

Benchmarking Supply Chain Performance: A Case Study in Indian Petroleum Sector

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ABSTRACT

The petroleum industry comprises of activities, which are geographically disbursed for exploration, procurement, transformation, storage, and distribution with transportation network linking facilities through which products flow. The supply chain in the petroleum industry covers a network of processes including placing order for raw material, in-bound logistics and delivery, conversion of raw materials to semi-finished and finished products and their storage, delivery to intermediate facilities, and flow to end customer through distribution channels. The challenge in this supply chain is not only due to the large number of activities, but also due to their dispersed execution which requires a high degree of coordination among all players, leading to evolve a systematic technique for measurement, analysis and improvement in the performance. The sample analyzed has clearly demonstrated that big companies need to rationalize on supply-chain-asset productivity. It demands operational strategies encompassing the logistics and distribution planning mainly for the demand side, which attracts huge investment in the assets and accounts for high pipeline stock. The operational strategies of the companies should be able to follow an agile inventory strategy to storage, which incorporates wireless technology, inventory scenario along with orchestration of demand, and supply data across the supply chain.

Keywords: M110: Supply Chain Management, Supply Chains, Logistics, Inventory Management (Based on JEL Classification)

INTRODUCTION

Managing supply chain plays a pivotal role in enhancing productivity and profitability of an organization. This integrates several components like sourcing raw materials, production, storage, transportation, and delivery to customer. In the chain, information and finance flow bi-directionally with end customer as the driving force.

Performance measurement of these flows plays an imperative part in fixing targets, assessing execution, and future decisions in supply chain. Measurement of performance of supply chain uncovers the gap between planning and implementation, aiding organizations to take corrective actions. Nevertheless, it is perceived that creating key performance indicators are extremely complex but a ready arrangement of guidelines is not promptly accessible for organizations and SCM

professionals. The actual value created at logistics level in terms of customer satisfaction and cost can be measured through supply chain performance.

In recent times, supply chains are becoming more complex as there is a shift in the structure of the chain from a linear to a network form. In turn, it is creating the need to track an increasing quantum of information allowing evaluation of functioning of the entire supply chain. Hence, it is essential to logically choose the parameters for measuring its performance.

Most organizations desire a standard model, which includes metrics of performance to improvise the supply chain proficiency. Supply Chain Operation Reference (SCOR) model is a versatile model to analyze the performance. SCOR model has built up a set of metrics pertaining to reliability, responsiveness, agility, cost, and assets.

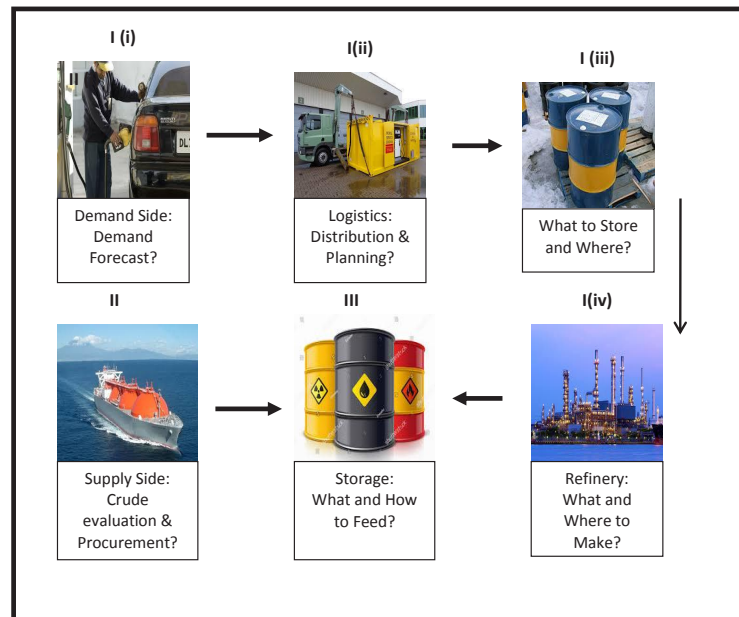
The petroleum industry comprises of activities, which are geographically disbursed for exploration, procurement, transformation, storage, and distribution with transportation network linking facilities through which products flow. The supply chain in the petroleum industry covers a network of processes including placing order for raw material, in-bound logistics and delivery, conversion of raw materials to semi-finished and finished products and their storage, delivery to intermediate facilities, and flow to end customer through distribution channels. The challenge in this supply chain is not only due to the large number of activities, but also due to their dispersed execution which requires a high degree of coordination among all players, leading to evolve a systematic technique for measurement, analysis, and improvement in the performance.

This paper focuses on three different areas – literature survey to understand the petroleum industry supply chain and the challenges; measuring supply chain performance of Indian petroleum industry using both financial metrics and select metrics of SCOR model; and evolving strategies to overcome challenges and improve supply chain performance.

SUPPLY CHAIN IN PETROLEUM INDUSTRY: OVERVIEW

The petroleum industry involves highly specialized business processes, which mostly work in silos with limited information sharing across the units. An International Report has exhibited that most of the firms in Oil and Gas Industry give top priority to cost-reduction decisions (www.dvngl.com). This is quite obvious because net profit margin of renowned and big oil companies are measured to be around 6.5% (www.forbes.com) which is far less than other chemicals (~15% net profit) industry. Management of Supply Chain plays a crucial role in cost reduction, which can bring competitive edge on cost front.

Supply chain of Petroleum Company involves: (i) crude oil operation/purchase, (ii) crude transportation to refineries, (iii) refining operations, (iv) product purchase, (v) product transportation, and (vi) distribution of product to end user. Demand of end customers derived from real time, historical and forecasted sales. Such a demand is met by either by sourcing the crude oil, or performing all activities including exploration to produce the product. However, Economics decide whether to buy or produce.



Source: Compiled by authors

Fig. 1: Petroleum Industry Supply Chain and Decision

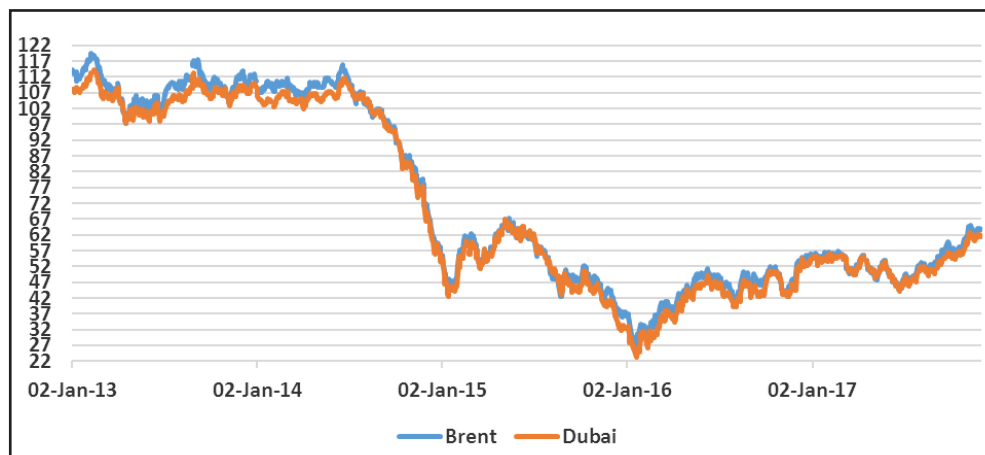
The petroleum industry can be divided into two parts by keeping the refinery in the middle. The upstream supply chain consists of acquiring the crude and this segment involves forecasting, exploration, and logistics management needed to get the crude oil extracted from

wells and move to the refinery. The downstream supply chain operation is comparable to standard manufacturing supply chain and focuses on distribution of consumable products (like diesel, gasoline, lubricant oil, etc.) to retailers and end consumers.

Figure 1 shows the redesigned ideal supply chain and related decisions. Both supply and demand sides simultaneously govern the flow in the chain. Hence, the ultimate decisions of what, when and where to deliver the products (POS) is influenced by right decision leading to cost minimization and speed of market reach.

Price of crude oil has never been stable and seen many peaks and troughs in recent years. The price of crude oil remained above \$100 until August 2014 (Fig. 2). The benchmarked price of \$100 for a long time forced many firms to increase their investments in technology to lower production cost, looking for alternative energy sources and reducing scope of business. The increased focus on

technology has also influenced the demand side through fuel-efficient transportation. The geopolitical equations among oil-producing countries like OPEC, the US, and CIS countries resulted in fall in crude prices. Marker Crude Oil Brent reached its nadir at 25.985 \$/Bbl on Jan. 20 while Dubai to 22.80 \$/Bbl on Jan. 21 of 2016. Thereafter, price rise has occurred with Brent at 63.22 \$/Bbl and Dubai at 60.85 \$/Bbl on 30 Dec. 2017. Oil prices now have started being governed by marginal cost (additional cost for producing one extra barrel) rather than breakeven or demand/supply or geopolitical opportunistic cost dynamics. Price trend of Marker crude oils Brent and Dubai since Jan. 2013 until Nov. 2017 is depicted in Fig. 2:



NB: Majority of traded crude oils are listed at premium or discount to marker crudes Brent (low sulphur) and Dubai (high sulphur)

Source: <http://markets.businessinsider.com/>

Fig. 2: Crude Oil Price Trend (S/Bbl)

The petroleum-industry supply chain is unique compared to conventional manufacturing industry supply chain due to following factors:

- Volatility and variability towards upward trend in prices of crude oil, which is the primary raw material for refinery, often puts supply chain under pressure to partially offset the cost. Usual economic factors, issues like political instability, terrorism, war, OPEC domination, traders' belief of future market govern the pricing. Crude oil suppliers often form cartels making the crude market a sellers' market leaving little option to oil refiners and marketers. Petroleum-industry supply chain often experiences uncertainty in supply of crude.
- Acquisition of crude oil is based on forecast and usually faces long lead-time. Transport is largely

through ships to reach shore of the importers country followed by additional weeks for unloading, processing, and finished product production and thereafter distribution of products through various means like oil tankers, rail & road transportation, pipelines leading to a very long supply chain.

- Inventory in petroleum industry is non-discrete in nature – typical SKUs are not available. End products like petrol, diesel, and kerosene are measured in kiloliters while LPG, Naphtha, Fuel Oil, and Bitumen are sold in metric tons.
- From single raw material (Crude) many end products are produced like diesel, gasoline, kerosene, naphtha, etc. It is contrary to standard manufacturing chains where many items are put together to arrive at a single finished product.

- The manufacturing process in petroleum industry is continuous and the refineries must run in 24×7 basis with high-capacity utilization. There is hardly any scope for short-term capacity change and the production cannot be stopped at will.
- End products resulting from refining of crude oil are highly standardized and there is hardly any scope to make any change in product slate-basis demand. This makes it extremely difficult to effect manufacturing or geographic postponement or advancement or increase/decrease manufacturing of one product over other basis demand, which are often used as effective strategy for customization, profitability, demand materialization, and inventory management. Therefore, petroleum supply chain is required to focus more on efficiency than on responsiveness.
- Collaboration or integration across the chain is a major challenge in this sector as crude oil producers, refiners, and marketers primarily work in silos. Most companies had pieces of supply chain tools in place, but not fully integrated due to technology limitations. High level of fluctuations in oil prices comes in the way of collaboration, be it for short term or long term.
- The end consumable products like petrol, diesel, kerosene, etc., are having very high risk of contamination, which may affect image of the firm and consequential loss in market share. Stringent quality checks must be in place in each stage of the chain from journey of crude oil to refinery to storage and dispatch of products until it reaches end consumer.
- The long supply chain results in very high inventory-holding cost for the petroleum industry. Majority of the products, whether crude oil or finished/intermediate products, move in bulk mainly through ships, pipelines, rail wagons, or road oil tankers. A large chunk of oil inventory thereby remains on transportation in addition to stationary storages. As petroleum oil plays a crucial role in any country's economic activity, sufficient amount of inventory should always be available as back up. As per the norm of International Energy Agency storage of 90 days of net oil import (in the form of crude, finished product, or combinations) is required to be maintained. Inventory-carrying cost in petroleum indus-

try, therefore, plays a major role in profitability of this sector.

- Extreme diversity is experienced in petroleum supply chain. Varietal disciplines need to be covered in each link like *crude procurement*, which includes international pricing, contracts, forecasting, chartering, crude operations, relationship management, and risk management; *refining*, which consists of processing, chemistry, engineering, and optimization; *primary and secondary distribution* such as domestic/export/import pricing, market knowledge, contracts, credit control, logistics, and customer relationships.

Above-mentioned variance and complexity compel petroleum supply chain to strive towards continual reorientation for adjusting itself to dynamic environments and thereby adopt 'Adaptive Supply Chain (ASC)'. ASC uses detailed information on demand and supply requirement and contributes to the improvement by focusing on four different aspects of the *Process*. Designing process to run the supply chain management; *People process* for proper communication and knowledge sharing of best practices with people in the organization; *Technology process* for best in class IT platforms for real-time connectivity; and *Performance management* process which is driven by data (mainly financial data) and data-driven decision making (Tomkins, 2003).

INDIAN PETROLEUM INDUSTRY: SUPPLY CHAIN PRACTICES

Supply chain cost in Indian petroleum industry accounts for 20% or more of total refining and distribution cost. In India, around 13% of GDP is spent on logistics as against 10% in developed countries. (Annual report 2016-17, Ministry of Petroleum and Natural Gas, Government of India).

The upstream supply chain deals with exploration, forecasting, acquisition of raw material (crude oil) along with the logistics necessary to deliver raw material from distantly located sources to refineries. Forecasting, production, and logistics of the end products to consumers across the market including refining are covered by the downstream supply chain.

The unique characteristics of Indian petroleum-industry supply chain are high transportation cost and very complex

and lengthy supply chain. This supply chain is also very inflexible in terms of product customization and volumes of production handled. Oil companies continually strive to integrate the value chain to extract maximum benefit.

To carry out supply chain integration and optimization, the three oil majors in India, Indian Oil Corporation Ltd. (IOCL), Hindustan Petroleum Corporation Ltd. (HPCL), and Bharat Petroleum Corporation Ltd. (BPCL) adopted customized SCM solutions towards improvement in demand planning, integrated planning, distribution planning, and refinery production planning. In addition to that, Internet-of-Things (IoT) is also being brought in for real-time data assimilation, validation, and dissemination in the form of reports, dashboards, and alerts so that the responsiveness of the whole system improves across the chain. Faster and more efficient planning and execution helps the firms to get competitive edge over other players in the market.

OBJECTIVES

This paper examines the processes and practices of Indian petroleum-industry supply chain with a special focus on performance measurement. It has studied the petroleum-industry supply chain from the year 2000 to understand issues, the industry was facing during different time periods. An attempt is made to bring forth the unique characteristics of the oil industry supply chain, specifically in India context. This paper has developed and analyzed performance measures of the Indian petroleum-industry supply chain through different models and suggested strategic initiatives, which can help the industry to improve performance.

LITERATURE REVIEW

Petroleum industry is pivotal for the growth and development of any country and more so for oil-deficient countries like India. Capital and distribution intensive features of this industry significantly influence overall performance of firms.

Supply chain of this industry faces series of challenges because of limited crude resources and fluctuating crude oil prices. Distribution, storage, and logistics always act as inhabiting factors in this industry and have undergone changes over the years on various occasions. In India, major supply chain restructuring and consolidation in the industry was initiated in the year 2000 in order to streamline the supply-chain process and improve business

performance of the public sector oil firms. In this industry, there are many series of transactions between distributors and wholesalers, retailers, end customers. These vary in volumes. It is empirically proved that a single transaction or product lifting at the rack, at least five to seven parties are involved which increases overhead costs of documentation and communication across all the parties (Bever, 2002; Coia, 1999; Tierney, 2004). Hence, a fully integrated ERP system has become a basic requirement to improve efficacy of the chain.

Inefficiency of the chain often results from various non-value adding factors. Extended waiting time of oil cargo in the Indian ports due to congestion and less-efficient port operations and multiple rounds of checks to avoid adulteration result in longer supply chain time. Similarly, continuous and less-flexible refining process produces several downstream products, which may not have immediate market demand, and in turn, increases inventory-holding cost (Verma, , Wadhwa, & Deshmukh, 2007). These bottlenecks in the industry have led to evolution of performance measurement of supply chain across the links in the chain.

There is no unique reference model that each firm in the petroleum industry can follow to make their supply chain more efficient. Firms need to customize standard models to suite formulating strategy towards improvement in performance, reducing wastage, and optimization of the chain. Effective ERP system should be in place to integrate all linkages to overcome the gaps originated due to inadequate data infrastructure, which is impacting communication between marketing, manufacturing, and distribution units (Foti, 2006; Verma, Wadhwa, & Deshmukh, 2006).

Accenture's benchmarking study, which involved 14 global major and regional midsized companies, shows that the downstream supply chain of petroleum industry lags in many areas such as analytical sophistication, technology upgradation, information symmetry within the firm, alignment towards common organizational goals, match between supply, demand and margin maximization because of crude price volatility, state-of-art process, and innovation. Accenture and INSEAD research show a mutual relationship between supply chain excellence and increased market capitalization. Improvement in downstream process can raise internal rate of return of petroleum firms by 35-50% (D'Avanzo, Hans von, Van, & Luk, 2003).

The petroleum industry continues to face several risks in the area of crude oil procurement, operations, marketing, government and political actions, collaboration and

pricing, which affect their supply chain. Crude price volatility and logistics transfer continues to be the focus in this industry. Hence, a well-devised operations risk management system for supply chain is emphasized to be integral part of the oil firm's overall risk management system (Enyinda, 2011). Focus should be on shared goal setting across the firm along with the suppliers and distributors, collaborative planning, risk sharing and reward, and reorganization sharing (Talavera, 2015; Urciuoli, Mohanty, & Else, 2014).

Supply Chain Performance Management (SCPM) is gaining importance as it helps firms to identify areas that need improvement and compare themselves with competitors and market leaders. The insights about functioning of supply chain is tracked using key indicators like inventory level, supply chain management cost, etc. Proper selection of set of KPIs helps in identifying deviation between planning and implementation, which offers opportunity for identification and correction of impending problems (Chae, 2009; Leończuk, 2016).

The supply chain performance measure can be focussed on strategic, tactical, and operational dimensions. In SCPM, agile and resilient approaches are followed. These approaches consider economic (like quality, delivery, time, inventory level, etc.) and operational (cost, return on asset, C2C cycle, efficiency, etc.) performance of the chain (Leończuk, 2016).

There exist three types of processes in supply chain: primary process which defines the main value-added activities of an organization; secondary process that performs necessary actions like developing a Sales & Operational plan; and development process that improves both primary and secondary processes (Syed, 2013).

The complications of processes and stages where they are performed make performance measurement of supply chain of oil firms more difficult. There are initiatives to use Analytical Hierarchy Process and Balanced Scorecard to evaluate the performance of the industry supply chain. In these tools, the measurements are focussed on both internal and external parameters. The internal perspectives revolve around financial and business processes of the firm. The external perspectives are focussed on end users, innovative techniques, and learning. Among the perspective factors, quality of the product, regular supply of raw material (crude oil), market share, and utilization of information technology are vital. It can be seen that petroleum firms seem to be lacking in developing performance measures using the firm's financial data. The implementation of standard supply chain framework for performance measurement like SCOR is not seen in

petroleum industry. The lack of performance measure following standard practices is one of the major gaps identified in the supply chain of the industry (Verma, & Deshmukh, 2007 & 2009).

SCOR model, whilst using detailed financial data of the firm, is being introduced with a focus in manufacturing industries albeit very little absorption in petroleum sector both in contexts of India and abroad. SCOR is composed of three levels of processes in which levels one and two are called 'SCOR process' and 'SCOR process type', respectively. Level-3 process is sub-processes of level-2 (Chithambaranathan, Subramanian, & Palaniappan 2015; Kocaoğlu, Gülsün, & Tanyas, 2011; Ma. Gloria V. Talavera 2015; Ling, Qin, & Xu 2011; Salazar, 2012; Seifbarghy, 2010).

This paper attempts to bridge the gap as found in the literature reviewed, introducing both financial metrics and SCOR performance attributes to measure supply chain performance of downstream oil PSUs in India.

METHODOLOGY

The review of literature has already identified a lack of integrated approach towards supply chain performance measurement. Moreover, in the capital and distribution-intensive oil sector, supply chain efficiency is subject to various geopolitical and qualitative factors. In spite of that, this paper has tried an integrated methodology, which encompasses financial metrics and the inclusive SCOR model.

This paper has used primary and secondary data for analysis wherein, secondary data include published reports & industry forecast as available from different databases like Bloomberg, Prowess, Indiatats, etc., apart from the Annual Reports and other published reports of the firms. In order to understand the finer details of Supply Chain performance of oil sector, unstructured interviews with the executives and suppliers were conducted.

Aggregated and disaggregated data as reported by Bloomberg and Prowess, related to the sectors and the firms were studied. The accumulated data from these databases were analyzed broadly into two stages.

Stage I: Financial Analysis

In this stage, the Industry reports, Annual Reports, and their relevant schedules were used to understand both operational & financial performance using different ratios.

Moreover, Du-Pont model linking investment and firm performance has also been used. The Du-Pont model will help to understand not only business performance, but also the effect of improvement in Supply Chain on business.

Hence, when the financial ratios calculated are put on a time scale, their impact or otherwise can be traced in the Du-Pont model. Thus, the data so used for ratios were focusing mainly on Supply Chain issues involving the firms as these ratios indicate supply chain performance.

Financial Metrics

SI	Metrics	Measurement	Terminology
1	SCL (lower the better)	DRM + DWIP + DFG	SCL= Length of supply chain in days SCI= Supply chain Inefficiency ratio SWCP = Supply chain working capital productivity ITR= Inventory turnover ratio DCER = Distribution cost efficiency ratio AP = Account Payable AR = Account Receivable DRM = Days of raw material DWIP = Days of work in progress DFG = Days of finished goods ICC = Inventory Carrying Cost INV = Total Inventory SWC = Supply Chain Working Capital SCC = Supply Chain Management Cost NS = Net Sales DC = Distribution Cost
2	SCI (lower the better)	SCC / NS where $SCC=DC+(INV \times ICC)$	
3	SWCP (higher the better)	NS / SWC where $SWC = INV + AR - AP$	
4	ITR (higher the better)	NS / INV	
5	DCER (lower the better)	DC / NS	

Source: Compiled from J. Shah & N. Singh, 2001, "Benchmarking Internal Supply Chain performance: Development of a Framework", & authors' compilation

SCOR Metrics

SI	Metrics	Measurement	Terminology
1	DSO(AM.2.1) (lower the better)	$(AR / GS) \times 365$	DSO = Days Sales Outstanding IDOS = Inventory days of supply DPO = Days Payable Outstanding C2C = Cash to Cash Cycle time AP = 5 point rolling average of gross account payable AR = 5 point rolling average of gross account receivable COGS = Cost of Goods Sold GS = Gross Sales INV= 5 point rolling average of gross value of Inventory at standard cost TGAMP = Total Gross Annual Material Purchase RSCFA = Return on Supply Chain Fixed Assets SCR = Supply Chain Revenue TCS = Total Cost to Serve [This is approximated as Cost of sales + Inventory Holding Cost + Purchase of Stock in trade] SCFA=Supply Chain Fixed Assets [Approximated as 40% of total fixed Assets] RWC = Return on Working Capital
2	IDOS(AM.2.2) (lower the better)	$(INV/COGS)*365$	
3	DPO(AM.2.3) (higher the better)	$(AP/TGAMP)*365$	
4	C2C(AM.1.1) (lower the better)	DSO+IDOS – DPO	
5	RSCFA(AM.1.2) (higher the better)	$(SCR-TCS) / SCFA$	
6	RWC(AM.1.3) (higher the better)	$(SCR- TCS)/(INV + AR - AP)$	
7	TCS(CO.1.001) (lower the better)	Planning Cost + Sourcing Cost + Material Landed Cost + Production Cost + Order Management Cost + Fulfillment Cost + Returns Cost	

Stage - II

During this stage, SCOR model has been used to understand supply chain performance of the firms in petroleum sector in India. In the SCOR model, five attributes in two categories are considered for supply chain performance evaluation. The three attributes related to Reliability, Responsiveness, and Agility are customer focused for which data will be required at the firm micro level. Hence, this article has considered internal-facing attributes consisting of 'Cost' and 'Assets Management Efficiency'. The 'Assets Management Efficiency' attribute will be more critical for the oil companies due to their capital intensity and huge investment in distribution and storage. These features equally contribute towards 'Cost' attributes for the oil firms. Briefly, the following table indicates the final matrices that are used in this article for analysis.

In order to draw conclusion, a benchmarking approach is used in this article, which derives a scenario to guide the firms to improve their supply chain performance.

The methodology narrated previously has been applied on select firms in the downstream activities of the industries. As has already been indicated, the upstream activities in the industry is dominated by a single state-owned enterprise and through imports. The firms selected for the analysis account for more than 75% of the supply chain activity in the industry.

PERFORMANCE ANALYTICS - INDIAN DOWNSTREAM PETROLEUM SUPPLY CHAIN

The petroleum supply chain of downstream players is analyzed with the help of financial metrics such as SCL, SCI, SWCP, DCER, and ITR. IOCL, BPCL, and HPCL are selected here for the analysis.

Financial Ratio Analysis

As the first part of analysis, the relevant financial parameters are tabulated (Table 1 in Appendix-1) for inter-firm comparison during the three years ending 2016-17. Among the three firms studied, IOCL remained a dominant revenue firm in the period of the analysis. However, it has also recorded a decline of 5% in its total income during the three year ending 2016-17. BPCL was the only firm, which has recorded an income growth of 1.6% over the three years among the three firms studied. In

spite of decline in income, IOCL has shown 73% increase in profits over the three years due to 10% reduction in its total expenses. BPCL has recorded the lowest growth of 37% in profits among the three firms over the three years. It is also observed that all the three firms have gained from inventory in 2016-17 using price arbitrage. In income per unit of sale, BPCL has recorded the highest income. However, in terms of growth, it has actually declined by 20% in 2016-17 compared to 2014-15. Highest employee cost was incurred by IOCL for per unit of sale, but BPCL has incurred highest increase of 38% in the growth of employee cost in the three years. The increase may be attributed to its acquisition of refineries operations. IOCL incurred highest finance cost, which is in fact more than three times of the other competing PSUs, which may be due to the huge asset base of the firm. Among the three firms, BPCL has leveraged its finance cost per unit of sale better financially. Total expense per unit of sale of IOCL remained low compared to the other two firms as it has its own sources of raw material. In spite of such an advantageous position, the expenses of IOCL other than raw material and product purchase were very high compared to the other two firms. The firm spends more on the employees also for the given scale of operations. Thus, IOCL shows huge scope for improvements based on the financial metrics analyzed.

Source: Compiled from "Supply Chain Operations Reference Model: Overview of SCOR Version 11" APICS, 2014

Analysis of Supply Chain Performance Metrics

The simple financial indicators used have shown volatility in performance across the firms on different elements of supply chain. Hence, further analysis is done using specific Supply Chain ratios / metrics.

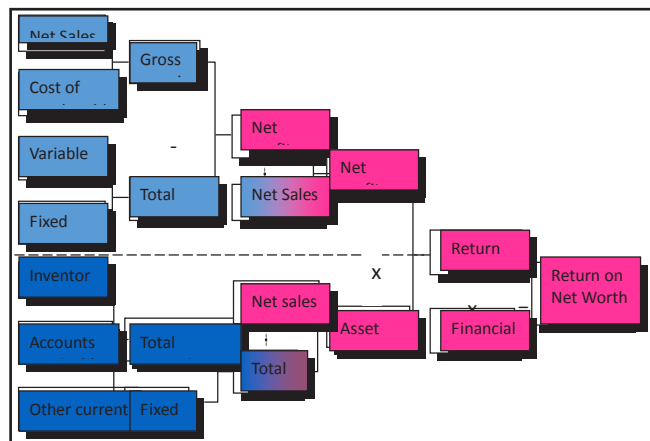
As a first measure, the Inventory Turnover Ratio (Table 2 in Appendix-1) is found to be better for BPCL with higher turnover ratios in all the years compared to the other firms. Similarly, the Distribution Cost of BPCL (Table 3 in Appendix-1) is found to be lowest among the other two companies in all the years. The relationship is further extended to measure the Length of Supply Chain (Table 4 in Appendix-1). In this measure, also, it is found that BPCL had the lowest number of days of inventory in Supply Chain. Higher level of inconsistency is found in HPCL, where the number of days was highest in five out of seven years of comparison. Further, fine-tuning of this measure has been undertaken through SCIR and SWCP. Supply chain efficiency was found to be higher

in BPCL in all the years of comparison with the other firms (Table 5 in Appendix-1). IOCL has turned out to be more inefficient in Supply Chain performance. In terms of SWCP (Table 6 in Appendix-1), BPCL was found to be more productive until 2015-16. However, in 2016-17 HPCL has outperformed.

A summary of all measures of latest two years ending 2017 is compared for understanding the performance of the firms (Table 7 & 8 in Appendix-1). In the comparison, it is found that BPCL has emerged as a better performer among the three in all the parameters in 2015-16. However, in 2016-17, BPCL could not perform better in SWCP. In both the years, in spite of being a larger firm, IOCL could not perform better. On closer analysis, it can be seen that BPCL's better performance may be attributed to distribution cost efficiency, financial productivity, and better inventory management. However, its raw material and product-purchase cost were higher compared to net sales, which may be due to its lower share of own production in sales. The SWCP of BPCL is poor compared to HPCL due to high dependence on working capital for given turnover in 2016-17.

Du-Pont Strategic Analysis

The overall financial performance can be further measured with Du-Pont model, which systematically relates all investments across the firms and measures the return on assets.



Source: Management & Accounting Web (<http://maaw.info>)

Fig. 3: Du-Pont analysis

The analysis giving return on assets for the firms in the past seven years ending 2016-17 is tabulated (Table 9 in Appendix-1) which is showing that BPCL has steadily outperformed the other two firms in all the years except

2010-11. The reasons for better performance of BPCL may be tracked to better current assets and fixed assets management for the given turnover they achieved. Though IOCL has huge turnover, the asset productivity could not convert that turnover into return on assets. Hence, irrespective of lower turnover by BPCL, they have efficiently used both current and fixed assets. In this industry, inventory management and better control of inventory could improve the asset productivity as demonstrated by BPCL. The analysis through Du-Pont model suggests that the supply chain performance in this industry is more influenced by inventory management than the distribution aspect. Moreover, the analysis of the firms studied reiterates the fact that overall performance of the firms is more influenced by the current assets in general and all forms of inventory in particular.

SCOR Metrics

The supply chain performance evaluation of the three companies is assessed using the Asset Management Efficiency and Cost attributes of SCOR model. Accordingly, C2C, RSCFA, RWC, and TCS are calculated. Calculations of these KPIs (level-1 metrics) are done based on level-2 metrics such as DSO, DPO, IDOS, and SCFA.

C2C time was calculated as lowest for BPCL at 50 days in 2016-17 and the highest of 76 days was recorded by IOCL. It is noticed that all companies have recorded the lowest C2C in the year 2014-15. Though BPCL is found to have a better C2C in 2016-17, it is the highest (poor) for the firm across the years. Moreover, it is also seen that none of the firms have shown any consistency in the C2C measure over the years. One of the stabilized factors is their Daily Sales Outstanding, which is calculated at around 7 days for all the firms in 2016-17. Hence, it is evident that all the firms use the delay in DPO for the given size of IDOS to keep a better C2C. They may be able to sustain such a bad practice being a PSU; however, the C2C glaringly reveals the poor inventory management (Table 10 in Appendix 1).

RSCFA was calculated for the sample firms studied, revealing the net supply chain revenue productivity out of supply chain assets. All firms scored a negative value of RSCFA from 2012-13 to 2014-15, which indicates poor supply chain asset utilization. However, the trend has changed since 2015-16 and BPCL generated almost three times net supply chain revenue for the deployed supply chain assets and remained the best performer in the last

two years. The inconsistent performance of all the firms in RSCFA is a real concern, which may be eroding the profitability of the firms (Table 11 in Appendix-1).

RWC is the best measure, which can clearly indicate and supplement the reasons for RSCFA performance of firms. The calculated values of RWC for the oil PSUs show negative returns for all the firms from 2012-13 to 2014-15 as it is seen in RSCFA also. Hence, it is clear that the poor performance of the firms during the three years is mainly due to poor current asset management and, hence, had an impact on the revenue productivity. All the firms have generated positive returns in the last two years ending 2016-17 and the best return was recorded by BPCL in both the years (Table 12 in Appendix-1).

Finally as an absolute measure, TCS is calculated, which indicates the costs incurred by the firms through supply chain to serve the consumers. TCS was higher for IOCL as it being the bigger firm compared to the other two. Least cost was incurred by HPCL to serve the customers. However, IOCL has managed to reach the same cost levels as recorded by them in 2010-11 compared to BPCL (23% increase in 2016-17 over 2010-11) and HPCL (30% increase in 2016-17 over 2010-11) (Table 13 in Appendix-1).

SCL and IDOS experienced a sharp fall (improvement) from 2013-14 to 2014-15 whilst a sharp hike (deterioration) from 2014-15 to 2015-16 and 2015-16 to 2016-17. The sustained high price of crude oil and associated products for long time compelled the firms to minimize their inventory-holding days which started getting relaxed with crude oil price started falling steadily from above 100 \$/Bbl in Apr. 2014 until Jan. 2016 when it reached its nadir at \$20 level. Significant increase in days of inventory holding for both raw material and finished good inventory was noticed during low-price regime. Inventory was built up taking advantage of lower crude price albeit fall in market share for sales from expansion of sales by private players like Reliance and Essar. Storing additional inventories are seen during 2015-16, though decline in crude price continued throughout 2014-15 also, which reflects oil companies were too skeptical about crude price movements and took a very cautious approach for any change in strategy in this aspect. This is primarily because raw materials cost account for ~70-80% of total expenses and any move, if goes wrong, may put a firm in financial jeopardy. Inventory holding alone brought down company profitability by around 50-60% in 2014-15 and boosted 70-80% in 2016-17. Oil price volatility shapes

the strategy of oil firm than their internal performances alone.

Whilst progressing from 2014-15 to 2016-17, SCI ratio deteriorated year-on-year for both BPCL and HPCL primarily due to increase in supply chain management cost, more particularly higher inventory holding. For IOCL, there was deterioration in first year and then improvement in next year.

SWCP showed steady deterioration from 2014-15 to 2016-17 for BPCL and HPCL primarily due to higher inventory holding non-commensuration with incremental net sales. For IOCL, there is not much difference between 2014-15 and 2015-16 but a deterioration observed from 2015-16 to 2016-17.

High inventory holding results in low ITR. All three companies experienced drastic fall in ITR from 2015-16 to 2016-17. Both inventory and net sales in monetized terms increased but increase in inventory holding was much higher than net sales.

Companies with higher own sourcing of products have an edge on profitability. HPCL's own sourcing of products is just half of its sales; whereas, for other two, it is on higher side. HPCL has to churn out big money for external sourcing of products. Therefore, HPCL may look for enhancing its refining share.

BPCL is consistent outperformer in ROA. Both IOCL and HPCL have to focus on improving ROA.

BENCHMARKING OF PERFORMANCE OF INDIAN PSU DOWNSTREAM PETROLEUM COMPANIES

The supply chain performance of the firms can be further analyzed using performance-benchmarking approach. The benchmarking process has considered measures only related to asset management efficiency attributes in downstream oil PSUs. The performance benchmarking of the three attributes namely C2C, RSCFA, and RWC are considered in time t , where $t = 2016-17$. The values of all components of each KPI and the KPI itself are arranged in descending order of performance. Such arranged values are classified into 'Superior' and 'Parity' positional performance under each component and KPI, which are the 90th and 50th percentile values as per the SCOR analysis. The 70th percentile value is considered as

the 'Advantage' positional performance, which can also be obtained as the average of Parity and Superior.

The table so developed is matched with the actual performance of respective KPIs for each firm against the benchmark values. The feasibility of performance improvements for each component against the benchmark values are tested and futuristic improvements are suggested.

The benchmarking process has been followed for all the three firms for all these three KPIs. For C2C (Table 14 in Appendix-1), IOCL is identified as a poor performer. As can be seen, the actual position of IOCL is much lower than Parity benchmark identified. Based on the table, IOCL may be able to improve upon its performance by focusing on improvement in IDOS and DPO. They may not be able to improve their performance in DSO as it is beyond the feasibility zone. In short, they have to lag their payments for improvement in DPO and reduce the level of inventory in IDOS.

A similar exercise for HPCL suggests that the firm needs to improve on IDOS to perform better in C2C. Their payable and receivable managements are already performing well. The superior benchmarking of HPCL in DPO at more than 90 days does not match well with the maximum general commercial credit, which is maximum of 90 days. Hence, the superiority derived in the table is only showing the best among the mediocre performers. However, the inventory levels are leading towards poor C2C performance. In case of BPCL, their performance as benchmark is already superior in C2C among the given firms. It can improve its performance in C2C beyond superior by improving DPO and DSO.

In RSCFA (Table 15 in Appendix-1), the performance of HPCL is found to be poor. In order to improve their

performance at least to a parity level, they need to improve upon their SCR and SCFA. They will be able to improve provided their overall SCR improves along with SCFA productivity. Secondly, for IOCL, though it is in parity position among the three, they need to relook at their TCS and SCFA. They have to focus on control of overheads as well as improving their SCFA productivity.

In RWC (Table 16 in Appendix-1), IOCL is a poor performer and it has to focus on better inventory and receivable management which can bring down their TCS. In case of HPCL to go beyond parity, its Supply Chain revenue and lag of payables should be improved. It may be noted that BPCL has performed better on all the three KPIS.

FINDINGS

Inventory holding, be it crude oil or finished goods or work-in-progress, impacts substantially on profitability of petroleum sector. All three companies incurred huge setback in 2014-15 and huge boost in 2016-17 from inventories. In both the years, days of inventory holding were very high and product price shifted downwards and upwards, respectively. The firms incur loss when price shifts downwards from higher inventory cost against lower selling price and reap benefits when price shifts upwards from lower inventory cost against higher selling price. This results from wide variation in price-changeover cycle.

Comparative performance of sample firms during 2010-17 as analyzed through different parameters may be summarized to indicate the areas of improvement for the firms. The following matrix prioritizes the areas of improvement for the firms.

Company	Priority 1	Priority 2	Priority 3
IOCL	ITR,SCL,SCI,SWCP,IDOS	DCER,ROA,RSCFA,RWC,DPO, DSO	
BPCL	DPO,DSO	SCL,SWCP,IDOS	ITR,DCER,SCI,
HPCL	DCER,SCL,IDOS	ITR,SCI,ROA,RSCFA,RWC	SWCP,DSO

Just by maintaining lower inventory, performance can be enhanced for many of these metrics, e.g., ITR, DCER, SCI, SCL, IDOS, and C2C. However, all three companies gained very high profit in 2016-17 due to higher inventory availability at lower cost.

In 2016-17, IOCL, BPCL, and HPCL net profit without inventory impact was INR 3848 Crores, 2442 Crores, and

1755 Crores, respectively, which got enhanced to INR 19,108 Crore, 8040 Crore, and 6209 Crore, respectively, due to price changeover gain from inventory. Contrary to this, in 2014-15, IOCL, BPCL, and HPCL net profit without inventory impact was INR 13,489 Crores, 9598 Crores, and 6482 Crores, respectively, which got reduced to 5273 Crores, 5085 Crores, and 2733 Crores, respectively, due to price changeover loss from inventory.

Therefore, these companies should strengthen their price-forecasting model and keep their special focus on inventory management with forecast pricing on day-to-day basis to maintain optimum level of inventory that satisfies financials also. Performance of DPO, DSO, and DCER can be enhanced by improving AP, AR, and DC, respectively. ROA can be improved through higher sales and lower inventory.

THE WAY FORWARD

Strategically, it is seen that these companies pose that their Supply Chain is more driven by demand. On the contrary, the analysis and the gaps identified in the article show most of their strategies are influenced by the supply side. The Supply Chain decisions involved in the industry (Figure 2.1) revolve around storage and logistics at every critical stage in the process. Unlike other industry, these decisions are highly critical not only for Supply Chain performance, but also for the overall performance and Return on Investment of the firm in the industry. The sample analyzed has clearly demonstrated that big companies like IOCL need to rationalize on Supply Chain asset productivity, which demands operational strategies encompassing the logistics and distribution planning mainly for the demand side, which attracts huge investment in the assets and accounts for high pipeline stock. On the other hand, the operational strategies of the companies like HPCL and BPCL should be able to follow an agile inventory strategy to storage, which incorporates wireless technology, inventory scenario along with orchestration of demand, and supply data across the Supply Chain. It is found that the sample firms are Human Resource loaded, hampering Human Resource productivity of Supply Chain. It is understandable that for a PSU, a lean structure may be difficult in the short run. However, in the end the organizations should have a clear-cut strategy for phase out of non-productive Human Resource and investment towards technology to automate the supply chain. This would also help effectiveness of agile inventory management for these organizations.

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APPENDIX-1
**Table 1: Annual Result Comparison of Indian PSU Downstream Petroleum Companies
(14-15 to 16-17)(in INR crore)**

Performance Parameters	2016-17			2015-16			2014-15		
	IOCL	BPCL	HPCL	IOCL	BPCL	HPCL	IOCL	BPCL	HPCL
Financial Performance (INR Crores)									
Gross Sales/Income from operations	445,373	242,048	213,803	406,828	217,895	197,744	467,932	238,087	217,061
Other Income	4209	2601	1515	2322	1776	1144	4146	2200	1952
Total Income	449,582	244,649	215,318	409,150	219,671	198,888	472,078	240,287	219,013
Consumption of Raw Materials	156,910	67,711	45,138	142,266	61,007	40,812	205,312	94,424	56,158
Purchase of Traded Goods	141,925	114,220	122,732	143,629	100,829	115,948	177,534	117,052	129,278
Increase/Decrease in Stocks	(15,260)	(5,578)	(4,454)	3,479	834	91	8,216	4,513	3,749
Employees Cost	9,658	3,429	2,946	7,114	2,758	2,321	7,105	2,086	2,415
Depreciation/amortization	6,223	1,891	2,535	4,819	1,845	2,653	4,529	2,516	1,979
Excise Duty	85,500	39,837	26,779	59,652	29,490	20,043	30,408		11,720
Finance Cost	3,445	496	536	3,090	565	654	3,435	583	707
Transport Expense			5,317			5,262			4,999
Exploration Cost			15			21			27
Other Expenses	34,858	11,599	4,753	29,640	11,952	5,307	29,212	11,697	3,831
Total Expenses	423,259	233,605	206,297	393,689	209,280	193,112	465,751	232,871	214,863
Exceptional Item				1,364			1,668		
Prior Period Expenses / Income									(4.47)
Tax	7,215	3,004	2,812	5,584	3,335	2,050	2,722	2,331	1,421
Net Profit/(Loss)	19,108	8,040	6,209	11,241	7,056	3,726	5,273	5,085	2,733
Physical Performance (MMT)									
Crude Throughput	65.19	25.39	17.81	56.7	24.1	17.2	54	23	16
Market Sales (including export)	83.49	37.74	35.23	80.7	38.4	34.2	77	37	32
Other Parameters									
GRM (\$/Bbl)	7.8	5.4	6.2	5.1	6.4	6.7	0.27	3.62	2.84
Equity Share Capital	4739	1311	1016	2428	723	339	2428	723	339
EPS	40.31	61.31	61.12	43	103	114	22	70	81
Public Share Holding									
- No. of Shares (Crores)	207.16	97.77	49.67	76	33	17	76	33	17
- Share Holding (%)	42.66	45.06	48.89	31	45	49	31	45	49
Dividend per equity share (Rs.)	19	32.5	30	9	15	16	6.6	23	25
Share Price - NSE	385.77	433.18	525.65	419	1004	911	356	850	675
Date	31.3.17	31.3.17	31.3.17	02.06.16	02.06.16	02.06.16	29.05.17	29.05.16	29.05.15

Performance Parameters	2016-17			2015-16			2014-15		
	IOCL	BPCL	HPCL	IOCL	BPCL	HPCL	IOCL	BPCL	HPCL
Financial Performance (INR Crores)									
Observations									
Crude throughput as % of Total Sales	78	67	51	70	63	50	70	62	50
Gain(-ve)/Loss(+ve) from Inventory per MT of Sales (INR)	(1,828)	(1,478)	(1,264)	431	217	27	1,067	1,220	1,172
Income per unit of of Sales (INR/MT)									
Sales Income (Net of excise duty)	43,104	53,580	53,087	43,021	49,064	51,959	56,821	64,348	64,169
Cost per unit of of Sales (INR/MT)									
Employee Cost	1,157	909	836	882	718	679	923	564	755
Finance Cost	413	131	152	383	147	191	446	158	221
Expense per unit of Sales (INR/MT)									
Raw mat & Product Purchase	35793	48206	47650	35427	42145	45836	49720	57156	57949
Total Expense (including Excep Item and Tax)	51560	62694	59355	49645	55368	57065	61057	63568	67587
Net Profit per unit of Sales	2289	2130	1762	1393	1838	1089	685	1374	854
Expense efficiency ratio %									
Raw mat & Product Purchase cost as % of Total expense	71	78	81	73	77	81	82	91	86
Expense other than raw materials, product purchase and inventory as % of Total Expense	33	25	21	26	22	19	16	7	12
Total Expense as % of Gross Sales	95.0	96.5	96.5	96.8	96.0	97.7	99.5	97.8	99.0
Expense on employees as % of Gross Sales	2.2	1.4	1.4	1.7	1.3	1.2	1.5	0.9	1.1
Raw mat & Product Purchase cost as % of Gross Sales	67	75	79	70	74	79	82	89	85

GRM – Gross Refining Margin = Combined selling price of all products at refinery gate – cost of crude oil

Source: Authors deduction based on annual Reports of IOCL, BPCL, and HPCL

Table 2: Inventory Turnover Ratio (ITR) of Indian PSU Downstream Petroleum Firms (Higher the Better)

Companies	16-17	15-16	14-15	13-14	12-13	11-12	10-11
IOCL	7.43	12.54	10.46	7.70	7.94	7.34	6.94
BPCL	12.45	16.26	16.78	13.83	14.72	13.47	9.99
HPCL	11.85	15.97	16.64	12.09	12.78	9.28	8.97

Source: Authors deduction based on financial data taken from Prowess database

Table 3: Distribution Cost Efficiency Ratio (DCER) of Indian PSU Downstream Petroleumfirms (Lower the Better)

Companies	16-17	15-16	14-15	13-14	12-13	11-12	10-11
IOCL	0.029	0.051	0.042	0.036	0.033	0.031	0.035
BPCL	0.023	0.025	0.021	0.017	0.0159	0.0157	0.019
HPCL	0.034	0.037	0.032	0.028	0.025	0.025	0.029

Source: Authors deduction based on financial data taken from Prowess database

Table 4: Length of Supply Chain(SCL) (in Days) of Indian PSU Downstream Petroleum Firms (Lower the Better)

Companies	16-17	15-16	14-15	13-14	12-13	11-12	10-11
IOCL	129	78	62	83	89	98	115
BPCL	96	70	49	59	58	68	83
HPCL	127	89	67	98	83	127	136

Source: Authors deduction based on financial data taken from Prowess database

Table 5: Supply Chain Inefficiency Ratio (SCI) of Indian PSU Downstream Petroleum Firms (Lower the Better)

Companies	16-17	15-16	14-15	13-14	12-13	11-12	10-11
IOCL	0.0560	0.0665	0.0613	0.0622	0.0581	0.0585	0.0641
BPCL	0.0395	0.0371	0.0329	0.0316	0.0295	0.0305	0.0388
HPCL	0.0511	0.0496	0.0440	0.0442	0.0409	0.0469	0.0514

Source: Authors deduction based on financial data taken from Prowess database

Table 6: Supply Chain Working Capital Productivity (SWCP) of Indian PSU Downstream Petroleum Firms (Higher the Better)

Companies	16-17	15-16	14-15	13-14	12-13	11-12	10-11
IOCL	11.71	23.04	22.72	12.88	11.79	12.95	12.41
BPCL	18.90	30.45	56.27	23.97	20.79	22.73	16.32
HPCL	22.46	29.46	49.43	16.81	20.62	15.25	14.07

Source: Authors deduction based on financial data taken from Prowess database& Company Annual Reports

Table 7: Summary of Performance Measures of Indian PSU Downstream Petroleumfirms (2015-16)

Companies	SCL (Days)	SCI	SWCP	ITR	DCER
IOCL	78	0.0665	23.04	12.54	0.051
BPCL	70	0.0371	30.45	16.26	0.025
HPCL	89	0.0496	29.46	15.97	0.037

Source: Authors deduction based on financial data taken from Prowess database& Company annual report

Table 8: Summary of Performance Measures of Indian PSU Downstream Petroleumfirms (2016-17)

Companies	SCL (Days)	SCI	SWCP	ITR	DCER
IOCL	129	0.0560	11.71	7.43	0.029
BPCL	96	0.0395	18.90	12.45	0.023
HPCL	127	0.0511	22.46	11.85	0.034

Source: Authors deduction based on financial data taken from Prowess database & Company annual report

Table 9: Return on Asset (ROA) Values of Indian PSU Downstream Petroleum Firms (Higher is Better)

Companies	16-17	15-16	14-15	13-14	12-13	11-12	10-11
IOCL	0.0765	0.0399	0.0188	0.0210	0.0165	0.0140	0.0307
BPCL	0.0987	0.0756	0.0577	0.0419	0.0299	0.0148	0.0206
HPCL	0.0744	0.0424	0.0324	0.0168	0.0092	0.0096	0.0190

Source: Authors deduction based on financial data taken from Prowess database& Company annual report

Table 10: C2C (in days) of Indian PSU Downstream Petroleum Firms (Lower the Better)

Companies	16-17	15-16	14-15	13-14	12-13	11-12	10-11
IOCL	75.82	22.28	17.29	41.04	48.90	53.14	54.50
BPCL	49.58	25.86	5.71	26.67	32.06	28.59	43.34
HPCL	52.00	23.31	1.52	50.89	30.03	81.29	75.84

Source: Authors deduction based on financial data taken from Prowess database & Company annual report

Table 11: RSCFA of Indian PSU Downstream Petroleum Firms (Higher the Better)

Companies	16-17	15-16	14-15	13-14	12-13	11-12	10-11
IOCL	1.99	0.70	-0.82	-1.10	-0.60	0.12	-0.61
BPCL	2.97	1.60	-0.05	-0.09	-0.16	0.57	-0.41
HPCL	1.65	0.86	-0.41	-0.52	-0.51	0.17	0.45

Source: Authors deduction based on financial data taken from Prowess database & Company annual report

Table 12: RWC of Indian PSU Downstream Petroleum Firms (Higher the Better)

Companies	16-17	15-16	14-15	13-14	12-13	11-12	10-11
IOCL	2.29	2.41	-2.35	-1.48	-0.65	0.14	-0.73
BPCL	2.93	4.39	-0.20	-0.12	-0.16	0.66	-0.46
HPCL	2.48	2.23	-1.59	-0.60	-0.79	0.21	0.54

Source: Authors deduction based on financial data taken from Prowess database & Company annual report

Table 13: TCS(in INR million) of Indian PSU Downstream Petroleum Firms (Lower the Better)

Companies	16-17	15-16	14-15	13-14	12-13	11-12	10-11
IOCL	3,291,858	3,373,096	4,560,142	4,983,062	4,457,479	3,709,057	3,262,369
BPCL	1,940,086	1,784,121	2,310,985	2,531,261	2,348,963	1,993,216	1,500,481
HPCL	1,808,475	1,727,256	2,039,325	2,212,341	2,059,936	1,673,687	1,339,445

Source: Authors deduction based on financial data taken from Prowess database & Company annual report

Table 14: Performance Benchmarking of C2C (in Days) of Indian PSU Downstream Petroleum Firms (2016-17)

	IOCL	BPCL	HPCL	Parity	Advantage	Superior
2016-17						
DSO	7.26	7.37	7.01	7.26	7.14	7.01
IDOS	132.81	100.50	141.09	132.81	116.66	100.50
DPO	64.26	58.28	95.15	64.26	79.71	95.15
C2C	75.82	49.58	52.95	52.95	51.27	49.58

Parity (50th percentile value), Advantage (70th percentile or average of Parity & Superior) & Superior (90th percentile)

Source: Authors deduction based on financial data taken from Prowess database& Company annual report

Table 15: Performance Benchmarking of RSCFA of Indian PSU Downstream Petroleum Firms (2016-17)

	IOCL	BPCL	HPCL	Parity	Advantage	Superior
2016-17						
SCR(in INR million)	4,152,433	2,313,605	2,046,895	2,313,605	3,233,019	4,152,433
TCS(in INR million)	3,291,858	1,940,086	1,808,475	1,940,086	1,874,281	1,808,475
SCFA(in INR million)	431,518	125,748	144,528	144,528	135,138	125,748
RSCFA	1.99	2.97	1.65	1.99	2.48	2.97

Parity (50th percentile value), Advantage (70th percentile or average of Parity & Superior) & Superior (90th percentile)

Source: Authors deduction based on financial data taken from Prowess database& Company annual report

Table 16: Performance Benchmarking of RWC of Indian PSU Downstream Petroleum Firms (2016-17)

	IOCL	BPCL	HPCL	Parity	Advantage	Superior
2016-17						
SCR(in INR million)	4,152,433	2,313,605	2,046,895	2,313,605	3,233,019	4,152,433
TCS(in INR million)	3,291,858	1,940,086	1,808,475	1,940,086	1,874,281	1,808,475
INV(in INR million)	591,823	193,488	181,999	193,488	187,745	181,999
AR(in INR million)	85,024	47,582	40,642	47,582	44,112	40,642
AP(in INR million)	301,075	113,598	126,581	126,581	213,828	301,075
RWC	2.29	2.93	2.48	2.48	2.71	2.93

Parity (50th percentile value), Advantage (70th percentile or average of Parity & Superior) & Superior (90th percentile)

Source: Authors deduction based on financial data taken from Prowess database& Company annual report