According to different economists, historians, and M&A specialists, five merger waves have been identified in the history of the United States as shown in figure 9. The first two occurred before the Great Depression of 1929. The starting dates and the duration of each of these waves could not be precisely specified. Bruner[32] recognizes only four waves, considering the last two of Gaughan's[33] depiction (fourth wave 1984-1989, fifth wave 1992-2000) as one wave divided in two phases (wave 4a 1981-1987 and wave 4b 1992-2000). In addition to that, Lipton recognizes a sixth wave that started after the bursting of the Millennium Bubble in 2002 and is still ongoing (end of 2006).

[31] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 126.

[32] Robert F. Bruner, Applied Mergers and Acquisitions (New Jersey: John Wiley & Sons, Inc., 2004), 72-75.

[33] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 28-9.

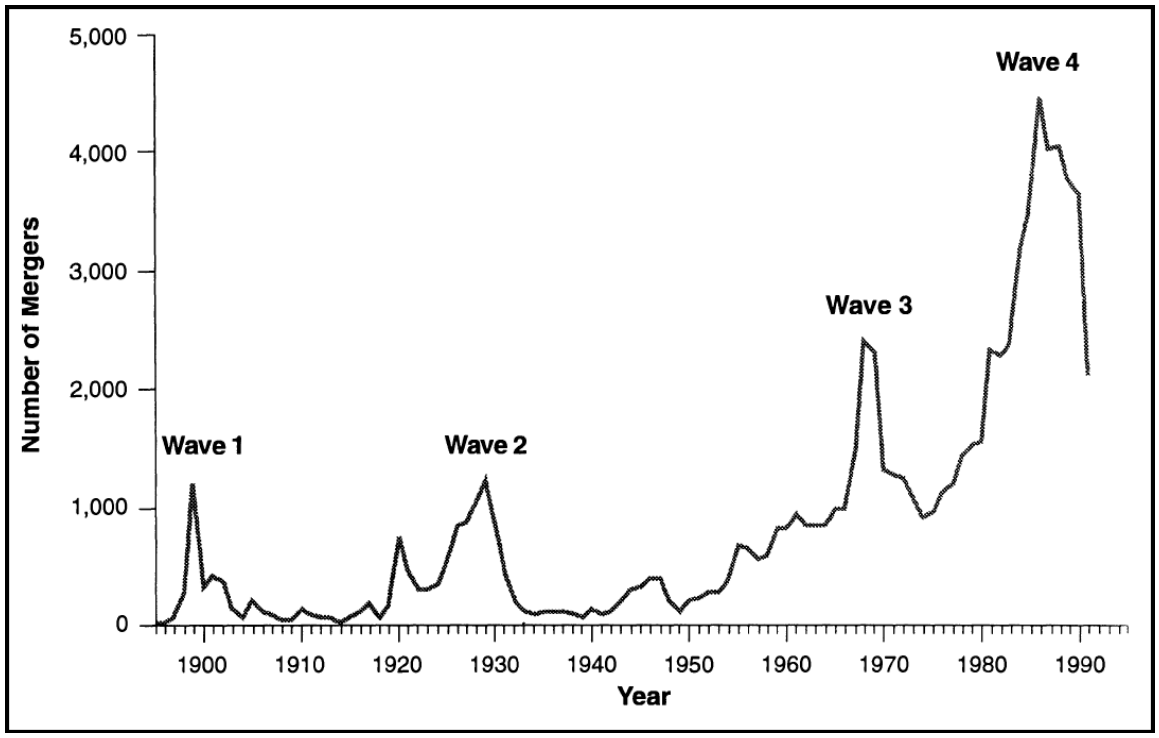

Figure 9. **Number of Mergers in the United States, 1895 to 1990 (From[34])**

Figures 9 and 10 are obviously supporting this hypothesis of merger waves. Figure 9 shows the number of mergers in the United States from 1895 until 1990. In Figure 10, the blue curve represents the number of mergers (beginning in the 1880s), and the yellow curve shows the Standard and Poor's (S&P) price/earnings ratio (P/E) for the same period. "A close association between aggregate merger activity and the S&P P/E is apparent, and it can be regarded as the second major regularity in aggregate merger data. Any hypothesis that claims to explain merger waves must account for this relationship."[35]

[34] Linda Brewster Stearns and Kenneth D. Allan, "Economic Behavior in Institutional Environments: The Corporate Merger Wave of the 1980s," American Sociological Review 61, no. 4 (August 1996): 699-718, http://www.jstor.org/stable/pdfplus/2096400.pdf (accessed April 9, 2008).

[35] Klaus Gugler, Dennis C. Mueller, and B. Burcin Yurtoglu, "The Determinants of Merger Waves," (Discussion Paper, Series 05-15, Utrecht School of Economics, Tjalling C. Koopmans Research Institute), http://www.uu.nl/uupublish/content/05-15.pdf (accessed February 20, 2008).

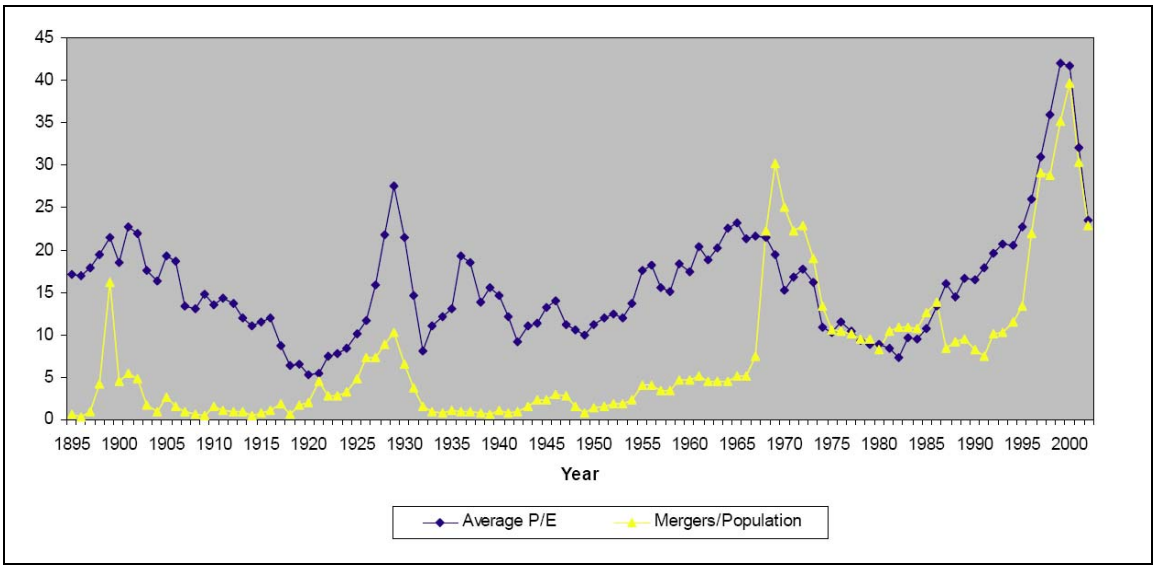

Figure 10. **Mergers & Average P/E Ratio (From [36])**

In the following paragraphs, a brief narrative of the five merger waves is provided, following Gaughan's perspective, clarifying some of their major features and characteristics.

a. First Merger Wave (1897 – 1904)[37]

The first U.S. merger wave began at the end of the nineteenth century and succeeded the depression of 1883, which ended in 1896. Table 5 shows the types of mergers during this period. This wave affected a wide variety of firms, which eventually became highly concentrated, as the majority of mergers that occurred during this wave were horizontal. Thus it was characterized by several scholars in the past (Stigler 1950) as a period of "merger for monopoly." During this period the principal steel, telephone, oil, mining, railroad and other giants of the basic manufacturing and transportation industries in the U.S. market were formed, such as DuPont, Standard Oil, Eastman Kodak and U.S. Steel. A representative example of this period is the merger of U.S. Steel with

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[36] Klaus Gugler, Dennis C. Mueller, and B. Burcin Yurtoglu, "The Determinants of Merger Waves," (Discussion Paper, Series 05-15, Utrecht School of Economics, Tjalling C. Koopmans Research Institute), http://www.uu.nl/uupublish/content/05-15.pdf (accessed February 20, 2008).

[37] Bruner, Applied Mergers and Acquisitions. According to Bruner this wave occurred from 1895–1904.

Carnegie Steel and more than seven hundred other smaller steel firms. The resulting mega-steel company controlled 70~80% of the steel production in the United States.

Type of Merger	Percentage (%)
Horizontal	78.3
Vertical	12.0
Horizontal & Vertical	9.7
Total	100.0

Table 5. **Mergers of the First Wave by Type(After[38])**

The majority of the accessible literature describing the period and the prospective reasons that ignited the wave recognize, as factors that contributed most at the initiation, the capital market buoyancy on the one hand and the consequent introduction of the Antitrust Sherman Act in 1890 on the other. The latter was the first effort of the U.S. federal government to oppose the combination of entities that could possibly harm competition, such as cartels and monopolies, and it intended to prevent the artificial raising of prices by restriction of trade or supply among different states and countries. The Department of Justice was largely responsible for the limited impact of the newly introduced law. However, the Sherman Act was vague and unable to oppose mergers and acquisitions using stock for stock exchange. Consequently, it could not prevent the dominance of an industry by a specific company if it was achieved solely by merit. As a result, taking into consideration their prior attitude towards trusts, several companies took advantage of the misconception of the law and started to form near monopolies, without any regulatory interference, igniting a massive reorganization of the industrial landscape of the United States. The first U.S. merger wave was a fact causing eighteen hundred firms of different market sectors to disappear.[39] Ninety-three consolidated firms were created instead with an important, if not dominant, share of the market in their respective industries.

[38] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 31.

[39] Bruner, Applied Mergers and Acquisitions, 87.

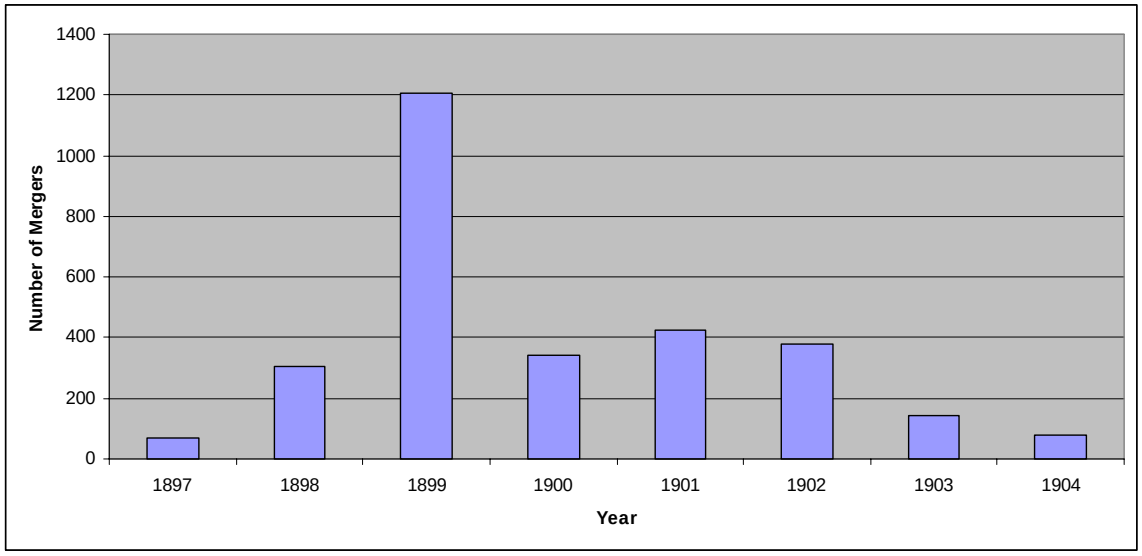

Figure 11. **Mergers of the First Wave 1895-1904 (After [40])**

Year	Number of Mergers
1897	69
1898	303
1899	1208
1900	340
1901	423
1902	379
1903	142
1904	79

Table 6. **Number of Mergers of the First Wave(After[41])**

President Theodore Roosevelt's (1901-1907) policy towards trusts and monopolies, which made him known as a "trust buster," ultimately contributed to the reduction of the number of mergers as depicted in Figure 11 and Table 6. His decision in 1902 to enforce the Sherman Antitrust Act in the famous Northern Securities Case proved to be an important turning point of the first wave. A U.S. Supreme Court decision

40 Gaughan, Mergers, Acquisitions and Corporate Restructuring, 31.

41 Ibid.

in 1904 to extend the application of Sherman Antitrust law to horizontal mergers, and then the First World War, are pointed to as the causes of the end of the first wave.

b. Second Merger Wave (1916 – 1929)

The second merger wave began almost twenty years after the peak of the first wave. Again, regulatory changes towards trusts, as long as the "federal government's encouragement of the formation of business cooperatives to enhance the nation's productivity as part of the war effort," [42] were the most important reasons that led to the initiation of this wave. During President William Howard Taft's administration, the Justice Department succeeded in breaking up some of the major trusts, regardless of the fact that his predecessor (President Teddy Roosevelt) held the reputation of being the trust buster. The decision of the U.S. Supreme Court in 1911 to accuse and prosecute Standard Oil (John D. Rockefeller) for discriminatory practices and abuse of power in the oil industry was a clear sign of the upcoming changes of the legal framework towards monopolies. The introduction of Clayton Act in 1914, which was designed specifically to level out the weaknesses of the previous legislation (Sherman Act), strengthened the U.S. government's attitude towards antitrust enforcement.

The new legislation was actively encouraging companies to form oligopolies instead of monopolies. Thus, Stigler (1950) characterized this period as a "merger for oligopolies." The majority of transactions that occurred during this second wave were vertical mergers. In addition, many companies in unrelated business merged, hence introducing the first large-scale formation of conglomerates. Although mergers affected industries across the board, certain industries such as primary metals, petroleum products, food products, chemicals and transportation equipment experienced a disproportionately large number of transactions. Large companies that still operate today were integrated at that time, such as Ford, General Motors, John Deere and the Union Carbide Corporation. In order to understand the intensity of transactions of this second wave, between 1926 and 1930, 4,600 mergers took place and almost 12,000 firms

[42] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 38.

disappeared from the business map, compared to the relatively smaller numbers of 2,943 and 1,800 respectively, of the first wave.

Another very interesting feature of this merger wave (common also to the first one) was the major influence that investment bankers exercised among senior business executives. A reason for that was the tendency of companies that started using debt to finance the deals that were taking place. Therefore, when bankers thought that a merger was against the bank's policies or ethical interests, they had no problem vetoing any deal and withholding funds from firms seeking financing. The increased influence they could impose derived from the fact that in those years only a small number of investment banks held the majority of capital available for financing M&A activity, as the investment banking industry was more concentrated. This wave coincided with a boom in the stock market that began following the recession of 1923 and ended with the stock market crash on "Black Tuesday," (October 29, 1929) the largest market drop in history until October 1987. This market collapse signaled the beginning of the Great Depression, and hence, the end of the second merger wave.

c. Third Merger Wave (1965 – 1969)

The economic prosperity of the 1960s, as well as the concurrent increase of the stock market, created the ideal environment for the third wave to burst out. Although there were sings of increased merger activity even from the mid 1950s, the peak of this wave occurred later. The strong economy provided firms with the required resources to acquire other companies, but the political environment of the 1960s (the Johnson Administration of 1963-1969), was highly against monopolistic trends and favored aggressive antitrust enforcement. The overall antitrust stance of the federal government was strengthened with the introduction of the Celler-Kefauver Act in 1950. According to existing legislation (Clayton Act of 1914), the acquisition of other firms' stock was considered illegal when the transaction resulted in a merger, which was significantly reducing the degree of competition within an industry.

However, the existing law could not ban the anticompetitive acquisition of the targeted firm's assets. The Celler-Kefauver Act was introduced to address this

loophole of the law.[43] Consequently, horizontal mergers became less popular, the total number of both horizontal and vertical dealings was reduced and another kind of transaction appeared and dominated the market: conglomerate mergers. Since all kinds of deals were subject to strict antitrust enforcement, profitable companies with large cash flows available that were unwilling to pay out to shareholders in the form of dividends, tried to diversify and expanded their business outside one industry category as an alternative way to utilize these funds. Many major established firms accepted the concept and diversified into various industries and areas.

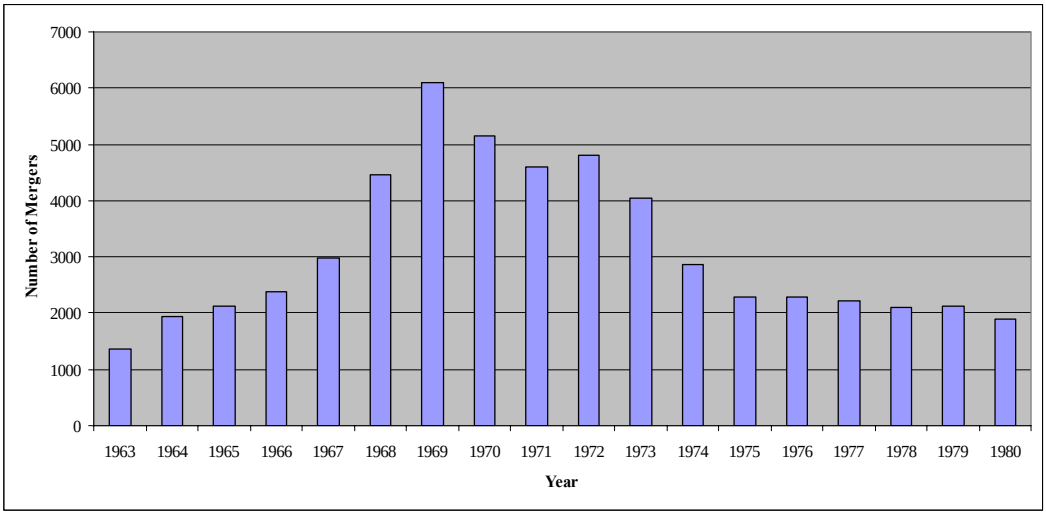

Figure 12. **Number of Mergers 1963-1980(After[44])**

Throughout this period, the majority of deals were friendly arrangements and stock was the primary medium of exchange. Until that time, the term "diversified firms" was applicable to those firms that owned some subsidiaries outside the main industry category where the majority of their business activities were concentrated. The conglomerates that were formed, such as IT&T, Ling-Temco-Vaught (LTV), Teledyne and Litton Industries, had a large percentage of their activities dispersed in different industries. Another reason that accelerated the conglomerate movement during this third wave was the rapid growth of management science and the introduction of related

[43] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 41.

[44] Ibid.

concepts in the business world. All the introduced management methodologies and principles enhanced the belief that even the most complex organizations could be manageable.

The intensity of this wave compared to the years before and after (in number of transactions) is presented in Figure 12. According to Federal Trade Commission (FTC) reports, almost 80% of the mergers that took place in the ten-year period between 1965 and 1975 were conglomerate mergers.[45] The strength of this trend is also illustrated by the fact that the number of conglomerate firms increased from 8.3% of Fortune 500 firms in 1959 to 18.7% in 1969.[46] Although almost 6,000 mergers took place and more than 25,000 firms disappeared, neither competition nor market concentration in the U.S. economy was affected. President Richard M. Nixon, who took office in 1969, was generally more tolerant of merger activity. The tough antitrust enforcement of the Justice Department ended in 1972 as the Supreme Court failed to accept the interpretation of antitrust laws adopted from the Department of Justice. The conglomerate stocks crashed in 1969-70 and the diversified companies never achieved the benefits expected to be derived from diversification.[47] The oil crisis of 1973 resulted in a sharp increase in inflation and a worldwide economic downturn, which marked the end of this merger wave.

d. Fourth Merger Wave (1984-1989)

The downward trend that characterized M&A activity in the decade of 1970–1980 started to change in 1981. The period of economic prosperity of the latter half of the 1980s gave the signal for a fourth merger wave, generally referred to as the merger wave of the 1980s, or the takeover wave, which coincided with the Ronald Reagan administration. According to Sian Owen:

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[45] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 40.

[46] Owen, "The history and mystery of merger waves."

[47] Martin Lipton, "Merger Waves in the 19th, 20th and 21st Centuries," (The Davies Lecture, Osgoode Hall Law School, York University, September 14, 2006), http://osgoode.yorku.ca/media2.nsf/58912001c091cdc8852569300055bbf9/1e37719232517fd0852571ef00701385/$FILE/Merger%20Waves_Toronto_Lipton.pdf (accessed March 2008).

> It is also worth noting that the 1980s was a period in which companies had to respond to a series of shocks that impacted on just about every type of company. These included the growth of industrial deregulation, severe changes in the costs of inputs, such as oil, and the rapid developments in technology that took place throughout this period. [48]

Despite the fact that the first major hostile bid, which was to acquire ESB by Morgan Stanley on behalf of Inco, was made in 1974 before this fourth wave had started, the unique characteristic of this wave was the significant role of hostile mergers. Hostile mergers had already become an acceptable form of corporate expansion since 1908[49] and therefore many firms had played the takeover game for maximization of their profits in a very short time. The distinction between friendly and hostile transactions was based on the reaction of the target company's board of directors. The merger was considered friendly if the board approved the takeover; if the board was opposed, the takeover was considered hostile. Although the absolute number of hostile takeovers is not high with respect to the total number of takeovers, the relative percentage of hostile takeovers in the total value of takeovers is large. The term corporate raider[50] was introduced during this period in the vocabulary of corporate finance in order to define the person who was making profits by takeover attempts without ever taking ownership of the targeted firm. The basic concept of the raiders' efforts was concentrated in selling the target company's shares at a price higher than the original one they paid to acquire them in the first place.

Another notable characteristic of the merger wave of the 1980s was the size and prominence of the M&A targets. The volume of transactions and the size of deals exceeded any precedent making this wave known as the wave of the mega merger. Some of the largest firms in the country, companies which due to their size were considered untouchable in the past, "became the targets of unwelcome acquisition bids

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[48] Owen, "The history and mystery of merger waves."

[49] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 53.

[50] Ibid.

and fought vigorously to defend themselves;" [51] consequently, the amount of money that was spent to complete such deals was very large. Table 7 lists the ten largest acquisitions during this period. It was the era of the billion dollar deals. "Almost half of all major U.S. companies were the recipients of an unsolicited takeover bid in the 1980, which is a clear indicator of the volume of transactions taking place during this particular wave."[52] The volume of transactions was not equally distributed among the different industry areas. During the first half of the 1980s, the oil and gas industry accounted for 21.6% of the total volume of M&A activity,[53] while during the other half the large volume of deals shifted towards drugs and medical equipment. Deregulation in the industry that showed the large volume of transactions seemed to be the reason for this disproportionate distribution of deals among the industries. When, for example, the airline industry was deregulated, airfares became subject to competition. Consequently, some air carriers could no longer compete effectively, causing their position in the market to deteriorate, resulting in a consolidation in the industry.

Year	Buyer	Target	Price ($Billions)
1988	Kohlberg Kravis	RJR Nabisco	25.1
1984	Chevron	Gulf Oil	13.3
1988	Philip Morris	Kraft	13.1
1989	Bristol Myers	Squibb	12.5
1984	Texaco	Getty Oil	10.1
1981	DuPont	Conoco	8.0
1987	British Petroleum	Standard Oil of Ohio	7.8
1981	U.S. Steel	Marathon Oil	6.6
1988	Campeau	Federated Stores	6.5
1986	Kohlberg Kravis	Beatrice	6.2

Table 7. **Ten Largest Acquisitions 1981 – 1989 (Aftrer[54])**

[51] Owen, "The history and mystery of merger waves."

[52] Ibid.

[53] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 56.

[54] Ibid, 56.

In addition to the aforementioned during this fourth merger wave, some additional characteristics appeared such as the aggressive role of investment bankers, the aggressive use of debt, etc. Those additional features differentiated this period from anything known in the history of U.S. mergers. This merger wave is also the one that generated the greatest volume of academic analysis and a plethora of different reasons has been put forward for its taking place. One possible reason is that the U.S. government relaxed some of the restrictions on takeover activity that the earlier law had put in place. An alternative explanation is that it represented a return to specialization after the excessive diversification and expansion of the 1960s wave. Many of the companies that were most active during the earlier merger wave found that there were incredible difficulties inherent in managing a company spread over many different markets and countries.

According to Gaughan's rationalization the fourth merger wave ended in 1989, following the end of the long economic expansion of the 1980s that led the economy to a mild recession as well as the collapse of the junk bond market, which had financed many of the leverage buy-outs (LBOs) of the period.

e. Fifth Merger Wave (1992-2000)

The fifth merger wave followed the economic recession of 1990-91, coincided with Clinton's administration, and exceeded all of the previous waves in both number of transactions and value. This was the largest post-war period of expansion of the U.S. economy, a fact that was creating supporting conditions for the development of the fifth wave. However, apart from that, there is strong evidence that the high rate of deregulation, which occurred in several different industries as well as technological innovations, played a crucial role to expansion of this wave. Due to the aforementioned, some scholars have characterized the 1990s as the "decade of deregulation."[55] Aside from the type of transactions (horizontal mergers), the last two waves have little in common. The number of hostile transactions was reduced to a minimum, resulting in this

[55] Gregor Andrade, Mark Mitchell, and Erik Stafford, "New Evidence and Perspectives on Mergers," Journal of Economic Perspectives 15, no. 2 (Spring 2001): 103-120.

wave being regarded as entirely friendly; only 4% of deals were denoted as hostile. Another very important difference was the popularity of stock as the basic medium of transactions. Debt-financed mergers were less common, while the use of stock was increased by approximately 50% compared to the wave of the 1980s. Table 8 was adopted from a recent study and depicts in detail the differences in the nature of merger and acquisition activity, which occurred in the years from 1973 until 1998. "A possible cause for the change in nature of deals from the hostility of the 1980s to the more restrained activity of the 1990s is the improvement of the framework in corporate governance."[56]

	1973–1979	*1980–1989*	*1990–1998*	*1973–1998*
N	789	1,427	2,040	4,256
All Cash	38.3%	45.3%	27.4%	35.4%
All Stock	37.0%	32.9%	57.8%	45.6%
Any Stock	45.1%	45.6%	70.9%	57.6%
Hostile Bid at Any Point	8.4%	14.3%	4.0%	8.3%
Hostile Bid Successful	4.1%	7.1%	2.6%	4.4%
Bidders/Deal	1.1	1.2	1.0	1.1
Bids/Deal	1.6	1.6	1.2	1.4
Own Industry	29.9%	40.1%	47.8%	42.1%
Premium (Median)	47.2%	37.7%	34.5%	37.9%
Acquirer Leverage > Target Leverage	68.3%	61.6%	61.8%	62.9%
Acquirer Q > Target Q	68.4%	61.3%	68.3%	66.0%
Relative Size (Median)	10.0%	13.3%	11.2%	11.7%
Fraction of Acquirer Announcement Returns < −5%	14.9%	17.0%	19.4%	17.5%
Fraction of Acquirer Announcement Returns > 5%	9.6%	11.3%	10.7%	11.1%

Table 8. **Characteristics and Descriptive Statistics of Mergers by Decade(From[57])**

During the 1990s, the level and the effectiveness of monitoring the transactions increased greatly. The attitude of the managers towards those deals was totally altered as it became much more difficult for them to enter into highly risky deals.

56 Andrade et al., "New Evidence and Perspectives on Mergers," 106.

57 Ibid.

They did not want to repeat the same mistakes of the previous period during which many of the transactions made had only short-term financial gains. They were forced to consider more carefully whether or not to enter the market; thus, they "focused more on strategic deals that did not unduly rely on leverage." [58]

As had happened with all the waves in the past, this fifth wave introduced another unique characteristic in the competition of companies for corporate control. "In the mid-1990s, the market became enthralled with consolidating deals — what were called roll-ups."[59] The strategy behind roll-ups was to put together smaller companies into national business and enjoy economies of scale. The defense industry was included among others with those that tried to create efficiencies adopting this policy of roll-up deals. In addition to that, as the idea of globalization, a concept that was introduced in the 1990s, and global economy was evolving, the demand for growth became imminent. On the assumption that size matters, companies of unprecedented size and global reach were created as shown in Figures 13 and 14.

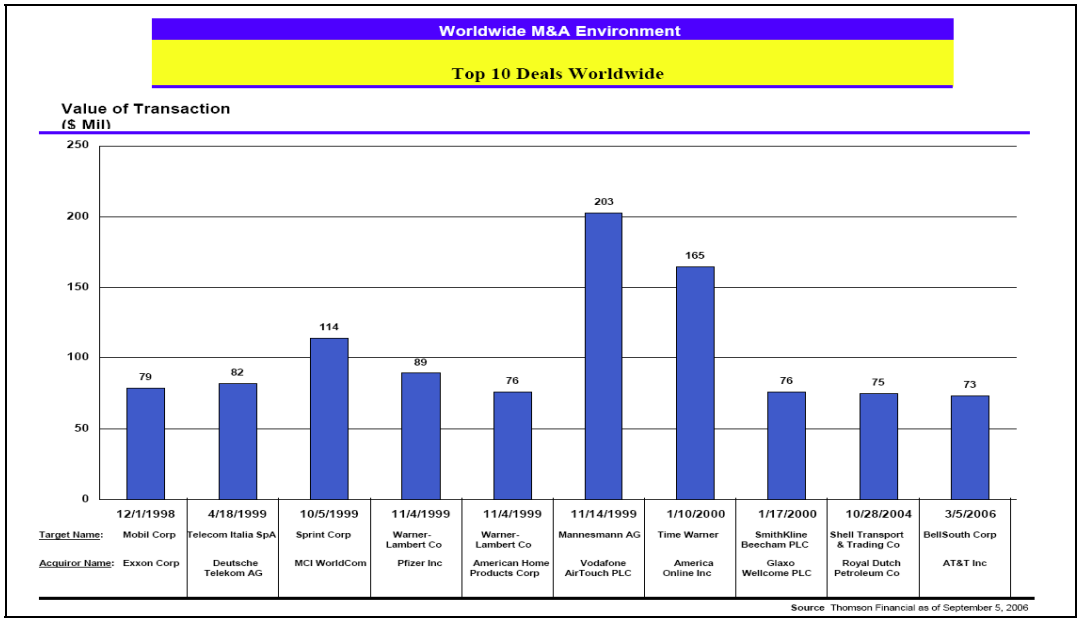


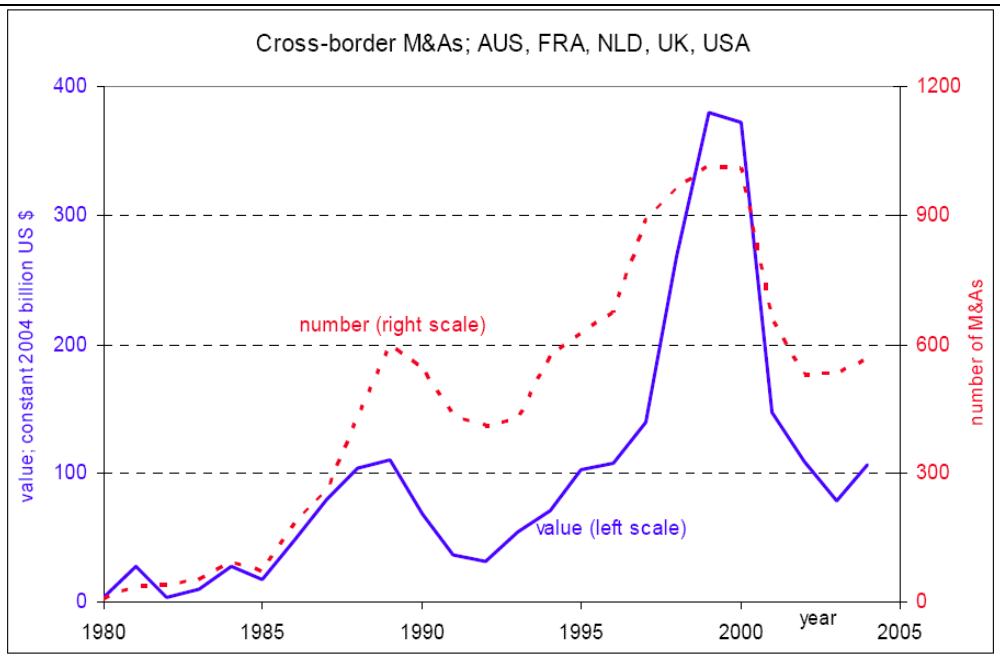
Figure 13. **Top Ten Deals Worldwide(From[60])**

58 Gaughan, Mergers, Acquisitions and Corporate Restructuring, 59.

59 Ibid, 61.

60 Lipton, "Merger Waves."

The relatively controlled antitrust environment, as well as the new global view of competition, is responsible for the formation of once-unthinkable combinations. Citibank and Travelers, Chrysler and Daimler Benz, Exxon and Mobil, Boeing and McDonnell Douglas, AOL and Time Warner, and Vodafone and Mannesmann were some of the huge mergers that took place. "Thus from a modest $342 billion of deals in 1992, the worldwide volume of mergers marched steadily upward to $3.3 trillion worldwide in 2000."[61] Nine of the ten largest deals in history all took place in the three-year period from 1998-2000, with the tenth in 2006 (Figure 13).



Source: Brakman, Garretsen, and van Marrewijk (2005); value is deflated using USA GDP deflator.

Figure 14. **Top Ten Deals Worldwide(From[62])**

The year 2000 started with the announcement of the record-setting $165 billion merger of Time Warner and AOL. However, after a five-year burst of telecommunications, media and technology (TMT) mergers, there was a dramatic slow down in the TMT sector, as well as in all mergers. It started with the collapse of the

61 Lipton, "Merger Waves."

62 Charles Van Marrewijk, "An overview of cross-border mergers and acquisitions for five countries," (paper, Erasmus University Rotterdam, Department of Economics, October 2005), http://people.few.eur.nl/vanmarrewijk/pdf/marrewijk/fm%20corporate%202005.pdf (accessed May 2008).

Internet stocks at the end of the first quarter and was followed by the earnings and financing problems of telecommunications. "Following the bursting of the Internet bubble in March 2000, M&A activity declined sharply" [63], signaling the end of the fifth wave, "in tandem with the stock market and the U.S. economy and in conjunction with the rise of global and security concerns." [64]

C. MERGERS & ACQUISITIONS IN DEFENSE INDUSTRY

1. Introduction

The legislative framework that governs corporate mergers and acquisitions is extensive and covers many different aspects. For the purposes of the consolidation of the U.S. defense industry and its potential relationship with the cost growth of weapon systems, it is more relevant to focus on the antitrust part of the statutory framework and how this is generally conceived and interpreted. In addition, its actual implementation in relation with the proposed defense industry mergers and acquisitions can offer some useful insights, especially in terms of the evolution of governmental policies over time, for defense industrial base restructuring.

2. Legislation and Antitrust Issues

a. The Basic Elements of the Antitrust Legal Framework

The main purpose of the antitrust legislative and regulatory framework is to protect the competition in a market. More specifically, mergers and acquisitions are regulated in an effort by the government to preserve a healthy dynamic market, where the benefits of competition, such as affordable prices, high quality and efficient production, are available to the buyers.[65] It is easy to understand that the importance and the impacts

63 Bruner, Applied Mergers and Acquisitions, 75.

64 Ibid, 87.

65 E. Thomas Sullivan and Jeffrey L. Harrison, Understanding Antitrust and Its Economic Implications, 4th Ed. (LexisNexis, 2003), http://www.lexisnexis.com/lawschool/study/understanding/pdf/AntitrustCh1.pdf (accessed April 19, 2008).

of the antitrust legislation extend far beyond the defense industry, or any particular industry; it can affect the whole market and thus the economy, as well as the welfare of the buyers, regardless if they are individual consumers, corporations or the government. The discussion of the antitrust law extends into many different interrelated areas, including politics, economic theory and even history.[66] What is more important though, for the purposes of this study, is the fact that antitrust legislation has a long history and has been continuously adapting and evolving as a regulating mechanism to protect the competition, even if the two terms, protection and competition, may appear by definition as contradictory.

b. Sherman Act (1890)

We can trace the origins of the existing antitrust legislation back to 1890 with the Sherman Antitrust Act, a historic legislative initiative, arguably intending to cure some of the severe difficulties of the agricultural sector at the time.[67] This Act established the legal barrier against the creation of monopolies and the restraint of trade, imposing criminal penalties for such conduct. Its main goal was to preserve economic liberty of the market, and to prevent any attempts to impose restrictions on free trade and competition.[68] It is worth noting that the first great merger wave, of the period 1897–1904, did not stop or slow down despite the relatively new statutory measure.[69] This can be attributed to the fact that the Sherman Act text resembled more of a statement of general antitrust and antimonopoly principles than to an easily interpretable and applicable legislative document, to facilitate the courts in ruling for business agreements whether they were legal or in fact they deteriorated competition and free trade.[70]

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66 Sullivan and Harrison, Understanding Antitrust and Its Economic Implications.

67 E. Thomas Sullivan, The Political Economy of the Sherman Act: The First One Hundred Years, (New York: Oxford University Press, 1991), 32.

68 Legal Information Institute (LII), Cornell University Law School, Wex, "Antitrust - antitrust: an overview," http://topics.law.cornell.edu/wex/Antitrust (accessed April 19, 2008).

69 Gaughan, Mergers, Acquisitions and Corporate Restructuring, 100.

70 Sullivan and Harrison, Understanding Antitrust and Its Economic Implications.

Furthermore, the government resources that provided oversight and ensured the compliance of business transactions with the antitrust legislation were insufficient at the time.[71]

c. Clayton Act– Federal Trade Commission Act (1914)

The Clayton Act was the second attempt of the government to introduce a control mechanism against the formation of monopolies that constituted a threat to free market and competition. This law was drafted and passed, with the main goal to enhance the framework that the Sherman Act had already established. Several issues relating to unlawful corporate practices and subsequent financial market turbulences prepared the ground for drafting and acceptance of the new legislation.[72] The Clayton Act provided a more elaborate definition and description of the prohibited practices, maintaining the same fundamental principles, but making their enforcement more feasible by the judicial authorities.[73] This law includes provisions for the prohibition of specific corporate practices, among which are: price discrimination between customers, tying contracts, acquisition of stock competing firms if this harmed competition, and interlocking directorates when the directors or officers belong to companies that are competitors in the same market.[74] The Clayton Act provided the first specific framework directly applicable to mergers and acquisitions, offering a tool to oppose to the formation of monopolies.[75]

The Clayton Act was amended with the Celler-Kefauver Act of 1950 to provide for the prohibition of the acquisition of another firm by buying its assets instead of its stocks, if the result was harmful for the competition.[76] In 1914, the same year the

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[71] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 101.

[72] Carlos D. Ramírez and Christian Eigen-Zucchi, "Why Did The Clayton Act Pass? An Analysis of the Interest Group Hypothesis," (working paper, Department of Economics, George Mason University, 1998), http://economics.gmu.edu/working/WPE_98/98_03.pdf (accessed April 19, 2008).

[73] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 101.

[74] LII, Cornell University Law School, "U.S. Code Collection - Title 15, Chapter 1 – Monopolies and Combinations in Restraint of Trade,"
http://www.law.cornell.edu/uscode/html/uscode15/usc_sup_01_15_10_1.html (accessed April 19, 2008).

[75] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 102.

[76] Ibid., 103.

Clayton Act was passed, the government also passed the Federal Trade Commission Act. This Act created the Federal Trade Commission (FTC) along with other provisions. The FTC was established as the agency responsible for the enforcement of the antitrust legislation,[77] and retains this role still today. The bureau of competition of the FTC is the department that performs the antitrust duties and reviews the merger and acquisition proposals.[78] The antitrust division of the Department of Justice, headed by an Assistant Attorney General, nominated by the President and confirmed by the Senate,[79] has also joint jurisdiction in the enforcement of the antitrust legislation and was created in its present form in 1933, with the mission to promote and maintain competition in the U.S. economy.[80]

d. Hart-Scott-Rodino Act

The Hart-Scott-Rodino Act was passed in 1976 and sets the requirements for pre-merger notification and review of the proposed merger or acquisition by the FTC and the antitrust division of the Department of Justice.[81] This law prevents anti-competitive mergers and acquisitions before they actually take place. It sets provisions and thresholds for review that, in combination with Section 7 of the Clayton Act, constitute the backbone of the antitrust enforcement legal framework. The Hart-Scott-Rodino Act is particularly interesting for the defense industry consolidation, at least for the larger scale mergers and acquisitions, since these are filed and reviewed if they meet certain requirements set by this statute. The parties that propose to consolidate have to submit completed filings, pay the fee and enter into a 30-day waiting period before the merger is completed, unless the government chooses to extend this period due to the need

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[77] Federal Trade Commission, "Annual Report of the FTC for the Fiscal Year Ended June 30, 1916," http://www.ftc.gov/os/annualreports/ar1916.pdf (accessed April 19, 2008).

[78] Federal Trade Commission, Bureau of Competition, "Who We Are," http://www.ftc.gov/bc/index.shtml (accessed on April 19, 2008).

[79] Department of Justice, Antitrust Division, "Sections and Offices," http://www.usdoj.gov/atr/sections.htm#aag (accessed April 22, 2008).

[80] U.S. Department of Justice, Antitrust Division, "Antitrust Division Manual - Chapter I,B," http://www.usdoj.gov/atr/foia/divisionmanual/ch1.htm (accessed April 19, 2008).

[81] Gaughan, Mergers, Acquisitions and Corporate Restructuring, 103.

for additional information. Some of the basic requirements that determine whether the filing for review is needed are the following:[82]

- If any of the proposing parties is engaged in commerce or in any activity that affects commerce.
- If the acquiring party, after the acquisition, will have an aggregate total of assets of the acquired more than a specified amount (adjusted and published, last threshold was $252.3 million).
- If the acquiring party, after the acquisition, will have an aggregate total of assets of the acquired between the adjustable specified amounts (last thresholds were $63.1 and $252.3 million). The acquiring party has net annual sales or total assets more than the specified amount (last adjustment was to $126.2 million), while its net annual sales or total assets exceed the specified amount (last adjustment was to $12.6 million), if the acquired party is in manufacturing, otherwise only the total assets are considered.
- Other requirements also are included, with adjustable thresholds that are published.
- The statute has a list of exemptions.

e. Horizontal Merger Guidelines

The FTC and the Department of Justice published the joint "Horizontal Merger Guidelines" in 1992 (latest version), with amendments in 1997. These Guidelines are designed to implement the antitrust legislation in determining whether a merger or acquisition acts against the competition in the market.[83] These Guidelines are common for all types and categories of industries, but they have provisions in order to consider their particular characteristics.[84] These guidelines are also applied in the case of the

[82] LII, Cornell University Law School, "U.S. Code Collection - Title 15, Chapter 1, §18a. Premerger notification and waiting period," http://www.law.cornell.edu/uscode/15/usc_sec_15_00000018---a000-.html (accessed April 22, 2008), and Federal Trade Commission, "Premerger/Hart-Scott-Rodino Act," http://www.ftc.gov/bc/hsr/hsrwhatsnew.shtm (accessed April 22, 2008).

[83] Federal Trade Commission, Bureau of Competition, "1992 Horizontal Merger Guidelines [With April 8, 1997, Revisions To Section 4 On Efficiencies]," http://www.ftc.gov/bc/docs/horizmer.htm (accessed April 19, 2008).

[84] Robert Pitofsky, Chairman, prepared statement of The Federal Trade Commission, presented before the Committee on the Judiciary Subcommittee on Antitrust, Business Rights, and Competition, United States Senate, July 24, 1997, http://www.ftc.gov/os/1997/07/defense4.htm, (accessed April 19, 2008).

defense industry mergers and acquisitions review to decide whether the antitrust agencies will rule against a proposed merger and therefore challenge it.

The Guidelines define five basic assessment steps performed by the antitrust agencies to make their determination upon a proposed merger action:[85]

- Step 1: Significant increase of concentration resulting in a concentrated market.
- Step 2: Concerns about potential adverse competitive effects.
- Step 3: Whether entry in the particular market is easy, meaning timely, likely and sufficient either to deter or to counteract the competitive effects of concern.
- Step 4: Efficiency gains will result from the merger that cannot reasonably be achieved with other means.
- Step 5: If, unless the merger takes place, either party to the transaction is likely to fail and exit the market.

f. The Herfindahl – Hirschman Index (HHI)

The antitrust agencies use the Herfindahl–Hirschman Index (HHI) as a measure for market concentration. The formula to calculate the HHI is given by:

$$\sum_{i=1}^{n} (\mathbf{Share_i})^2 ,$$

where, ***n*** is the number of companies in the specific market and ***Share$_i$*** is the market share of the ***i*** company (values in the 0 to 100 range).[86] In the case of a pure monopoly, the HHI has its maximum value of 10,000, while for perfect competition HHI will have an approximate value of 0. The antitrust agencies consider three ranges of HHI values after the merger, according to which they categorize the market concentration. These ranges[87] are as follows:

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[85] U.S. Department of Justice and the Federal Trade Commission, "Horizontal Merger Guidelines," www.usdoj.gov/atr/public/guidelines/horiz_book/hmg1.html (accessed April 20, 2008).

[86] Ibid.

[87] Ibid.

- **HHI ≤ 1000:** Unconcentrated market; the proposed merger is not likely to produce negative effects on the competition.
- **1000 ≤ HHI ≤ 1800:** Moderately concentrated market; the decision depends on the increase that the merger is estimated to bring in the concentration (higher or lower than 100), and on other considerations.
- **HHI ≥ 1800:** Highly concentrated market, the decision depends on the increase that the merger is estimated to bring in the concentration (higher or lower than 50), and on other considerations.

It is easy to see that even if the number of the remaining firms in a market is smaller after mergers take place, the market concentration as calculated using the HHI may produce different results.

3. What Did Really Happen After All?

For the period of 1982-1992, which is before the consolidation wave in the defense industry and the reduction in defense procurement expenditures, an increase in the HHI took place for aircraft and aircraft engines manufacturing sectors.[88] This is an indication that an increase in market concentration, at least in some sectors, had already begun prior to the consolidation period. This assumption is also found in another study, where the market shares were calculated for fixed-wing aircraft and for guided missiles sectors based on procurement data for the periods of 1994-1996 and 1996-1998.[89] The results show that there has not been an increase in market concentration for these two sectors. In fact, the HHI was lower in the period of 1996-1998 than from 1994-1996. This approach may have some restrictions, using procurement data instead of the value of shipments, as the U.S. Census Bureau uses. However, it raises the question whether the

[88] Kenneth Flamm, "U.S. Defense Industry Consolidation in the 1990s," in The Defense Industry in the Post-Cold War Era, Corporate Strategies and Public Policy Perspectives, ed. Gerald I. Susman and Sean O'Keefe (New York: Pergamon, 1998).

[89] Jongwoo Kim, "Concentrated?: High-Tech Defense Industries In The Post–Cold War Era," LBJ Journal Of Public Affairs XII (Spring 2000), http://www.lbjjournal.com/PrintLBJArchives/2000/055%20kim.pdf (accessed April 16, 2008).

decline in the number of the prime contractors after the consolidation wave actually represents an increase in the concentration of the market, and whether the concentration had already increased before.

Other points can differentiate the defense industry mergers and acquisitions from the commercial market's similar activity. Specifically, there are views that while defense oriented companies have actually performed a high number of consolidation agreements, this has remained in the region of financial deals and did not translate into reduction of the existing industrial overcapacity[90]. From this perspective, the defense industry did not follow the normal market approach towards efficiency, in the face of declining demand, partially due to exogenous factors and pressures, such as political influence[91].

4. The Role of DOD in the Consolidation of Defense Industry

a. Introduction

The DoD decided to assume an active role in promoting, encouraging and supporting the consolidation in the U.S. defense industry, even though this strategy also brought inherent risks relating to potentially harmful effects to the competition in the particular market. More specifically, in 1993, Secretary of Defense William Perry openly encouraged consolidation of the defense industry in an effort to reduce overhead due to overcapacity that was no longer necessary under the new conditions of reduced defense expenditures.[92] Subsequently, the Defense Science Board task force published a report in 1994, which concluded that the antitrust legal framework and the responsible agencies for its enforcement were sufficient to cover the issue of defense industry mergers and acquisitions, but the DoD should express its views, which should be taken into careful

90 Gholz et al.,Restructuring the U.S. Defense Industry.

91 Ibid.

92 Flamm, "Post-Cold War Policy and the U.S. Defense Industrial Base, The Bridge," National Academy Of Engineering 35, no. 1 (Spring 2005), http://www.nae.edu/NAE/bridgecom.nsf/weblinks/MKEZ-6AGPFS?OpenDocument (accessed April 19, 2008).

consideration.[93] The official DoD policy was revised in 1996 to establish the assessment by the DoD of potential implications from mergers and acquisitions of primary defense companies and the cooperation with the antitrust agencies.[94]

It is interesting that the antitrust review of the proposed mergers and acquisitions of defense contractors was not met with consensus. On the contrary, opposing views were expressed, among which was the complete exemption of defense firms from any antitrust agencies review.[95]

b. Restructuring Costs and Savings Issues

An important tool that the DoD used in order to support the consolidation was the allowance of the restructuring costs that resulted from a merger or acquisition. This was a strong incentive to promote the consolidation of primary defense contractors. A memorandum by Under Secretary of Defense, John M. Deutch, established this allowance for acquisition in July 1993.[96] This memorandum provided that these costs could be allowable if it could be shown that the projected savings would be higher than the costs and that the merger preserved a critical defense capability.[97] This approach made it possible for defense contractors to charge restructuring costs to cost-reimbursement type contracts with the DoD, avoiding any obstacles due to the interpretation of the Federal Acquisition Regulation, thus facilitating the mergers and acquisitions processes. The basic prerequisite to justify the restructuring costs allowance was that the contractors had to show that significant projected savings would result from

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[93] Department of Defense (DoD), Report of the Defense Science Board task force on Antitrust Aspects of Defense Industry Consolidation, April 1994, http://stinet.dtic.mil/cgi-in/GetTRDoc?AD=ADA278619&Location=U2&doc=GetTRDoc.pdf (accessed April 19, 2008).

[94] DoD, Directive Number 5000.62, "Impact of Mergers or Acquisitions of Major DoD Suppliers on DoD Programs," (October 21, 1996) http://www.acq.osd.mil/ip/docs/500062.pdf (accessed April 19, 2008).

[95] William E. Kovacic and Dennis E. Smallwood, "Competition Policy, Rivalries and Defense Industry Consolidation," The Journal of Economic Perspectives 8, no.4 (Autumn 1994): 91-110.

[96] U.S. General Accounting Office (GAO), Issues Related to Acquisition and Merger Restructuring Costs (T-NSIAD-94-247, July 27, 1994, Testimony Before the Subcommittee on Oversight and Investigations, Committee on Armed Services, House of Representatives), http://archive.gao.gov/t2pbat2/152213.pdf (accessed April 19, 2008).

[97] Ibid.

the consolidation. The DoD issued regulations regarding the costs of the defense contractor firms restructuring, but these regulations were considered by the General Accounting Office (now Government Accountability Office) as inconsistent with the requirements set by the legislation, specifically by section 818 of the National Defense Authorization Act for FY 1995.[98] The estimation for the anticipated savings from the consolidation proved to be a difficult task with considerable uncertainty. In 1998, there were still concerns whether the DoD's estimations for savings were accurate or in fact overstated, while it was discovered that the Services' budget requirements did not include these savings as a factor.[99]

c. Mergers and Acquisitions Proposals Reviews

The antitrust analysis of a proposed merger or acquisition is not a simple task. Potential anticompetitive consequences have to be identified by the agencies, taking into account a multitude of different, and in some cases contradicting, factors. As mentioned above, the Defense Science Board in 1994 concluded that the existing legislative and regulatory framework provided sufficient means and tools to cope with this difficult analysis. Nevertheless, the burden of the decision relied on the antitrust agencies, with the DoD to act mainly as an advisor providing information and expertise, even though its views were always of primary importance. The participation of DoD in the review of the proposed mergers and acquisitions is the basic difference in the antitrust analysis between a defense industry case and a general commercial market business integration proposal.[100] We can reasonably assume that over time, the role of the DoD in the proposed mergers and acquisitions reviews became increasingly active; however, the legal framework did not change and the antitrust agencies retained their authority and

[98] GAO, Defense Restructuring Costs: Payment Regulations Are Inconsistent with Legislation (NSIAD-95-106, August 10, 1995), http://www.gao.gov/archive/1995/ns95106.pdf (accessed April 20, 2008).

[99] GAO, Defense Industry Restructuring: Updated Cost and Savings Information (NSIAD-98-156, April 30, 1998), http://www.gao.gov/archive/1998/ns98156.pdf (accessed April 20, 1998).

[100] Ilene Knable Gotts, The Merger Review Process: A Step-by-step Guide to U.S. and Foreign Merger (American Bar Association, 2006).

responsibility to decide upon the proposals.[101] This kind of cooperation may have actually accelerated the merger and acquisition wave in the defense industry, at least until 1998, the period when the policy of the DoD became more conservative and reluctant towards further consolidation.[102]

In order to identify possibilities for anticompetitive results, the antitrust agencies need to specify what markets are affected by the proposed consolidation action, a question not so easily answered due to the complexity of the weapon systems and their importance and applications in different types of missions. Apart from the issues related to competition, market shares and barriers for potential new entrants in this market, the projected efficiencies are another factor to consider, while determining the balance between benefits and costs of the merger or acquisition.[103] These projected efficiencies were one of the primary arguments in supporting the consolidation by different parties.[104] In cases where the antitrust agencies and the DoD found that there were significant possibilities of future problems in DoD programs due to a proposed merger or acquisition, the proposing firms had to take certain steps to cure antitrust issues before the consolidation got approval, usually to protect proprietary information.[105]

Except the cases of horizontal mergers or acquisitions that took place during the 1990s, defense companies also performed vertical consolidation actions, when higher level contractors acquired companies that were their suppliers. The existing mechanism could not provide accurate estimates to the DoD for this phenomenon or its possible consequences for competition or other aspects of the defense market, at least

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101 DoD, Annual Industrial Capabilities Report to Congress, February 2003, http://www.acq.osd.mil/ip/docs/ind-cap-annual-report-to-congress_2003.pdf (accessed March 2008).

102 John Deutch, "Consolidation of the U.S. Defense Industrial Base," Acquisition Review Quarterly (Fall 2001), http://www.dau.mil/pubs/arq/2001arq/Deutch.pdf (accessed March 2008).

103 Pitofsky, prepared statement.

104 Jerrold T. Lundquist, "Shrinking Fast and Smart," Harvard Business Review (November-December 1992).

105 GAO, Defense Industry Consolidation: Competitive Effects of Mergers and Acquisitions (T-NSIAD-98-112, March 4, 1998, Testimony Before the Subcommittee on Acquisition and Technology, Committee on Armed Services, U. S. Senate), http://www.gao.gov/archive/1998/ns98112t.pdf (accessed April 19, 2008).

until 1998, when these difficulties were recognized.[106] The antitrust agencies applied the same principles in their analysis for vertical integration as for horizontal mergers or acquisitions, focusing on the safeguarding of confidential information.[107]

The antitrust agencies in the 1990s had to cope with a massive merger wave which extended far beyond the defense industry. In 1996 a total of 3,094 proposed consolidation transactions were filed under the requirements of the aforementioned Hart-Scott-Rodino Act, a number that constituted a historical top until then.[108] The dollar value of the mergers from 1992-1998 increased by approximately ten times.[109] The difficulties are obvious and in some cases the proposals were rejected, but ultimately the consolidation prevailed, resulting in a much smaller number of prime contractors in the defense industry.[110] The DoD continued to support the consolidation as the primary strategy to reduce excess capacity and increase efficiency in the defense industry, stating that there were no indications that competition faced negative consequences and that the actions by the DoD and the antitrust agencies were successful and sufficient.[111] However, from 1998 and with the merger wave still ongoing, significant concerns began to emerge from various parties and analysts as to whether the consolidation of the U.S. defense industrial base had gone too far, potentially affecting future competition and weapon systems cost for the DoD.[112]

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106 GAO, Defense Industry Consolidation.

107 Pitofsky, prepared statement.

108 Joel I. Klein, Assistant Attorney General Antitrust Division, Department of Justice, (statement before the Antitrust, Business Rights and Competition Subcommittee, Committee on the Judiciary U.S. Senate, February 26, 1998), http://0225.0145.01.040/atr/public/testimony/1581.htm (accessed April 19, 2008).

109 Klein, (statement before the Committee on the Judiciary U.S. Senate, June 16, 1998), http://www.usdoj.gov/atr/public/testimony/1795.htm (accessed April 20, 2008).

110 GAO, Defense Industry Consolidation.

111 U.S. Office of the Secretary of Defense, Report on the Effects of Mergers in the Defense Industry, March 1997, http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA323934&Location=U2&doc=GetTRDoc.pdf (accessed March 2008).

112 Leslie Wayne, "The Shrinking Military Complex; After the Cold War, the Pentagon Is Just Another Customer," New York Times, February 27, 1998, http://query.nytimes.com/gst/fullpage.html?res=9B0DEEDB113EF934A15751C0A96E958260 (accessed March 2008).

d. Some Conclusions

The Government dealt with the merger wave of the defense industry in the 1990s mostly using the existing legal and regulatory framework, adding the contribution of the DoD's expertise and information, to assist the antitrust agencies. However, the general approach was the same with the commercial industry mergers and acquisitions reviews. The DoD encouraged and maintained a policy that was favorable to mergers and acquisitions, considering the resulting savings and benefits as important and the consequences on the competition as of minor significance[113]. Under this policy, the vast majority of the proposed mergers and acquisitions for this period were approved, even though in some cases the antitrust agencies required corrective measures before proceeding.

The legal framework that covers the mergers and acquisitions requires careful scrutiny of the proposals, but at the same time, it leaves considerable margins for different interpretations. It is important to take into account the fact that there was a widely adopted view among the different parties about the value that the consolidation would eventually bring for all the stakeholders, including the DoD and the taxpayers. We already have mentioned that DoD officially followed this policy, but at the same time, several analysts shared the same views and had high expectations from the capacity reduction and subsequent efficiencies. Furthermore, defense industry executives at the highest level, largely agreed with this approach, summarizing the policy measures that they believed as the most appropriate and effective in: reduction of excess capacity, increase of the exports of weapon systems and development of technologically advanced products[114]. This situation created a climate favorable to the consolidation, possibly contributing to the approval of merger and acquisition proposals by the antitrust agencies.

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[113] DOD, Annual Industrial Capabilities Report to Congress, January 2001 (http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA386142&Location=U2&doc=GetTRDoc.pdf, accessed in March 2008)

[114] Statement of Norman R. Augustine, President, Lockheed Martin Corporation, Before the Federal Trade Commission Hearing on the Changing Nature of Competition in a Global and Innovation-Driven Age, Nv. 2, 1995 (http://www.ftc.gov/opp/global/augustin.shtm, accessed on 04/19/2008)

The legal framework remains the same until today, and the DoD plays an active role in reviewing the proposed mergers and acquisitions, in cooperation with the antitrust agencies, with an emphasis in the prevention of anticompetitive results[115].

D. TOP FIVE U.S. DEFENSE INDUSTRY CONTRACTORS

As described in a previous section, the 1990s and the ongoing fifth merger wave were a period of mega-transactions that also affected the defense industry. In addition to the market's trend of intense M&A activity, the message of Defense Secretary Les Aspin and Deputy Secretary William Perry, at the now famous "Last Supper," was clear: "consolidate or evaporate." Thus, the reaction was almost imminent and the consequent result was a significant reduction in the number of prime contractors in ten of the twelve markets, which the DOD identified as important to national security[116]. From Table 9 below (first published in a GAO report on April 30, 1998) it is obvious that the end of the massive consolidation period created five enormous companies dominating almost every sector of the defense industry. The largest number of reductions has been in the tactical missile, fixed-wing aircraft, and expendable launch vehicle markets. For example, the number of contractors producing tactical missiles dropped from thirteen to four. Only two contractors now compete in such key defense markets as expendable launch vehicles, tracked combat vehicles, strategic missiles, and torpedoes.

Sector	Reduction in contractors	1990 contractors	1998 contractors
Tactical missiles	13 to 3	Boeing Ford Aerospace General Dynamics Hughes Lockheed Loral LTV Martin Marietta McDonnell Douglas Northrop	Boeing Lockheed Martin Raytheon

115 DOD, Annual Industrial Capabilities Report to Congress, February 2007 available at http://www.acq.osd.mil/ip/docs/annual_ind_cap_rpt_to_congress-2007.pdf, (accessed on 04/20/2008)

116 GAO, Defense Industry Restructuring: Updated Cost and Savings Information (NSIAD-98-156, April 30, 1998), http://www.gao.gov/archive/1998/ns98156.pdf (accessed April 20, 1998). Note: submarines and ammunition are not included since these sectors did not experience any changes. The electronics sector is not included.

		Raytheon Rockwell Texas Instruments	
Fixed-wing aircraft	8 to 2	Boeing General Dynamics Grumman Lockheed LTV-Aircraft McDonnell Douglas Northrop Rockwell	Boeing Lockheed Martin
Expendable launch vehicles	6 to 2	Boeing General Dynamics Lockheed Martin Marietta McDonnell Douglas Rockwell	Boeing Lockheed Martin
Satellites	8 to 5	Boeing General Electric Hughes Lockheed Loral Martin Marietta TRW Rockwell	Boeing Lockheed Martin Hughes Loral Space Systems TRW
Surface ships	8 to 5	Avondale Bath Iron Works Bethlehem Steel Ingalls NASSCO Newport News Tacoma Tampa	Avondale Bath Iron Works Ingalls NASSCO Newport News
Tactical wheeled vehicles	6 to 4	Am General BMY GM Canada Oskosh Stewart & Stevenson Teledyne Cont. Motors	Am General GM Canada Oskosh Stewart & Stevenson
Tracked combat vehicles	3 to 2	FMC General Dynamics Harsco (BMY)	General Dynamics UDLP
Strategic missiles	3 to 2	Boeing Lockheed Martin Marietta	Boeing Lockheed Martin

Torpedoes	3 to 2	Alliant Tech Systems Hughes Westinghouse	Lockheed Martin Raytheon
Rotary wing aircraft	4 to 3	Boeing Bell Helicopters Sikorsky McDonnell Douglas	Boeing Bell Helicopters Sikorsky

Table 9. **Prime Contractors in Defense Markets Sectors (1990-98) (From[117])**

A brief comparative analysis of data included in the DoD report named "100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards," which is published annually will provide sufficient evidence for the volume of contracts awarded to the prime contractors. Data in this report reflect the net value of both debit and credit procurement actions over $25,000. The scope of this brief analysis is to identify what proportion of deals the remaining five huge contractors (Boeing, Lockheed Martin, General Dynamics, Raytheon and Northrop Grumman) receive yearly from the procurement expenditures of the DoD. This report contains summary data on the 100 companies, including their subsidiaries, which were awarded the largest total dollar volume of Department of Defense prime contract awards during each fiscal year[118]. Table 10 and figure 15 was constructed from the data collected from this report for the fiscal years 1993 until 2006[119].

From the total amount, DOD appropriates in contracts among the different categories of procurement on average 61.15% of it is awarded to the Top 100 companies and their subsidiaries. At the beginning of the fifth merger wave (FY1993) which strongly affected the defense industry, the contemporary top 5 contractors were given the

[117] Reproduced from General Accounting Office, Defense Industry Restructuring: Updated Cost and Savings Information NSIAD-98-156 April 30, 1998 available at http://www.gao.gov/archive/1998/ns98156.pdf, (accessed on 04/20/1998). Note: Submarines and ammunition are not included since these sectors did not experience any changes. The electronics sector is not included.

[118] General Accounting Office, Defense Industry Restructuring: Updated Cost and Savings Information NSIAD-98-156 April 30, 1998 available at http://www.gao.gov/archive/1998/ns98156.pdf, (accessed on 04/20/1998). Note: Submarines and ammunition are not included since these sectors did not experience any changes. The electronics sector is not included.

[119] The report for FY2006 was the last one available online when the web site was accessed (May 2008) at http://siadapp.dmdc.osd.mil/procurement/historical_reports/statistics/procstat.html.

13.68% of the total awards. This percentage started steadily to increase as each of the "merger of equals" took place (Northrop Corp. and Grumman Corp in 1994, Lockheed and Martin Marietta in 1995, Boeing and Mc Donnel in 1997). At the end of the merger wave, this percentage has more than doubled, reaching since then an average of 29.87%.

Fiscal Year	Top 100 Companies	Lockheed Martin Corp.	Raytheon Co.	Northrop Grumman Corp.	Boeing Co.	General Dynamics Corp
1993	61.52	5.58	2.61	2.42	1.34	1.73
1994	61.89	5.51	2.31	4.40	1.01	2.37
1995	58.86	8.91	2.45	2.47	1.51	1.44
1996	58.43	10.03	2.51	2.17	1.44	2.23
1997	58.18	9.97	2.45	2.97	8.26	2.58
1998	60.09	10.44	4.79	2.27	9.19	3.11
1999	60.33	10.13	5.11	2.27	9.25	3.64
2000	61.95	11.35	4.75	2.31	9.03	2.31
2001	62.79	10.15	3.85	3.56	9.22	3.39
2002	62.78	9.95	4.10	5.11	9.65	4.08
2003	64.04	10.49	3.79	5.32	8.30	3.94
2004	63.62	8.97	3.47	5.16	7.40	4.15
2005	60.60	7.22	3.38	5.02	6.80	3.95
2006	61.07	9.02	3.41	5.64	6.88	3.41

Table 10. **Percentage of Total Procurement Prime Actions (above $25,000) (After[120])**

Since 1999, the ranking of the "Top 100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards" shows little changes with Raytheon, General Dynamics and Northrop Grumman fighting for the third, fourth and fifth place, respectively. The first two were firmly occupied from Lockheed Martin and Boeing. Every fiscal year the top five companies are awarded with almost half of the amount of procurement actions that the top one hundred companies share.

120 Constructed from the authors using data from DOD report named "100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards," for the years 1993 until 2006 available online at the web page of the Statistical Information Analysis Division (SIAD) of the http://siadapp.dmdc.osd.mil/procurement/historical_reports/statistics/procstat.html.

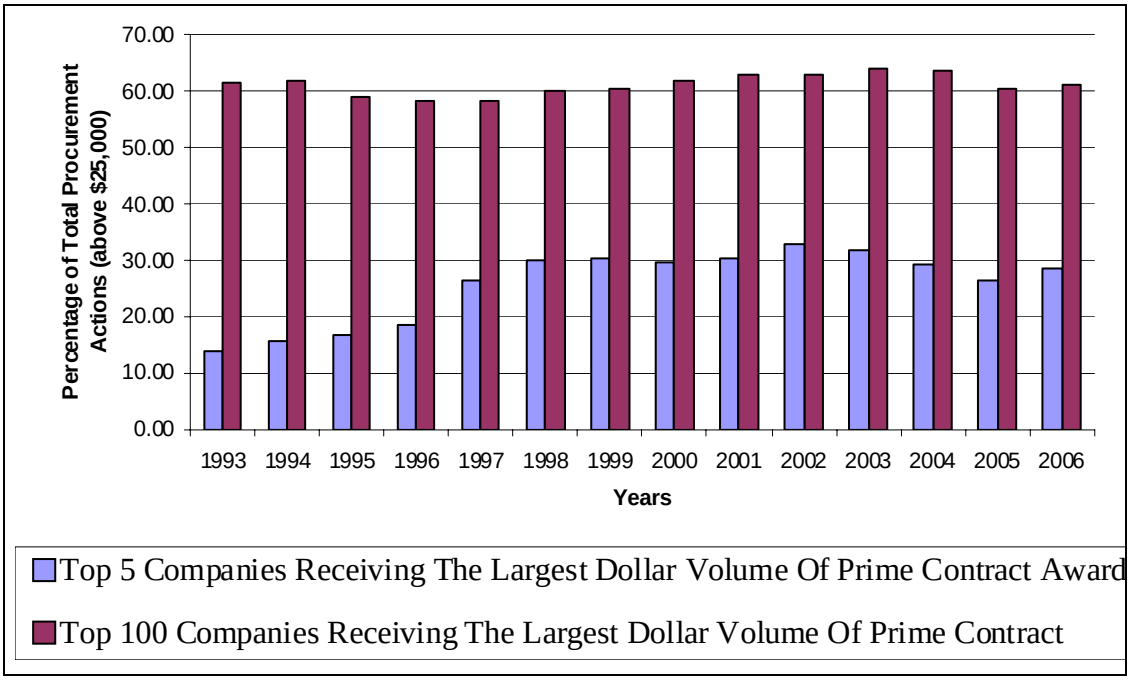

Figure 15. **Distribution of Prime Contracts Awards (After[121])**

The consolidation diagrams presented in Figures 21 through 25 at the end of this chapter provides the reader with an idea about the intensity of M&A transactions that occurred in the defense industry during the fifth merger wave and altered the picture of the market.

121 Developed from the authors using data available at the report named "100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards" which is published annually and is available online at dtic.net. The data are also available at the Statistical Information Analysis Division (SIAD) web site of the DoD at http://siadapp.dmdc.osd.mil/ (assessed April 2008).

1. The Boeing Company

The Boeing Company is the leading company in both global aerospace and the defense market, with a 9.3% share of the market; and in the United States market, with an 11.7% share of the market by value.[122] As shown in Figure 16, Boeing seems to have gained the most from the defense consolidation period. Before the merger with the McDonnel–Douglas in 1997 it was rarely ranked among the ten first contractors of the U.S. defense market. During the years that the majority of mergers in the defense industry took place, the rate of increase to the proportion of contracts awarded to the company was very high. Hence, since 1998 she has been awarded an average of 8.60% of prime procurement contracts, a percentage that ranks Boeing almost permanently in second place of the top one hundred list.

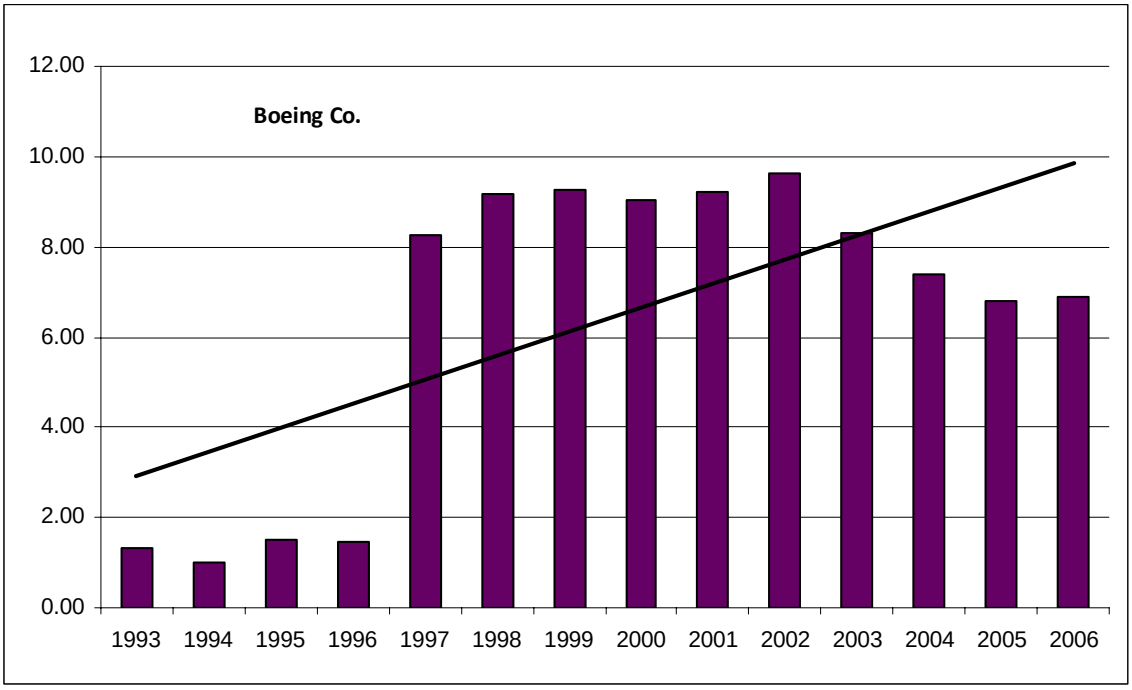

Figure 16. **Percentage of Total Procurement awarded to Boeing (After[123])**

[122] Datamonitor. "Global Airspace & Defense: Industry Profile," (January 2008), www.datamonitor.com (accessed April 17, 2008).

[123] Developed from the authors using data available at the report named "100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards" which is published annually and is available online at dtic.net. The data are also available at the Statistical Information Analysis Division (SIAD) web site of the DoD at http://siadapp.dmdc.osd.mil/ (assessed April 2008).

2. Lockheed Martin

Lockheed Martin Corporation occupies the second place in the global aerospace and defense market, with a 6.0% share of the market's value and the second place in the U.S. aerospace and defense market with a share of 10.5%[124]. In the top one hundred list of companies with the procurement prime awards, it constantly holds first place. The proportion of contracts awarded was increased after the consolidation with Martin Marietta Corporation. From that point on, Lockheed Martin accounts for an average of 9.72% of prime contracts as depicted in Figure 17.

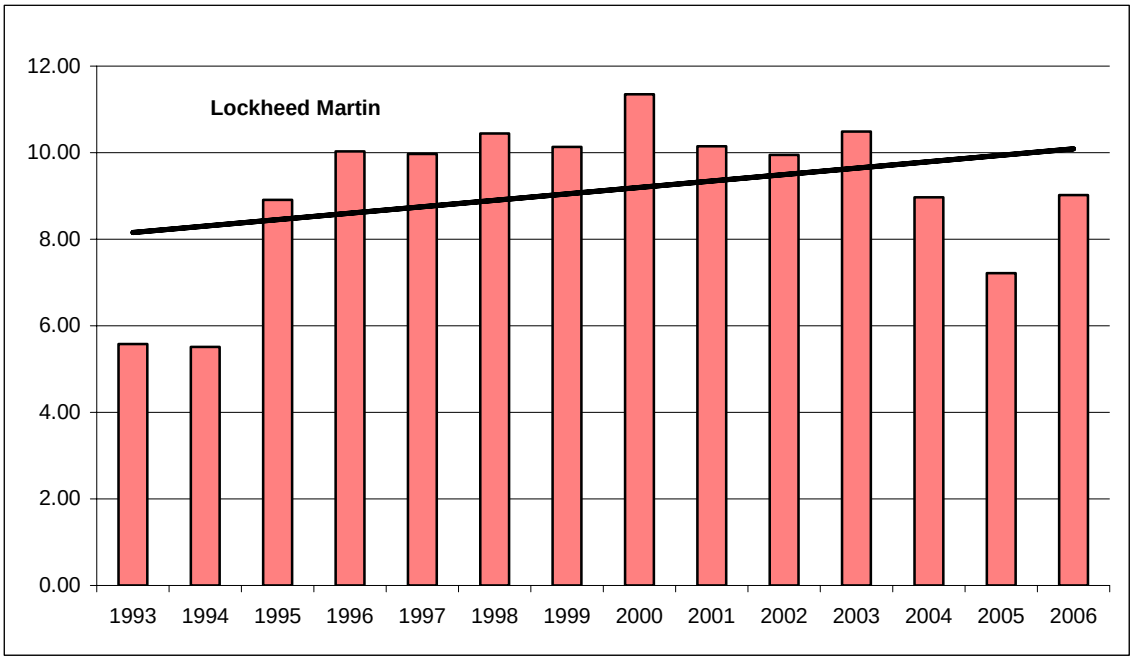

Figure 17. **Percentage of Total Procurement awarded to Lockheed Martin (After[125])**

[124] Datamonitor. "Global Airspace & Defense: Industry Profile."

[125] Developed from the authors using data available at the report named "100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards" which is published annually and is available online at dtic.net. The data are also available at the Statistical Information Analysis Division (SIAD) web site of the DoD at http://siadapp.dmdc.osd.mil/ (assessed April 2008).

3. Northrop Grumman

In comparison to the top two giants of the industry, Northrop Grumman Corporation occupies the third place in the U.S. aerospace and defense market, accounting for a share of 10.5% of the market's value. The percentage of the total procurement spending that is awarded to the company almost doubled after the intense M&A activity of the 1990s, now reaching the level of 5% of the total amount, with an average of 3.65% for the time period of the existing data as depicted in Figure 18.

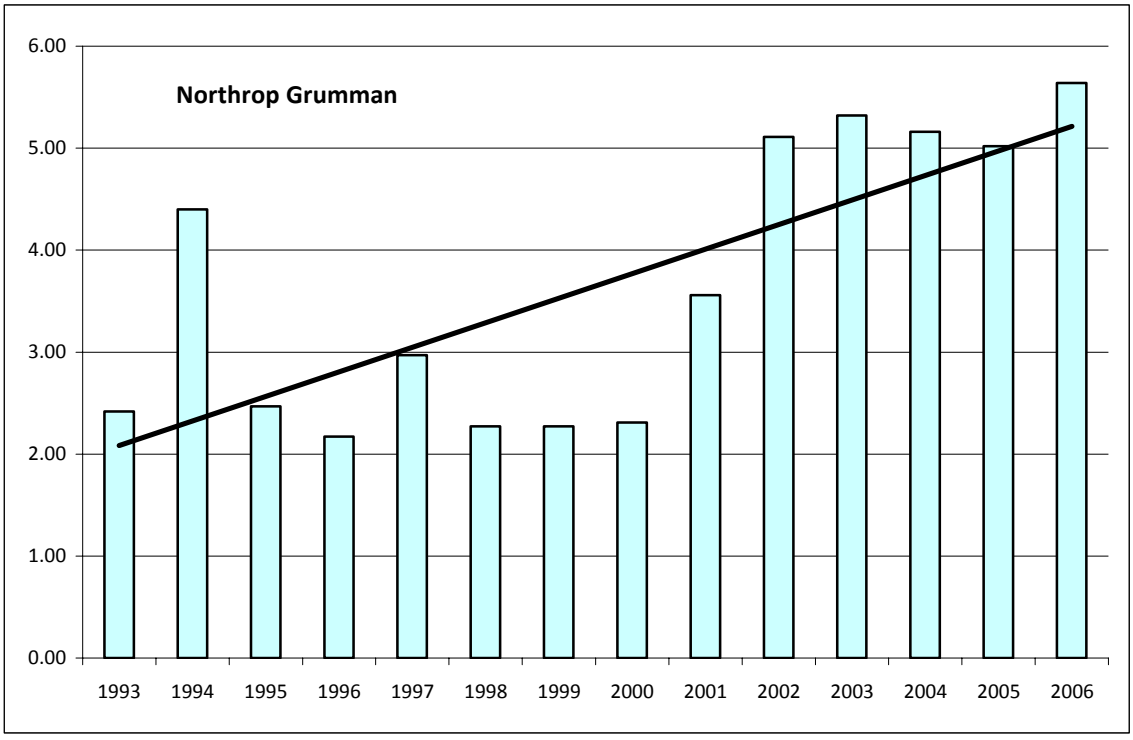

Figure 18. **Percentage of Total Procurement awarded to Northrop Grumman (After[126])**

126 Developed from the authors using data available at the report named "100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards" which is published annually and is available online at dtic.net. The data are also available at the Statistical Information Analysis Division (SIAD) web site of the DoD at http://siadapp.dmdc.osd.mil/ (assessed April 2008).

4. General Dynamics

The percentage of total procurement, which is yearly awarded to General Dynamics, has shown a significant increase over the years of consolidation. The company is now occupying the fourth place in the ranking "Top 100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards," accounting for an average 3.02% of the total amount spent on procurement as depicted in Figure 19.

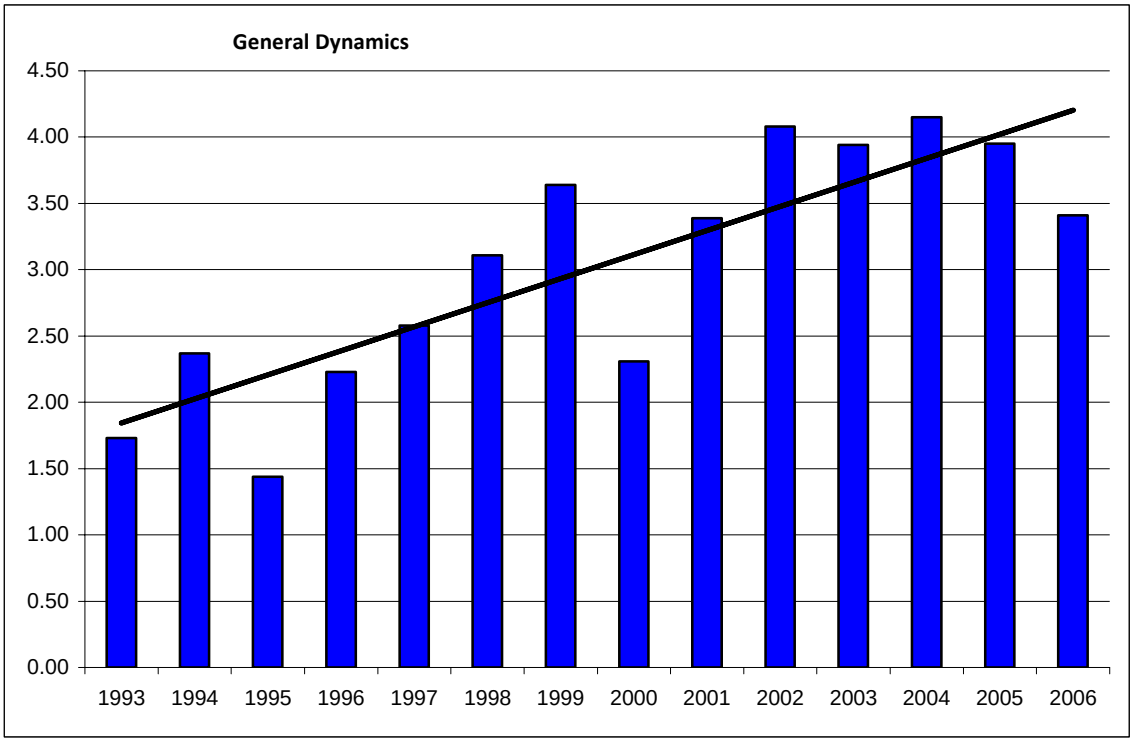

Figure 19. **Percentage of Total Procurement awarded to General Dynamics (After[127])**

[127] Developed from the authors using data available at the report named "100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards" which is published annually and is available online at dtic.net. The data are also available at the Statistical Information Analysis Division (SIAD) web site of the DoD at http://siadapp.dmdc.osd.mil/ (assessed April 2008).

5. Raytheon

Last but not least among the five top contractors, Raytheon holds the fifth place in the ranking of the "Top 100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards," accounting for an average of 3.50% of the total amount spent on procurement as depicted in Figure 20. For Raytheon the proportion of contracts awarded has increased as an effect of the defense industry consolidation but at a lower rate than others. The company is constantly competing with General Dynamics for fourth place on the list.

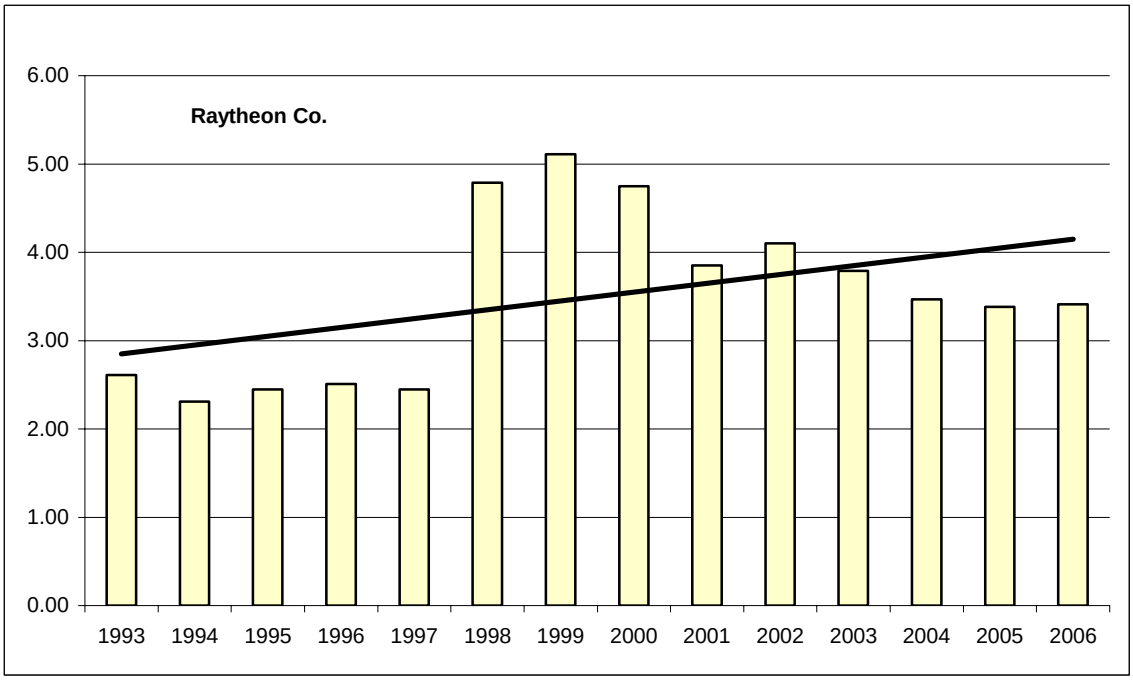

Figure 20. **Percentage of Total Procurement awarded to Raytheon(After[128])**

[128] Developed from the authors using data available at the report named "100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards" which is published annually and is available online at dtic.net. The data are also available at the Statistical Information Analysis Division (SIAD) web site of the DoD at http://siadapp.dmdc.osd.mil/ (assessed April 2008).

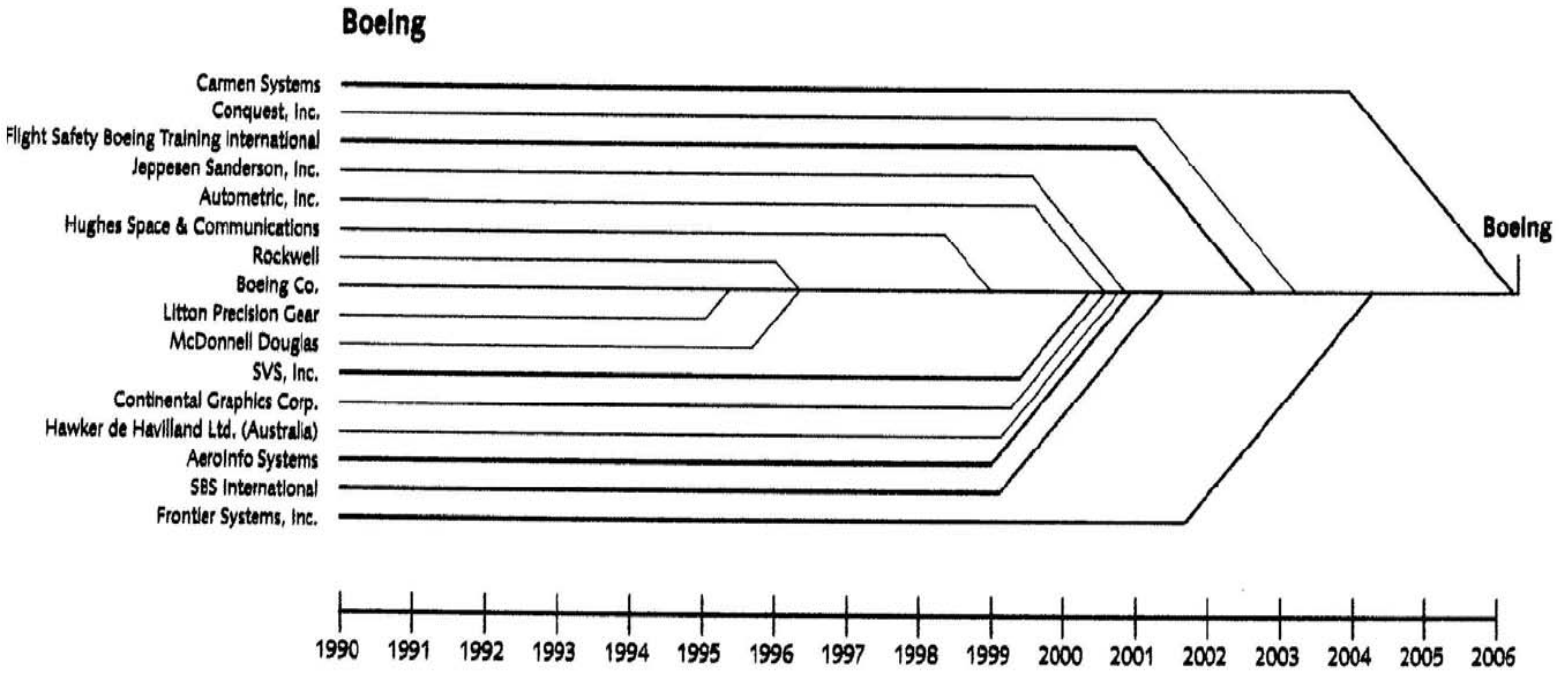

Figure 21. **The Boeing Company Consolidation Diagram(From[129])**

129 Sources DM&A, Washington Technology, various company reports and analysis by CSIS Defense Industrial Initiatives Group.

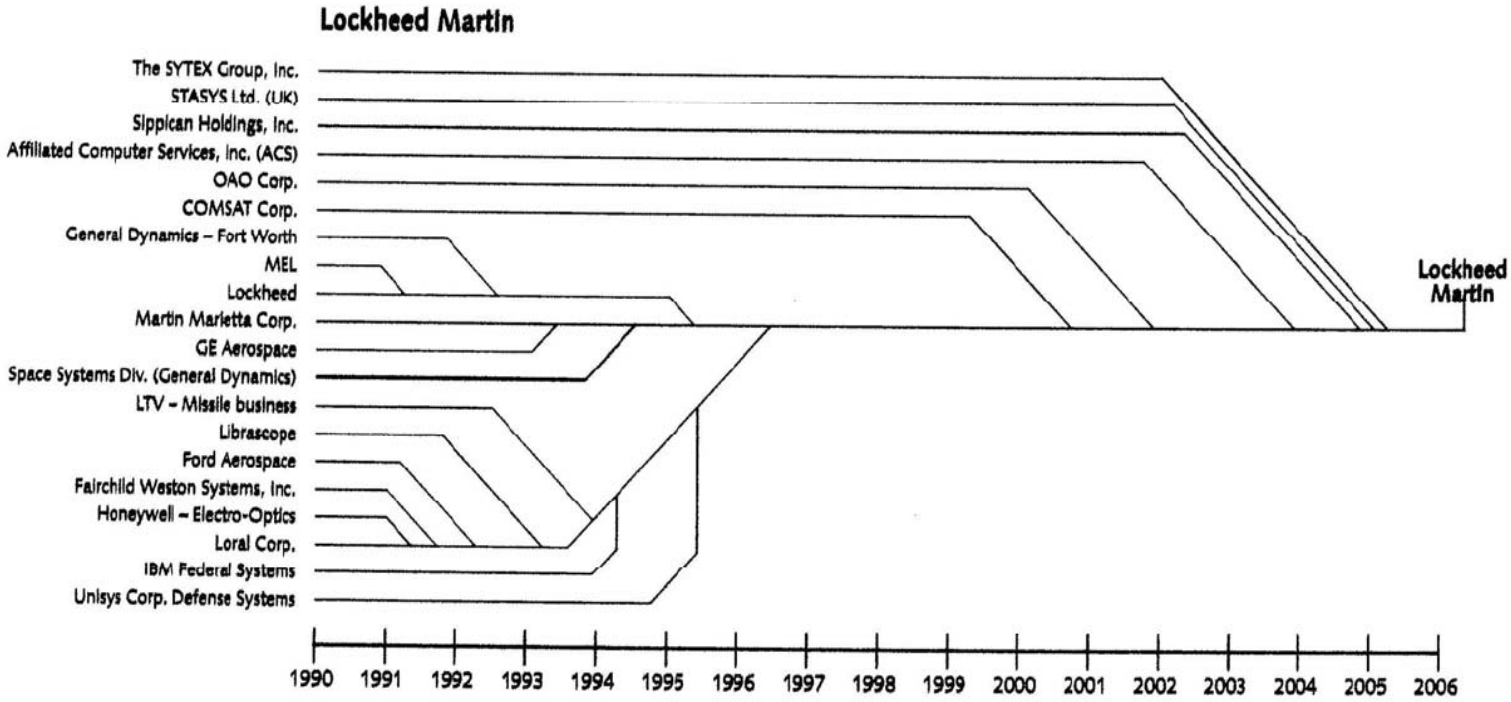

Figure 22. **Lockheed Martin Corp. Consolidation Diagram(From[130])**

130 Sources DM&A, Washington Technology, various company reports and analysis by CSIS Defense Industrial Initiatives Group.

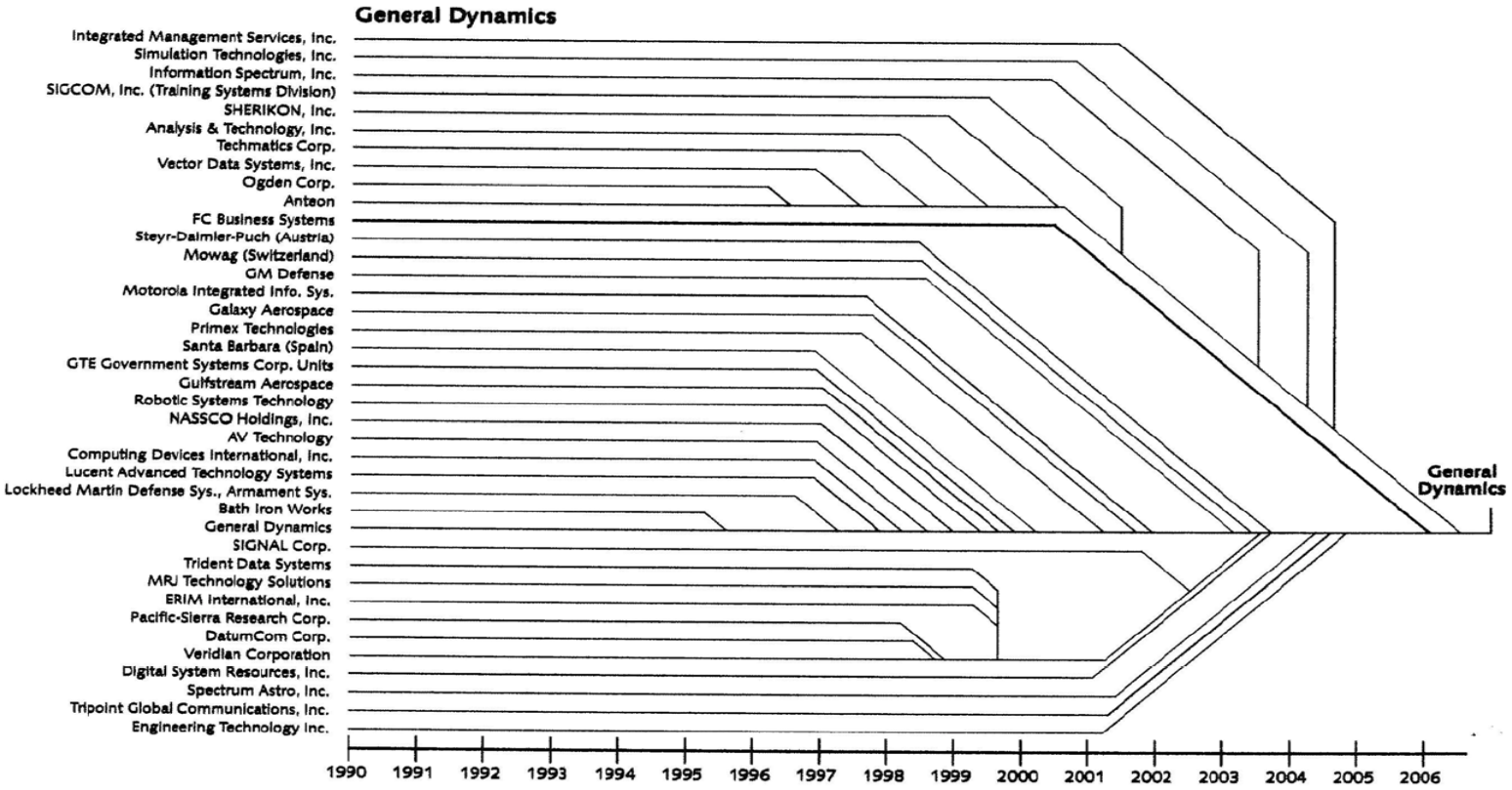

Figure 23. **General Dynamics Corp. Consolidation Diagram(From[131])**

131 Sources DM&A, Washington Technology, various company reports and analysis by CSIS Defense Industrial Initiatives Group.

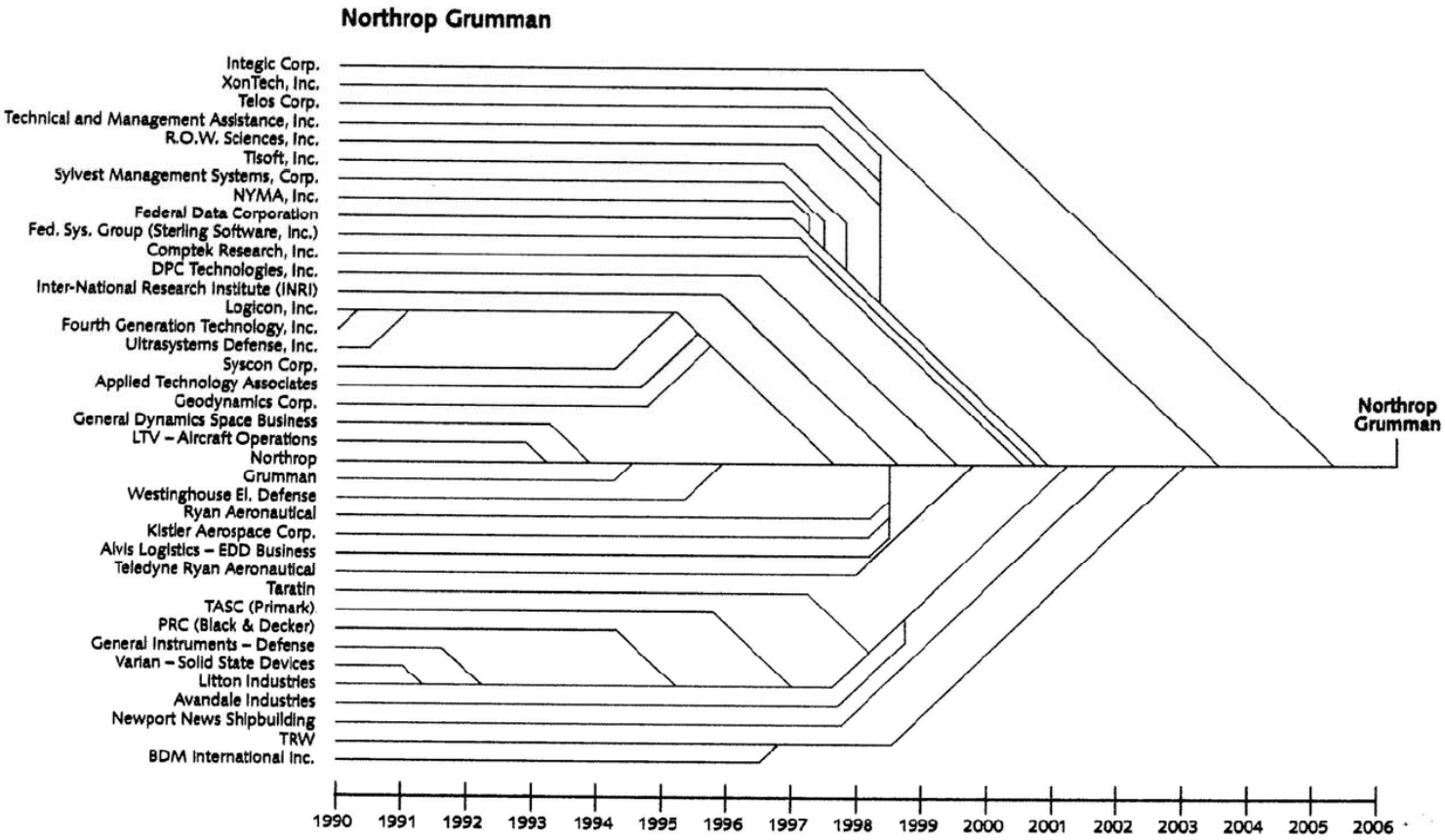

Figure 24. **Northrop Grumman Corp. Consolidation Diagram (From[132])**

132 Sources DM&A, Washington Technology, various company reports and analysis by CSIS Defense Industrial Initiatives Group.

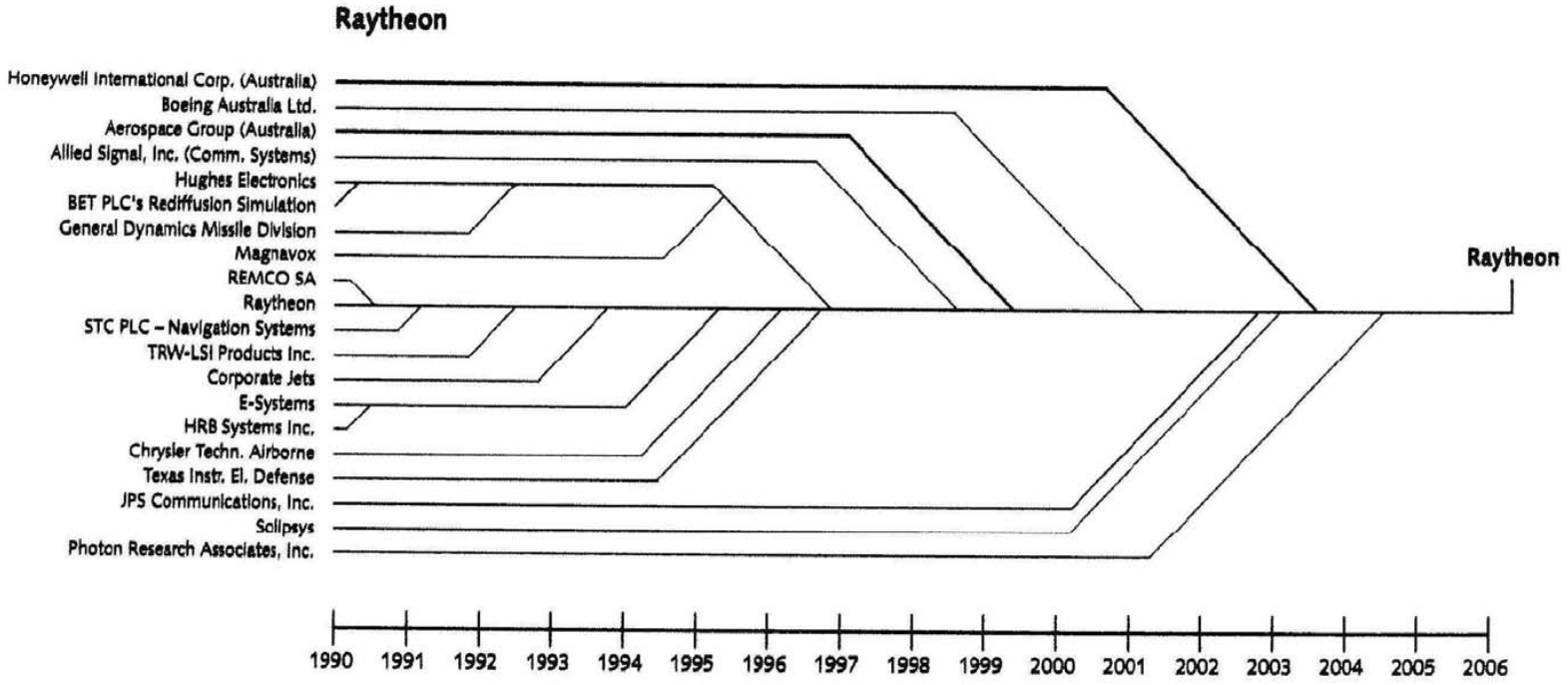

Figure 25. **Raytheon Company Consolidation Diagram (From[133])**

133 Sources DM&A, Washington Technology, various company reports and analysis by CSIS Defense Industrial Initiatives Group.

III. METHODOLOGY

A. INTRODUCTION

Cost estimation and different ways to measure and report it, is a major issue in every organization dealing with acquisition of systems and program management. DoD Instruction 5000.1 is the fundamental acquisition policy document that sets the framework of acquisition and program management within the military environment and provides useful details about procedures which should be followed during the life cycle of each program. In addition, DoD Instruction 5000.2 provides details for the operation of defense acquisition system and lists the type and number of records and reports required to assure that everyone involved directly or indirectly to the project management of system has access to adequate information about the evolution of the program and can participate in the respective decision making process. One of the mandatory requirements for each one of the major defense acquisition programs is the almost quarterly submission of cost estimations and possible changes through the SARs. The purpose of the SAR is to inform the associated committees of the Congress and the Senate about the evolution of MDAP and consequences on the appropriated budget for each program. This analysis is solely based on cost data derived from selected acquisition reports submitted after 1980, although SAR cost information is available for hundreds of programs dating back to December 1969. The purpose of this thesis is to investigate whether the period of intense M&A activity of the 1990s in the defense industry has affected the cost of weapon systems. Therefore, the analysis of systems' cost data before the 1980s is considered beyond the scope of this survey.

B. ASSUMPTIONS AND GUIDELINES

The data that were used to calculate cost growth of the examined MDAPs are derived from a database developed in a previous analysis on the same field of defense industry consolidation. That database is a result of the collection of SAR submittals of weapons systems since 1980. However, the large amount of information of the accessible

database rendered mandatory the adoption of an additional number of criteria in order to facilitate the analysis. The majority of assumptions made and guidelines are thoroughly presented below:

- Defense industry consolidation that took place from 1993 until 1998 resulted in the formation of mainly top five defense contractors that dominate the market. A previous chapter presented that the proportion of prime defense contracts awarded to the top five contractors reaches 30% of the total amount spent on procurement, when at the same time the top 100 contractors absorb 60% of it. Thus, only the programs of Boeing, Lockheed Martin, Northrop Grumman, General Dynamics and Raytheon are examined throughout this analysis, as it is assumed that any possible trends concerning cost growth of systems will be reflected to the top contractors programs.
- In order to identify differences and possible trends and summarize conclusions all the examined programs were divided into three broad categories, mainly from the submittal dates of the SARs in which they were reported. Hence, the fist category incorporates programs that were completed in the years before the start of consolidation; that is, before 1993. The second category includes programs that started after the end of the period of interest (after 1997). The last one contains all those programs whose reporting cycle in the SARs includes the years of intense merger activity (1993 until 1997) and therefore are examined separately.
- One of the most important entries in every report for every program is the baseline year. This date is essential as it provides information about the beginning and reference year of cost estimation. For long lasting programs that appear in the SARs for decades, it is a common for cost estimators to reconfigure the baseline year for a program. Although there is strong belief that when in the course of reports of a program there is a change in the baseline year, the rest of the program for cost estimation should be considered as a new program; in this analysis we neglect this belief. As will be described in a later section, cost growth is being calculated as a ratio of cost estimates and therefore inflation factors are eliminated; hence, the series of numbers (cost estimates) for a program are taken all into consideration even if there was a change in baseline year.
- As was presented in a previous chapter, the official metric to quantify the degree of competitiveness in a specific industry is the Herfindahl–Hirschman Index (HHI). The antitrust authorities are also using this index as a criterion for the approval of a proposed merger or acquisition. The official source that provides the values for the HHI for the different industries is the U.S. Census Bureau. Every different industry is tagged with a number according to the North American Industry Classification System (NAICS). This NAICS number has replaced the older U.S.

Standard Industrial Classification (SIC) system. Since the NAICS number for each program was available in the database from where cost data were extracted, the results of the statistical analysis were also sorted by NAICS in an effort to directly relate the officially calculated degree of concentration in the industry, as expressed by the HHI, with the programs' cost growth.

- Each of the selected programs provided a set of numbers reflecting the fluctuation of the cost growth index of the respective program. The method to calculate cost growth is described analytically in a later paragraph. The average of these series of numbers resulted in the average cost growth for each system, which was the number used for further analysis.

After examining the available database through the perspective formed from the criteria listed above, from almost 358 programs, 113 programs were analyzed and the geometric average of cost growth was calculated.

C. COST GROWTH CALCULATIONS

It is very important to note that the information that the SAR reports include are not intended to serve as a basis for statistical analysis. The relevant literature mentions several limitations for the use of the data of SAR reports for the calculation of cost growth and attempts to deal with these limitations in different ways. However, the cost growth of weapon systems programs can still be useful to provide some quantitative assessments for the related issues. The limitations that exist have not prevented several studies for the programs cost growth, due to the insights that they can offer, in terms of the overall issue of the cost of weapon systems that the DoD procures.

Due to the limitations of cost growth, this metric has to be combined with other relevant information and views in order to draw any conclusions. Even with this combination, the conclusions are inherently risky in terms of the actual causes and effects related to the cost of weapon systems. Nevertheless, useful indications can emerge from this kind of analysis.

In the existing literature, the definition of cost growth can be seen either as the ratio of a current cost estimate to a previous cost estimate of the same system in the past, and alternatively as the difference between the most recent or final estimate and the initial

one. In this analysis, cost growth was calculated for every one of the selected systems as the ratio of the current cost estimate (in base year dollars) to the baseline cost estimate (again in base year dollars). In this approach a time series of numbers, each one reflecting at the specific SAR from which data were derived, was produced for each program. This method was selected as it offered the advantage to eliminate problems caused from inflation factors because it compares amounts of money of the same year (baseline year). Thus, any change in baseline year seemed to have minor effects on the calculated numbers as it affected not only current year estimates but baseline estimates as well. Additionally, in order to account for changes in cost growth due to changes made in the quantities of the respective weapon systems, a calculation of unit cost growth was applied. The following table is a representative sample of the database information used to calculate unit cost growth.

Weapon System	Base Year	SAR Date	Service	Baseline Estimate			Current Estimate		
				Base Year	Then Year	Quantity	Base Year	Then Year	Quantity
C-5 RERP	2000	6/30/2002	Air Force	**8798**	11093.9	**126**	**8480.8**	10269.7	**112**
C-5 RERP	2000	9/30/2002	Air Force	**8798**	11093.9	**126**	**8480.8**	10269.7	**112**
C-5 RERP	2000	12/31/2002	Air Force	**8798**	11093.9	**126**	**8554.7**	10257.1	**112**
C-5 RERP	2000	6/30/2003	Air Force	**8798**	11093.9	**126**	**8554.7**	10257.1	**112**
C-5 RERP	2000	9/30/2003	Air Force	**8798**	11093.9	**126**	**8554.7**	10257.1	**112**
C-5 RERP	2000	12/31/2003	Air Force	**8798**	11093.9	**126**	**8463.2**	10192.3	**112**
C-5 RERP	2000	6/30/2004	Air Force	**8798**	11093.9	**126**	**8463.2**	10192.3	**112**
C-5 RERP	2000	9/30/2004	Air Force	**8798**	11093.9	**126**	**8463.2**	10192.3	**112**
C-5 RERP	2000	12/31/2004	Air Force	**8798**	11093.9	**126**	**8639.7**	11046.8	**112**
C-5 RERP	2000	6/30/2005	Air Force	**8798**	11093.9	**126**	**8639.7**	11046.8	**112**
C-5 RERP	2000	9/30/2005	Air Force	**8798**	11093.9	**126**	**8639.7**	11046.8	**112**
C-5 RERP	2000	12/31/2005	Air Force	**8798**	11093.9	**126**	**8494.1**	11054.1	**112**
C-5 RERP	2000	6/30/2006	Air Force	**8798**	11093.9	**126**	**8494.1**	11054.1	**112**
C-5 RERP	2000	9/30/2006	Air Force	**8798**	11093.9	**126**	**8494.1**	11054.1	**112**
C-5 RERP	2000	12/31/2006	Air Force	**8798**	11093.9	**126**	**12983.7**	17506.2	**111**
C-5 RERP	2000	6/30/2007	Air Force	**8798**	11093.9	**126**	**12983.7**	17506.2	**111**
C-5 RERP	2000	9/30/2007	Air Force	**8798**	11093.9	**126**	**12983.7**	17506.2	**111**
C-5 RERP	2000	12/31/2007	Air Force	**8798**	11093.9	**126**	**8478**	11130.9	**111**

Table 11. **Database Table Example used for Unit Cost Growth Calculation**

The data contained in the shaded columns were used for the calculation. The formula that was applied is presented below:

$$\text{Unit Cost Growth} = \frac{\text{Current Estimate} \big/ \text{Current Quantity}}{\text{Baseline Estimate} \big/ \text{Baseline Quantity}}.$$

All amounts are expressed in baseline year dollars.

The same calculation is repeated for as many entries (different SARs) that exist in the database. The outcome is a series of numbers, the geometric average of which is calculated, and represents the mean Unit Cost Growth for the examined weapon system. The geometric mean was used for two reasons: first, to extract a single value of the examined metric for each weapon system; and second, because it is more appropriate as a measure, when working with percentages, rather than the true values, as was the case in this study. The formula to calculate the geometric mean is the following:

$$\text{Geometric Mean} = \sqrt[n]{CG_1 \times CG_2 \times ... CG_n}.$$

The function of MS Excel to calculate the geometric mean was used.

D. DATA ANALYSIS

After calculating the values of cost growth for the selected weapon systems programs, a basic statistical analysis was performed. Specifically, the descriptive statistics function of the data analysis add-in feature for MS Excel was applied. The results are included and discussed in the next chapter. Following the initial analysis, data were sorted according to the NAICS number in an effort to relate the examined weapons system and its cost growth with the available values of the HHI.

It is important to note that the U.S. Census Bureau has values for HHI for five-year-long periods. Therefore, the amount of HHI data is limited, posing restrictions for detailed quantitative analysis and formulation of models.

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IV. STATISTICAL ANALYSIS AND RESULTS

A. INTRODUCTION

Using the methodology previously described in chapter III, this chapter presents the descriptive analysis findings. First, a basic analysis is presented including findings of the distribution of values of cost growth of all programs and then the distribution among formatted time categories. Second, a narrative presentation is made using available data for the NAICS categories in which the selected programs belong.

B. RESULTS AND FINDINGS

1. All Programs

As described in the previous chapter, the selected programs of the top five contractors were distributed in the three time periods of interest. The findings are presented in Table 12.

	Before Consolidation	Including Consolidation	After Consolidation	
	(T<1993)	**(1993< T < 1997)**	**(T> 1997)**	**Total**
Boeing	9	6	12	27
Lockheed Martin	7	12	10	29
Northrop Grumman	0	5	9	14
General Dynamics	13	5	5	23
Raytheon	4	9	7	20
Total	33	37	43	113

Table 12. **Distribution of systems examined among different categories**

The application of descriptive statistics for the cost growth values, gave the results depicted in Tables 13, 14 and Figure 26.

	Cost Growth			
	All Systems	*Before 1993*	*Including*	*After1997*
Mean	1.145525536	1.154832227	1.179712001	1.10896693
Standard Error	0.027057106	0.05476323	0.053245167	0.035048468
Median	1.078556918	1.083243668	1.107108068	1.063693154
Mode	#N/A	#N/A	#N/A	#N/A
Standard Deviation	0.287620982	0.314590807	0.32387771	0.229828172
Sample Variance	0.082725829	0.098967376	0.104896771	0.052820989
Kurtosis	3.833400928	-0.054044667	6.658460884	1.314996604
Skewness	1.411080642	0.679946793	2.243011216	0.474355287
Range	1.924584961	1.286938826	1.720389139	1.199455172
Minimum	0.560927175	0.605432518	0.765122997	0.560927175
Maximum	2.485512135	1.892371344	2.485512135	1.760382346
Sum	129.4443855	38.1094635	43.64934403	47.685578
Count	113	33	37	43

Table 13. **Descriptive Statistics of Systems calculated Cost Growth**

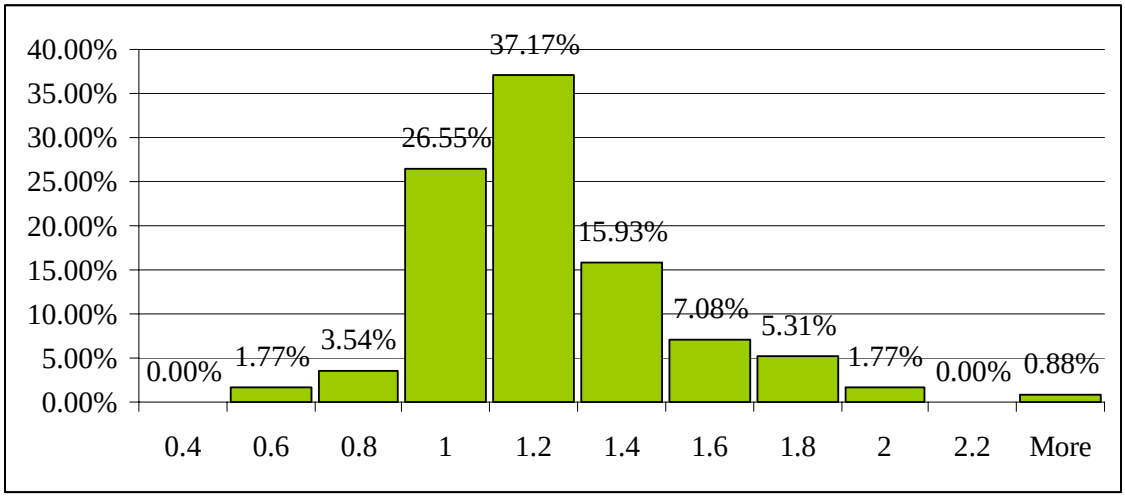

Figure 26. **Distribution of examined systems Cost Growth (All Selected Programs)**

Cost Growth Interval Values	All Programs
0.4 – 0.8	5.31%
0.8 – 1.2	63.72%
1.2 – 1.6	23.01%
Above 1.6	7.96%

Table 14. **Distribution of Cost Growth Values**

2. Programs Before Consolidation (prior 1993)

The calculated values of cost growth for programs before the consolidation period are presented in Table 15 and Figure 27:

	NAICS	Weapon System	Manufacturer	Calculated Cost Growth
1	332993	Avenger (FAADS LOS-R)	Boeing	**1.118764366**
2	336411	CH-47D	Boeing	**1.22094507**
3	336411	CSLR	Boeing	**0.817965126**
4	336411	EA-6	Boeing	**0.883443068**
5	336414	IUS	Boeing	**1.544952871**
6	336411	KC-135R	Boeing	**0.758522008**
7	336414	PeaceKeeper	Boeing	**1.195323666**
8	336414	Sea Lance	Boeing	**1.083243668**
9	336414	SRAM-II	Boeing	**1.060379149**
10	336414	F-16	Lockheed Martin	**1.073157728**
11	336611	LSD-41	Lockheed Martin	**0.962378972**
12	336611	LSD-41 (CV)	Lockheed Martin	**0.917673975**
13	336411	P-3C	Lockheed Martin	**0.987189659**
14	336411	RPV	Lockheed Martin	**0.889740688**
15	336414	UTDMDSS	Lockheed Martin	**1.049137522**
16	332993	Trident	Lockheed Martin	**1.155126096**
17	332993	ACM	General Dynamics	**1.516407934**
18	336992	Bradley FVS	General Dynamics	**1.731555969**
19	336411	F-16	General Dynamics	**1.049171156**
20	336414	GLCM	General Dynamics	**1.892371344**
21	336992	M1 Tank	General Dynamics	**1.306829889**
22	336611	NSSN	General Dynamics	**1.042483885**
23	332995	Phallanx CIWS	General Dynamics	**1.203628042**
24	336611	SSN-21 Seawolf	General Dynamics	**1.726894956**
25	336611	SSN-688 Los Angeles	General Dynamics	**1.177606645**
26	336414	Stinger	General Dynamics	**1.255858439**
27	336414	Stinger RMP	General Dynamics	**0.605432518**

28	336414	Tomahawk	General Dynamics	**0.84876667**
29	332993	Trident II SUB	General Dynamics	**0.818640741**
30	336414	Sparrow AIM-7M	Raytheon	**1.317064876**
31	336411	Tacit Rainbow	Raytheon	**0.786522893**
32	336414	Sidewinder AIM-9M Navy	Raytheon	**1.394069216**
33	336414	Sidewinder AIM-9M USAF	Raytheon	**1.718214694**

Table 15. **Systems examined Before Consolidation (prior 1993)**

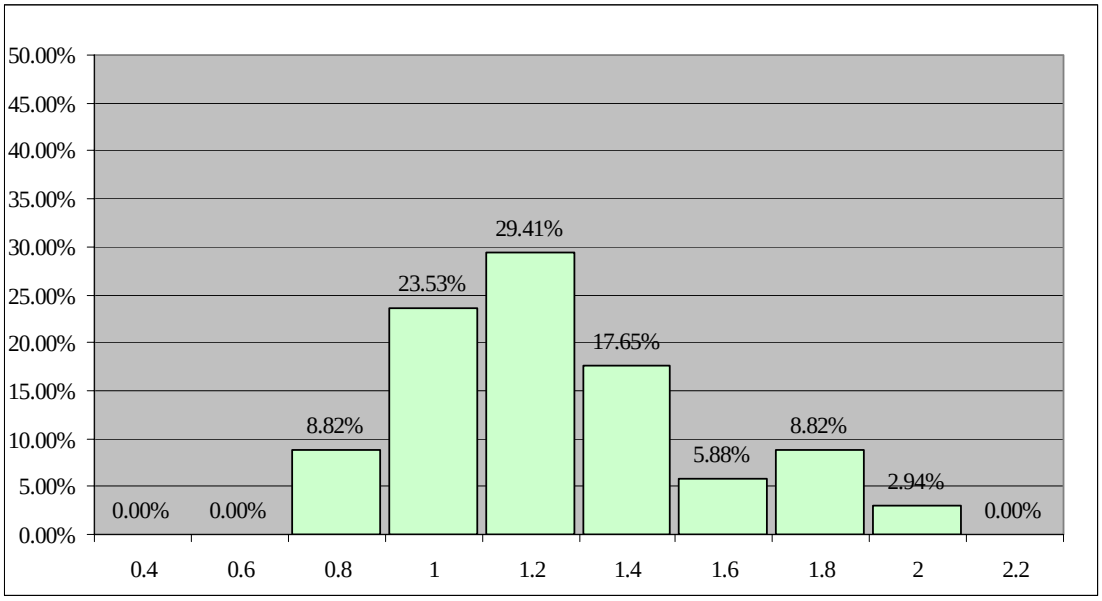

Figure 27. **Distribution of Cost Growths for systems before consolidation**

3. Programs Including Consolidation Period (between 1993 and 1997)

The calculated values of cost growth for programs during the consolidation period are presented in Table 16:

	NAICS	**Weapon System**	**Manufacturer**	**Calculated Cost Growth**
1	336411	AV-8 Remanufacture	Boeing	**1.065977316**
2	336411	C-17A	Boeing	**1.49031003**
3	334511	E-3RSIP AWACS	Boeing	**1.124134484**

4	336411	F/A-18 E/F	Boeing	**1.062733596**
5	332995	JDAM	Boeing	**0.883041373**
6	336411	T-45 TS	Boeing	**1.064106908**
7	332993	ATACAMS-APAM	Lockheed Martin	**0.986640918**
8	332993	ATACAMS-BAT	Lockheed Martin	**1.81356796**
9	334511	ATIRCM/CMWS	Lockheed Martin	**1.267117068**
10	336411	F-22	Lockheed Martin	**1.334273566**
11	332993	JASSM	Lockheed Martin	**0.765122997**
12	336414	Longbow Hellfire	Lockheed Martin	**1.146621691**
13	541512	MCS (ATCCS)	Lockheed Martin	**1.043534325**
14	334220	NAVSTAR GPS	Lockheed Martin	**0.959162866**
15	334220	SBIRS	Lockheed Martin	**1.795215248**
16	332993	Trident II MSL (D-5)	Lockheed Martin	**1.229928839**
17	336414	Titan IV	Lockheed Martin	**1.252481642**
18	336414	THAAD	Lockheed Martin	**1.601835841**
19	336611	DDG-51	Northrop Grumman	**0.984758614**
20	336411	E-2C Reproduction	Northrop Grumman	**1.129474529**
21	336411	JSTARS	Northrop Grumman	**1.177392073**
22	336611	LHD-1	Northrop Grumman	**0.88525463**
23	336414	Minuteman III GRP	Northrop Grumman	**1.133774786**
24	336992	EFV (AAAV)	General Dynamics	**1.39785463**
25	336611	LPD-17	General Dynamics	**1.265046752**
26	336992	M1A2 ABRAMS Upgrade	General Dynamics	**1.035893266**
27	334511	SSN-21 / AN/BSY-2	General Dynamics	**2.485512135**
28	336611	Strategic Sealift	General Dynamics	**0.923973389**
29	332993	AIM-9X	Raytheon	**1.009048048**
30	336414	AMRAAM	Raytheon	**1.159309474**
31	334511	CEC	Raytheon	**1.034414335**
32	332993	JSOW (AIWS)	Raytheon	**0.954242059**
33	334511	NAS	Raytheon	**0.955638828**
34	334220	NESP	Raytheon	**0.89278149**
35	336414	Patriot Pac-3	Raytheon	**1.27462087**

36	334220	Smart-T	Raytheon	**0.957439387**
37	336414	STD MSL 2	Raytheon	**1.107108068**

Table 16. **Systems Examined including Consolidation period (between 1993 - 1997)**

The distribution of values of calculated cost growth among different intervals is depicted in Figure 28.

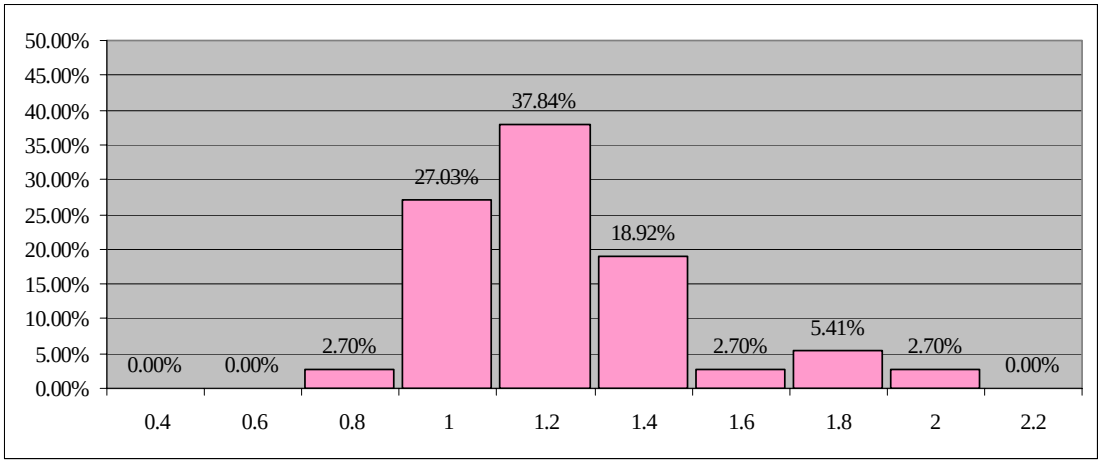

Figure 28. **Distribution of Cost Growths for Systems during Consolidation**

4. Programs After Consolidation Period (after 1997)

The calculated values of cost growth for programs after the consolidation period are presented in Table 17:

	NAICS	Weapon System	Manufacturer	Calculated Cost Growth
1	336411	ABL	Boeing	**1.063693154**
2	334511	C-130 AMP	Boeing	**1.507778138**
3	336411	CH-47F	Boeing	**1.405536717**
4	336411	EA-18G	Boeing	**1.022363591**
5	336414	EELV	Boeing	**1.423290924**
6	541512	FCS	Boeing	**1.259994685**
7	334220	JTRS GMR (Cluster 1)	Boeing	**1.013976414**
8	334220	JTRS NED (Waveform)	Boeing	**1.503781658**

9	541512	MPS	Boeing	**0.964891074**
10	332993	NMD	Boeing	**1.315894231**
11	336411	P-8 (MMA)	Boeing	**0.98852256**
12	334220	Wideband Gap Filler	Boeing	**0.974405811**
13	334220	AEHF	Lockheed Martin	**1.308484535**
14	336411	C-130J	Lockheed Martin	**1.168238036**
15	336411	C-5 REPR	Lockheed Martin	**1.171722084**
16	332995	GMLRS	Lockheed Martin	**1.0807726**
17	332995	HIMARS	Lockheed Martin	**1.078556918**
18	336411	JSF (F-35)	Lockheed Martin	**1.149705409**
19	334220	MUOS	Lockheed Martin	**0.941377857**
20	332995	MLRS Upgrade	Lockheed Martin	**0.895321783**
21	332993	PATRIOT / MEADS CAP	Lockheed Martin	**0.968273865**
22	334511	SSDS	Lockheed Martin	**0.560927175**
23	336611	ASDS	Northrop Grumman	**1.212607838**
24	334511	B-2 PMP	Northrop Grumman	**0.927693539**
25	336611	CVN-21 (RDT&E)	Northrop Grumman	**0.976461591**
26	336611	CVN-68	Northrop Grumman	**1.142523537**
27	336611	DDG 1000 [DD(X)]	Northrop Grumman	**1.131351647**
28	336411	E-2 Adv Hawkeye	Northrop Grumman	**1.034386408**
29	336411	Global Hawk	Northrop Grumman	**1.760382346**
30	334511	MP RTIP	Northrop Grumman	**0.898033307**
31	336611	T-AKE	Northrop Grumman	**1.021927241**
32	334220	JTRS HMS (Cluster 5)	General Dynamics	**1.015998713**
33	336611	SSGN Ohio Class	General Dynamics	**0.994806924**
34	336611	SSN-774 Virginia Class	General Dynamics	**1.333942454**
35	336992	Stryker IAV	General Dynamics	**1.051664969**
36	334220	WIN-T	General Dynamics	**1.084515647**
37	332993	BMDS (RDT&E)	Raytheon	**1.557661977**
38	334511	Cobra Judy	Raytheon	**1.003073289**
39	332993	Excalibur	Raytheon	**1.136013602**
40	334220	GBS	Raytheon	**0.598751564**

41	332993	Navy Area TBMD	Raytheon	**1.101677791**
42	336414	SM-6	Raytheon	**0.967489495**
43	336414	Tactical Tomahawk	Raytheon	**0.967104899**

Table 17. **Systems examined After Consolidation period (after 1997)**

The distribution of values of calculated cost growth among different intervals is depicted in Figure 29.

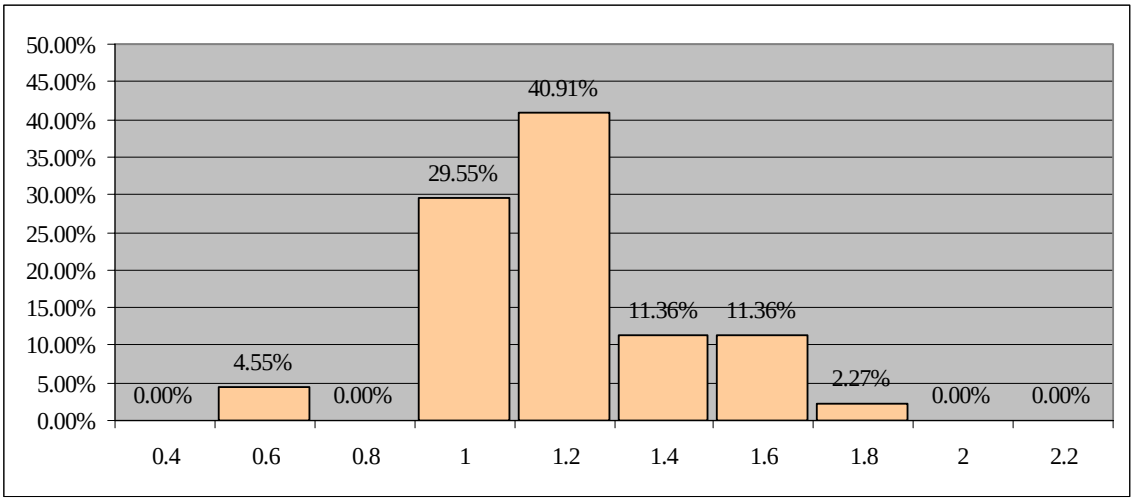

Figure 29. **Distribution of Cost Growths for Systems After Consolidation**

Despite the fact that the selected programs represent a relatively small sample of the total history of the programs that are included in the SAR reports, and therefore the estimations or inferring are risky, we can still identify some interesting points in relation with the cost growth. The categorization of the results, based on the range of cost growth values in Table 18, shows a difference between the periods before and after the defense industry consolidation. More specifically, we can observe a higher concentration of values within the range of 0.8-1.2 after the consolidation period. The percentage for this range is 52.94% for the period before the consolidation, whereas the percentages for the periods during and after the consolidation were 64.86% and 70.45% respectively.

Cost Growth Interval Values	Before Consolidation	Including Consolidation	After Consolidation
	(T<1993)	**(1993< T < 1997)**	**(T> 1997)**
0.4 – 0.8	8.83%	2.70%	4.55%
0.8 – 1.2	52.94%	64.86%	70.45%
1.2 – 1.6	23.53%	21.62%	22.73%
Above 1.6	11.76%	10.81%	2.27%

Table 18. **Distribution of Cost Growth Values**

From the descriptive statistics, a reduction in the standard deviation is observed for the programs after the period of consolidation, indicating a lower dispersion of values in relation with the mean.

The calculated values of cost growth after the consolidation period tend to concentrate in the range of 0.8 – 1.2, having a lower percentage of "extreme" values, including those that are below 0.8. After the consolidation, a percentage of 86.36% of programs had cost growth values below 1.4, whereas 79.41% of programs before consolidation fell into the same range. The most notable difference is identified in the range of 0.8-1.2, the percentage of which has significantly increased. In addition, the proportion of programs exceeding the value of 1.6 has become very low. In Figure 30 is presented a comparative analysis of the distribution of cost growth values among different intervals.

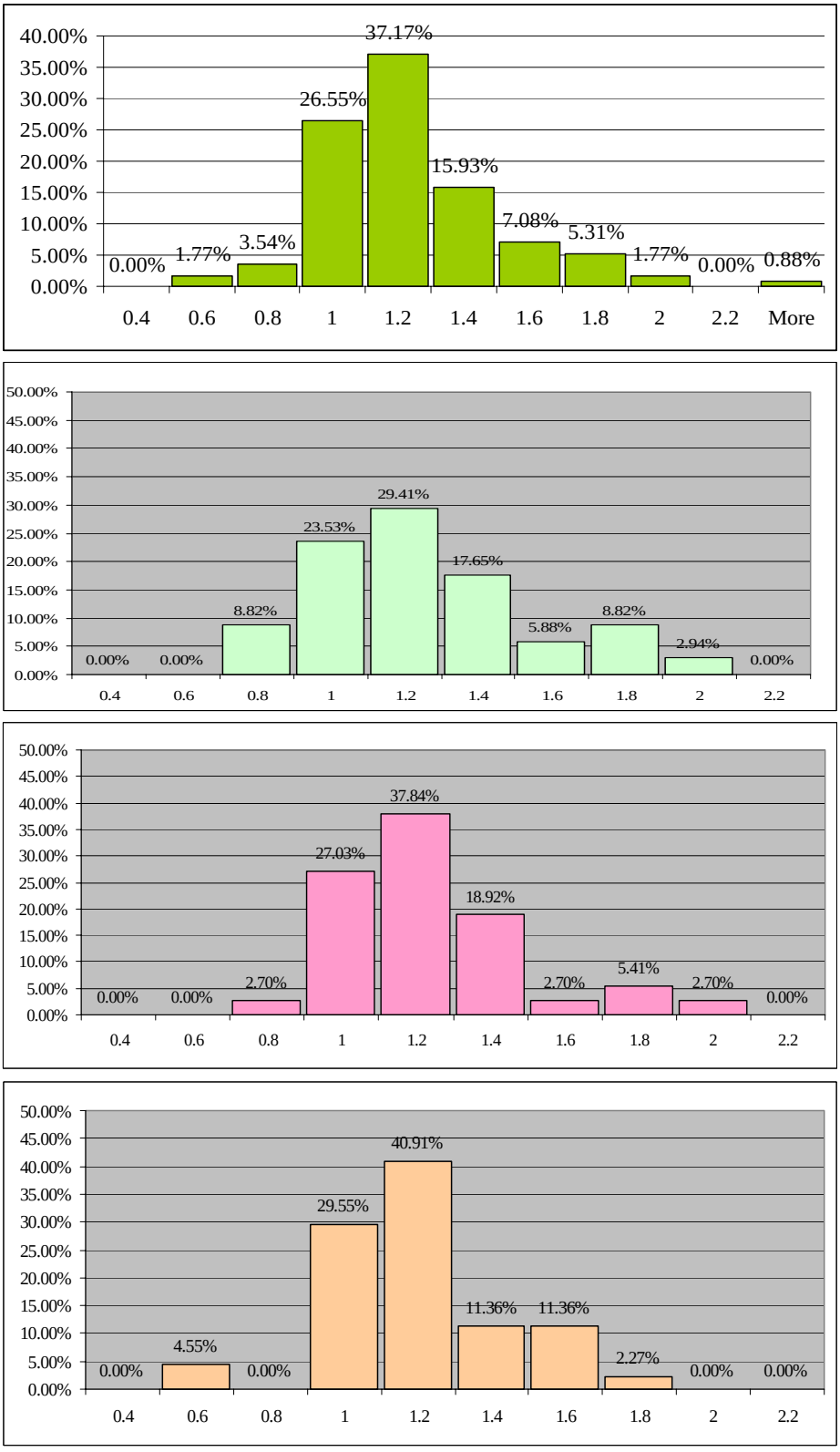

Figure 30. **Comparative Distribution of Cost Growths**

5. Analysis by NAICS

The selected programs were categorized by their NAICS number using the information provided in the database. The NAICS data were available from the U.S. Census Bureau Web Site, but for the purposes of this study, several limitations exist: some NAICS categories do not fully correspond with a single SIC code (the previous codification system). In addition, for some categories, after 1997, only data for the immediate higher-level category were available. For example, there are no data available after 1997 for codes numbers 336411 and 336414; instead, only data for 33641 are provided. For this reason, it is difficult to accurately describe the trend of the industrial concentration for these NAICS categories. Nevertheless, we can make assumptions based on the available data. The NAICS categories of the selected programs are listed in Table 19.

NAICS 1997	DESCRIPTION
332993	Ammunition (except Small Arms) Manufacturing
332995	Other Ordnance and Accessories Manufacturing
334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
336411	Aircraft Manufacturing
336414	Guided Missile and Space Vehicle Manufacturing
336611	Ship Building and Repairing
336992	Military Armored Vehicle, Tank, and Tank Component Manufacturing
541512	Computer Systems Design Services

Table 19. **NAICS categories for Selected Programs (After[134])**

134 Data from U.S. Census Bureau website. http://www.census.gov/epcd/www/naics.html (accessed May 10, 2008).

From the values of the HHI, listed in Table 20, a general picture for the degree of concentration in some categories of the industry can be derived. More specifically, for Shipbuilding and repairing sector (336611), the values for 1987, 1992 and 1997, indicate that for the period of the consolidation, there was no increase in concentration. If any increase existed, this had started before this period. In addition, there is a very large increase in 2002, well after the period of intense mergers and acquisitions activity of the 1990s.

Year/ NAICS	1982	1987	1992	1997	2002
332993	1003	988	1529	1,782.90	953.10
332995	1061	1858	1929	1,935.80	2,833.50
334220	-	-	-	971.9	583.6
334511	-	401	385	1,144.60	1135.9
336411	1358	1686	2717	1,636.90	1,518.40
336414	1578	1220	1570	1,636.90	1,518.40
336611	418	755	878	872.70	2,202.70
336992	-	-	-	563.30	742.1

Table 20. **HHI Values for NAICS categories for Selected Programs (After[135])**

For the aircraft manufacturing industry (336411), we do not have adequate information. However, it seems that this category was already highly concentrated in 1992, before the initiation of the consolidation activity. Furthermore, their higher-level category (33641) shows a moderate concentration for 1997 and 2002, but since no specific data are available for 336411, no definite conclusion can be drawn. The possibility for considerably higher concentration in sector 336411, seems rather low because this would mean that the concentration would reach extreme values. Although there is a high uncertainty, it seems that the actual concentration in this already highly concentrated industrial sector did not change dramatically in the 1990s. The situation for the sector of guided missiles and space vehicle manufacturing (336414) is somewhat different, with lower concentration values, seemingly smoother and more stable over

135 Data from U.S. Census Bureau website. http://www.census.gov/epcd/www/naics.html (accessed May 10, 2008).

time. For the Other ordnance & accessories manufacturing sector (332995), a high concentration had begun before the consolidation period, and remained in high values throughout the duration for which data are available, reaching the highest value among all the categories of the selected programs in 2002.

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V. CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

After the end of the Cold War period, the U.S. defense industry underwent a very extensive consolidation phase. At the same time, defense spending decreased. The end of this period of intensive mergers and acquisitions activity left only a handful of major defense contractors in the market. One sensible expected outcome of this consolidation was the increase of the efficiency of the defense contractors with subsequent results on the costs of weapon systems, ultimately saving money for the government. Thus, the federal government had actively supported the wave of mergers and acquisitions in the defense industry. Nevertheless, several issues were addressed in studies and surveys by governmental and non-governmental research institutes and organizations. This analysis is by no means all-inclusive and is intended to supplement past and future research in this area. From the SAR database, the raw data was organized and analyzed to calculate unit cost growths of selected systems (that met our analysis criteria) and to assist in providing answers to the research questions posed at the beginning of this thesis.

B. CONCLUSIONS

1. Primary Research Question

- Is there any obvious impact caused from the consolidation to the cost growth of the major defense acquisition programs (MDAP)?

Based on the results that were derived from the information included in the available database for the selected programs, an obvious quantitative impact on the cost growth of the programs can not be directly observed. This means that a significant increase or decrease, at least on a large scale, is not derived. However, in the findings it was identified that for the group of the selected programs that took place after the period of the intense merger and acquisition activity of the U.S. defense industry, the geometric

mean of their cost growth is somewhat less dispersed from the mean, showing a higher concentration in the range of 0.8 – 1.2.

At this point it can not be concluded that the consolidation was actually the sole cause, or even a partial cause, for this observation. The size of the sample is not sufficiently large, but it includes almost all of the programs for which the top five companies were prime contractors. Therefore, the results can be used as an indication to direct further research upon this area.

From a qualitative and descriptive standpoint, we can conclude that after the consolidation the results indicate that for the top five contractors, the geometric average of the cost growth of the weapon systems acquisition programs generally does not give higher values than the period before the consolidation.

Cost growth is a comparative metric showing the increase of the cost of a program after its initiation. Many different factors can affect this increase, including quantity changes, program management, technology maturity, etc. Although the SAR reports explain the various increases in cost, attributing them to specific categories, the role of the industry for cost growth must not be underestimated. Efficiency in the defense industry can be transferred in cost savings for the buyers and partially in cost stability for the programs.

One of the primary arguments of those that supported the consolidation was the cost reduction for the defense industry by eliminating unnecessary capacity and adding flexibility. It would be reasonable to expect some part of the anticipated improvements to transform into significant cost savings, or program stability.

The U.S. defense industry consolidation created a lot of debate, one of the root causes for which were concerns regarding the competitive effects. These concerns included the possibilities for significant increases in the cost of weapon systems acquisition programs due to lack of sufficient competition. These concerns arguably contributed to the gradual change of the governmental policy that supported mergers and acquisitions towards a more conservative approach, skeptical to further consolidation.

The results from the available information do not indicate that for the period after the consolidation higher increases in the cost of programs took place. This does not necessarily show that the consolidation improved the overall situation, but only that there are not any indications for significant increases. This is further supported by the results for the programs that took place during this period, which indicate a gradual increase in the concentration of the derived values within the range of 0.8-1.2.

There can be different interpretations of these results. It is possible that if the consolidation had not taken place, the geometric average of the cost growth would show the same behavior. On the other hand, it would be more reasonable to expect a situation with higher increases in cost, based on the problems of this industrial sector and the decreased demand after the Cold War. Since the results indicate that, at least, the values were kept within reasonable limits, it can be reasonably inferred that after the consolidation, cost growth shows a more controlled pattern of behavior. It is possible that other factors have contributed to this pattern, such as the acquisition reform efforts. The root causes have to be further explored, although this is a complicated issue and absolute or definite answers are rather unlikely.

2. Secondary Research Questions

a. What were the causes that led to U.S. defense industry consolidation?

The consolidation of the U.S. defense industry was an intense phenomenon with many aspects. At its beginning, it was generally attributed to the anticipated reduction of the demand for weapon systems and the decline of defense expenditures, due to the end of the Cold War and the expected Peace Dividend.

The available historical information for defense spending clearly indicate that periods like the one that followed the Cold War, with decreases in defense spending after some years of high defense budgets, are not unique, but similar previous cases exist. This directs the analysis towards exploring other potential causes that have, at least, contributed to the consolidation.

From the historical information and various studies for the merger waves in the U.S. industry in general, it can be derived that defense industry mergers and acquisitions activity took place within a period of a general merger wave, the fifth wave. This fact could be an indication that the defense industry consolidation is not an isolated phenomenon, despite the particular characteristics of the specific industrial sector. Further research is required to explore the possible connections between the two consolidation waves. Nevertheless, to attribute the defense industry consolidation solely to the governmental policy of the period is a risky assumption. The support of the government for the mergers, by distributing their costs on subsequent government contracts and by approving the proposed mergers and acquisitions, seem to have played a role in facilitating the mergers and acquisition, but this does not directly lead to the conclusion that these were the main causes of the phenomenon.

b. Are there any identifiable trends of the weapon systems cost growth based on the information, which are included in the Selected Acquisition Reports (SAR)?

From the results that were derived from the available data for the cost of weapon systems programs, there are not any indications for existing general trends. This means that the majority of the unit cost growth of the selected programs shows a high degree of fluctuation instead of a discernible trend, increasing or decreasing.

Many different diagrams with various combinations (e.g., by company, by period, by NAICS, etc.) were tried for the purposes for this study. However, these combinations did not reveal any trend. The only significant observation was for a number of programs of Boeing, including the period of consolidation, that showed a significant increase in cost growth during the program and then stabilization at reasonable levels. However, this number of programs is small, so the results were not included.

c. Are there any obvious consequences of the consolidation for the U.S. and foreign buyers of U.S. weapon systems?

For the U.S. and foreign buyers of weapon systems the results for the cost growth of weapon systems of the top five defense contractors possibly indicate a somewhat increased predictability in terms of the probability that the cost of a system can disproportionately increase during the course of a program. Again, this cannot be directly

attributed to the consolidation, but overall the situation appears as more beneficial for the buyers, especially in terms of budgeting and cost overruns.

C. RECOMMENDATIONS FOR FUTURE RESEARCH

Based upon difficulties confronted for the completion of this study, some useful ideas for further research are listed below:

- Exploit resources and available actual data (DD350) to recalculate Herfindahl–Hirschman Index (HHI) based on procurement dollars. Results can be used to relate market concentration with cost growth
- Extend period of study, at least for major defense contractors, to include prior periods.
- Explore possible metrics to develop time series and perform further analysis.
- Perform in-depth research for defense mergers and acquisitions using actual financial information.

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