

Inferences about Supply Chain Practices using Financial Ratios

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Each year Gartner Inc releases a list of top 25 supply chain performers, where three financial ratios get 50% weightage in the ranking process. Establishing the best practices from which other companies can learn has been the motivation of this listing. However, deriving insights about the supply chain practices from the financial data has not been looked into in academic literature. In this research, we inquire what companies across industry sectors can learn about the supply chain practices of the leaders by analyzing publically available financial data. We were able to draw valuable inferences about the structure of supply chains using the financial ratios.

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I. INTRODUCTION

Each year Gartner, a leading information technology research and advisory company, releases a list of Top 25 supply chain performers. Gartner has been producing the Top 25 list since 2004. Gartner releases a list of companies that are perceived to be the best operating supply chains for that year. The ranking is based on a composite score where 50% of the weight is given to financial performances (involves three financial ratios), 25% weight to opinion component (involves Gartner expert panel and a peer panel poll) and 25% peer polling conducted via Web-based structured voting process. Along with the listing, Gartner report includes additional analysis and insights about the supply chain characteristics of the leaders and key trends (Aronow et al. 2015). The expectation is that other companies can learn from the leaders and improve their supply chain practices. For

example, Hoffman et al. (2012) state that producing the ranking is to raise awareness of the supply chain discipline, how it impacts the business, and to catalyze the debate and the cross-fertilization of ideas about what supply chain excellence really means. Hoffman et al. (2013) state that producing the ranking goes beyond excellence to identify leadership in the supply chain, highlighting best practices and help raise the bar for the supply chain profession. Aronow et al. (2015) state that the primary objective of producing the ranking has been to foster the celebration, sharing of best practices and to raise the bar of performance for the broader supply chain community.

The impact of supply chain performance measurements with financial performances has been debated and described in the literature. Researchers have proposed various approaches to measure supply chain performance and describe how these measurements impact financial ratios.

However, the primary focus of this stream of research has been linking the supply chain performance (operational) measures to the financial performance. Our literature search did not find any article that draws insights on the supply chain practices using financial performance; this research was motivated by this gap in the literature. We inquire whether the financial performance data can be used to derive insights about the supply chain practices and performance. Specifically, we would like to inquire what other companies across industry sectors can learn about the supply chain practices of the leaders using publicly available financial data. This approach would help companies to analyze and learn about the supply chain practices of the leaders (as published by Gartner), compare and contrast the supply chain leaders and peers who come from different industry sectors. Learning from the supply chain leaders, establishing the best practices and raising debate about the supply chain excellence have been the focus of this ranking. This research thus contributes towards this debate and discussions about the supply chain structures and the practices across industry.

Remaining part of this paper is organized as follows. In the next section, we review academic literature pertaining to the link between supply chain and financial performances. Then we describe the methodology and postulate research questions in the context of the data in section 3. This is followed by the data analysis and inferences in section four. Finally, we conclude with summary the findings, contributions and discuss the future research directions.

II. LITERATURE REVIEW

2.1. Financial Ratios

The financial statement released by an organization at the end of every fiscal year and quarters, consists of Income Statement,

Balance Sheet, Statement of Cash Flows and Statement of Stockholders' Equity. The Table 1 lists the components of the financial statements and how the supply chain performances impact them, whereas the Table 2 lists and describes the financial ratios used in the analysis of supply Chain performances. The basic income statement components are revenues, product costs, and administrative overhead costs. The net income figure is arguably the most focused-upon performance metric in the business community. Another salient feature of the income statement is that it highlights the profitability of the firm. Supply chain decisions and performance have direct impacts on income through each of the three primary components of the income statement.

The balance sheet summarizes components such as assets, liabilities and stockholder's equity. Within the balance sheet, a key component to recognize an organizational success (or failure) is the control of working capital. Working capital is defined as current assets minus current liabilities, which plays a major role in keeping the organization healthy and viable. The primary components of current assets are cash (and cash-like investments), accounts receivables, and inventories. The primary component of current liabilities is accounts payables. Not only do supply chain decisions have a direct impact on working capital, but also working capital flows and balances have a direct impact on the financial viability and performance of a firm.

An organization with insufficient working capital will then have to borrow funds to meet its needs but on the other hand, an organization with excess working capital will have the ability to fund expansion without increasing borrowings. One useful supply chain performance measure that can evaluate working capital performance is the cash conversion cycle (C-C-C), which is defined as "Days of Inventory + Days of Accounts

Receivable - Days of Accounts Payable. One of the goals of cash conversion cycle is to balance the investments a company makes in inventory and extending credit to customers with payments that a company makes for purchases. In addition to working capital, the balance sheet helps measure utilization of the organization's physical assets. Plant, Property and Equipment (PP&E) productivity is measured by dividing sales revenues by the amount recorded for net PP&E. This measure gives an indicator of how productive the physical assets of the organization are.

The Statement of Cash Flows contains information generated through the Income Statement and Balance Sheet, but it states the information in a form where managers and

investors can see the sources and uses of cash in three primary areas of the firm: operations, investing, and financing. The information on this statement is important to analyze the health of an organization, because a company requires positive operational cash flows to endure over time. The supply chain organization impacts cash flow statement through actions that influence the income statement or balance sheet of the firm. The Statement of Shareholders' Equity summarizes the ownership portion of the firm – capital stock sales and purchases, income generation and payment of dividends, and other related items. The supply chain management function impacts the Shareholders' Equity by impacting the net income generated for the firm.

TABLE 1. FINANCIAL PERFORMANCES IMPACTED BY THE SUPPLY CHAINS.

Financial Statement	Components	How Financial Performances are impacted by the supply chain
Income statement	Revenues	Lead time, Time to market for new products, Response time to customer requests, On-time delivery, Product quality, Product returns, Stock outs, Fill rates
	Product Costs	Transportation costs, Network distance, Procurement costs, Inventory costs (raw materials, work in progress, finished goods), Storage costs, Packaging costs, Waste, Stock outs, Forecast accuracy, Number of suppliers, Product remediation costs
	Sales, General, and Administrative Costs	Warranty costs, Selling costs, Transaction accuracy (invoices, shipping documents, export documentation), Exchange rate control
Balance Sheet	Inventory Days	Holding costs – financing, warehousing, tracking, moving, insurance, Obsolescence, Theft, Forecasting accuracy, Sourcing time, Delivery time
	Accounts Receivable Days	Bad debt, Follow-up calls to receive payments, Unable to ship due to non-payment, Exchange rate changes, Correct invoicing terms Proof of receipt
	Accounts Payable Days	Discounts not taken, Late payments; subsequent orders delayed, Correct invoicing terms, Payment penalties
	Fixed Assets	A long-term investment a company benefits from such as equipment, buildings, supply chain technologies, machinery, land and other intangible assets.
	Total Assets	Cash, accounts receivables, fixed assets and all other assets that are expected to provide benefits for over a year or long term in general are presented as total assets in the Balance sheet.

TABLE 2. FINANCIAL RATIOS USED IN THE ANALYSIS OF SUPPLY CHAINS.

Name of the Ratio	Type of the ratio	Description
Cost of Goods Sold (% Revenue)	Efficiency ratio	The COGS formula is important as it helps analyze purchase costs and payroll costs are being controlled.
Inventory Turnover	Efficiency ratio	This ratio helps analyze efficient management of inventories and its movements across a company's supply chain.
Cash Conversion Cycle (C-C-C)	Efficiency ratio	The cash conversion cycle estimation measures to what extent trade is tied up in stock before the stock is sold and cash is collected from clients.
Return on Capital Employed (ROCE)	Profitability Ratio	The ratio is based on operating profit and capital employed. This can be used to refer to many different ratios.
Asset Utilization	Efficiency ratio	This ratio shows how efficiently a company can use its assets to generate sales
Return on Assets (ROA)	Profitability Ratio	This ratio shows how well the company can convert its investments in assets to profit.
Gross Profit Margin	Profitability Ratio	This ratio shows how profitable the core business activities are without taking into consideration the indirect costs.
Operating Margin	Profitability Ratio	This ratio shows how strong and profitable the company's operations are.

2.2. DuPont Ratio Analysis

Du Pont ratio analysis is a financial ratio commonly used to measure an organization's financial performance. The Du Pont ratio analysis evaluates the areas of profitability (P) and operating efficiency (E) through assessing the performance of the components contributing to return-on-assets (ROA). ROA measures how much profit a company generates compared to the assets employed in the business. It consists of a profitability measure (Net Profit Margin) and an efficiency measure (Total Assets Turnover), which can be expressed in the following formula (Dehning and Stratopoulos, 2002):

Return on Assets (ROA)
 = Net Profit Margin x Total Assets Turnover
 = (Net Income/Sales) x (Sales/Total Assets)
 DuPont analysis can also be applied based on the return on equity (ROE) ratio, which is computed using the following formula:

Return on Equity (ROE)
 = Net Profit Margin * Total Assets Turnover * Equity multiplier
 = [Net Income /Sales] * [Sales/Total Assets] * [Total Assets/Equity]

The ROE form is not applicable for this research as ROE is affected by changes in the company's financial structure (Soliman, 2007). Since this research focuses on how the company performs business operations not on how it decides to finance such operations, the ROA form is more relevant.

2.3. The SCOR Model

Researchers have proposed various approaches to develop management systems to measure supply chain performance, connect these measurements with financial measurements. The SCOR model was one the

most popular model used in the industry today. The Supply-Chain Council (SCC) developed the SCOR model, which is based on five core processes (plan, source, make, deliver, and return) and three levels of process details (top level, configuration level, and process element level). This model attempts to integrate the concepts of business process reengineering, benchmarking, process measurement, and best practice analysis, which allows the management of an organization to make connections between strategies and processes that have a significant impact on the overall performance of the supply chain (Lockamy and McCormack, 2004; and Huang et al., 2004). The SCOR model thus provides standard descriptions of supply chain processes that make up the supply chain and, a process framework for defining relationships among these processes.

Using this model, companies can select the metrics to measure the supply chain process performance such as order fulfillment cycle time, upstream supply chain flexibility, upstream supply chain adaptability, downstream supply chain adaptability, supply chain management cost, cost of goods sold (COGS), cash to cash cycle time, return on supply chain fixed assets and return on working capital. These supply chain performance measures fall into five categories: reliability, responsiveness, flexibility, cost, and asset metrics. These performance metrics are designed to provide a view of overall supply chain performance at level 1 (top level), and level 2 (configuration level) and level 3 (process element level) metrics to support to the level 1 (Huang et al., 2004).

2.4. Supply Chain and Finance Link

Now we want to review important articles that have examined the link between the supply chain operational performances to financial performances. Presutti and Mawhinney (2007) describe how supply chain

metrics can be linked to financial metrics; supply chain performance metrics used were based on the SCOR model and the financial metrics used were based on the concept of Economic Value Added (EVA). The book by Camerinelli (2009) describe the link between financial performance and supply chain decisions based on the level 1 and level 2 metrics of the SCOR model. Hutchison et al. (2009) describes how cash-to-cash (C2C) strategies can be used in a supply chain to realize opportunities for improving efficiency, profitability, cash flow management, and communication channels among supply chain members. The C2C calculation includes three financial variables: inventory, accounts receivable, and accounts payable.

Kremers (2010) describe how supply chain operational performances can be evaluated in terms of its impact on cash flow, market value, and internal financial performance metrics using the SCOR model. Wisner (2011) describes how supply chain functions influence company's financial statements (income statement, balance sheet, statement of cash flows, and statement of stockholders' equity). Their framework identified the supply chain performance measures that are relevant to each financial statement component, which is helpful in ensuring supply chain actions and decisions are compatible with the company's financial goals.

Elgazzar et al. (2012) proposed a method to link supply chain processes performance to the priorities of the company's financial strategy using multi-criteria decision making approach called as fuzzy analytic hierarchy process (FAHP). According to this method, SC operations' performance is measured based on the SCOR model's standard performance metrics, while the company's financial performance priorities are determined using Du Pont ratio analysis. To link supply chain operations' performance to the financial performance priorities, the

relative importance weights of supply chain processes performance measures are determined with respect to the priorities of the company's financial strategy using the FAHP technique. This paper presents a six-steps procedure and provide illustrations using a numerical example. The authors state that this approach helps convert the connection between supply chain operational performance and financial performance into an implementable performance measurement system.

We would like to highlight two observations that we made by reviewing the articles pertaining to supply chain and finance link. First, all the articles are conceptual in nature and do not involve any empirical analysis. Second, the emphasis has been to describe how supply chain measures can impact the financial measurements. We did not find any article that tries to describe the supply chain practices based on the financial measurements.

2.5. The Gartner TOP Supply chain Top 25

As discussed in the introduction, Gartner releases a list of companies that are perceived to be the best operating supply chain for that year (Aronow et al. 2015; Aronow et al. 2014, Hoffman et al. 2013; Hoffman et al. 2012). Gartner analysts derive a master list of companies from the Fortune Global 500 and the Forbes Global 2000, with a revenue cutoff of \$12 billion. Gartner then pares the combined list down to the manufacturing, retail and distribution sectors, thus eliminating certain industries, such as financial services and insurance. Then, Gartner, ranks companies based on a composite scoring method where 50 percent of the total score is based on the publicly available financial data published by every organization at the end of every financial year. The following three financial ratios make up the 50% of the total score: ROA makes up 25%, inventory turns makes up

15%, and revenue growth makes up 10%. They indicate that Inventory turns offers an indication of cost management, and ROA provides a general proxy for overall operational efficiency and productivity. Revenue growth, while clearly reflecting myriad market and organizational factors, offers some clues to innovation. A three-year weighted average for the ROA and revenue growth metrics, and a one-year quarterly average for inventory turns are used. Financial data from the past three years are used and different weights are used for the three years. For example, the following yearly weights are used to rank companies in 2014: 50 percent for 2013, 30 percent for 2012, and 20 percent for 2011. The remaining 50 percent of the total score is based on opinion from selected panel members. 25 percent of which is contributed by the pioneering work of Gartner's analysts who are selected to contribute opinions based on their research. Another 25 percent is derived from a peer opinion panel, which consists of supply chain professionals across various segments of businesses.

In summary, the academic researchers have presented frameworks and approaches to connect the supply chain performance measures to the company's financial performances. The emphasis has been to explain how the supply chain practices and the resulting performance measures impact the financial performances. The Gartner's methodology on the other hand uses three financial ratios: Return on Assets (ROA), inventory turns and revenue growths to infer the supply chain performances. In effect, Gartner is using the financial ratios to capture and make inferences on company's supply chain practices and excellence. This research was motivated by this observation, making inferences about supply chain structure and performance using financial ratios, has been not reported in the academic literature. Specifically, we would like to inquire what other companies across industry sectors can

learn about the supply chain practices of the leaders by analyzing only the financial data, which is publically available. We accomplish this research objective by posing specific research questions in the following section.

III. RESEARCH METHODOLOGY AND OBJECTIVES OF THIS STUDY

We started the selection of various companies for this study from the Gartner's TOP 25 listing for the year 2014, which uses data from the calendar years 2013, 2012 and 2011. We used Nasdaq's online database to identify the SIC codes and the industry sector the supply chain leaders belong to. The Table 3 includes seventeen Supply Chain leaders out of the twenty five announced by Gartner; the remaining seven companies are not traded in US markets or data is not available. These seventeen supply chain leaders fall into thirteen industry groups.

Nasdaq's online database was used to select the competitors/peers to the supply chain leaders in each industry sector. Primary

competitors were identified based on SIC codes, industry sectors and revenue cap as the list of competitors was vast and exhaustible. We selected top 10 companies by revenue in each industry sector, which include the supply chain leaders, thus 130 companies are selected for our research. Each of the company's financial data was obtained from Compustat database for this research. We were able to obtain financial data for 115 companies from Compustat, remaining 15 companies were removed from the list because of the incomplete or missing data.

As stated above, the objective of this research is to inquire what other companies across industry sectors can learn about the supply chain practices of the leaders by analyzing only the financial data. Specifically, we want to investigate what inferences about the supply chain structure and the performance can be drawn using the financial ratios. We would like to accomplish this research objective by analyzing the following research questions in the context of the data:

TABLE 3. GARTNER 25 BY INDUSTRY SECTOR.

SIC Code	Industry Sector	Top Supply Chain Companies
366	Computer Manufacturing	Apple
28	Package Goods/Cosmetics	Procter & Gamble, Unilever, Colgate-Palmolive
59	Catalog/Specialty Distribution	Amazon
58	Restaurants	McDonald, Starbucks
367	Semiconductors	Intel
30	Shoe Manufacturing	Nike
20	Beverages (Production/Distribution)	Coca-Cola, Pepsi
53	Department/Specialty Retail Stores	Wal-Mart
357	Electronic Components	Seagate
283	Major Pharmaceuticals	Johnson & Johnson
35	Industrial Machinery/Components	Cummins
37	Auto Manufacturing	Toyota
52	Retail: Building Materials	Home Depot

1. *Inter-Group Comparison: What are the characteristics of the supply chains of companies in each industry sector. What are the similarities and differences among the industry sectors?*
2. *Intra-Group Comparison: What are the differences between the supply chain leader(s) with their competitors in each sector? Specifically, what are the differences between the group and the leaders?*

As stated above, we used data from calendar years 2013, 2012 and 2011; computed all the financial ratios for the three years and calculated weighted average using the same weights used by Gartner. Specifically, 50% weight for 2013, 30% for 2012, and 20% for 2011. The results are presented and observations are discussed in the next section.

IV. DATA ANALYSIS AND INFERENCES

4.1. Inter-group Comparisons

We computed financial ratios for all the companies and averaged them by group. Table 4 presents the average efficiency ratios (COGS, Gross profit margin and inventory turnover) by Industry Group and they are sorted in the descending order of cost of goods sold (COGS). The primary significance of cost of goods sold (COGS) is to demonstrate the incurred costs in providing services or manufacturing goods. Supply chain companies continually strive to optimize the COGS by incorporating demand driven operations, incorporating IT-based solutions and streamlining operations.

The following are the key observations that can be derived from COGS ratio:

- Auto manufacturing has the highest COGS due to its labor intensiveness and high operational costs. Retail industry has similar percentage as goods are generally bought from a manufacturer.
- Semiconductors, major pharmaceuticals and packaged goods/cosmetics industries have significantly lower COGS as they have lower material costs and its corresponding transportation costs.

TABLE 4. AVERAGE EFFICIENCY RATIOS BY INDUSTRY GROUP.

Industry Sector	COGS (% Revenue)	Gross Profit Margin	Inventory Turnover
Auto Manufacturing	76.31	0.24	9.82
Retail: Building Materials	71.48	0.29	10.39
Department/Specialty Retail Stores	69.94	0.3	5.26
Computer Manufacturing	62.08	0.38	17.88
Restaurants	61.86	0.38	80.82
Industrial Machinery/Components	59.45	0.41	7.16
Electronic Components	57.03	0.43	7.65
Shoe Manufacturing	54.54	0.45	4.36
Catalog/Specialty Distribution	53.46	0.47	11.38
Beverages (Production/Distribution)	43.14	0.57	6.11
Package Goods/Cosmetics	41.28	0.59	4.6
Semiconductors	37.25	0.58	4.14
Major Pharmaceuticals	30	0.7	4

**TABLE 5. CASH CONVERSION CYCLE AND WORKING CAPITAL
(AVERAGE BY SECTOR).**

Industry Sector	Days' Sales Outstanding	Days' Inventory Outstanding	Days' Payable Outstanding	C-C-C (Days)	Working Capital (mil \$)
Catalog/Specialty Distribution	74.57	306.52	234.02	735.35	2940.9
Semiconductors	51.07	627.66	86.46	592.27	4401.1
Major Pharmaceuticals	76.88	302.89	106.87	272.89	12826.4
Industrial Machinery/Components	88.89	153.72	44.26	198.35	4093.7
Auto Manufacturing	102.13	130.65	63.84	168.95	18126.9
Electronic Components	63.33	122.45	59.78	126.00	3623.3
Computer Manufacturing	71.56	129.92	82.89	118.59	7848.6
Beverages (Production/Distribution)	49.26	116.29	83.13	82.42	829.0
Shoe Manufacturing	42.56	78.4	54.82	66.15	1696.0
Package Goods/Cosmetics	40.38	111.87	88.92	63.33	-446.1
Restaurants	18.48	58.48	20.93	56.03	312.2
Retail: Building Materials	37.52	53.41	37.26	53.67	952.9
Department/Specialty Retail Stores	3.06	4.28	40.45	-33.12	398.2

- Rest of the industry sectors described above has an average cost of goods sold of 50 – 70 % in terms of revenue.

Effective inventory management is a key factor in demonstrating the efficiency of a supply chain. Depending on the industry sector inventory turnovers are varied widely. Inventory turnover demonstrates how often the complete inventory is translated into revenue. Effectively managing high inventory turnovers is important to reduce costs and optimize supply chain operations. Days to replenishment describes the number of days it takes for a company to refill its stock. Managers take strategic steps to pile-up inventory or reduce it based on many factors such as rising raw material costs and perishability. The following are the key observations that can be derived from inventory turnover ratio:

- Restaurants have high inventory turnovers, as most of the items are perishable. With only 5 days to replenish, their transportation costs are highest in this sector.

- Computer Manufacturing, catalog and specialty distribution, building materials have average inventory turns and subsequent, days to replenishment. Their usual inventory turns average at 10 – 20 times a year.
- Auto manufacturing, electronic components, industrial machinery manufacturing, beverage industry have a slightly lower inventory turns averaging between 5 – 10 times a year.
- Retail stores, packaged goods/cosmetics, shoe manufacturing, semiconductors and major pharmaceuticals have lower inventory turns with an average less than 5 times a year.

The working capital requirement is another important measurement in supply chain, which is determined by the cash conversion cycle (C-C-C). Various components describe cash conversion cycle such as, days' sales outstanding (DSO), days' inventory outstanding (DIO) and days' payable outstanding (DPO). Working capital is directly tied to the cash conversion cycle (C-C-C). The Table 5 presents the average C-C-C

and working capital usage by industry sector and observations are sorted in descending order of C-C-C. In general lower C-C-C leads to lower working capital requirements as depicted in the table for the four industry sectors that are at the bottom of the table and remaining sectors high C-C-C leads to higher working capital. However working capital does not sort in the same order as C-C-C because of industry sector specific differences.

The following are the key observations that can be derived from C-C-C and Working Capital ratios:

- Retail stores exhibit a higher DPO (supplier side), as they tend to have a strong bargaining power with their suppliers and dealers alike; Retail stores tend to be consistently profitable as they receive accounts payable from customers earlier than, they invest in inventory and relatively have a lower accounts payable. Working capital is well managed in the retail industry as a result of effective cash conversion cycle.
- Catalog/specialty distribution companies have the highest cash conversion cycle at

736 days. The high DIO is due to the size of the inventories distribution companies carry.

- Comparatively restaurants have lowest DSO (customer side) and quick inventory turnover while they have a high bargaining power among suppliers.
- Auto manufacturers fall on the higher side of working capital requirements, as their DPO (supplier side) is much lesser than DIO and DSO (customer side).
- Semiconductor industry has a high cash conversion cycle, due to larger inventory holdings (DIO).
- Department/Specialty Retail Stores have low DIO and DSO (customer side), whereas DPO (supplier side) is high, which leads to negative C-C-C.

Analyzing profitability and efficiency ratios of the described industry sectors provides an opportunity to evaluate key performance metrics of the industry sectors. The Table 6 presents the key performance ratios, the observations are sorted in descending order of ROA.

TABLE 6. KEY PERFORMANCE RATIOS (AVERAGE BY SECTOR).

Industry Sector	ROA	Asset Utilization	Operating Margin	ROCE
Beverages (Production/Distribution)	10.90%	0.63	22.36	18.00%
Retail: Building Materials	9.30%	2.37	7.52	20.80%
Restaurants	8.90%	1.08	21.06	21.40%
Major Pharmaceuticals	8.70%	0.51	24.19	15.90%
Package Goods/Cosmetics	8.10%	1.01	15.46	21.40%
Catalog/Specialty Distribution	7.90%	1.89	4.9	8.90%
Electronic Components	7.80%	1.09	14.5	16.20%
Shoe Manufacturing	7.60%	1.45	9.56	17.40%
Semiconductors	7.50%	0.55	17.56	11.20%
Industrial Machinery/Components	7.40%	0.69	16.27	12.70%
Computer Manufacturing	6.50%	0.81	12.93	14.60%
Department/Specialty Retail Stores	4.90%	1.94	4.34	12.90%
Auto Manufacturing	3.30%	0.82	5.12	5.30%

The following are the key observations that can be derived from ROA, ROCE, Asset Utilization and Operating Margin ratios:

- Industrial machinery/components and the beverage industry have the lowest asset utilization among the various industry sectors. This gives us valuable insight into the inefficient or often outdated supply chain practices in place.
- In the retail: building materials sector, the management's approach to mobilize its assets to generate more revenues is systematically in place, and its asset utilization ratio is a staggering 2.37. This means the sector approximately makes twice the revenues invested.
- Gross profit margin, which measures a company's manufacturing and distribution efficiency during the production process. It is a profitability measurement of how much from each dollar of a company's revenue is available to cover overhead, other expenses and profits are the highest in the pharmaceutical industry.
- Being the early adopters of many efficient supply chain techniques, this industry sector continues to demonstrate and innovate.
- An effective supply chain also tends to have a higher operating margin. Lean practices in industry sectors such as restaurants, beverage manufacturers and pharmaceuticals as discussed earlier in this chapter correlate to the higher operating margins shown below.
- The ROCE measures a company's ability to generate more earnings out of every dollar of capital employed. A high ROCE (20 % and above) for industry sectors such as restaurants, retail and building materials and packaged/cosmetic goods, indicates a successful and a growing company. A higher ROCE also means that a larger chunk of profits can be invested back into

the company for the benefit of both the company and its shareholders.

- In the lower band of the spectrum lies the mighty auto manufacturing sector, which has a low ROCE, ROA, and low operating margins as they have been ailing in the saturated industry. Sales are low compared to other sectors and auto manufacturers are still adapting to efficient supply chain management techniques to improve their asset utilization and reduce varying fluctuations in demand.
- An average ROCE (10 – 15 %) for majority of the industry sectors signify that their capital management in financial terms and asset management in supply chain terms are performing at optimum.

4.2. Comparison of Leaders and Leader/Sector Average

Now we want compare supply chain leaders across industry sector and also compare the leader with industry sector averages. Essentially we want to see how the supply chain leaders differ from the industry sector average. The Table 7 presents key performance indicators for the supply chain leaders and contrasted with industry sector average. The following are the key observations that can be derived from the comparison of supply chain leaders and leader and sector averages:

- Apple Inc. leads the list for 2015 according to Gartner survey data. They have set certain benchmarks for SC processes and management in several aspects. The COGS is 58.42 % of annual revenue, which has gradually decreased over a period, enhancing the profitability of the tech giant. The cash conversion cycle is about 3 times lower than the group average. This means a more efficient and profitable supply chain operations are in place.

- Intel Corporation has been tackling various issues with inventory management and rising operational expenses. With, the highest cost of goods sold among all of the industry sectors at 91 % cost of goods sold as percentage of revenue, Intel continues to be a leader in their industry sector with a higher ROA and ROCE compared to its group average.
- McDonald's and Starbucks are the SC leaders in the restaurant sector with a contrasting COGS ratio between them. The earlier has a lower cost of goods sold than the later, with reasons related to fixed costs and assets. Both these SC leaders exhibit a comparably shorter cash conversion cycles. While, McDonald has a higher ROA and ROCE, the Starbucks was barely profitable based on the ROA. This was directly impacted by the low net income it generated in 2013.

**TABLE 7: GROUP AVERAGE AND LEADER COMPARISON
(LEADER'S RATIOS ARE IN PARENTHESIS)**

Industry Sector	COGS (% Revenue)	Gross Profit Margin	Inventory Turnover	C-C-C (Days)	ROA	ROCE
Auto Manufacturing <i>Leader: Toyota Motor</i>	76.31 <i>(76.1)</i>	0.24 <i>(0.10)</i>	9.82 <i>(1.99)</i>	168.95 <i>(50.37)</i>	3.30% <i>(1%)</i>	5.30% <i>(1%)</i>
Retail: Building Materials <i>Leader: Home Depot</i>	71.48 <i>(65.25)</i>	0.29 <i>(0.35)</i>	10.39 <i>(4.65)</i>	53.67 <i>(-24.75)</i>	9.30% <i>(13.3%)</i>	20.80% <i>(30.8%)</i>
Department/Specialty Retail Stores <i>Leader: Wal-Mart</i>	69.94 <i>(73.63)</i>	0.3 <i>(0.26)</i>	5.26 <i>(7.78)</i>	-33.12 <i>(-26.99)</i>	4.90% <i>(8%)</i>	12.90% <i>(19%)</i>
Computer Manufacturing <i>Leader: Apple</i>	62.08 <i>(58.42)</i>	0.38 <i>(0.42)</i>	17.88 <i>(56.6)</i>	118.59 <i>(37.77)</i>	6.50% <i>(18%)</i>	14.60% <i>(30%)</i>
Restaurants <i>Leader 1: McDonald's</i> <i>Leader 2: Starbucks</i>	61.86 <i>(55.88)</i> <i>(74.71)</i>	0.38 <i>(0.44)</i> <i>(0.25)</i>	80.82 <i>(126.95)</i> <i>(10.01)</i>	56.03 <i>(22.57)</i> <i>(16.05)</i>	8.90% <i>(15%)</i> <i>(0%)</i>	21.40% <i>(25%)</i> <i>(36%)</i>
Industrial Machinery/Components <i>Leader: Cummins</i>	59.45 <i>(72.33)</i>	0.41 <i>(0.28)</i>	7.16 <i>(5.26)</i>	198.35 <i>(95.27)</i>	7.40% <i>(10.1%)</i>	12.70% <i>(15.4%)</i>
Electronic Components <i>Leader: Seagate Technology</i>	57.03 <i>(67.1)</i>	0.43 <i>(0.33)</i>	7.65 <i>(11.26)</i>	126 <i>(62.57)</i>	7.80% <i>(20%)</i>	16.20% <i>(32%)</i>
Shoe Manufacturing <i>Leader: Nike</i>	54.54 <i>(53.37)</i>	0.45 <i>(0.47)</i>	4.36 <i>(3.76)</i>	66.15 <i>(82.09)</i>	7.60% <i>(14%)</i>	17.40% <i>(27%)</i>
Catalog/Specialty Distribution <i>Leader: Amazon</i>	53.46 <i>(69.42)</i>	0.47 <i>(0.31)</i>	11.38 <i>(6.97)</i>	735.35 <i>(-70.98)</i>	7.90% <i>(1%)</i>	8.90% <i>(4%)</i>
Beverages (Production/Distribution) <i>Leader 1: Coca-Cola</i> <i>Leader 2: Pepsi</i>	43.14 <i>(35.24)</i> <i>(43.32)</i>	0.57 <i>(0.65)</i> <i>(0.57)</i>	6.11 <i>(5.04)</i> <i>(8.44)</i>	82.42 <i>(102.95)</i> <i>(64.61)</i>	10.90% <i>(10%)</i> <i>(9%)</i>	18.00% <i>(18%)</i> <i>(17%)</i>
Package Goods/Cosmetics <i>Leader 1: Procter & Gamble</i> <i>Leader 2: Unilever</i> <i>Leader 3: Colgate-Palmolive</i>	41.28 <i>(46.44)</i> <i>(56.42)</i> <i>(38.83)</i>	0.59 <i>(0.54)</i> <i>(0.44)</i> <i>(0.61)</i>	4.6 <i>(5.66)</i> <i>(7.14)</i> <i>(4.75)</i>	63.33 <i>(7.04)</i> <i>(1.22)</i> <i>(50.09)</i>	8.10% <i>(8%)</i> <i>(11%)</i> <i>(16.2%)</i>	21.40% <i>(15%)</i> <i>(27%)</i> <i>(44%)</i>
Semiconductors <i>Leader: Intel Corporation</i>	37.25 <i>(90.34)</i>	0.58 <i>(0.1)</i>	4.14 <i>(1.99)</i>	592.27 <i>(50.37)</i>	7.50% <i>(16.2%)</i>	11.20% <i>(44%)</i>
Major Pharmaceuticals <i>Leader: Johnson & Johnson</i>	30 <i>(25.57)</i>	0.7 <i>(0.74)</i>	4 <i>(2.32)</i>	272.89 <i>(168.96)</i>	8.70% <i>(10%)</i>	15.90% <i>(18%)</i>

- Amazon.com leads the catalog and specialty distribution segment with managing a complex network of warehouses and a high inventory. Their supply chain model stands out offering customers high value and choices. With 70 % of revenues towards cost of goods sold, which is a nominal ratio for any retail industry, they are striving in setting benchmarks for supply chain operations that are offering better returns than classic brick & mortar companies. Although, the key performance indicators are not on par with the industry average. Since, Gartner uses a composite score to identify top SC performers, Amazon was ranked No.1 overall.
- Pharmaceutical industry represented by Johnson & Johnson has the lowest COGS among its counterparts across different industry sectors. This explains the relatively lower direct raw material costs as opposed to retail industry, where COGS was much higher.
- Wal-Mart stores have been continually challenged with fierce competition from other industry sectors such as online retail industries such as Amazon. Although they have similar COGS ratios, Wal-Mart is tackling higher operational costs and logistics costs when compared.
- In the beverage industry, Coca-Cola and Pepsi have contrasting ratios among them with approximately 8% difference in their financial structure. This industry sector has invested primarily in automated operations systems, which account to high fixed assets. The number of inventory turns for Coca-Cola is lower and subsequently a high cash conversion cycle than Pepsi and also the group average.
- Toyota Motor's COGS is comparable to the group average but has a lower gross profit margin. A lower inventory turnover than the industry average but, interestingly has a lower cash conversion cycle time. The ROA and ROCE are lower than the group average, and Toyota continues to set benchmarks in the SC practices with its just-in-time manufacturing system in place.
- From the packaged goods & cosmetics, P&G, Unilever and Colgate-Palmolive have been listed as top SC companies consistently for years now. While, their key performance indicators have comparable numbers compared to their industry and usually outperform. Colgate-Palmolive has an average inventory turn but relatively has a high ROA and ROCE. Although, P&G and Unilever top the list in this segment their performance in cash conversion cycle time while, the other key performance indicators were lower than Colgate-Palmolive Inc.
- Nike has comparable performance ratios to their industry average. The high return on capital employed shows how strategic and profitable the company's assets are performing based on operational decisions. The higher time taken to convert the inventory directly correlates to the higher cash conversion time.
- Seagate's performance indicators demonstrate the strong SC leadership in this industry segment. A higher inventory turnover means the company is efficiently selling its inventory and is generating healthy profits from a lower cash conversion cycle.
- Cummins has a higher COGS compared to the industry sector and subsequently, a lower gross profit margin. This is also directly related to the lesser inventory turnover but it fares better at other performance indicators.
- In general, supply chain leaders tend to outperform their competitors in their segment on many financial aspects. To analyze this and verify the validity of this

statement, the top SC companies are presented in a descending order of their cost of goods sold (as percentage of revenue). The initial analysis on COGS shows, Intel and Cummins Inc. are the only SC organizations that have a higher COGS compared to their group average. This translates to a much lower gross profit margins and eventually a lower inventory turns when compared..

- The above table also, helps to recognize the variability of supply chain performance of the leaders based on key performance indicators. Furthermore, the discussion continues in comparing and contrasting the leaders with their peers in the next section. The difference in their financial structures was studied in the earlier section which has provided a basis for exploring the differences in their supply chains and its performance.

4.3. Intra-Group Comparisons

We would like to now compare the SC leader and the competitors in each industry group and understand the commonality and differences among them. An insight into the variability among the leader and unranked companies would be help supply chain manager operational decisions. We have analyzed all thirteen groups; however presenting three industry groups for space limitation. We decided to include the

following three industry groups because they exhibit unique patterns in terms variability in the financial ratios.

Industry Group: Auto Manufacturing

The average car manufacturing has three times the levels of inventory of any other process industry with only slight improvements in inventory. Table 8 provides a detailed auto manufacturing industry analysis with comparing the companies in the peer group. Due to high margins and a focus on new product launch, the industry has been slow to adopt supply chain practices. As the rate of new products slow, supply chain excellence will matter more than ever to the industry.

By comparing Toyota motor’s key financial metrics with its peers, gives a deeper insight into individual supply chain strategies and performance. While, Toyota motors cost of sales is lesser than Ford’s, GM’s and Paccar Inc’s, and also inventory turns are higher. Honda, Tata and Tesla have much lesser COGS % than Toyota but have comparatively lesser ROCE.

The cash conversion time for Toyota is around 222 days, which is lower than some of its competitors. The just-in-time manufacturing method has made the supply chain more fluid and allowing a balance between accounts payable and accounts receivable.

TABLE 8. AUTO MANUFACTURERS KEY PERFORMANCE INDICATORS.

Company Name	COGS (% Revenue)	Inventory Turnover	C-C-C	Working Capital	ROCE	ROA	Asset Utilization	Gross Profit Margin	Operating Margin
Toyota motor (Leader)	76.1	10.32	222.2	10070	8.6%	4.4%	0.62	0.24	8.92
Ford motor	82.5	15.72	421.1	77438	4.1%	3.5%	0.73	0.18	5.65
General motors	84.2	9.32	51.3	19089	6.4%	3.2%	0.93	0.16	4.31
Honda motor	67.4	6.13	150.5	10292.6	6.7%	3.7%	0.76	0.33	6.16
Paccar	79.8	16.79	435.7	8689	8.8%	5.7%	0.83	0.20	10.67
Tata motors	72.2	6.20	-43.0	718.7	5.8%	6.0%	1.07	0.28	3.15
Tesla motors	72.1	4.26	-55.2	590.8	-3.5%	3.1%	0.83	0.28	-3.04

TABLE 9. CATALOG/SPECIALTY KEY PERFORMANCE INDICATORS.

Company Name	COGS (% Revenue)	Inventory Turnover	C-C-C	Working Capital	ROCE	ROA	Asset Utilization
Amazon (Leader)	69.42	6.97	-70.98	1645	4.0%	0.7%	1.85
Liberty Ventures	16.19	4.88	253.06	-659	-0.1%	0.6%	0.09
Overstock Inc.	80.98	39.06	-21.27	25.709	12.8%	27.7%	4.08
Best Buy	76.09	6.00	-31.88	3049	16.3%	3.8%	3.03
Ebay	24.64	0.00	606.43	10644	11.7%	6.9%	0.39

The average inventory outstanding is specifically high in this industry. A high variability in the cash conversion time is observed in this industry sector as each supply chain focuses on different aspects for improvements.

With Tata motors having the highest asset utilization ratio followed by GM, their return on capital employed is much lower than Toyota's. The operating margin of Toyota's is much higher than some of its competitors primarily due to higher net income. This also translates to a higher earnings from every dollar invested. Even though, the net sales are comparable, the peers in this industry have emphasis on higher net sales.

Catalog/Specialty Distribution

Table 9 provides a detailed industry analysis with comparing the companies in the peer group for this sector. A big advantage for Amazon is that it manages and ships not only its own inventory but also that of other retailers such as Eddie Bauer and Target, giving it an economy of scale that dwarfs its rivals. As it stands, Amazon can currently ship some 10 million products, compared with Wal-Mart's 500,000. As Amazon offers same-day, second-day and other fulfillment options, it competes with bricks-and-mortar companies and many more.

The COGS (as % of revenue) is high due to the scale of diversity of products Amazon offers. Overstock and Best Buy also

have comparable COGS due to their operational structures. Liberty and Ebay have lower inventory turnovers and they have focused around logistics management to optimize profits. This can further be analyzed by looking into the cash conversion cycle times. Liberty and Ebay has a lower CCC because of their supply chain structure and operational focus. Amazon has an industry leading CCC time because it receives cash directly from the customers even before paying their suppliers saving them the cost of debt and the need for a high working capital. Best buy and Ebay have a higher cash conversion cycle time and subsequently, a high working capital to support operations.

The ROCE ratio for Amazon is 4%, which is much lower than its peers. Best buy, Overstock and Ebay have a higher ROCE with lesser assets making them more profitable according to the financial interpretations. ROA is even higher for the competitors, which means the annual net income is higher than the average total assets for 2013. Since, Amazon has made huge investments in better supply chain management techniques, the improvements would surface down the years on the key performance indicators. In terms of asset utilization Overstock Inc. has the highest ratio in the industry sector, followed by Best buy and then Amazon. This demonstrates the operational capabilities of these companies are better than that of Amazon based on financial ratio data. It still retains position as the top SC leader in 2013 according to Gartner; this is

based on the composite score where 50% of the weight is from opinion and peer review components.

Industry Group: Package Goods/Cosmetics

In general, the package goods and cosmetics industry is considered as a leader within supply chain management, according to key performance indicators progress has stalled. The companies in this industry sector peer group grew topline revenue by 7%, increased the number of days of inventory by 3%, and fought an uphill and then a downhill battle to manage operating margins. The efforts towards supply chain excellence have been more project-based than systemic, and the industry has been slow to manage the end-to-end value chain. Barriers exist to design supply chains across sales and marketing to improve the end-to-end flows, and costs and waste are being pushed backwards in the chain towards suppliers. These companies tend to be more sales-driven (opportunistic) or marketing-driven (focused on share) than driving long-term value which result in a lower cost of goods sold compared to other industry sectors. Packaged goods/cosmetics

companies have adopted market-driven practices like demand sensing, test and learn practices, and demand orchestration in order to drive themselves off of the current supply chain plateau. Companies within this industry group have shown more resilience than companies in other industry sectors, with more reliable results in both operating margin and days of inventory.

Table 10 provides a detailed industry analysis which compares the companies in the peer group for this sector. In the packaged goods industry sector, Colgate Palmolive consistently outperforms its peers on operating margin and ROCE. In terms of COGS as percentage of revenue, the industry sector has the lowest among others. Estee Lauder Inc has the lowest among its peers, followed by Avon products and Colgate-Palmolive. Subsequently, these companies have a lower inventory turns and a higher cash conversion cycle.

The industry leader for 2013, Unilever has recorded the highest inventory turnover and the lowest cash conversion cycle of 1.22 days. This means a reduced usage of working capital to fund operations, which is taken care by interest-free money that was generated.

TABLE 10. PACKAGE GOODS/COSMETICS KEY PERFORMANCE INDICATORS.

Company Name	COGS (% Revenue)	Inventory Turnover	C-C-C	Working Capital	ROCE	ROA	Asset Utilization	Gross Profit Margin	Operating Margin
Unilever (Leader)	56.42	7.14	1.22	-4103.1	26.7%	10.6%	1.09	0.44	15.10
Procter & Gamble (leader)	46.44	5.66	7.04	-6047	14.7%	8.1%	0.60	0.54	19.04
Colgate-Palmolive (leader)	38.83	4.75	50.09	352	43.9%	16.2%	1.26	0.61	23.71
Church & Dwight	52.21	6.66	53.82	464.6	17.4%	9.3%	0.75	0.48	19.68
Ecolab	48.21	4.83	159.04	1209.7	11.0%	4.9%	0.67	0.52	13.39
Avon products	35.20	3.48	14.06	1238.6	18.6%	0.9%	1.53	0.65	7.95
Coty	36.37	2.78	29.68	953.7	8.9%	2.6%	0.72	0.64	9.57
Estee Lauder	16.52	1.51	191.69	2362.6	29.8%	14.3%	1.43	0.83	15.26

Colgate-Palmolive has a higher cash conversion cycle among its peers resulting in a greater need for efficient working capital management. The key observation from this group is that the three leaders achieve better supply chain excellence using different financial matrices, which indicates significant differences in their supply chain structure.

V. SUMMARY OF THE FINDINGS AND CONCLUSIONS

As discussed in the data analysis and inference section, we have been able to make several observations in this research. First, we can draw valuable insights into the supply chain practices using the financial ratios that are computed from the publicly available data. We deployed a number of financial ratios that can be used for this purpose; and our analysis shows that just three financial ratios (ROA, inventory turns and revenue growth) used by Gartner do not provide adequate understanding of the supply chain practices and performances of the leaders.

Second, the supply chain leaders identified by Gartner fall into thirteen industry sectors and the supply chain structure of these industry sectors exhibit different supply chain characteristics. Supply chain characteristics of the supply chain leaders vary and the differences in their supply chain practices are largely attributed to the industry sector differences. Hence, supply chain leaders from different industry sectors are not comparable. Rather a company may carefully look into the leaders in their sector to benchmark the supply chain practices.

Third, interesting variability emerges between leader and peers in the respective sectors when intra-group comparisons are made. In general the supply chain leaders outperform compared to their respective industry sector averages; however, this observation is not generalizable to all the sectors. We presented intra-group comparisons

for three industry sectors to demonstrate the variability exists among the leader and peers within groups. In the Catalog/Specialty Distribution sector, Amazon.com outperformed the industry average. However, intra-group comparisons demonstrated that some of its peers were performing better than Amazon. This indicates that Amazon got elevated to the Top 25 list because of peer opinion panel and poll scores (which counts for 50% of the ranking).

In case of Package Goods/Cosmetics sector, we had three companies from Gartner's Top 25 list; the three leaders outperform the peers in two different dimensions each. Hence, these three companies exhibit different supply chain practices and excel on different dimensions. On the other hand, Auto Manufacturers sector, the leader performed well overall compared to peers.

This research thus demonstrates how the publically available financial data can be leveraged to analyze and learn about the supply chain practices and performances of leaders and their competitors. As discussed in the literature review section, there are many articles that provided the description on how supply chain performance measures impact the financial measures with illustrative examples. Deriving the inferences on the supply chain structure and performances using financial data (empirical research) has not been reported. This reverse modeling approach is important to derive insights from the supply chain leader listing such as Gartner's 25.

One of the limitations of this study is the sample size; we have used analyzed 115 companies that fall into 13 industry segments and data from 2011-2013. This study can be expanded with wider sample size and also more granular SIC codes (three or four digits). Another extension to this study is the longitudinal analysis to characterize the trends in supply chain management practices and performances. Nevertheless, this research demonstrates how publically available

financial data can be used to learn about the supply chain characteristics and performances. This approach is very valuable for industry professionals. Often detailed description on how the leader's supply chain structured is internal and not available. In such cases, the approach developed in this this research would provide valuable insights that help them in their supply chain decisions. We hope this research spurs further research and theoretical development on this approach which is valuable for managers.

REFERENCES

- Aronow, S., Burkett, M., Romano, J. and Nilles, K., "2015 Supply Chain Top 25: The Art and Science of Supply Chain", *Supply Chain Management Review*, 19(5), Sep/Oct 2015, 14-23.
- Aronow, S., Hofman, D., Burkett, M., Romano, J. and Nilles, K., "The 2014 Supply Chain Top 25: Leading the Decade", *Supply Chain Management Review*, 18(5), Sep/Oct 2014, 8-17.
- Camerinelli, E., *Measuring the value of the supply chain: Linking Financial Decisions and Supply Chain Performance*. Ashgate Publishing Group, 2009.
- Dehning, B. and Stratopoulos, T., "DuPont analysis of an IT-enabled competitive advantage", *International Journal of Accounting Information*, 3(3), 2010, 165-176.
- Elgazzar, S.H., Tipi, N.S., Hubbard, N.J. and Leach, D.Z., "Linking supply chain processes' performance to a company's financial strategic objectives", *European Journal of Operational Research*, 223(1), 2012, 276-289.
- Hofman, D., Aronow, S., and Nilles, K., "The 2013 Supply Chain Top 25: Learning from Leaders", *Supply Chain Management Review*, 17(5), Sep/Oct 2013, 12-16 and 18-21.
- Hofman, D. and Aronow, S., "The Supply Chain Top 25: Raising the Bar", *Supply Chain Management Review*, 16(5), Sep/Oct 2012, 10-12,14,16-19.
- Huang, S.H., Sheoran, S.K. and Wang, G., "A review and analysis of supply chain operations reference (SCOR) model", *Supply Chain Management*, 9(1), 2004, 23-29.
- Hutchison, P.D., Farris, M.T. and Gary, M.F., "Supply chain cash-to-cash: a strategy for the 21st century", *Strategic Finance*, 91(1), 2009, 41-48.
- Kremers, L., "The Link between Supply Chain and Finance", *Supply Chain Asia*, 2010, 22-25.
- Lockamy, A. and McCormack, K., "Linking SCOR planning practices to supply chain performance", *International Journal of Operations & Production Management*, 24(12), 2004, 1192-1218.
- Presutti Jr, W.D., Mawhinney, J.R., "The supply chain-finance link", *Supply Chain Management Review*, 11, 2007, 32-38.
- Soliman, M.T., "The Use of DuPont Analysis by Market Participants", *The Accounting Review*, 83(3), 2008, 823-853.
- Wisner, P., "Linking Supply Chain Performance to a Firm's Financial Performance", *Supply Chain Management Review*, 2011.