International Scientific Journal ***Innovative Economics and Management***

E-ISSN:2449-2604

http://iem.ge; editor@iem.ge

Vol. 13 No1.2026

Evaluating Supply Chain Efficiency in Algerian Chemical Firms: A Focus on Scor Performance Indicator

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ARTICLE INFO	ABSTRACT
Keywords: Supply Chain Management; SCOR Model; Performance Measurement; Petrochemical Industry.	*This study evaluates the efficiency of supply chain management within the Algerian petrochemical sector, focusing on the CP2K Plastic Comple. The research operationalizes the Supply Chain Operations Reference (SCOR) model to assess supply chain performance across its five core attributes: reliability, responsiveness, agility, cost, and asset management. data were collected through semi-structured interviews and analysis of official documentation and statistical records. The findings reveal that the CP2K complex demonstrates high reliability in order fulfillment. Responsiveness and agility are evidenced by short order fulfillment cycle times and relative flexibility in production volume adjustments, though unplanned stoppages due to equipment failure and resource shortages highlight operational vulnerabilities. The study confirms that the SCOR model provides a comprehensive and applicable framework for measuring supply chain performance in this context. However, findings also underscore the complex's reliance on imported raw materials and exposure to global supply chain disruptions, as well as the absence of advanced technological integration.*
JEL classification:	*L91, L61, R42, C81*
Received: *05.12.2025* ***Revised:*** *16.02.2026* ***Accepted:*** *06.04.2026*	https://doi.org/10.46361/2449-2604.13.1.2026.6-16

ალჟირის ქიმიური ფირმების მიწოდების ჯაჭვის ეფექტურობის შეფასება: ფოკუსირება Scor-ის შესრულების ინდიკატორზე

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ინფორმაცია სტატიის შესახებ	აბსტრაქტი
საკვანძო სიტყვები: მიწოდების ჯაჭვის მენეჯმენტი; SCOR მოდელი; შესრულების გაზომვა;	*ნაშრომში შეფასებულია ალჟირის ნავთობქიმიურ სექტორში მიწოდების ჯაჭვის მართვის ეფექტურობა, რომელიც ფოკუსირებულია CP2K პლასტმასის კომპლექსზე. კვლევა ახორციელებს მიწოდების ჯაჭვის ოპერაციების საც–ნობარო (SCOR) მოდელს, რათა შეაფასოს მიწოდების ჯაჭვის მუშაობა მისი ხუთი ძირითადი ატრიბუტის მიხედვით: საიმედოობა, რეაგირების უნარი, მოქნილობა, ღირებულება და აქტივების მართვა. მონაცემები შეგროვდა ნახევრად სტრუქტურირებული ინტერვიუების და ოფიციალური დოკუ–*

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International Scientific Journal **Innovative Economics and Management**
E-ISSN:2449-2604
htpp://iem.ge; editor@iem.ge
Vol. 13 No1.2026

ნავთობქიმიური მრეწველობა	*მენტაციისა და სტატისტიკური ჩანაწერების ანალიზის გზით. შედეგები აჩვენებს, რომ CP2K კომპლექსი აჩვენებს მაღალ საიმედოობას შეკვეთების შესრულებისას. რეაგირების უნარი და მოქნილობა დასტურდება შეკვეთების შესრულების მოკლე ციკლის დროით და წარმოების მოცულობის კორექტირების შედარებითი მოქნილობით, თუმცა აღჭურვილობის გაუმართაობისა და რესურსების დეფიციტის გამო დაუგეგმავი შეჩერებები ხაზს უსვამს ოპერაციულ დაუცველობას. კვლევა ადასტურებს, რომ SCOR მოდელი უზრუნველყოფს ყოვლისმომცველ და გამოსაყენებელ ჩარჩოს მიწოდების ჯაჭვის მუშაობის გასაზომად ამ კონტექსტში. თუმცა, შედეგები ასევე ხაზს უსვამს კომპლექსის დამოკიდებულებას იმპორტირებულ ნედლეულზე და გლობალური მიწოდების ჯაჭვის დარღვევების ზემოქმედებას, ასევე მოწინავე ტექნოლოგიური ინტეგრაციის არარსებობას.*
JEL კლასიფიკაცია:	*L91, L61, R42, C81*
მიღებულია: 05.12.2025 **რეცენზირებულია:** 16.02.2026 **დამტკიცებულია:** 06.04.2026	https://doi.org/10.46361/2449-2604.13.1.2026.6-16

Introduction and review of literature

The contemporary economic landscape is characterized by intense competition, globalization, and highly complex operating environments. For modern enterprises, particularly in the industrial sector, success is no longer determined solely by internal efficiency, but by the seamless integration of a network of interconnected activities. This network, widely known as the supply chain, has emerged as a critical determinant of organizational competitiveness, sustainability, and long-term profitability (Liang, Yang, Cook, & Zhu, 2006), and to enhance competitiveness, numerous firms have adopted supply chain management (SCM) to improve organizational effectiveness and achieve key objectives, including greater customer value, more efficient resource utilization, and increased profitability (Lai, Ngai, & Cheng, 2002) This value is not limited solely to customers; rather, it encompasses stakeholders as well (Lambert & Cooper, 2000) .

The evolution of the supply chain concept is not a recent phenomenon but a gradual development. While logistical activities for moving materials have existed since ancient times, the integrated notion of the "supply chain" began to crystallize in the mid-twentieth century. Initially, during the 1950s and 1960s, the focus was on "workplace logistics," which concentrated on the flow of materials within a single facility. In the 1970s, characterized by the oil crisis and economic instability, the focus shifted to the distribution of finished goods, emphasizing cost reduction and energy efficiency (Thomas & Griffin, 1996). During the 1980s, the modern concept of supply chain management fully crystallized, broadening its scope from internal logistics to a comprehensive flow of materials, information, and finance across multiple organizations—from raw material suppliers to end consumers. The evolution of supply chain management (SCM) continued in the 1990s, as organizations expanded enterprise resource management best practices to include strategic suppliers and the logistics function within the value chain. Supplier efficiency was broadened to encompass a more sophisticated alignment of cost and quality considerations. Rather than duplicating non-value-added activities such as incoming inspection, manufacturers began to rely on supplier quality control by sourcing exclusively from a limited number of qualified or certified suppliers. More recently, numerous manufacturers and retailers have adopted the SCM concept to enhance efficiency across the value chain. Manufacturers now leverage supplier capabilities and

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technology to support new product development, while retailers seamlessly integrate physical distribution functions with transportation partners to achieve direct store delivery or cross-docking, thereby eliminating the need for receiving inspection. Customer-centric enterprise vision serves as a key mechanism for facilitating SCM evolution, driving change across all internal and external links of the firm (Tan, 2001) .

Building upon the concept of the supply chain, Supply Chain Management (SCM) is defined as the integrative function responsible for overseeing and optimizing all activities related to sourcing, procurement, conversion, and logistics management (Nikfarjam, Rostamy-Malkhalifeh, & Mamizadeh-Chatghayeh, 2015). It represents a shift from managing individual functions to managing a coordinated network of activities across company boundaries. The importance of SCM lies in its capacity to reduce transaction costs, facilitate information exchange, enhance market sensitivity, and ultimately improve financial performance and competitive advantage.

Drawing upon a literature review in their study, (Mentzer, et al., 2001) proposes that supply chain management, as a management philosophy, is characterized by the following attributes:

- A systemic approach to viewing the supply chain as a whole, and to managing the total flow of goods inventory from supplier to end customer;
- A strategic orientation toward collaborative efforts aimed at synchronizing and integrating operational and strategic capabilities both within and across firms into a unified entity;
- A customer focus directed at creating unique and customized sources of customer value, thereby leading to customer satisfaction.

An effective supply chain management system is built upon several core processes and flows. Seven primary flows traversing the supply chain can be identified:

Material Flow: The physical movement of goods from suppliers to customers.

Cost Flow: The accumulation and allocation of costs across the supply chain to determine the final product cost.

Information Flow: The exchange of data related to orders, forecasts, inventory levels, and production schedules.

Demand Flow: Information on customer demand that travels upstream to guide production and procurement.

Financial Flow: The movement of funds from the end customer back to the suppliers, serving as the lifeblood of the supply chain.

Payment Flow: Related to cash flows and the management of accounts payable and receivable.

Commercial Flow: The transfer of ownership as goods move through the supply chain, facilitated by contracts and transactions.

The literature review in this paper classifies performance indicators into several types (Reiner & Hofmann, 2006). Quantitative or financial indicators are typically associated with productivity, cost, and profitability, while qualitative or non-financial indicators focus on aspects such as flexibility, delivery performance, supplier reliability, and customer satisfaction. A major challenge in this field lies in the difficulty of integrating these diverse measures and agreeing upon a standardized set of indicators. Among the various models developed to address this complexity, the Supply Chain Operations Reference (SCOR) model is recognized as the most comprehensive and widely accepted framework. Developed by the Supply Chain Council (SCC), the SCOR model provides a standardized methodology for describing, measuring, and evaluating supply chain performance, and was designed with the intention to support better software systems, benchmarking, as well as recognizing and adopting best practices rapidly (Reiner & Hofmann, 2006).

The strength of the SCOR model lies in its structured three-level hierarchy, which links processes (Plan, Source, Make, Deliver, Return, and Enable) to performance metrics, thereby enabling cross-industry benchmarking and continuous improvement.

It provides a useful framework that takes into account the performance requirements of firms that are members of the supply chain.

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The SCOR model views activities within the supply chain as a series of inter-organizational processes, where each organization consists of four components: plan, source, make, and deliver. Each of these components is considered a critical internal process within the supply chain and is associated with four measurement criteria: (1) supply chain reliability, (2) responsiveness/agility, (3) costs, and (4) assets. The first two criteria pertain to performance measures related to effectiveness (customer-oriented), while the latter two criteria pertain to performance measures related to efficiency (internally oriented) of the firm. Customer-oriented measures are concerned with how well the supply chain delivers products/services to customers, such as delivery performance. Internally oriented measures, in contrast, are concerned with the efficiency of supply chain operations, including cycle time (Lai, Ngai, & Cheng, 2002) .

Cohen and Roussel (2004) argue that the maturity classification embedded in the Supply Chain Operations Reference (SCOR) model is intrinsically linked to organizations' ability to govern the entire spectrum of the supply chain. According to their framework, this scope is delineated across the following distinct levels (Estampe, Lamouri, Paris, & Brahim-Djelloul, 2013):

Level 1: Functional Integration: The objective is to respond to improvements in the performance of a firm's internal processes without seeking optimality through other supporting processes.

Level 2: Internal Integration: The objective is to develop tools for measuring overall performance within the firm, thereby verifying overall performance by pursuing optimality between resource demand and resource management.

Level 3: External Integration: The objective is to extend the scope of performance measurement to include the firm's key external actors, linking them to the pursuit of shared performance.

Level 4: Inter-Firm Collaboration: The adoption of a shared organizational strategy (design, management methods, shared risks, etc.) enables the selection of common performance objectives.

Methodology

This study applies the Supply Chain Operations Reference (SCOR) model to one of the most significant enterprises operating in Algeria's petrochemical sector: the CP2K Plastic Complex, a subsidiary of the national hydrocarbon company Sonatrach. Located in the industrial zone of Skikda.

The National Petrochemical Company (ENIP), established in 1984 with its headquarters in the Skikda industrial zone, was initially focused on converting gaseous and liquid hydrocarbons into raw materials for the local and international petrochemical industry, as part of a diversification strategy, ENIP embarked on a multi-faceted project to establish a high-density polyethylene (HDPE) production unit, this project was realized through a strategic international partnership with the Spanish multinational corporation Repsol and its subsidiary, Quimica Repsol, resulting in the creation of a mixed-economy company under Algerian-Spanish ownership for the operation and production of the final product.

The collaboration between Enip and Repsol regarding the HDPE project was formally decided in 1988. By 1989, the project was designated as a priority by the Algerian government, this initiative was driven by the domestic market's demand for high-density polyethylene, a raw material essential for the film industry, particularly given the national company's inability to meet local needs with low-density polyethylene and the high costs associated with importing it.

In March 1990, a memorandum of understanding was signed between ENIP and Repsol, this led to the formal establishment of the Mediterranean Condensates Company (POLYMED) on December 15, 1990, as a mixed economic enterprise, the financing arrangement was secured over four years, from 1991 to 1995, with the Algerian partner, ENIP, holding a 66.66% majority stake and the Spanish partner, Repsol, holding the remaining 33.33% of the share capital.

The project site was inaugurated in 1996, with civil engineering and infrastructure works commencing in 1997. Plant assembly began in 1998, a period during which ENIP was restructured into a joint-stock company, construction of the POLYMED plant was completed in March 2002, followed by the signing of a financial

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restructuring agreement for the company at the level of the Prime Minister's office.

Subsequently, on January 1, 2010, POLYMED was integrated into the National Petrochemical Industries Company, which was itself merged with the national company for research, production, transportation, processing, and marketing of hydrocarbons, SONATRACH, as a result of this merger, the Skikda complex (CP2K) lost its administrative and financial autonomy, becoming solely a production unit, the CP2K complex is located within the industrial zone, approximately 3 km east of the city of Skikda.

The activity of the complex was centered on the production of high-density polyethylene (HDPE) with an annual capacity of 130,000 tons. The raw materials utilized in this process were as follows:

- Ethylene (C_2H_4): Served as the main reactant. Initially, it was supplied by the adjacent CP1K complex; however, it is currently imported,
- Isobutane (C_4H_{10}): Functioned as part of the reaction medium and acted as a diluent. It was sourced from the nearby GL1K complex,
- Hexene (C_6H_{12}): Played a role in regulating polymer density, thereby contributing to the flexibility, resistance, and crystallinity of the final product,
- Hydrogen (H_2): Acted as a chain transfer agent, serving to regulate the length of the polymer chains,
- Catalyst: A chromium-based catalyst, commercially known as MAGNAPORE 963, was employed and was sourced from the United States.

The final product, high-density polyethylene, was manufactured in several distinct grades, each characterized by specific properties and applications:

- Blow Molding Grade (HDPE SOUFFLAGE / PEHD 5502)

This grade was produced in granular form and was distinguished by: Exceptional Environmental Stress Crack Resistance (ESCR), Excellent stiffness and impact resistance and Precision in die cutting, it was primarily used in the manufacture of small to medium-capacity bottles.

- Injection Molding Grade (HDPE INJECTION / PEHD 6030)

This crystalline grade was characterized by: Excellent processability, High mechanical properties, A recommended processing temperature range of 190°C to 240°C.

- Film Grade (HDPE FILM / HDPE TR144)

This film grade was noted for: Excellent processability, Excellent weldability and sealability, good impact and tear resistance, A recommended processing temperature range of 180°C to 210°C, it was utilized in the production of film for bags, including garbage bags and all-purpose bags.

To assess the efficiency and effectiveness of the CP2K supply chain, this study operationalized the SCOR model's five core performance attributes: Reliability, Responsiveness, Agility, Cost, and Asset Management.

Results

- **Reliability Measurement**

First: On-Time Delivery Performance Indicator

To assess delivery performance at the complex, the order delay rate was calculated as follows:

$$(\text{Number of Delayed Orders}) / (\text{Total Number of Orders}) \times 100$$

The table below presents the monthly order delay rate and the cumulative delay rate.

Table 1. Order Delay Rate

Indicator	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Delay Rate (%)	0	0	0	0	0	0	0	9.09	0	0	0	0
Cumulative Delay Rate (%)	0	0	0	0	0	0	0	1.16	1.02	0	0	0

Source: Documentation provided by the Procurement Department

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As indicated in the table, a threshold of 5% was established as the maximum allowable order delay rate to measure delivery performance and assess the reliability of on-time deliveries, throughout most of the year, the order delay rate for the plastics complex stood at 0%, remaining well below the 5% target, the sole exception was observed in August, during which the delay rate reached 9.09%, this anomaly was attributed to shipping delays caused by significant disruptions and rising costs in maritime transport. These disruptions were a consequence of the closure of several major ports worldwide, a situation exacerbated by the geopolitical complexities arising from the Russian invasion of Ukraine during that period.

Second: Order Fulfillment Optimization Indicator

To measure the efficiency of order fulfillment at the complex, the order optimization rate was calculated as follows:

$$(\text{Number of Optimally Fulfilled Orders}) \,/\, (\text{Total Number of Orders}) \times 100$$

The table below presents the monthly order optimization rate and the cumulative optimization rate.

Table 2. Order Fulfillment Optimization Indicator

Indicator	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Optimization Rate (%)	99.21	80.26	96.92	91.76	98.43	85.00	98.43	97.43	98.41	95.33	-	-
Cumulative Otimization Rate (%)	99.21	88.92	91.46	91.51	92.93	91.83	92.38	93.20	93.50	-	-	-

Source: Documentation provided by the Procurement Department

As indicated in the table, a minimum threshold of 80% was established for the order optimization rate to assess performance reliability based on the proportion of optimally fulfilled orders, throughout the observed period, the optimization rate for the plastics complex ranged between 80% and 99%, this indicates that products were consistently delivered to the correct location, at the right time, in the appropriate quantity, at a suitable cost, and in proper packaging condition, this high level of performance was attributed to the operational effectiveness within the plastics complex and the proficient management of orders from the moment of receipt through to delivery, which included continuous adaptation to fluctuations in demand.

Third: Order Shipping Rate Indicator

To measure order shipping rates at the plastic complex level, the calculation method is as follows:

$$(\text{Number of Shipped Orders}) \,/\, (\text{Total Inventory}) \times 100$$

The following table shows the order shipping rates:

Table 3. Order Shipping Rate Indicator

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	oct
Inventory	1540	1489	3552	2524	3159	3219	2073	2196	633	194
Shipped Orders	1485	290	844	1106	1569	1488	506	970	1234	1705
Shipping Rate	96.40%	19.50%	23.80%	43.90%	49.70%	46.20%	24.40%	44.20%	195.00%	880%

Source: Documents provided by the Sales Department

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From the table, it can be observed that a 100% benchmark was established to measure order shipping rates and assess performance reliability based on the number of shipped orders relative to total inventory. The shipping rates showed relative variation. During the last three months of the year, the shipped order rates exceeded the established benchmark, which can be attributed to effective adaptation to unexpected order fluctuations and unplanned production. January recorded a rate approximately equivalent to the benchmark, followed by February with a significantly low rate due to the production of a type of PEHD (High-Density Polyethylene) that had limited demand during that period.

- **Flexibility Measurement**

First: Order Fulfillment Lead Time Indicator

To measure the order fulfillment lead time at the complex, the calculation method is as follows:

(Total Order Completion Duration) / (Total Orders)

The following table illustrates the order fulfillment lead time.

Table 4. Order Fulfillment Lead Time Indicator

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fulfillment Lead Time	2	2	2	2	3	3	4	10	9	5	2	2

Source: Documents provided by the Procurement Department

The table indicates that a 100% benchmark was established to measure order shipping rates and assess performance flexibility through order fulfillment lead time.

The order fulfillment cycle time remained consistently short throughout most months of the year. This efficiency is attributed to CP2K's adherence to precise and well-defined schedules for completing deliveries, as well as their commitment to respecting agreed-upon delivery deadlines.

However, the months of August and September recorded significantly longer cycle times. This deviation is explained by delays in the shipment of raw materials during that period, which subsequently impacted the overall order fulfillment process.

Secondly: Production Flexibility Indicator

To measure production flexibility at the CP2K complex level, production capacity is calculated, and the quantity produced is compared with the expected production quantity.

The table below represents the order fulfillment time.

Table 5. Production Flexibility Indicator

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Production Forecasts	5200	5200	5400	5400	5500	5000	5000	5200	5000	5200	5000	5000
Quantity Produced	2929	3877	5163	2650	3585	3060	3752	1670	1518	750	0	2833
Cumulative Quantity Produced	2629	6806	11968	14618	18204	21264	25016	26686	28204	28954	28954	31787

Source: Documents provided by the Product Management Department

According to the tables, we observe that the complex measures the flexibility of its supply chain performance through its production flexibility. The production capacity of the complex was set at 60,000 tons, and a 100%

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International Scientific Journal **Innovative Economics and Management**
E-ISSN:2449-2604
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Vol. 13 No1.2026

target was established for measuring the production planning and forecasting reliability rate. Production forecasts throughout the year were approximately 5,000 tons, while actual quantities produced ranged between 2,000 and 5,000 tons.

Table 6. Production Flexibility Index with Cumulative Production Planning and Forecast Reliability Rate

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Production Planning and Forecast Reliability Rate (%)	56.31	74.55	95.60	79.04	65.18	61.20	75.03	34.79	30.36	14.42	00	56.65
Cumulative Production Planning and Forecasting Reliability Rate (%)	56.31	65.43	75.74	68.95	68.17	67.07	60.27	64.30	60.30	56.00	51.06	51.51

Source: Documents provided by the Product Management Department

This indicates that the complex possesses relative flexibility in adjusting production volume and responding to environmental variables in the design of its products.

However, in October, a quantity of only 750 tons was produced due to the unavailability of distilled water required to start the plant's boilers. In November, production ceased entirely due to a machinery malfunction caused by faulty isolation valves on the machine's protective filter, compounded by a shortage of distilled water for boiler operation.

- **Cost Measurement**

Firstly: Product Cost Indicator

To measure product costs at the CP2K complex, all direct and indirect costs related to the production processes of finished goods are calculated.

The costs included in the product cost calculation are presented in the following table:

Table 7. Direct and Indirect Costs of Products

Cost Category	Value (DZD)
Total Direct Costs	67,060,020.67
Production Costs Excluding Depreciation	256,044.61
Depreciation Costs and Lost Values	164,156,675.86
Total Product Cost	270,963.77

Source: Documents provided by the Analytical Accounting Department

The table reveals a 16.94% increase in costs, attributable to the rise in raw material prices and the increase in maritime freight rates, driven by volatility in the international economic conditions.

Secondly: Warranty Cost Indicator

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Regarding warranty costs, which include expenses related to diagnosing and rectifying product defects, these are not included in the complex's budget, this is attributable to the strategy adopted by the complex for handling non-conforming products, the complex neither disposes of nor reprocesses non-conforming material, which represents one of its most significant positive attributes.

Instead, it exports these products to China at a 5% discount from the actual price. A product is considered non-conforming if it is in powder form, consists of oversized granules, or exhibits an excessively bright white color.

- **Measuring Asset Management Efficiency**

Firstly: Inventory Indicator

To measure the inventory indicator for the complex, according to Appendix (17), the following costs are calculated:

Cost of goods inventory = 125,473,890.17

Cost of raw materials and office supplies inventory = 697,735,228.08

Cost of other purchases inventory = 3,916,682,173.29

Cost of products inventory = 2,107,733,238.67

Cost of equipment inventory = —

Cost of external supplies inventory = 35,065,857.51

The total inventory cost is estimated at 6,882,690,387.72 Algerian Dinars. The complex's total inventory is stored in warehouses within the complex, except for raw materials inventory, which is stored in dedicated tanks for liquid materials at the Skikda port warehouses and delivered directly via pipelines extending to the complex's plant. The distance of the raw materials warehouse is the reason for the increase in inventory cost compared to other costs.

However, on the other hand, the complex implements improvements in internal supply activities to continuously avoid high inventory levels and reduce the time spent in the cash flow cycle. The inventory turnover rate achieved ranged between 19% and 24%, while the benchmark set for good inventory turnover performance was ≥ 10%. This is attributable to its reliance on real-time production scheduling in managing its stored assets.

Secondly: Asset Turnover Indicator

To measure the asset turnover indicator for the complex, total product revenues are divided by total assets as follows:

$$(\text{Total Revenues}) \,/\, (\text{Total Assets}) \times 100$$
$$(1{,}469{,}664{,}800\ ) \,/\, (7{,}143{,}072{,}952.86) \times 100$$

= 20.57%

Based on this calculation, we find that the asset turnover for the complex is approximately 20.57%, this means that the complex generated a return equivalent to 20.57% of its total asset value.

This figure can be used as a starting point for evaluating the complex's performance and efficiency in utilizing its assets to generate returns. Accordingly, it can be stated that, to some extent, the complex utilized its assets with relative efficiency.

Conclusions

The CP2K complex, like other economic enterprises, is potentially exposed to various risks and challenges, whether internal or external, international or national, for this reason, it resorts to measuring supply chain performance, considering it a crucial element in determining the efficiency of the enterprise's activities, the indicators were favorable for the complex.

Regarding the delay rate, the order delay rate for the complex was estimated at 0%, meaning less than 5%, with the exception of August, when the delay rate reached 9%, exceeding the set threshold, this was attributed to shipping delays caused by disruptions in maritime transport and its rising costs, due to significant disruptions resulting from the closure of some major ports worldwide, which is related to Russia's invasion of Ukraine,

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causing additional complications during that period.

Concerning order optimality, the order optimality rate for the CP2K complex ranged between 80% and 99%. This indicates that appropriate products were delivered to the right place, at the right time, in the right quantity, at the right cost, and in adequately packaged condition, this is attributable to the effectiveness of performance at the plastics complex level and the efficient management of orders from the time of receipt to the time of delivery, as well as continuous adaptation to changes in demand.

Regarding shipping rates, they were relatively variable, during the last three months of the year, the rate of shipped orders exceeded the set threshold, due to effective adaptation to unexpected changes in orders and unplanned production, in January, the rate was approximately equal to the set threshold, followed by February with a very low rate, due to the production of a type of PEHD (High-Density Polyethylene) that was in low demand during that period.

Concerning order fulfillment time, the cycle time was short in almost all months of the year because the complex adheres to specific and precise schedules in completing delivery operations and commits to agreed delivery dates, however, in August and September, the cycle time was long due to delays in shipping raw materials for the same reasons mentioned previously.

Regarding the calculation of production flexibility, production forecasts throughout the year were approximately 5,000 tons, while actual quantities produced ranged between 2,000 and 5,000 tons. This indicates that the complex possesses relative flexibility in adjusting production volume and responding to environmental variables in the design of its products. However, in October, a quantity of only 750 tons was produced due to the unavailability of distilled water required to start the plant's boilers. In November, production ceased entirely due to a machinery malfunction caused by faulty isolation valves on the machine's protective filter, compounded by a shortage of distilled water for boiler operation, the complex measures the flexibility of its supply chain performance.

Through these two indicators, we were able to determine the extent to which the plastics complex's supply chain achieves optimal performance measurement through the flexibility metric.

By calculating the complex's product cost indicator, which includes all direct and indirect costs related to the production processes of finished goods, and storage costs, we observed a difference in the total product cost between the two years, with an increase of 16.94%. This is attributable to the rise in raw material prices and the increase in maritime freight rates, driven by volatility in international economic conditions.

However, this increase did not negatively impact the complex's performance, as it was generating surplus revenues in the same year, as revealed through the calculation of the complex's asset turnover. The asset turnover reached approximately 20.57%, meaning that the complex generated a return equivalent to 20.57% of its total asset value. This figure can be used as a starting point for evaluating the complex's performance and efficiency in utilizing its assets to generate returns, accordingly, it can be stated that, to some extent, the complex utilized its assets with relative efficiency.

The success of the complex's supply chain performance measurement process was contingent upon selecting an appropriate set of indicators that accurately and validly reflected the overall performance of the chain towards achieving customer satisfaction and the satisfaction of all chain parties. The study concluded in this regard the following:

The complex relies on both financial and non-financial indicators to measure its supply chain performance, which has enabled it to be aware of all aspects of its activities and, accordingly, to forecast and plan effectively for the future to achieve customer satisfaction, profitability, and sustainability.

This has resulted in efficient and effective management, as demonstrated through the results of the aforementioned analysis.

Despite the large size of the complex's warehouse, it is insufficient to accommodate the quantities of material produced, sometimes exposing it to damage.

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The effectiveness of the plastics complex's supply chain has enabled it to adapt better to market and demand changes, which has improved demand forecasts and production planning, allowing for more effective demand fulfillment, thereby increasing its growth opportunities and enabling it to capitalize on available opportunities in local markets.

Furthermore, the effectiveness of the plastics complex's supply chain has saved costs and increased its efficiency by reducing delivery time, improving product quality, and consequently enhancing customer responsiveness.

Regarding any delays in order shipment, transportation, or customs clearance of goods, hedging mechanisms are in place; that is, there are contractual clauses covering such cases. These are borne by the supplier, who is required to provide compensation. However, the institution does not employ any exchange rate risk hedging techniques, meaning that the institution itself bears the risks arising from exchange rate fluctuations.

While theoretical frameworks for measuring supply chain performance are well-established, their empirical application in specific contexts, particularly within large Algerian industrial complexes such as the Sonatrach CP2K complex, remains limited. Furthermore, a pressing need emerges to assess not only the use of these models but also their effectiveness in capturing the nuances of modern, technology-driven supply chains. This gap serves as the direct impetus for the current study, which aims to empirically evaluate the performance indicators used at the CP2K plastic complex, test the applicability of the SCOR model in this context, and explore the extent to which its indicators align with the complex's operational realities and strategic objectives.

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