Supply Chain Metrics That Matter: A Focus on Aerospace & Defense

Using Financial Data from Corporate Annual Reports to Better Understand the Aerospace & Defense Industry

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Research

Supply Chain Metrics That Matter is a series of reports published throughout the year by Supply Chain Insights LLC. They are a deep focus on a specific industry.

These reports are based on data collected from financial balance sheets and income statements over the period of 2000-2012. In these reports, we analyze how companies made trade-offs over the course of the last decade in balancing growth, profitability, cycles and complexity.

Within the world of Supply Chain Management (SCM) each industry is unique. We believe that it is dangerous to list all industries in a spreadsheet and declare a supply chain leader. Instead, we believe that we have to evaluate change over time by peer group. In this series of reports we analyze the potential of each supply chain peer group, share insights from industry leaders from each industry, and give recommendations based on general market trends.

Disclosure

Your trust is important to us. As such, we are open and transparent about our financial relationships and our research process. This independent research is 100% funded by Supply Chain Insights.

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Research Methodology

The basis of this report is publicly available information from corporate annual reports from the period of 2000-2012 for publicly-owned companies involved in the aerospace & defense industry.

The financial ratios used enable supply chain leaders to better understand where the industry is on the Supply Chain Effective Frontier. In this report, we share a framework for supply chain excellence that balances growth, profitability, cycles and complexity metrics. In each *Supply Chain Metrics That Matter* report, we share insights from each of these metrics categories. Because the supply chain is a complex system that must be managed holistically, we share the trends on each of these dimensions during the last decade.

In picking companies for the Supply Chain Metrics That Matter reports, we traditionally rely on companies recently listed in the Fortune Global 500. For the aerospace & defense industry, we identified 5 companies using the Fortune Global 500, the Morningstar peer group and NAICS codes[i] to inform our decision. Our goal was to select and analyze several of the most important companies in the industry.

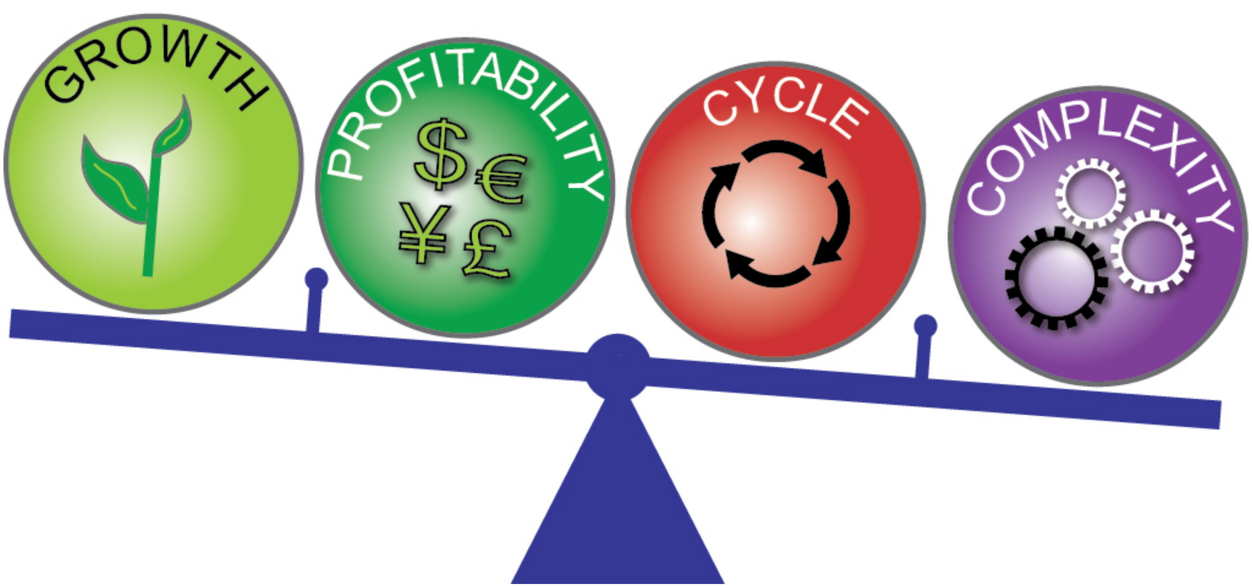
We use the financial data to help readers learn from past trends, to better understand current operating environments, and we provide recommendations for the future. We augment the financial data analysis with information from our quantitative and qualitative research studies as well as our work with clients operating within the industry.

Executive Overview

Each industry deals with its own form of complexity. For the aerospace & defense (A&D) industry, the complexity lies in sourcing and the management of platforms through the design and manufacturing processes. Over the last decade these challenges have become more complex and global. The rise of composite materials, quickly evolving software products in the cockpit, and increasing governmental compliance requirements are trends that the supply chain leader is grappling with in the world of the A&D supply chain. Take the **Boeing** 747-8 International as an example. This airplane, first delivered in 2012, has approximately 6 million individual components. It was designed to maximize the use of new composite materials to improve fuel efficiency and strength. Components for the aircraft are manufactured in nearly 30 countries by 550 separate suppliers.[ii] The resulting sourcing challenges, and evolving design and release schedules, are significant obstacles for the supply chain leader to balance

In our research, we have sorted over 50 financial metrics into four categories: growth, profitability, cycle, and complexity. We have termed this the Supply Chain Effective Frontier and is shown in Figure 1. Balancing the Supply Chain Effective Frontier is the process of actively managing these four competing sets of metrics in any supply chain. It is a challenge and requires understanding and management of trade-offs.

Figure 1. The Supply Chain Effective Frontier



Rising complexity in the supply chain has impacted financial results. As shown in Table 1, the average A&D operating margin is mid-range falling between chemical manufacturers and semiconductor & hard disk drive manufacturers. They are one of only four industries to have increased operating margin over the period 2000-2012. Their results for Cash-to-Cash cycle and Inventory Turns are even less promising. The Cash-to-Cash cycle has increased by 60%

since 2000 and Inventory Turns have decreased by 33%. Both metrics are headed in the wrong direction.

Table 1. A Review of Industry Progress from 2000-2012

Industry	Average Operating Margin	Operating Margin Percentage Change (2000-2012)	Average Cash-to-Cash Cycle	Cash-to-Cash Cycle Percentage Change (2000-2012)	Average Inventory Turns	Inventory Turns Percentage Change (2000-2012)
Pharmaceutical	0.25	-22%	190.3	25%	2.0	47%
Medical Device Manufacturers	0.18	-84%	211.6	7%	2.2	6%
Consumer Packaged Goods	0.17	27%	28.3	-68%	5.6	9%
Food	0.16	-30%	38.1	-17%	6.4	16%
Consumer Electronics	0.12	74%	9.3	-45%	43.8	-35%
Apparel	0.10	-9%	127.7	3%	3.2	-4%
Chemical	0.09	-25%	78.1	-12%	5.3	5%
Aerospace & Defense	0.07	10%	117.6	60%	6.9	-33%
Semiconductors & Hard Disk Drives	0.07	2814%	34.8	105%	9.7	-34%
Automotive	0.04	-92%	75.9	-28%	9.9	-16%
Third Party Logistics	0.03	-104%	27.5	52%	36.6	76%
Contract Manufacturing	0.02	-43%	38.8	-44%	8.0	38%

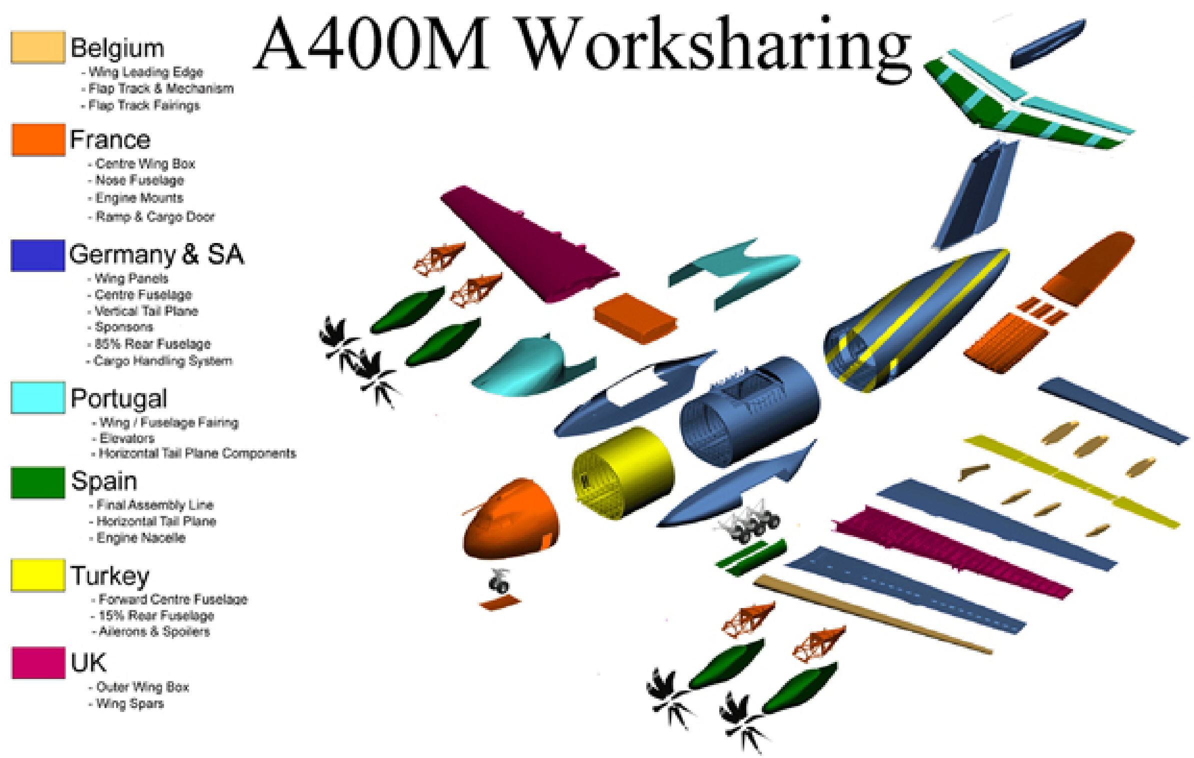
Source: Supply Chain Insights LLC, Corporate Annual Reports 2000-2012
Aerospace & Defense: Airbus Group, General Dynamics Corporation, Lockheed Martin, Textron Inc., The Boeing Company
Apparel: American Apparel, Inc., Columbia Sportswear Co., Hanesbrands, Inc., PVH Corp, Ralph Lauren Corp., VF Corp.
Automotive:: Daimler AG, Ford Motor Co., General Motors Co., Honda Motor Co., Ltd., Toyota Motor Corp., Volkswagen AG
Chemical: BASF SE, E. I. du Pont de Nemours and Co., The Dow Chemical Co.
Consumer Electronics: Apple Inc., Dell Inc., Intel Corp., Motorola, Inc. (now Motorola Solutions, Inc.)
Consumer Packaged Goods: Colgate-Palmolive Co., The Procter & Gamble Co., Unilever N.V./PLC
Contract Manufacturing: Benchmark Electronics, Inc., Celestica Inc., Kimball International
Food:: Campbell Soup Co., General Mills, Inc., Kellogg Co.
Medical Device Manufacturers: Boston Scientific Corp., Medtronic, Inc., St. Jude Medical, Inc., Zimmer Holdings Inc.
Pharmaceutical: Eli Lilly and Co., Merck & Co., Inc., Pfizer, Inc.
Semiconductors & Hard Disk Drives: Broadcom Corporation, Intel Corporation, Seagate Technology PLC, Taiwan Semiconductor Manufacturing Company, Limited, Texas Instruments Inc. Western Digital Corporation
Third Party Logistics: Kuehne + Nagel International AG, Panalpina Welttransport Holdings AG, R.R. Donnelley & Sons Company

It is a catch-22. Supply chain is more difficult for these companies, but also more critical for success. In this report, we take a look of the four components of the Supply Chain Effective Frontier and examine the performance of the industry as a whole, and analyze the success of five A&D companies on results over the last decade.

Complexity of the Industry

Design complexity reigns. It is not only **Boeing**'s 747-8 International that is complex. In this industry, sourcing and design complexity is the rule, not the exception. Figure 2, provided by CNC Design Consultants, illustrates the different partners in the construction of **Airbus**'s A400M military transport aircraft. Nearly 10 countries are highlighted in producing portions of the plane. Just as in the case of **Boeing**'s 787 Dreamliner, production was finished late and over budget.

Figure 2. A400M Components[iii]



The industry is early in the design and implementation of effective sourcing and design networks. This network will ultimately enable companies to source parts from many parties in the design process and effectively assemble the product in the final stages. While the sophisticated CAD/CAM and Product Lifecycle Management (PLM) technologies easily facilitate global design collaboration, the missing gap is the effective coordination of final stage assembly.

Success in the A&D industry requires effective coordination of the first, second, third, fourth and even fifth tier suppliers in a fragile supply chain. **General Dynamics** summarizes some of the challenges in this excerpt from their 2012 annual report:

> “We manage our supplier base carefully to avoid customer problems. However, we sometimes rely on only one or two sources of supply that, if disrupted, could have an adverse effect on our ability to meet our customer commitments. Our ability to perform our obligations as a prime contractor may be adversely affected if one or more of these suppliers is unable to provide the agreed-upon supplies or perform the agreed-upon services in a timely and cost-effective manner.”

- General Dynamics, 2012 Annual Report, p 14

There is a domino effect at play and responsibility for managing risk has fallen through the cracks. This pattern is evident in the financial results of the five companies showcased in this report.

Growth: Slowdown

Growth has slowed. As shown in Table 2, only **Textron Inc.** and **The Boeing Company** have seen improvement since the 2000-2006 period. Difficulty executing projects has led to canceled contracts. Costs are high, and getting higher, resulting in price increases. Budget pressures and consolidation of major air carriers is putting a damper on double-digit growth. Defense contracts, especially in the US, have been squeezed with budget cuts and sequestration.[iv] In addition, the industry also experiences very cyclical growth based on government contracts and defense spending trends.

Table 2. Year-Over-Year Sales Growth (2000-2012)

Year-over-Year Sales Growth (2000-2012)			
Company	2000-2006	2007-2009	2010-2012
Airbus Group	19%	7%	7%
General Dynamics Corporation	15%	10%	0%
Lockheed Martin	9%	4%	2%
Textron Inc.	-2%	0%	5%
The Boeing Company	3%	4%	7%
AVERAGE	9%	5%	4%

Source: Supply Chain Insights LLC, Corporate Annual Reports 2000-2012

With slowing growth, supply chain excellence becomes more important. It can become a differentiator. This is especially true in after-market service and support offerings. Focusing on core supply chain capabilities is critical for the success of new products and the ability to earn new contracts in an even more competitive market.

Profitability: Single-Digit Margins

In a previous Supply Chain Metrics That Matter report, we examined the state of semiconductors and hard disk drive manufacturers. This industry is one of many suppliers to A&D. There is an increasing dependence on electronics and automation. Both industries have the same average operating margin over the period 2000-2012. It is 0.07. They are two very different supply chains with vastly different inputs, rhythms and cycles, but the same operating margin. Semiconductor and hard disk drive manufacturers are downstream suppliers and under intense cost and margin pressure. A&D manufacturers are located upstream in their supply chain with high value manufacturing and deliver a specialized product. Yet, their operating margin values remain challengingly low.

In contrast, compare A&D operating margin performance with medical device manufacturers in Table 1. Medical device manufacturers are located in similar supply chain position to A&D (upstream with specialized products). Yet, medical device manufacturers have an average operating margin nearly 2.5 times the margin performance for A&D.

As shown in Table 3, all but two of the companies are experiencing shrinking margins. Slowing growth and decreasing margins create an especially challenging operating environment.

Table 3. Operating Margin (2000-2012)

Operating Margin (2000-2012)			
Company	2000-2006	2007-2009	2010-2012
Airbus Group	0.04	0.02	0.03
General Dynamics Corporation	0.11	0.12	0.09
Lockheed Martin	0.05	0.11	0.09
Textron Inc.	0.06	0.04	0.04
The Boeing Company	0.05	0.06	0.08
AVERAGE	0.06	0.07	0.07

Source: Supply Chain Insights LLC, Corporate Annual Reports 2000-2012

Cost control is critical to maintaining margin. Aerospace & defense companies are taking it seriously. To survive, this industry has developed some of the most advanced sourcing techniques and practices. This excerpt from **Lockheed Martin**'s 2012 annual report examines how they are addressing the issue.

> "Aspects of our business require relatively scarce raw materials. Historically, we have been successful in obtaining the raw materials and other supplies needed in our manufacturing processes. We seek to manage raw materials supply risk through long-term contracts and by maintaining a stock of key materials in inventory."

- Lockheed Martin, 2012 Annual Report, p 7

Cycle: Inventory Rising

Inventory is on the rise and working capital cycles are growing. While the industry has maintained a steady hand on Days of Payables over the last decade, Days of Inventory is growing.

The complexities of operating in this industry make programs commonly used in other industries difficult to implement successfully. For example, just-in-time (JIT) inventory management has proven tricky for A&D manufacturers. Reliability is not high enough to maintain reliable stores being pulled from downstream suppliers. As a result, aerospace & defense manufacturers are storing extra inventory as a precautionary measure. They have adopted just-in-case as opposed to just-in-time.

As a result, Days of inventory are high and climbing for the vast majority of the companies in the industry. In fact, Boeing represents the most extreme example with an increase of 251% from 2000-2012. This high level of inventory in a cyclical business makes them even more susceptible to business disruption

As shown in Table 4, the results are extreme. There are 172 days of inventory difference between **Lockheed Martin** and **The Boeing Company. Boeing** has better year-over-year growth numbers than **Lockheed** recently, but is extremely out of balance on inventory management. In contrast, **Lockheed** is experiencing low single digit growth, but is operating more profitably with significantly better inventory control.

Table 4. Days of Inventory (2000-2012)

Days of Inventory (2000-2012)			
Company	**2000-2006**	**2007-2009**	**2010-2012**
Airbus Group	164	204	162
General Dynamics Corporation	96	95	102
Lockheed Martin	33	19	22
Textron Inc.	84	103	97
The Boeing Company	55	96	194
AVERAGE	86	103	115

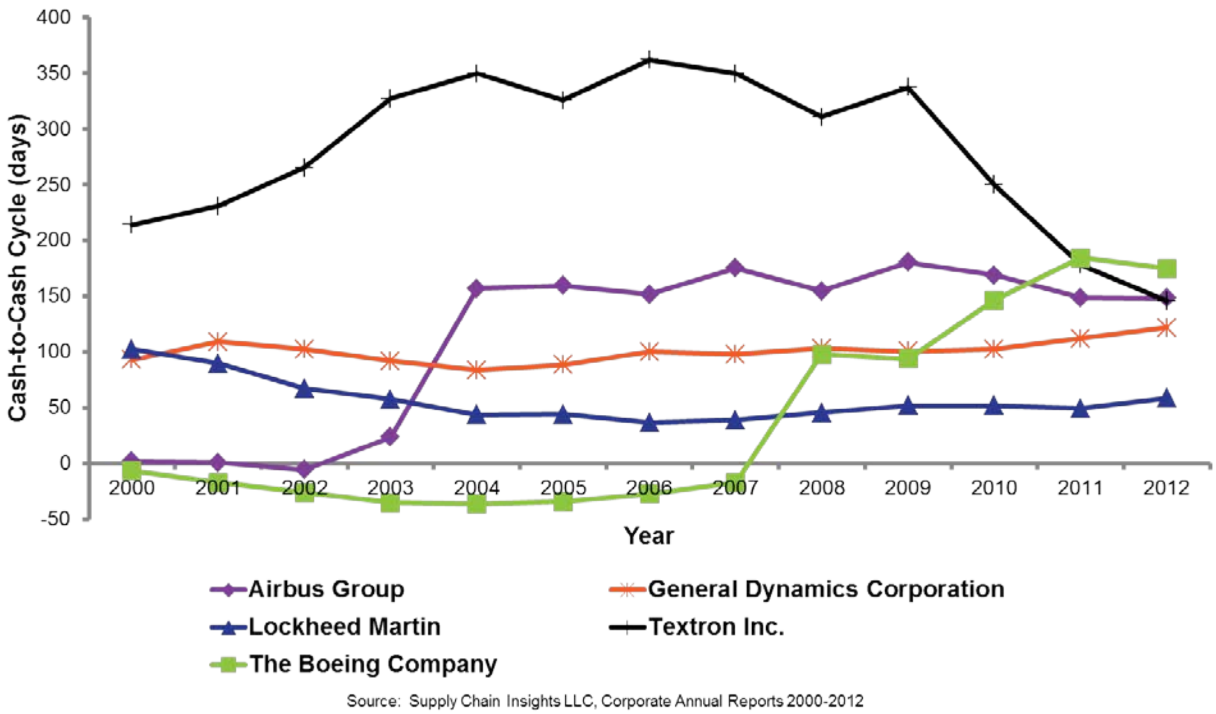
Source: Supply Chain Insights LLC, Corporate Annual Reports 2000-2012

As a result of climbing inventory levels, the Cash-to-Cash (C2C) cycle, as shown in Figure 3, is also rising. The Cash-to-Cash cycle is a compound metric that combines the impact of three individual metrics: Days of Inventory (DOI), Days of Payables (DOP) and Days of Receivables (DOR). The equation is shown below:

$$Cash - to - Cash\ Cycle = Days\ of\ Inventory + Days\ of\ Receivables - Days\ of\ Payables$$

When it comes to C2C, all A&D companies are increasing working capital except **Lockheed Martin** and **Textron**. **Textron** is an extreme example. The precipitous decline of **Textron**'s C2C is driven only partially by increasing Days of Inventory. Another component, Days of Receivables, has much more of an effect on this compound metric. For **Textron**, Days of Receivables has decreased from 189 in 2000 to 84 in 2012. This means they are collecting payment from customers significantly faster and closer in line to the industry average. This explains to a large extent the decline of C2C in Figure 3.

Figure 3. Cash-To-Cash Cycle (2000-2012)



Days of Payables is the third component of the Cash-to-Cash cycle. Performance of the five companies is shown in Table 5.

Unlike several other industries, A&D companies are not increasing payables to improve C2C cycles. They are not pushing cost and waste backwards in the supply chain and stressing their suppliers. In fact, 80% of the companies have reduced their Days of Payables since the 2000-2006 time period. This improves resiliency and is good news. However, when it comes to the C2C cycle as a whole, climbing inventory negates the more responsible Days of Payables management.

Table 5. Days of Payables (2000-2012)

Days of Payables (2000-2012)			
Company	**2000-2006**	**2007-2009**	**2010-2012**
Airbus Group	86	80	78
General Dynamics Corporation	33	36	37
Lockheed Martin	20	20	17
Textron Inc.	37	32	32
The Boeing Company	115	67	53
AVERAGE	58	47	43

Source: Supply Chain Insights LLC, Corporate Annual Reports 2000-2012

Complexity: Talent Management & Automation

Due to the complexity of the industry, A&D has not been able to drive the levels of employee productivity through automation and IT investments like other industries. Table 6 illustrates how the industry ranks compared to peers in driving revenue per employee growth since 2000.

Table 6. Revenue per Employee Across Industries (2000-2012)

Revenue per Employee (K$)	2000-2003	2004-2007	2008-2011	2012	Percentage Change over the Period
Consumer Electronics	466	685	744	911	**95%**
Pharmaceutical	322	410	522	601	**87%**
Chemical	447	753	807	814	**82%**
Consumer Packaged Goods	291	369	482	500	**72%**
Aerospace & Defense	274	325	378	418	**55%**
Automotive	419	529	609	624	**49%**
Food	313	372	427	457	**46%**
Medical Device	275	359	382	378	**37%**
Apparel	260	235	245	274	**5%**

Source: Supply Chain Insights LLC, Corporate Annual Reports 2000-2012
Aerospace & Defense: Airbus Group, General Dynamics Corporation, Lockheed Martin, Textron Inc., The Boeing Company
Apparel: American Apparel, Inc., Columbia Sportswear Co., Hanesbrands, Inc., PVH Corp, Ralph Lauren Corp., VF Corp.
Automotive: Daimler AG, Ford Motor Co., General Motors Co., Honda Motor Co., Ltd., Toyota Motor Corp., Volkswagen AG
Chemical: BASF SE, E. I. du Pont de Nemours and Co., The Dow Chemical Co.
Consumer Electronics: Apple Inc., Dell Inc., Intel Corp., Motorola, Inc. (now Motorola Solutions, Inc.)
Consumer Packaged Goods: Colgate-Palmolive Co., The Procter & Gamble Co., Unilever N.V./PLC
Food: Campbell Soup Co., General Mills, Inc., Kellogg Co.
Medical Device Manufacturers: Boston Scientific Corp., Medtronic, Inc., St. Jude Medical, Inc. Zimmer Holdings Inc.
Pharmaceutical: Eli Lilly and Co., Merck & Co., Inc., Pfizer, Inc.

The inputs to the value chain are less about labor and more about input into design. Component specifications are exacting in this industry. Table 7 illustrates the corporate performance of the five companies in the A&D peer group.

Table 7. Revenue per Employee (K$) (2000-2012)

Revenue per Employee (K$) (2000-2012)			
Company	2000-2006	2007-2009	2010-2012
Airbus Group	348	498	515
General Dynamics Corporation	274	331	349
Lockheed Martin	258	299	372
Textron Inc.	267	312	351
The Boeing Company	344	409	423
AVERAGE	298	370	394

Source: Supply Chain Insights LLC, Corporate Annual Reports 2000-2012

The industry is facing a talent shortage. The workforce is rapidly graying and retiring. Skill requirements are growing. Because of security clearances required to work at these levels, many firms have talent management issues. Automation is only part of the answer.

Recommendations

Supply chain effectiveness provides a unique lens to address many of the challenges of this industry. Here are our recommendations:

- **Increase Collaboration and Tie It to Execution.** Aerospace & defense firms operate in a supply chain with a significant amount of sub-tiers of suppliers and delegation. Even if the production of an item can be outsourced, risk always remains with the original equipment manufacturer (OEM). Instead of ignoring this, companies should face this head-on with an increased focus on communication and collaboration across the value chain. They should continue to work on refinement of execution in design platforms for final assembly using the emerging capabilities in B2B supply network functionality from **E2Open** and **Exostar.**
- **Inventory Is Not an Insurance Policy.** Inventory stores are rising in this cyclical industry. We are sounding the alarm. The industry needs to reexamine inventory policies and practices to reverse this growing risk.
- **Raise the Bar on Risk Management.** It is a fact. Supply chains are global and the risk of disruption is increasing. Look to other industries, consumer electronics especially, that have designed agile supply chains to counter the risk of unexpected events knocking production offline for weeks and/or months.

- **Extend Visibility.** OEM manufacturing can be knocked off schedule and off budget by a misstep in a second, third or even fourth tier supplier. By creating a visible and agile supply chain, with contingency plans in place for single- or sole-sourced products, A&D manufacturers will be better prepared for the inevitable hiccups.

Conclusion

The aerospace & defense industry operates a complex supply chain with a multitude of challenges. Growth is slowing. Governmental contracts are not only shrinking but becoming more stringent. Operating margin is declining and inventory is climbing. An increased focus on supply chain excellence can help. Other industries are leading and aerospace & defense manufacturers can regain lost ground quickly with renewed focus.

Appendix

Company Profiles

Company		Stock Exchange: Ticker Symbol	2012 Revenue (billions USD)	2012 Global Employees (thousands)	Country Where Based
AIRBUS GROUP	Airbus Group	FWB: EAD	72.6	140.4	France
GENERAL DYNAMICS	General Dynamics Corporation	NYSE: GD	31.5	92.2	USA (Virginia)
LOCKHEED MARTIN	Lockheed Martin	NYSE: LMT	47.2	120.0	USA (Maryland)
TEXTRON	Textron Inc.	NYSE: TXT	12.2	33.0	USA (Rhode Island)
BOEING	The Boeing Company	NYSE: BA	81.7	174.4	USA (Illinois)

Source: Supply Chain Insights LLC, Corporate Annual Reports 2012

Metric Equations

Metric Equations
Cash-to-Cash Cycle = Days of Inventory + Days of Receivables – Days of Payables
Days of Inventory = (Average Inventory/ Cost of Goods Sold) * 365
Days of Payables = (Accounts Payables/ Cost of Goods Sold) * 365
Days of Receivables = (Accounts Receivable/ Revenue) * 365
Inventory Turns = Cost of Goods Sold/ Inventory
Operating Margin = (Operating Income)/ (Revenue)
Revenue per Employee = Revenue/ Employee Count

Source: Supply Chain Insights LLC

Other Reports in This Series:

Supply Chain Metrics That Matter: A Focus on Retail
Published by Supply Chain Insights in August 2012.

Supply Chain Metrics That Matter: A Focus on Consumer Products
Published by Supply Chain Insights in September 2012.

Supply Chain Metrics That Matter: A Focus on the Chemical Industry
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Published by Supply Chain Insights in December 2013

Supply Chain Metrics That Matter: Semiconductors & Hard Disk Drives
Published by Supply Chain Insights in February 2014

About Supply Chain Insights LLC

Founded in February, 2012 by Lora Cecere, Supply Chain Insights LLC is focused on delivering **independent, actionable and objective advice for supply chain leaders**. If you need to know which practices and technologies make the biggest difference to corporate performance, turn to us. We are a company dedicated to this research. We help you understand supply chain trends, evolving technologies and which metrics matter.

About Abby Mayer

Abby Mayer (twitter ID @indexgirl), Research Associate, is one of the original members of the Supply Chain Insights LLC team. She is also the author of the newly-founded blog, Supply Chain Index. Her supply chain interests include connecting financial performance and supply chain excellence, as well as talent management issues and emerging markets.

Abby has a B.A. in International Politics and Economics from Middlebury College and a M.S. in International Supply Chain Management from Plymouth University in the United Kingdom. She has also completed a thru-hike of Vermont's 280 mile Long Trail, the oldest long distance hiking trail in the United States. As part of the planning and food prep process, she became interested in supply chain management when she was asked to predict hunger pangs for the entire three-week trip before departure. If that isn't advanced demand planning, what is?!?!

Endnotes:

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[i] All peer group companies profiled in this report were classified in one NAICS code: 336411
[ii] Boeing. "Boeing celebrates delivery of 50th 747-8." http://boeing.mediaroom.com/2013-05-29-Boeing-Celebrates-Delivery-of-50th-747-8
[iii] CNC Design Consultants. "CATIA brings business to South Africa." http://www.warthog.co.za/cdc/news_110705.htm
[iv] KPMG. "2013 Global Aerospace & Defense Outlook." http://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/Documents/aerospace-defense-outlook-2013.pdf

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