

Supply Chain Metrics That Matter: Semiconductors & Hard Disk Drives

Using Financial Data from Corporate Annual Reports to
Better Understand Semiconductor & Hard Disk Drive
Manufacturers

2/18/2014

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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 semiconductor and hard disk drive 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. Due to the fact that the supply chain is a complex system that must be managed holistically, we share the trends on each of these dimensions over the course of the last decade.

In picking companies for the Supply Chain Metrics That Matter report, we traditionally rely on companies recently listed in the Fortune Global 500. For the semiconductor & hard disk drive industry, we identified 6 companies using the Fortune Global 500, the Morningstar peer group and NAICS codes¹ to inform our decision.

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.

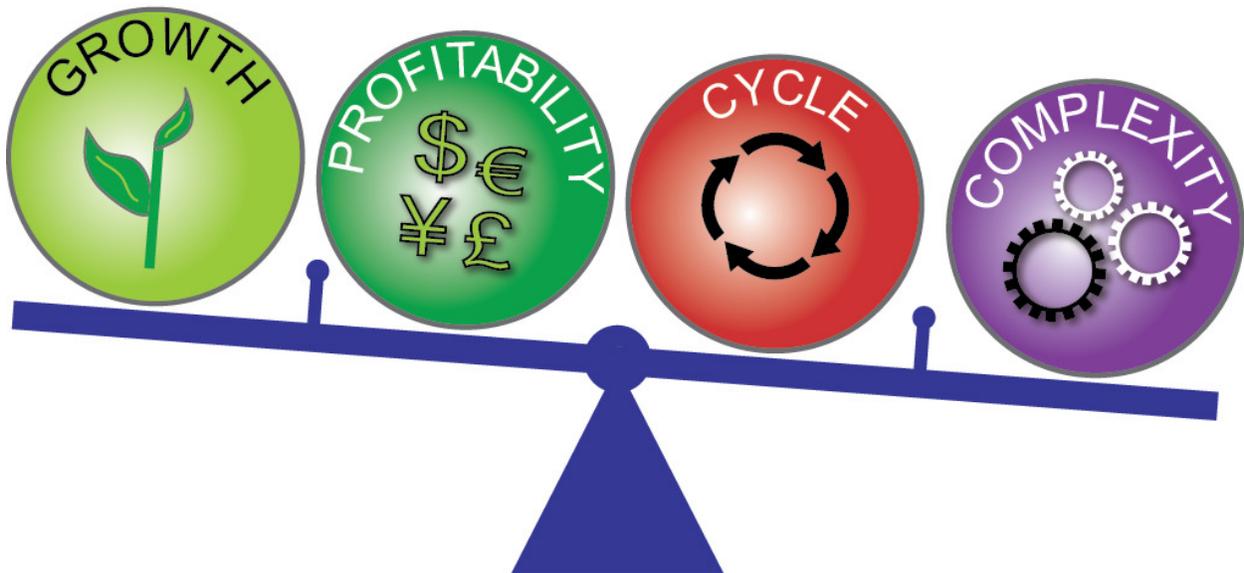
¹ All peer group companies profiled in this report were classified in one of two separate NAICS codes: 334413 and 334112.

Executive Overview

Supply chain leaders struggle to align corporate and supply chain strategy and drive improved performance. We term this difficult balancing act The Effective Frontier and explain it as the process of balancing growth, profitability, cycle and complexity within a company's supply chain operations.

A supply chain is a complex system with increasing complexity. A major gap in many supply chain strategies is a nuanced understanding of supply chain potential when these elements are viewed together as a system.

Figure 1. The Effective Frontier



The focus of this report is semiconductor and hard disk drive manufacturers. As seen in table 1, when it comes to supply chain performance, the industry is neither the best nor the worst. They fall squarely in the middle. While middle of the pack in operating margin, the industry has shown an increase in the cash-to-cash cycle and a decrease in inventory turns. With increasing complexity, the industry has struggled to maintain inventory turn performance over the period.

Companies further back in the supply chain have struggled to a higher degree to balance The Effective Frontier than those closer to usage. This is largely due to the bullwhip effect—the distortion of a demand signal as it gets passed downstream from trading partner to trading partner. The chemical industry manufacturers, like semiconductor & hard disk drive manufacturers, are three to five levels back in the supply chain. Comparing the results in table 1 for the two industries illustrates how much better the semiconductor & hard disk drive manufacturers have done in a similar orientation. Operating margin is comparable across the

two, but the chemical industry has a higher cash-to-cash cycle level and almost a 50% lower inventory turns value.

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% |
| 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
 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

Semiconductor and hard disk drive manufacturers have been successful in a challenging downstream position. Cost pressure from OEMS has not (as of yet) cut into margin, and growth levels have remained strong with the move to mobile. Inventory remains problematic with all six companies in this report, demonstrating increased DOI and decreased inventory turns, since the start of the century. Part of this is likely due to the lengthening of the global supply chain, while another part is partly due to rising product and process complexity, but it remains a concern.

Historically, the industry has made strong gains on productivity. An increasing move towards automation in the precision driven manufacturing environment is expected to continue the rise in revenue per employee performance.

In this report, we discuss the financial realities of the semiconductor and hard disk drive supply chain and offer recommendations for improvement.

Understanding the Industry

Financial results culled from NAICS classifications are shown in table 2. Inventory turns are down and revenue per employee performance is up for both of the peer groups. The results on the remaining metrics are more mixed.

Table 2. Semiconductor & Hard Disk Drive Industries (2000-2012)

| Semiconductor & Hard Disk Drive Industries (2000-2012) | | | | | |
|--|------------------|-----------------|--------------------|----------------------------|--------------|
| Industry | Operating Margin | Inventory Turns | Cash-to-Cash Cycle | Revenue per Employee (K\$) | SG&A Ratio |
| Hard Disk Drive Industry (n=5) | 0.08 ↑100% | 11 ↓16% | 35 ↓34% | 505 ↑19%* | 17% ↓6%^ |
| Semiconductor Industry (n=14) | 0.04 ↓69% | 6 ↓18% | 63 ↑58% | 352 ↑56%* | 10% ↑13%* |

Source: Supply Chain Insights LLC, Corporate Annual Reports 2000-2012
 Industry Average comprised of public companies (hard disk drive: NAICS 334112), (semiconductors: NAICS 334413) reporting in One Source with 2012 annual sales greater than \$5 billion
 *Calculated from 2002-2012 due to data availability; ^Calculated from 2003-2012 due to data availability

While every industry has a unique set of challenges and opportunities when it comes to maximizing potential and creating better functioning supply chains, the semiconductor & hard disk drive industry has special challenges. We examine several of those limiting factors here and then begin analysis of six companies within the peer group for a more close-up understanding of their financial performance over the preceding decade.

- **Competition.** Commoditization is a serious challenge, especially to semiconductor manufacturers. Providing the hardware is no longer enough. Building a brand presence, with a focus on additional services including software, is a necessity for success moving forward.
- **Longer Supply Chains.** Many semiconductor facilities have moved outside of the U.S. creating a longer supply chain stretching across geographies and leading to increased transit times. This increases the number of links in the supply chain creating interdependencies. It also creates a domino effect—an industry which can be easy to topple and hard to restore. The Thailand flooding in the fall of 2011 was a prime example of these challenges. The impact of the Thailand natural disaster rippled up to large consumer-facing businesses like **Dell** and **Apple**. **Seagate Technology PLC** summarized the situation the following way in their 2013 annual report.

"In early October 2011, floodwaters north of Bangkok, Thailand inundated many manufacturing industrial parks that contained a number of the factories supporting the HDD industry's supply chain. The HDD industry had concentrated a large portion of its supply chain participants within these industrial parks in an effort to reduce cost and improve logistics. As a result, the inundation of floodwaters into these industrial parks had caused the closure or suspension of production by a number of participants within the HDD supply chain. During the supply chain disruption in fiscal year 2012, we believe demand exceeded supply due to the impact from the flooding in Thailand, resulting in an increase in the average selling price ("ASP").

•Seagate Technology PLC 2013 Annual Report, p 44

- **Short Product Life Cycles.** The semiconductor industry has always operated on a highly cyclical cycle. This is best explained by the excerpt below from the 2012 annual report of **Texas Instruments, Inc.**

"The "semiconductor cycle" is an important concept that refers to the ebb and flow of supply and demand. The semiconductor market historically has been characterized by periods of tight supply caused by strengthening demand and/or insufficient manufacturing capacity, followed by periods of surplus inventory caused by weakening demand and/or excess manufacturing capacity. These are typically referred to as upturns and downturns in the semiconductor cycle. The semiconductor cycle is affected by the significant time and money required to build and maintain semiconductor manufacturing facilities."

•Texas Instruments, Inc. 2012 Annual Report, p 42

This creates ongoing challenges as there is no stable status quo for which companies can innovate towards. This is likely to continue to be a challenge moving forward.

- **Margin Pressure.** Many semiconductor and hard disk drive companies operate in the shadows of well-known brand names such as **Hewlett-Packard, Apple, Dell** and others with strong procurement practices. As a result of their downstream location, these companies are likely to experience cost pressure from upstream suppliers. This is similar to the relationship chemical companies have in relation to consumer packaged goods manufacturers and retailers. Pricing pressure is often passed down the line to the low tier suppliers.

The challenges are clear, but we find much to be optimistic about when it comes to supply chain management for semiconductor and hard disk drive manufacturers.

Growth: Robust with High Demand

Growth levels for semiconductor and hard disk drive manufacturers have been strong over the past decade. The downturn in the economy due to the recent recession hit the industry hard.

Product innovation is a major driver of growth. The growing demand for consumer electronics devices, and the proliferation of mobile and tablet products, drove a strong market for these products. The number of active cell phones is expected to top 7.3 billion by the end of 2014, according to the International Telecommunications Union.² In short, the number of cell phones will exceed the global population at some point this year. The growth levels for the profiled companies are shown in table 3.

Table 3. Year-Over-Year Sales Growth (2000-2012)

| Year-over-Year Sales Growth (2000-2012) | | | |
|---|-----------|-----------|-----------|
| Company | 2000-2006 | 2007-2009 | 2010-2012 |
| Broadcom Corporation | 24% | 8% | 23% |
| Intel Corporation | 2% | 0% | 16% |
| Seagate Technology PLC | 7% | 4% | 16% |
| Taiwan Semiconductor Manufacturing Company, Limited | 13% | -2% | 25% |
| Texas Instruments Inc. | 6% | 10% | 9% |
| Western Digital Corporation | 15% | 22% | 20% |
| AVERAGE | 11% | 4% | 18% |

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

Product innovation is the lifeblood of this industry. Strong planning processes enabled adaptation in the face of extreme supply and demand volatility.

Profitability: Wide Margins

Along with significant year-over-year growth, most manufacturers in these industries have enjoyed the luxury of large operating margins. As discussed earlier, because of their downstream position in the supply chain, they are at a disadvantage. However, they have

² Silicon India Magazine. World To Have More Cell Phone Accounts Than People By 2014. http://www.siliconindia.com/magazine_articles/World_to_have_more_cell_phone_accounts_than_people_by_2014-DASD767476836.html

bucked the trend due to excellence in product innovation and supply chain planning functions. It is simple. The industry is an outlier in operating margin. Not only are the margins comfortably large, they are also increasing post-recession. Each company has increased operating margin over the period from their starting results in 2000-2006 compared to their most recent three year period (2010-2012). The current results are shown in table 4.

Table 4. Operating Margin (2000-2012)

| Operating Margin (2000-2012) | | | |
|---|-----------|-----------|-----------|
| Company | 2000-2006 | 2007-2009 | 2010-2012 |
| Broadcom Corporation | -0.84 | 0.02 | 0.12 |
| Intel Corporation | 0.22 | 0.19 | 0.32 |
| Seagate Technology PLC | 0.03 | -0.04 | 0.14 |
| Taiwan Semiconductor Manufacturing Company, Limited | 0.28 | 0.32 | 0.35 |
| Texas Instruments Inc. | 0.11 | 0.21 | 0.23 |
| Western Digital Corporation | 0.01 | 0.09 | 0.13 |
| AVERAGE | -0.03 | 0.13 | 0.22 |

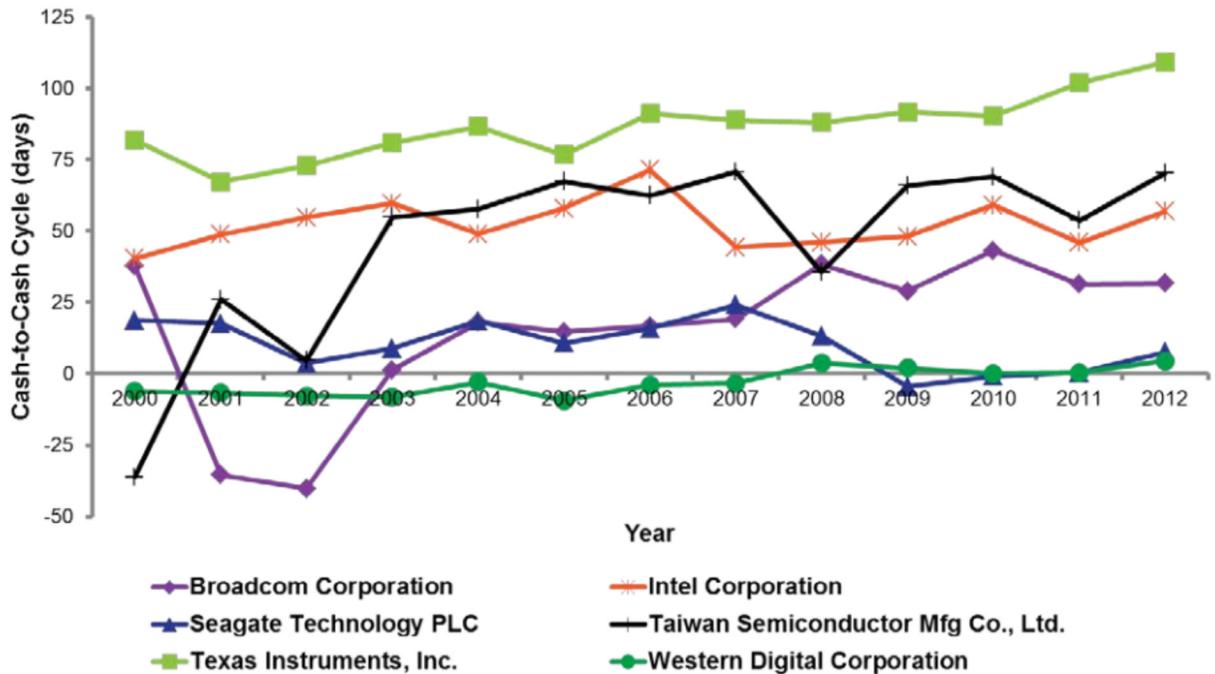
Source: Supply Chain Insights LLC, Corporate Annual Reports 2000-2012

Cost pressure originating at the end consumer is often pushed down the supply chain to downstream suppliers cutting into their margin levels. Although we do not see this occurring to a significant degree in these companies, it is a possibility to consider and prepare for. Improving supply chain performance is one of the best ways for leaders to manage tightening margins.

Cycle: Rising Inventory Levels

The cash-to-cash cycle remains our preferred singular metric for grasping the larger picture of supply chain performance within a company. This comes with one simple caveat. It is a compound and complex metric. The cash-to-cash cycle is not enough alone to understand the supply chain performance of any company. Instead, the components of the cash-to-cash cycle tell a critical piece of the story. The cash-to-cash performance of the companies is shown in figure 2.

Figure 2. Cash-to-Cash Cycle (2000-2012)



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

The trend is clear. Cash-to-cash performance is up across the board for the companies. The swings have stabilized in the more recent years, but are still positive. Financial analysis of the components demonstrates that collectively, companies have seen a 12% decrease in days of receivables and a 20% decrease in days of payables. This means that companies are collecting receivables sooner and meeting payables obligations sooner.

Table 5. Days of Inventory (2000-2012)

| Days of Inventory (2000-2012) | | | |
|---|-----------|-----------|-----------|
| Company | 2000-2006 | 2007-2009 | 2010-2012 |
| Broadcom Corporation | 38 | 55 | 52 |
| Intel Corporation | 70 | 72 | 84 |
| Seagate Technology PLC | 31 | 31 | 34 |
| Taiwan Semiconductor Manufacturing Company, Limited | 44 | 41 | 48 |
| Texas Instruments Inc. | 61 | 80 | 93 |
| Western Digital Corporation | 17 | 23 | 35 |
| AVERAGE | 43 | 51 | 58 |

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

The only missing piece is days of inventory which increased by 34% over the period. The days of inventory performance alone is shown in table 5. Table 5 illustrates that the inventory trend is not a single company mismanaging inventory. It is an industry trend and driven by rising product complexity. In fact, all 6 companies have grown their inventory levels since the 2000-2006 period. The lengthening of global supply chains has certainly contributed to a need for holding larger inventory, but in our experience, most supply chain leaders believe they have made significant progress on reducing inventory levels. The financial results tell a very different story. While many have improved safety stock levels, they have increased cycle and in-transit inventories. The result is a negative impact (and rising value) for days of inventory.

Complexity: Increasing Automation

Complexity has increased by orders of magnitude since the turn of the century and remains a challenge for most companies. **Broadcom Corporation** summarizes the complexity as such:

"Our products are incorporated into complex devices and systems, creating supply chain cross-dependencies. Accordingly, supply chain disruptions affecting components of our customers' devices and/or systems could negatively impact the demand for our products, even if the supply of our products is not directly affected."

•Broadcom Corporation 2012 Annual Report, p 15

Table 6. Revenue per Employee (K\$) (2000-2012)

| Revenue per Employee (K\$) (2000-2012) | | | |
|---|-----------|-----------|-----------|
| Company | 2000-2006 | 2007-2009 | 2010-2012 |
| Broadcom Corporation | 611 | 610 | 747 |
| Intel Corporation | 376 | 445 | 523 |
| Seagate Technology PLC | 153 | 217 | 228 |
| Taiwan Semiconductor Manufacturing Company, Limited | 382 | 385 | 409 |
| Texas Instruments Inc. | 346 | 425 | 421 |
| Western Digital Corporation | 212 | 170 | 142 |
| AVERAGE | 346 | 375 | 412 |

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

In the area of supply chain complexity, we look at revenue per employee. It is both widely available and easily comparable across industries. The results are shown in table 6.

The industry has made great strides in productivity. This is due to both automation and outsourcing. The demanding and precision-heavy manufacturing process, coupled with the need for sterility, makes these environments ideal for automation. As a result, we expect continued growth in revenue per employee as increasing amounts of manufacturing are automated and human labor is removed from the process.

Recommendations

The semiconductor and hard disk drive industries are better positioned than many of their peers. However, they are not resilient. The Thailand flooding of 2011 was a serious wake-up call. Here are our recommendations for continued improvement:

- **Focus on Relationships.** There is uncertainty on both sides of the semiconductor and hard disk drive companies. Supplier issues as well as increasing demands from OEMS create a challenging environment. A focus on brand presence, increased capabilities beyond hardware creation, and relationships will help to solidify the business model. The design network of Taiwan Semiconductor Manufacturing Company and the delivery of value-added services is an example of creating stickiness in relationships.
- **Drive Innovation.** In order to avoid commoditization, semiconductor and hard disk drive companies should focus on expanding their capabilities from hardware creation to an arsenal of service offerings focused on software and mobile design needs. This requires tight integration of new product and supply chain processes.
- **Focus on Inventory.** Lengthening global supply chains have resulted in climbing inventory numbers. Cash flow is key and improvement in days-of-payables and days-of-receivables management have been negated by climbing inventory stores.
- **Explore Automation.** The manufacturing needs of semiconductors and hard disk drive manufacturers make automation a core portion of the business. Use more advanced concepts in digital manufacturing coupled with the Internet of Things with sensors to drive productivity gains moving forward.
- **Don't Neglect Risk Management.** The Thailand floods of 2011 delivered a serious shock to the semiconductor and hard disk drive supply chains. There will be more critical events and they are unlikely to repeat themselves. Risk management is not about preparing for what has already happened, but rather designing a resilient and adaptive supply chain for events that have not yet occurred.

Conclusion

The semiconductor and hard disk drive industries have enjoyed high demand with the rise of personal computing and now mobile and tablet products. The results have been steady double-digit sales growth and wide margins. They have bucked a trend. The industry has rebounded from the recession stronger in margin. This is rare given their downstream location within many consumer electronics supply chains. However, rising complexity and outsourcing bring new supply chain challenges. The good news is that the supply chain capabilities within this industry are strong and ready to meet the challenge.

Company Profiles

| Company | Stock Exchange: Ticker Symbol | 2012 Revenue (billions USD) | 2012 Global Employees (thousands) | Country Where Based |
|--|----------------------------------|--------------------------------|--------------------------------------|---------------------|
|  Broadcom Corporation | NASDAQ: BRCM | 8.0 | 11.3 | USA (California) |
|  Intel Corporation | NASDAQ: INTC | 53.3 | 105.0 | USA (California) |
|  Seagate Technology PLC | NASDAQ: STX | 14.9 | 57.9 | USA (California) |
|  Taiwan Semiconductor Manufacturing Company, Limited | NYSE: TSM | 17.1 | 39.3 | Taiwan |
|  Texas Instruments Inc. | NASDAQ: TXN | 12.8 | 34.2 | USA (Texas) |
|  Western Digital Corporation | NASDAQ: WDC | 12.5 | 103.1 | USA (California) |

Source: Supply Chain Insights LLC, Corporate Annual Reports 2012

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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?!?!