Report On

Impact of Sales & Operation Planning (S&OP) in overall performance of the organization .

By

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An internship report submitted to the BRAC Institute of Governance & Development (BIGD) in partial fulfillment of the requirements for the degree of
Masters in Procurement and Supply Management (MPSM)

BRAC Institute of Governance & Development
Brac University

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Declaration

It is hereby declared that

1. The internship report submitted is my own original work while completing degree at Brac University.
2. The report does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The report does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I/We have acknowledged all main sources of help.

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Supervisor's Full Name & Signature:

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Letter of Transmittal

Md. Hasan Maksud Chowdhury

Assistant Professor

Brac Business School

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66 Mohakhali, Dhaka-1212

Subject: Subject: Submission of practicum report on Impact of Sales & Operation Planning (S&OP) in overall performance of the organization .

Dear Sir / Madam,

It is an immense pleasure for me to submit practicum titled "(Impact of Sales & Operation Planning (S&OP) in overall performance of the organization)" on r-pac Bangladesh ltd . partial requirement to fulfillment of MPSM at BIGD, BRAC University. This practicum has enabled me to gain a bridge between firsthand organizational experience and academic study of the S&OP. So, it becomes an extremely challenging and interesting experience.

I have attempted my best to finish the report with the essential data and recommended proposition in as compact and comprehensive a manner as possible.

I trust that the report will meet the desires.

Sincerely yours,

_____

Wahid Anwar

Student ID: 18282006

BRAC Business School

BRAC University

Date: Month Day, Year

Non-Disclosure Agreement

This agreement has made and entered into by and between r-pac Bangladesh Ltd as the First Party and the undersigned student at BRAC Institute of Governance and Development, BRAC University as the Second Party. The First Party has allowed the Second Party to prepare a report on Impact of Sales & Operation Planning (S&OP) in overall performance of the organization for the degree of Masters of Procurement and Supply Management. The Second Party will have the opportunity to work closely with the officials of the organization and have access to official data and information. Based on work experience, data, and information collected the Second Party will prepare a report. The Second Party will use all sorts of data and information for academic purposes and will not disclose to any party against the interests of the First Party.

Student's Full Name and Signature

Wahid Anwar

ID # 18282006

Organizational Supervisor's Full Name and Signature

Md. Shafiqul Azim

Director – Finance & Company Secretary

Acknowledgement

I would like to express my sincere gratitude to my practicum supervisor assistant professor **Md. Hasan Maksud Chowdhury of** BRAC Institute of Governance and Development (BIGD),BRAC University for his valuable feedbacks, suggestion and support throughout the practicum.

I am extremely thankful to my mentor from studied organization Mr Shafiqul Islam , director finance or creating suitable learning environment for me and for his continuous guidance, supervision and encouragement throughout the year.

I am most grateful to our course Coordinator , Training Officer Ms. Tanzina M Mizan for always standing behind us and guiding us directly and indirectly. I am equally thankful to all the faculties for their valuable support, suggestions and feedback and friends of BRAC Institute of Governance & Development, BRAC University for their kind support whenever needed.

5.0 List of Acronyms

S.No	Acronym	Full Description
1	S&OP	Sales and Operations Planning
2	MILP	Mixed Integer Linear Programming
3	LP	Linear Programming
4	SES	Single Exponential Smoothing
5	DES	Double Exponential Smoothing
6	TES	Triple Exponential Smoothing
7	LR	Linear Regression
8	MR	Multiple Regression
9	3PL	Third Party Logistics
10	BI	Business Intelligence
11	FOB	Freight on Board
12	CPT	Carriage Paid To
13	CFR	Cost and Freight
14	Exw	Ex Works
15	HS Code	Harmonized System
16	BL	Bill of Lading
17	SO	Shipping Order
18	AWB	Airway Bill

19	CBM	Cubic Meter
20	DO	Delivery Order
21	ETD	Expected Time of Departure
22	MTD	Multimodal Transport Document
23	ETO	Electro Technical Officer
24	MO	Marketing Officer
25	ETA	Expected Time of Arrival

Glossary

- **r-pac International:** A leading provider of retail supply chain solutions, specializing in printed packaging and garments trimmings for the fashion and accessory industries. Founded in 1987, headquartered in New York City, and serving clients in over 30 countries.
- **Globalization:** The process of interaction and integration among people, companies, and governments from different nations, driven by international trade and investment.
- **Brand Design:** The process of creating a distinctive identity for a brand, including its name, logo, and visual elements, to establish a unique and memorable presence in the market.
- **RFID Tags:** Radio-Frequency Identification tags are small electronic devices that store and transmit data, often used for tracking and identifying items in retail and supply chain management.
- **Bangladesh:** A country in South Asia, located on the Bay of Bengal and bordered by India and Myanmar. Known for its textile and garment industry, it's a significant hub for clothing manufacturing.
- **Demand Forecasting:** The process of estimating future customer demand for a company's products or services based on historical data and market analysis.
- **Sales and Operations Planning (S&OP):** A process that helps businesses align their sales and operational activities to improve forecasting accuracy, enhance collaboration, and optimize resources.
- **SWOT Analysis:** An analysis framework that identifies a company's Strengths, Weaknesses, Opportunities, and Threats, providing insights for strategic planning.
- **Lean Supply Chain:** A supply chain management approach focused on minimizing waste, reducing costs, and improving efficiency while maintaining high-quality standards.
- **Agile Inventory Management:** A flexible inventory management strategy that allows businesses to quickly respond to changes in demand and market conditions.
- **Corporate Social Responsibility (CSR):** A business practice that involves initiatives to assess and take responsibility for a company's effects on environmental and social wellbeing.

- **Digital Transformation:** The integration of digital technology into various aspects of a business, fundamentally changing how it operates and delivers value to customers.
- **COVID-19 Pandemic:** The global outbreak of the coronavirus disease in 2019, leading to significant disruptions in economies, industries, and daily life worldwide.
- **Eco-Friendly Packaging:** Packaging materials and practices that are environmentally sustainable, aiming to reduce environmental impact and promote recycling and reuse.
- **HSCODE:** Harmonized System Code, an international nomenclature for the classification of products, used for customs and trade purposes.
- **Supply Chain Management:** The management of the flow of goods, services, information, and finances as they move from supplier to manufacturer to wholesaler to retailer to consumer.
- **New Entrant Threat:** The risk posed by new companies entering the market, potentially leading to increased competition and changes in market dynamics.
- **Bargaining Power:** The ability of buyers, suppliers, or other entities in a market to exert pressure and influence on the pricing and terms of trade.
- **Substitute Product/Service Threat:** The possibility of customers switching to alternative products or services, affecting the demand for a particular company's offerings.
- **Competitive Tension:** Intense rivalry among companies in a market, often leading to aggressive pricing, marketing, and product development strategies.
- **Porter's Five Forces Analysis:** A framework for analyzing the competitive forces within an industry, developed by Michael Porter, to assess its attractiveness and profitability.
- **Proforma Invoice:** A preliminary bill of sale sent to buyers in advance of a shipment or delivery, detailing the products, quantities, and prices agreed upon in a transaction.
- **RFID Tags:** Radio-Frequency Identification tags are small electronic devices that store and transmit data, often used for tracking and identifying items in retail and supply chain management.
- **Quality Policy:** A set of principles and guidelines followed by a company to ensure the production of high-quality goods and services, meeting customer expectations and industry standards.
- **Mission Statement:** A concise statement outlining a company's purpose, goals, and core values, guiding its actions and decisions.
- **Vision Statement:** A forward-looking statement describing a company's aspirations, long-term objectives, and desired outcomes for the future.
- **Sustainability:** The practice of meeting the needs of the present without compromising the ability of future generations to meet their own needs, often involving environmentally responsible practices and resource conservation.
- **Demand Forecasting:** The process of estimating future customer demand for a company's products or services based on historical data and market analysis.
- **Digital Transformation:** The integration of digital technology into various aspects of a business, fundamentally changing how it operates and delivers value to customers.
- **Promotional Packaging:** Specialized packaging designed for promotional purposes, often used for gift sets, limited-edition products, and promotional displays to enhance brand visibility and sales.

- **Sales and Operations Planning (S&OP):** A strategic procedure aligning sales projections, production planning, and inventory management to improve supply chain efficiency and organizational performance.
- **Key Performance Indicators (KPIs):** Quantifiable metrics used to evaluate the effectiveness of a company's performance in achieving its strategic objectives.
- **Supply Chain:** The network of entities, activities, information, and resources involved in moving a product or service from the supplier to the customer.
- **Forecasting:** The process of estimating future demand for products or services to inform supply chain management decisions.
- **Bullwhip Effect:** A phenomenon in supply chain management where small fluctuations in demand at the consumer level can result in larger fluctuations upstream in the supply chain.
- **Total Productive Maintenance (TPM):** An approach to equipment maintenance that aims to achieve zero downtime by integrating smart machine learning techniques.
- **Non-Dominated Sorting Genetic Algorithm (NSGA-II):** An evolutionary algorithm used for multi-objective optimization problems, including supply chain optimization.
- **Capacity Planning:** The process of determining a company's production capacity requirements and ensuring resources are utilized efficiently.
- **Vehicle Routing Problem with Time Windows (VRPTW):** A combinatorial optimization problem in logistics that involves determining the most efficient routes for a fleet of vehicles with capacity and time constraints.
- **Event-Driven Process Chain (EPC):** A type of flowchart used for business process modeling, illustrating events and functions within a business process.
- **Material Requirements Planning (MRP):** A production planning, scheduling, and inventory control system used to manage manufacturing processes.
- **Fast-Moving Consumer Goods (FMCG):** Products that are sold quickly at relatively low cost, such as food, beverages, toiletries, and other consumables.
- **Industry 4.0:** The current trend of automation and data exchange in manufacturing technologies, including IoT, cloud computing, and cognitive computing.
- **Business Process Model:** A visual representation of a company's processes, illustrating activities, inputs, outputs, and relationships between different elements.
- **Integrated Database:** A unified database that combines different data structures and types of information for comprehensive analysis and decision-making.
- **Business Network:** An interconnected system of businesses, suppliers, distributors, and other partners collaborating to deliver products or services to customers.
- **Supply Chain Volatility (SCV):** The degree of variation and unpredictability in supply chain processes, influenced by factors like market demands, regulations, and raw material costs.
- **Optimization:** The process of making something as effective or functional as possible, often involving finding the best solution among various alternatives.
- **Machine Learning:** A subset of artificial intelligence that enables systems to learn and improve from experience without being explicitly programmed.
- **Quantitative Data:** Numerical data that can be measured and expressed using numbers, used for statistical analysis and modeling.

- **Qualitative Data:** Non-numeric data that describes qualities, characteristics, and attributes, often collected through interviews, observations, or open-ended surveys.
- **Key Performance Indicators (KPIs):** Quantifiable metrics used to evaluate the success of an organization or a particular activity.
- **Labor Productivity:** The measure of the amount of output produced per unit of labor input.
- **Forecast Accuracy:** The degree to which the predicted outcome matches the actual outcome.
- **Supply Chain Performance:** The efficiency and effectiveness of the processes and activities involved in the production and distribution of goods.
- **Just-in-Time (JIT) Inventory Management:** An inventory strategy where goods are produced or acquired exactly when they are needed in the production process or by customers.
- **Time Window Vehicle Routing Problem (TWVRP):** A variant of the vehicle routing problem where each customer has a specific time window within which the delivery must be made.
- **Total Productive Maintenance (TPM):** A maintenance strategy aimed at improving the productivity of manufacturing equipment by preventing breakdowns and downtime.
- **Fast-Moving Consumer Goods (FMCG):** Goods that are sold quickly at relatively low cost, such as food, beverages, toiletries, and other consumables.
- **Genetic Algorithm (GA):** A search heuristic that mimics the process of natural evolution to find optimal solutions to complex problems.
- **Machine Learning:** A subset of artificial intelligence that enables systems to automatically learn and improve from experience without being explicitly programmed.
- **Correlation:** A statistical measure that describes the extent to which two variables change together.
- **Quantitative Research:** Research based on numerical data, often analyzed using statistical methods.
- **Qualitative Research:** Research based on non-numerical data, often involving interviews, observations, or analysis of documents.
- **Sampling:** The process of selecting a subset of individuals or items from a larger population for research purposes.
- **Algorithm:** A step-by-step procedure or formula for solving a problem or completing a task.
- **Methodology:** The systematic, theoretical analysis of the methods applied to a field of study.
- **Data Collection:** The process of gathering and measuring information on variables of interest, in a systematic manner, to establish patterns, facts, or theories.
- **Validity:** The extent to which a concept, conclusion, or measurement is well-founded and corresponds accurately to the real world.
- **Reliability:** The consistency and stability of a research study's results over time and across different conditions.
- **Ethical Considerations:** The moral principles that guide researchers in conducting responsible and ethical research.

- **Bias:** Systematic error introduced into sampling or testing by selecting or encouraging one outcome or answer over others.
- **Confounding Variables:** Extraneous factors that may affect the relationship between the variables being studied, leading to inaccurate or misleading results.
- **Single-Case Study:** A research design involving the detailed and comprehensive study of a single case (or a few cases) within its real-life context.
- **On-Time Delivery (OTD):** A measure of the percentage of orders or products delivered to customers on or before the promised delivery date.
- **Make-to-Order (MTO):** A production approach where products are manufactured based on customer demand, rather than being produced and stored in anticipation of demand.
- **Sales and Operations Planning (S&OP):** A process that integrates an organization's sales and operations functions to improve overall supply chain performance. It involves forecasting, demand planning, and aligning production and distribution with customer demand.
- **Aggressive Integration of Multiple Functions:** The strategic approach of blending various functions within an organization, such as procurement, production, distribution, and marketing, to create a more cohesive and efficient supply chain.
- **Interconnectedness Across Functions:** Ensuring smooth connectivity and communication across all functions in an organization to enable information flow, informed decision-making, and the operation of a well-synchronized supply chain.
- **Tools and Techniques for Optimization:** The use of various methods to enhance supply chain performance, including forecasting techniques, optimization over production and order fulfillment, transportation optimization, minimizing unplanned shutdowns, balancing stocks, and supplier collaboration.
- **Forecasting with Pattern-Based Modelling Techniques:** Advanced forecasting methods like exponential smoothing, weighted moving averages, and multiple regression used to predict future demand patterns for improved revenue and profit margins.
- **Optimization Over Production and Order Fulfillment:** Using linear optimization and mixed integer programming to minimize production costs while improving order fulfillment percentages, aiming for a balance between efficiency and customer satisfaction.
- **Transportation Optimization for On-Time Delivery:** Employing optimization techniques to streamline transportation operations, reduce costs, and enhance the percentage of on-time deliveries, crucial for customer loyalty.
- **Maximizing Efficiency, Minimizing Unplanned Shutdowns:** Strategies to minimize unplanned shutdowns in production, optimizing efficiency and augmenting on-time delivery rates.
- **Balancing Stocks to Optimize Profit Margins:** Employing optimization techniques to strike a balance between overstocks and stockouts, leading to improved revenue and profit margins.
- **Supplier Collaboration for On-Time Delivery:** Emphasizing maximum on-time delivery from suppliers to ensure a consistent flow of materials, minimizing disruptions, and enhancing the overall supply chain's effectiveness.
- **Data Analysis Tools and Techniques:** Utilization of various data analysis tools, including Excel for forecasting, optimization through Excel Solver, simulation via Monte

Carlo simulation, and visualization with Power BI to extract meaningful insights from data.

- **Deduction, Induction, and Abduction Research Approaches:** Different approaches to research methodology. Deduction starts with a theory or hypothesis and tests it through observations. Induction uses specific observations and patterns to come up with new theories. Abduction is a process of forming explanatory hypotheses.
- **The Balanced Approach Model:** A supply chain management framework that emphasizes the importance of balancing various elements within a supply chain to enhance overall performance. It includes components such as customer focus, internal integration, external integration, strategic alignment, performance measurement, process management, technology utilization, and continuous improvement.
- **Quantitative Analysis and Modelling:** The use of quantitative methods to gain empirical insights into the relationships between sales and operation planning and supply chain performance metrics.
- **Historical Data Analysis:** Collecting and analyzing historical data related to various supply chain performance metrics to inform decision-making.
- **Surveys:** Collecting quantitative data from key stakeholders through surveys to understand their perspectives on supply chain performance.
- **Statistical Analysis:** The use of statistical techniques, including regression analysis, correlation analysis, and hypothesis testing, to uncover hidden relationships in quantitative data.
- **Interviews:** Qualitative data collection method involving in-depth interviews with key stakeholders to gain insights into challenges, barriers, and opportunities in supply chain management.
- **Observations:** A qualitative method involving firsthand observations of supply chain processes and activities to gain a deeper understanding.
- **Focus Groups:** Interactive sessions with employees from different departments to facilitate open discussions and gather qualitative data on supply chain improvement.
- **Case Studies:** Detailed analyses of other organizations' successful strategies to inform best practices.
- **Comparative Case Studies:** Analyzing organizations with varying approaches to supply chain management to identify successful strategies and areas for improvement.
- **Optimization Modelling:** Using mathematical models to optimize production, transportation, and other aspects of the supply chain.
- **Cross-Functional Teams:** Teams comprised of members from both sales and supply chain departments, working together to enhance overall supply chain performance.
- **Performance Metrics:** Quantitative measures used to evaluate the effectiveness and efficiency of sales and supply chain operations.
- **Root Cause Analysis:** The process of identifying and addressing the underlying causes of problems or disruptions in the supply chain.
- **Demand Forecasting:** The process of estimating future customer demand for products or services, often based on historical data and various forecasting techniques.
- **Transport Optimization:** The practice of optimizing transportation routes and methods to reduce costs and improve efficiency in the supply chain.

- **Inventory Management:** The strategic control and maintenance of inventory levels to balance supply and demand and minimize overstocks and stockouts.
- **Supplier Relationship Management:** The management of relationships and interactions with suppliers to ensure a reliable and efficient supply chain.
- **Scenario Planning:** The practice of creating and testing multiple scenarios to prepare for and mitigate potential risks and disruptions in the supply chain.
- **Mixed Integer Programming (MIP):** A mathematical optimization technique used for solving complex scheduling and production problems, such as those in underground mining operations.
- **Exponential Smoothing:** Forecasting techniques that emphasize recent data while diminishing the significance of older data points to predict future trends.
- **Weighted Moving Average:** A forecasting technique that assigns varying weights to historical data points to adapt to changing scenarios and mitigate the impact of outliers.
- **Multiple Regression:** A statistical technique that examines the relationships between multiple variables to create a comprehensive forecasting model.
- **Mean Absolute Percentage Error (MAPE):** A measure of the accuracy of forecasting models by calculating the average percentage difference between predicted and actual values.
- **Machine Learning Algorithms:** Advanced algorithms that enable computers to learn from data and make predictions, often used in demand forecasting for more accurate projections.
- **IoT (Internet of Things) Devices:** Devices that are connected to the internet and can provide real-time monitoring and data collection for improved supply chain operations.
- **Advanced Planning and Scheduling (APS) Software:** Software used to optimize and schedule production and resources in manufacturing processes.
- **Key Performance Indicators (KPIs):** Specific metrics used to evaluate and track the performance of various aspects of the supply chain, such as production and delivery.
- **Dashboards and Reporting Systems:** Tools and platforms that provide visual representations of supply chain data and performance metrics for easy monitoring and decision-making.
- **Continuous Supply Chain Improvement:** The ongoing process of identifying and implementing improvements in the supply chain to enhance efficiency and customer satisfaction.
-
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- **Aggressive Integration of Multiple Functions**: The strategic approach of blending various functions within an organization, such as procurement, production, distribution, and marketing, to ensure they work harmoniously to enhance supply chain performance.
- **Interconnectedness Across Functions**: The idea that functions within an organization should be interconnected, with each function informing and influencing the others to ensure a well-synchronized supply chain.
- **Tools and Techniques for Optimization**: Strategies and methods used to optimize various aspects of supply chain performance, including forecasting, production, transportation, inventory management, and supplier interactions.
- **Forecasting with Pattern-Based Modelling Techniques**: Advanced forecasting methods, such as single, double, and triple exponential smoothing, weighted moving averages, and multiple regression, used to predict future demand patterns accurately.

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Chapter 1 : Overview of practicum

Student information

Name: Wahid Anwar

ID # 18282006

Program : Masters of procurement and supply management (MPSM)

Practicum information :
Period , name , department , address :

Period : 1st Jan 2023 till 30th March 2023

Company name : r-pac Bangladesh Ltd

Department: Supply chain management

Address: Shanta Forum , Level 10, West Tower

187-188/B, Tejgaon-Gulshan Link Road, Dhaka-1208, Bangladesh

Line manager

Name of workplace supervisor: Shafiqul azim

Designation: finance director

Job description:

I have been working as a General Manager of Supply Chain since 2019, where I oversee the end-to-end supply chain department of the company. My previous role as the Head of Supply Chain involved managing all supply chain activities within the plant, such as customer service, planning, purchasing, shipping, and subcontracting, with a strong focus on improving service to the customer. Additionally, I was responsible for inventory management and profitability.

Currently, as a General Manager, I have a wide range of responsibilities that include directly managing key functions such as demand and supply planning, procurement, warehouse

management, inbound logistics, and outbound logistics. In this position, I oversee the entire supply chain process to ensure its smooth and efficient operation. My primary goals are to enhance customer satisfaction, optimize inventory levels, and maximize profitability for the company.

Practicum outcome

Contribution of student:

During my practicum experience, I was able to make significant contributions to my current organization by enhancing my skills and applying my theoretical knowledge in practical settings. Specifically, I developed expertise in Sales and operation planning process & deploying procurement policies, which improved the efficiency of the organization's operations in different ways such as improve customer satisfaction by reducing stock out , manage supply and demand more efficiently and effectively that help organization to reduce cost of inventory .

Additionally, I gained valuable experience in supply chain performance management, including reducing lead time of purchase orders, optimizing inventory levels, and reducing freight costs.

Through this practical experience, I was able to identify inefficiencies and bottlenecks within the supply chain, and implement solutions to address them. Overall, my practicum experience allowed me to put my theoretical knowledge into practice and develop valuable skills that have benefited my organization in various ways.

Benefit to the student

It was an excellent opportunity for me to closely review all the processes of the supply chain and other related functions . In the supply chain function, Sales and Operations Planning (S&OP) plays a crucial role in decision-making and managing supply and demand. Organizations that achieve success in their service levels, such as customer satisfaction, competitiveness, higher profitability, and efficient supply and demand management, rely on effective S&OP planning. Despite the many challenges and uncertainties, risks, and threats, organizations must develop a better plan that aligns with all stakeholder functions.

Additionally, I learned how crucial it is to manage the supply chain efficiently to meet customer demand while keeping costs low. Effective supply chain management can help organizations achieve a competitive advantage in their industry by improving customer service, reducing lead times, optimizing inventory levels, and enhancing operational efficiency.

Overall, my experience reviewing the supply chain processes and working with key stakeholders has provided me with valuable insights into how organizations can improve their supply chain management practices to achieve their business objectives.

Difficulties:

Working at r-pac Bangladesh has been an incredibly positive experience for me. It has provided me with the opportunity to connect with stakeholders closely. However, in the current post-COVID situation, managing the business has become increasingly volatile, and there are many uncertainties that I have to deal with on a daily basis. Due to time constraints, I am not always able to conduct a thorough analysis of data. Additionally, certain information cannot be shared with others due to r-pac's confidentiality policy.

Recommendations:

1. r-pac Bangladesh Ltd is a crucial player in the RMG sector, providing branding solutions for trims and accessories and serving as a reliable backward linkage supplier. However, the RMG accessories industry is facing a scarcity of skilled and mid-level technical personnel.
2. To strengthen its Sales and Operations Planning (S&OP) process, the company should prioritize improving forecast accuracy and demand management.
3. The company should place more emphasis on developing second-tier management who can take charge and provide leadership. Currently, the first-tier management is occupied with day-to-day tasks, leaving little time for strategic activities .
4. To enhance its operations, the company should prioritize utilizing its existing ERP solutions more effectively. Despite having numerous reports available in the ERP system, many of them remain untapped .
5. The company should prioritize retaining experienced employees and reducing the turnover rate.

Overview of the Organization (Chapter 2)

2. Introduction:

New York-based r-Pac has been producing printed packaging and garments trimmings for the fashion and accessory industries since its foundation in 1987. They were already well-known for

their proficiency in brand design and production solutions by the mid-1990s when they responded to the needs of globalization by expanding their operations throughout the world. r-Pac has been in business since 2009 and now serves clients in over 30 countries, one of which is Bangladesh. The headquarters and one of the company's manufacturing facilities are in Dhaka, while the other is in Tangail. Their offerings cover the gamut of packaging needs, from boxes to labels to hand tags to barcodes to RFID tags.

The R-PAC Timeline

- r-pac International is a leading provider of retail supply chain solutions.
- They offer brand concepts, graphics, goods, and solutions to retailers and brand owners.
- They have been in the industry for over 30 years.
- They have a worldwide infrastructure with factories in various countries.
- They provide brand management, quality control, and reasonable prices.
- r-pac International is based in New York City and has been producing printed packaging and garments trimmings since 1987.
- They have a solid reputation for innovative brand design and manufacturing solutions.
- They have 30 sites globally, including 16 in the United States dedicated to sales support.
- They have regional hubs in Hong Kong, Singapore, and Luxembourg.

Bangladesh R-PAC in Bangladesh

In 2004, r-pac Bangladesh opened its doors for business with the intention of becoming a trade company. In 2007, r-pac began producing its own products in response to rising demand and notable contributions to the market. Originally operating out of the Adamjee Export Processing Zone (EPZ), the firm later expanded to Tangail, where it is now known as rpac Bangladesh Ltd. Because of this calculated business decision, r-pac is now more equipped to meet customer demands.

The major milestone of r-pac in Bangladesh

R-pac first set up shop in Bangladesh as a business partner, contracting out its manufacturing to local, law-abiding firms. However, R-pac redirected its efforts to increase its production competence and made significant expenditures to update its own facility as demand increased.

Additional landmarks include:

- R-pac Bangladesh was founded in 2004 as a branch of the multinational packaging firm R-pac International.

- Established in 2007, R-pac Bangladesh's state-of-the-art production plant is outfitted with the most recent in manufacturing machines and technology.

- R-pac Bangladesh's contribution to the local economy has been substantial because of the amount of jobs it has generated. The organization takes pride in its talented staff and supports them through various training and advancement opportunities.

- R-pac Bangladesh has established a solid customer over the years, consisting of both domestic and foreign companies. The organization has worked with well-known names in the retail, fashion, cosmetics, and other sectors.

- R-pac Bangladesh is committed to providing goods and services of the highest quality. To enhance client happiness, the organization follows international quality certifications and employs rigorous quality control techniques.

- R-pac Bangladesh is devoted to sustainability and employs environmentally friendly procedures as part of its social and environmental responsibility. The firm is an advocate for green manufacturing, recycling, and waste reduction.

- Since its beginning, R-pac Bangladesh has maintained a steady rate of growth. In order to keep up with the needs of their ever-expanding consumer base, the firm has boosted their output, streamlined their operations, and widened their selection of available products.

Principles of Business

R-pac operates on a set of core beliefs and tenets that serve as the basis for the company's decisions. Among these guiding concepts are:

- r-pac International is a leading provider of retail supply chain solutions.
- They offer brand concepts, graphics, goods, and solutions to retailers and brand owners.
- They have been in the industry for over 30 years.

- They have a worldwide infrastructure with factories in various countries.
- They provide brand management, quality control, and reasonable prices.
- r-pac International is based in New York City and has been producing printed packaging and garments trimmings since 1987.
- They have a solid reputation for innovative brand design and manufacturing solutions.
- They have 30 sites globally, including 16 in the United States dedicated to sales support.
- They have regional hubs in Hong Kong, Singapore, and Luxembourg.

Mission and Vision

Our end objective is the same as yours.

For our clients, quality, consistency, and alignment with their goals have been the driving forces behind all we do since 1987. Our company's purpose is on the achievement of the desired outcomes for our clientele.

Mission

Join our group! Through superior execution, sustainable and ethical business methods, and the flexibility of being simple to work with, we want to assist our customers in establishing their brands and achieving their objectives. We now manufacture in over 25 countries and are investing and growing to meet the expanding demands of our customers.

Vision

With a focus on providing quality and value to customers across the retail supply chain, we aim to become the go-to source for branded trim and packaging around the world.

Tagline

The slogan "Packaging Solutions, Innovated" represents R-pac International's aim to provide clients with tailor-made packaging solutions.

Behavior Standards for R-PAC in Bangladesh:

R-pac Bangladesh staff members are expected to adhere to local, national, and international laws and regulations, as well as industry standards. They are expected to act with integrity, honesty, and fairness, avoiding conflicts of interest and operating in a manner consistent with the company's values. The company is committed to creating a welcoming and inclusive workplace, treating all employees with dignity and respect, regardless of their ethnicity, gender, religion, nationality, or other legally protected traits. Employees are responsible for safeguarding the privacy and intellectual property of R-pac Bangladesh and its customers, including trade secrets and proprietary information. Workplace safety and health are top priorities, with employees aiming for improvement and providing top-notch products and services. R-pac Bangladesh advocates for eco-friendly policies and practices, reducing waste and promoting sustainable activities. Employees are expected to maintain a professional demeanor, collaborate effectively, and foster a productive working environment. These standards should be adapted to fit the company's norms and cultural framework.

Quality policy :

- R-pac follows a set of quality principles to provide high-quality goods and services.
- The company focuses on listening to and fulfilling the demands of their clientele.
- R-pac promotes a culture of continuous improvement by identifying weak spots and optimizing processes.
- The company uses a process approach to control and optimize its processes.
- Quality assurance is everyone's job at R-pac, and employees are encouraged to contribute their knowledge and ideas.
- R-pac values its partnerships with vendors and collaborates with them to ensure the best raw materials and services.
- The company uses evidence-based decision making, considering quality measures, customer feedback, and performance indicators.
- R-pac manages risks in a preventative manner, recognizing and countering potential threats and openings.
- The company prioritizes the professional growth and development of its workers through training and education programs.
- R-pac's approach to quality management is based on these guiding concepts.

Product safety policy

The safety of our goods is important to us, and we are aware of the concerns our consumers have about them. As a company committed to producing high-quality accessories, we recognize that upholding the highest standards of product safety is essential to maintaining the credibility of our brands and operations.

R-pac Bangladesh Packaging Co.'s remit. Ltd. We pledge to foster a culture of accountability and safety at every level of the organization and in every facet of our operations for the benefit of our customers, employees, and the public at large.

Policy:

1. We only buy chemicals and other raw materials from suppliers who have received international certification.

    a) Comply with CPSIA Standards.

    b) Approval by a global body (Blue Sign, GOTS, STEP, Oekotex, ISO, etc.).

    c) Third-party results report.

2. The chemical must pass inspection after delivery according to the criteria described in Appendix-2.

    a) At the time of purchase, we anticipate receiving the requisite paperwork from the supplier.

    b) Complete Material Safety Data Sheet (16 points) in accordance with worldwide norms and regulations.

    c) Complete TDS in accordance with worldwide law and practice.

    d) Stick a GHS Label on the Chemical Jar.

    e) Declaration of MRSL and RSL

f) Confirmation of the ZDHC

g) Inventory and bill of lading.

h) If you don't have the CAS number, you'll need a hazard clearance (ZDHC, RSL, MRSL, etc.).

3. After manufacturing a product, we put it through rigorous third-party testing by famous labs like BB/ ITS/ SGS/ UL/ Q-tec/ KAKAEN & JP in order to ensure that it satisfies all of the necessary standards. Color fastness to hot pressing test, color fastness to rubbing test (wet and dry), color fastness to phenolic yellowing test, color fastness to rubbing test, color fastness to saliva (kids' item), color fastness to perspiration, etc. are all tests that can be performed in-house.

4. In order to produce and maintain product safety, we actively participate in standard-setting and industry organizations and remain abreast of new legislation, industry best practices, and market situations. Throughout the whole r-pac Bangladesh packaging co. ltd. system, we constantly reevaluate the relevancy of our criteria and standards and then improve upon them.

Appendix-2

Inspection and Audit Checklist

SL.	Criteria	Yes	No	Remarks
a)	Meet CPSIA Requirements?			
b)	Provide CPSIA Certification as per Appendix-1?			
c)	Have any International Certification (Such as Blue sign, GOTS, STEP, ISO etc.)? Please mention the certification in remarks.			
d)	Have any 3rd party test report?			
e)	Have any Oekotex certificate?			

f)	Provide Full MSDS/SDS as per international standard and regulation (16 points)?			
g)	Received Full TDS as per international standard and regulation?			
h)	Received with GHS Label?			
i)	Provide brand MRSL & RSL declaration			
j)	Hazard Clearance (ZDHC, RSL & MRSL etc.) Provided? If CAS No isn't available.			

Essential r-pac Bangladesh words that are used regularly.

Purchase order : A purchase order is a document provided by a buyer to a supplier to guarantee the fulfillment of a contract for a certain quantity, quality, and agreed-upon price.

Proforma Invoice: A proforma invoice (PI) is a bill of sale that is issued to the customer before the actual shipping or delivery of goods or services. It includes basic transaction facts such as the product type, quantity, and price.

Sales and Operations Planning (S&OP): To better satisfy consumer demand, optimize resources, and boost profits, firms can benefit from a process known as sales and operations planning (S&OP).

Forecast: A forecast is an examination and estimation of future events and trends.

Sales Forecast: Using past sales data and current market trends, businesses may make educated guesses on how much money they will make selling their goods and services in the future.

Invoice: An invoice is a commercial document issued by a seller to a buyer, indicating the products, quantities, and agreed prices for the products or services the seller has provided.

Numbers for SO and MO: "SO" often refers to "Sales Order," which is a document generated by a seller to confirm a customer's request to purchase products. "MO" could refer to "Manufacturing Order" or "Maintenance Order," depending on the context. These numbers typically serve as references for tracking and managing orders or tasks.

OOS: out of stock , this is refer number material currently out of stock in the factory

ETA : estimated arrival date ETD : estimated departure date

FOB : FOB" stands for "Free On Board." It is a shipping term used in international trade and logistics to specify when the responsibility and risk for goods are transferred from the seller to the buyer during the transportation of the goods

Ex Works (EXW): Ex Works is an international trade term that signifies that the seller's responsibility for a product ends when it is made available for pick-up at their premises or another specified location. The buyer is responsible for transportation, costs, and risks from that point.

CFR: CFR stands for "Cost and Freight." It is an Incoterm used in international trade to indicate that the seller is responsible for delivering the goods to a specific destination port and paying for the cost of transportation to that port. However, risk is transferred to the buyer once the goods are on board the vessel.

CPT: CPT stands for "Carriage Paid To." It is another Incoterm that means the seller is responsible for delivering the goods to a specific location (agreed upon by the buyer and seller) and paying the freight charges for the main carriage. Risk is transferred to the buyer when the goods are in the hands of the carrier.

HS Code (Harmonized System Code): The HS Code is a standardized code system used to classify and identify products for customs, tax, and trade purposes. It simplifies international trade and facilitates the collection of trade statistics.

Bill of Lading (BL): A Bill of Lading is a legal document issued by a carrier (like a shipping company) to the shipper. It serves as evidence of a contract for the carriage of goods and receipt of the cargo. It is also used for title to the goods, and it is required for the release of the goods at the destination port.

"DO" stands for "Delivery Order." A Delivery Order is a document issued by a carrier, such as a shipping company or a logistics provider, to authorize the release of goods to the recipient or another party specified in the document.

CBM: **Cubic Meters (CBM)**: In the context of shipping and logistics, CBM refers to the volume measurement in cubic meters used to determine the capacity or space occupied by cargo or goods.

Days of Inventory: days of inventory which need to be kept in stock to cater customer order .

Clearing and Forwarding Agent (abbreviation: C&F)

Exp: export permission which needs to take from bank to export the goods .

Product description

- R-pac International is a global leader in custom packaging and labeling
- They offer a wide range of products to meet various packaging requirements
- Their labels include sticky labels, pressure-sensitive labels, and shrink sleeves
- They provide labels and tickets for identification and inventory control, such as hangtags, price tags, barcode tags, and RFID tags
- They also offer printed cartons, boxes, and pouches for packaging goods
- Their focus is on promotional packaging, including gift sets, limited-edition packaging, and promotional displays
- They provide brand security solutions like anti-counterfeit labels, tamper-evident seals, and holographic packaging
- They prioritize sustainability by offering environmentally friendly packing options
- Their bespoke packaging services are developed in collaboration with customers
- Their product offerings may change based on market needs and customer preferences..

Supply chain management in action:

The r-pac Bangladesh Ltd. brand is recognized worldwide as a major player in 25 different markets. It has become the go-to source for sustainable supply chain solutions among Bangladeshi brands and textile manufacturers. The organization has created a full-fledged supply chain management system with an emphasis on environmental friendliness. This approach was developed to ensure that only high-quality, eco-friendly materials are used in the manufacturing of branding solutions goods. It guarantees that the needs of the clientele are fulfilled in terms of reasonable price and prompt shipping.

Key elements of r-pac Bangladesh's supply chain management are outlined below. End-to-end supply chain management procedures are used at r-pac Bangladesh, allowing for the best possible output.

Planning and forecasting involves estimating future product demand and collaborating with sales to obtain a rolling forecast.

Procurement and sourcing involve sourcing necessary components from approved vendors at a fair price and within a reasonable amount of time using SAP to generate purchase orders.

Inbound logistics involves acquiring resources for internal operations quickly and cheaply, with import management and export management being key components.

Warehousing is where goods are stored after processing through customs and the port, and it involves tasks such as receiving materials, issuing them to production, and managing stock using SAP.

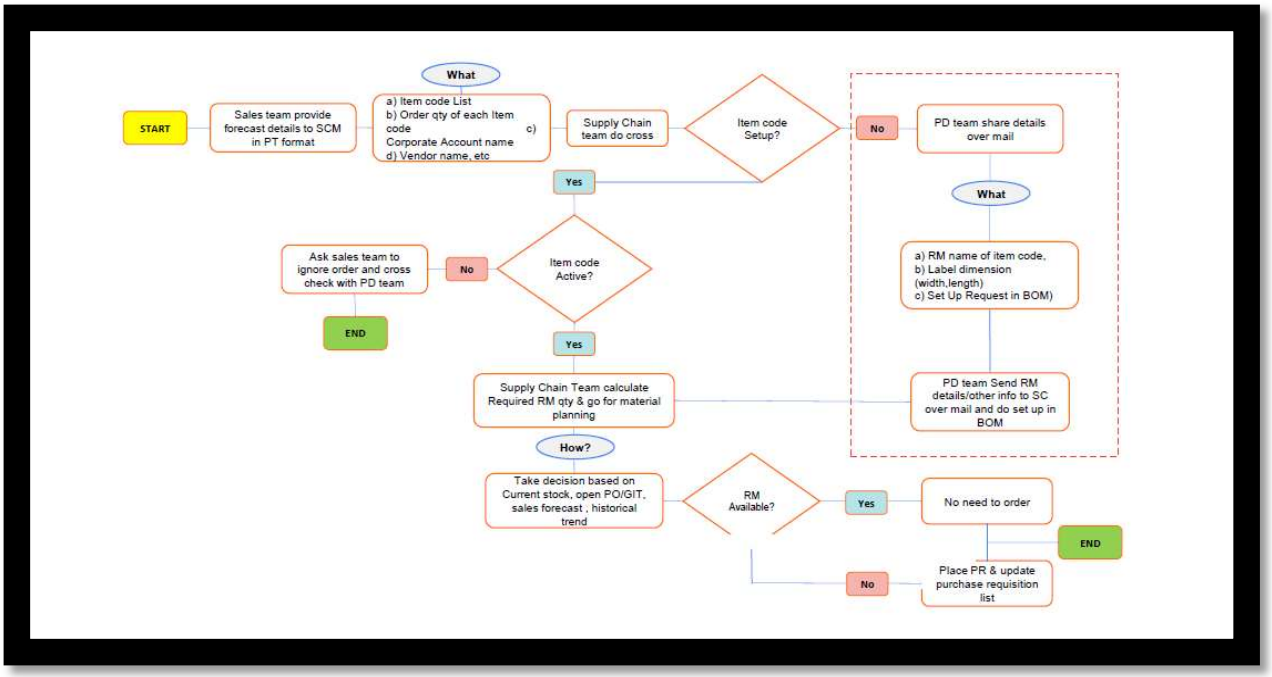
Distributions involve packing finished items into cartons, arranging them on racks, and preparing for the arrival of the C&F agent for shipping.

R-pac prioritizes sustainability and ethical practices in its supply chain management, aiming to enhance efficiency, effectiveness, and responsiveness while emphasizing sustainability and establishing mutually beneficial partnerships.

How S&OP Planning Is Put Into Action:

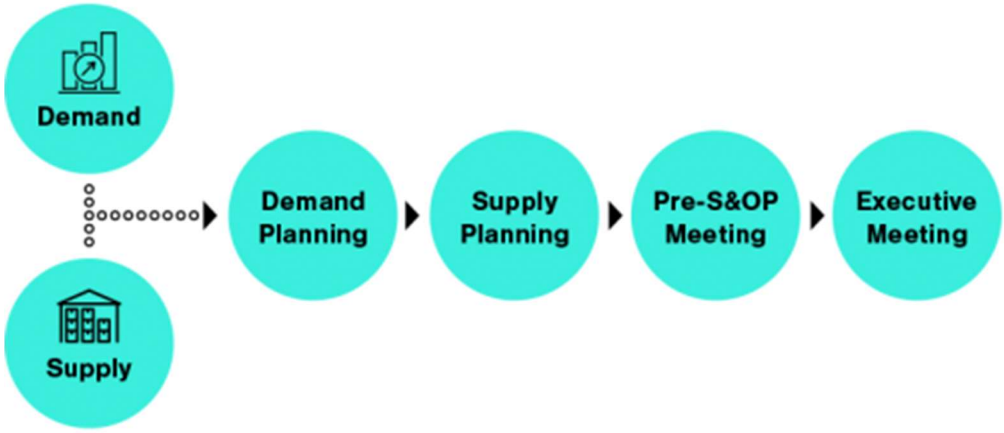
Plans like demand and supply planning, as well as forecasting, all flow out of r-pac's S&OP planning. It's a streamlined method of doing business that helps predict future demand and figure out how to meet it with the fewest possible resources.

The steps involved in r-pac's S&OP planning process are as follows:



S&OP cycle of planning:

When it comes to achieving r-pac's long-term objectives, planning is one of the most important activities on the ground. The company's yearly sales goal is set before Sales and Operations Planning (S&OP) begins. The company creates an annual plan to establish annual milestones with the long-term aim of Mission 2025 in mind, which determines the path for the following five years. By going through this procedure, you may be assured that your company's near-term goals will ultimately support its long-term mission.



Source : https://blog.board.com/what-is-sales-and-operations-planning/

To learn more about sales and operations planning, check out this article: https://blog.board.com/what-is-sales-and-operations-planning/.

Analysis of the Market and the Competition:

A Review of the Porter Five Forces

A company's competitive environment may be evaluated using Porter's five forces.

The results of r-pac Bangladesh ltd's Porter's Five Forces Analysis are presented below.

New entrant threat level: moderate

There is a fair amount of competition in the apparel and accessories market. However, high investment requirements and technical developments restrict the possibility of new competitors appearing in the market, even though there are possibilities for new enterprises to enter the industry. Another difficulty is getting nominations from brand offices and retailers. Sustainable procurement is becoming increasingly important, with buyers looking for reputable manufacturers that can guarantee social and environmental responsibility as well as green production methods.

There is a growing subset of the label and packaging industry that does not require a buyer nomination to enter the market. These companies specialize in care labels, offset printing, woven labels, flexography, and thermal printing, among other low-tech processes.

High supplier bargaining power

In this market, suppliers hold a lot of sway over pricing and other terms. Because of their high level of technical competence and specialized knowledge, and the small number of worldwide suppliers, these companies have considerable leverage in negotiations. Only a select few companies in the industry generate and convert raw materials like RFID chips needed in making RFID inlays. When it comes to cost, quality, and availability, suppliers have considerable sway.

Consumers have a lot of negotiating power.

Buyers in the accessories business wield a lot of clout in the garment market when it comes to negotiations. The market is skewed in favor of purchasers, who have the freedom to place orders anywhere they choose. There are two sorts of buyers in the accessories industry: customers who place orders and retailers who select vendors to fulfill those orders. R-pac Bangladesh has strong competition in this market since buyers have a lot of leverage.

Substitute product/service threat: little

R-pac Bangladesh faces moderate competition from similar businesses, but its long history in the market and loyal customers make it a strong competitor. The company's competitive edge is derived from its commitment to developing innovative solutions to customer problems, such as faster responses to emergencies, improved product quality, and convenient delivery. This approach, combined with new manufacturing methods, ensures high-quality service and convenience for clients.

High degree of competitive tension

The r-pac Bangladesh market is experiencing intense competition due to the increasing number of firms competing for customers' money. The competition is intensifying due to the similarity between competing products and services, low switching costs, and new label and package companies entering the market. Large companies with large expenditures, investments, or specialized assets are more likely to survive and remain operational, fueling competition due to the finite market share.

SWOT analysis:

Strengths:

R-pac Bangladesh is a reputable label and packaging company known for its trustworthiness and commitment to customer satisfaction. The company's value proposition is enhanced by creative solutions like door-to-door delivery services and investment in training and development. R-pac's breadth of service offerings allows it to cater to a wide range of customers and expand its business. The company has invested strategically in people, cutting-edge equipment, and quick response to customer inquiries, earning a stellar reputation for quick and effective responses. R-pac's demand-focused operations involve constantly tracking and assessing demand, allowing them to anticipate market changes, safeguard their supply chain, and improve service quality. Sales and Operations Planning (S&OP) helps businesses better predict and respond to supply and demand changes, enhancing customer service and satisfaction. R-pac's emphasis on infrastructure development has become a strength, providing clients with special advantages due to its facilities located both within and outside bound zones. The company specializes in cost-effective solutions without sacrificing quality, offering cheap prices that set it apart from competitors. R-pac's supply chain operations are a major strength, operating in a spirit of cooperation to cultivate productive relationships and ensure high standards of service.

Weaknesses:

R-pac Bangladesh faces intense competition due to numerous businesses, potentially threatening prices and profits. The clothing sector is heavily dependent on consumer sartorial needs, making it vulnerable to market changes. Limited geographical presence and local printers entering the market pose a threat to established businesses, as they create strong pricing rivalry with lower cost structures.

Opportunities:

The growth of e-commerce and rising consumer demand in the packaging sector presents opportunities for r-pac Bangladesh to increase their business income and customer satisfaction. The company could expand into new areas or offer diverse services. They aim to meet environmental demand by providing eco-friendly packaging solutions. Emerging technologies like RFID offer significant opportunities for r-pac, which invests heavily in R&D to satisfy customer demands for innovative products. They are committed to using sustainable materials in production.

Threats:

New companies in the label and packaging market may increase competition and reduce profits. Local printers and competitors may undercut r-pac Bangladesh's pricing due to lower overhead costs. Consumers' preference for digital labels and non-conventional options may threaten traditional solutions, necessitating R-Pac Bangladesh to adapt in today's competitive business environment.

Summary & Conclusions

r-pac Bangladesh Ltd has become a leading global provider of apparel identification solutions, thanks to its loyal customer base, brand recognition, diverse services, and increasing profits. However, the company faces challenges due to rising operating costs and fierce competition, emphasizing the need for constant analysis and optimization of its fulfillment process. The COVID-19 pandemic has shifted purchasing strategies to data-driven decisions, making it crucial for r-pac to manage cost pressures. To increase market share, the company must balance a lean supply chain with agile inventory management, predicting future demand and stocking up accordingly. A lean and agile supply chain structure can increase efficiency, reduce waste, and maintain agility. r-pac's commitment to innovation and digital transformation has improved efficiency and customer satisfaction. The company also emphasizes sustainability and corporate social responsibility, aiming to balance economic growth with social and environmental issues.

3.1 Project

Abstract

The present study endeavour explores the pivotal significance of Sales and Operations Planning (S&OP) in influencing the entire performance of enterprises' supply chains. This study aims to investigate the importance of effective Sales and Operations Planning (S&OP) procedures in enhancing supply chain operations and improving key performance indicators (KPIs). This paper aims to offer in-depth insights into the complexity, obstacles, and revolutionary possibilities of Sales and Operations Planning (S&OP) implementation through a thorough methodology that includes literature review, data analysis, and case studies. The project establishes its objectives in accordance with the overall research topic, so establishing a robust basis for a thorough academic investigation.

Introduction

The background information is essential for understanding the context and setting of a particular topic or issue.

In the current economic environment, which is marked by a growing interconnectedness of markets, swift improvements in technology, and constantly changing client demands, firms are faced with the critical need to manage their supply chains efficiently and effectively. Sales and Operations Planning (S&OP) plays a crucial role in the attainment of this ambitious objective. S&OP is a strategic procedure that serves as a pivotal element in aligning sales projections, production planning, and inventory management. Sales and Operations Planning (S&OP) serves as a crucial link connecting strategic goals with the practical implementation of supply chain activities.

3.2 Problem Statement

Despite the acknowledged significance of Sales and Operations Planning (S&OP), a considerable percentage of firms face significant obstacles when it comes to developing and executing these procedures. These problems involve a wide range of issues.

- The challenge of effectively forecasting client demand, which frequently results in either excessive inventory or insufficient supply availability.

- Insufficient Inventory Management: Suboptimal amounts of inventory leading to elevated carrying costs, probable obsolescence, and compromised cash flow.

- Operational inefficiencies arise from the misalignment between production and sales goals, leading to the occurrence of production bottlenecks, underutilization of capacity, and poor allocation of resources.

- Interdepartmental fragmentation refers to the inadequate level of collaboration and communication across several departments within a business, such as sales, marketing, and manufacturing. This lack of coordination results in poor decision-making and a deficiency in strategic alignment.

- Failure to fulfil Customer Expectations: The inability to effectively provide items within the specified timeframe and quantity to fulfil customer requirements, leading to potential negative consequences such as a decline in market share and harm to the company's reputation.

Research Gap

The current corpus of scholarly work recognizes the importance of Sales and Operations Planning (S&OP) in improving the performance of supply chains. However, there is a significant gap in thorough empirical studies that examine the various complex issues faced throughout the implementation of S&OP. Furthermore, there is a scarcity of empirical research that thoroughly investigates the precise influence of Sales and Operations Planning (S&OP) on crucial key performance indicators (KPIs) inside the supply chain. This research project aims to fill this knowledge gap by offering a comprehensive analysis of the complex correlation between sales and operations planning (S&OP) methods and the overall effectiveness of supply chains.

3.3 Objectives of the Report

The primary purpose of this research project is to achieve a set of objectives that have been carefully connected with the overarching research topic.

Investigate the Continuum of Sales and Operations Planning (S&OP) Maturity and Evaluate the Influence of Sales and Operations Planning on Critical Performance Metrics within the Supply Chain.

This study aims to analyse the evolutionary progression of Sales and Operations Planning (S&OP) adoption, tracing its trajectory from the first implementation phase to the subsequent stage of advanced optimization.

This study aims to examine the many elements that exert an impact on an organization's placement along the Sales and Operations Planning (S&OP) maturity continuum.

This inquiry seeks to identify the prevailing barriers and facilitators that exert influence on the advancement of Sales and Operations Planning (S&OP) maturity.

3.4 Literature Review

In today's fast-paced business climate, companies must be flexible and responsive to meet changing customer expectations while maintaining profitability. Efficient supply chain planning, including Sales and Operations Planning (S&OP), is crucial for balancing resources, aligning demand with supply, and enhancing organizational performance.

Optimization over production can lower manufacturing costs and increase order fulfillment percentages. The transportation problem in the Covid pandemic can be optimized using time window vehicle routing. Intelligent machine learning-based total productive maintenance approaches can achieve zero downtime in industrial machinery and reduce procurement risks and stock-outs.

Forecasting is the most starting activity of Supply Chain Management (SCM), indicating future value of interest for a given period. It influences customer needs and is an appropriate starting

point for SCM process optimization. However, supply chain volatility (SCV) is a significant challenge in SC management due to factors such as shorter product lifespans, longer production periods, more regulations, increasing competition, fluctuating raw material costs, and more.

The bullwhip effect is another type of SCM and demand volatility, where a small change in retail demand causes a larger change in demand farther up the supply chain. Information exchange across supply chain partners can improve prediction accuracy and supply chain performance. As globalization and market competition intensify, companies are encouraged to expand their business networks, moving away from local to increasingly complicated and dangerous supply chains. Seasonal changes in demand can have a significant impact on businesses' bottom line, leading to stockpiling and higher expenses.

Prediction techniques affect the reliability of forecasts, with time series methods like the simple moving average (SMA), exponential smoothing, and autoregressive integrated moving average (ARIMA) being the most common. Causal theories also consider external factors that affect predictions, emphasizing the importance of qualitative predictions for spotting information related to specific events and shifts in demand patterns that statistical algorithms miss.

Multiple regression models, econometric models, and multivariate autoregressive integrated moving averages (MARIMA) models are widely used forecasting methods. Supply chain management (SCM) is crucial for increasing organizational productivity and profitability. It involves calculating transportation costs, including outward and incoming trips, reverse logistics expenses, and information-sharing costs.

To optimize the supply chain, objective function combinations are chosen to measure supply chain efficiency by metrics such as profit, manufacturing costs, logistics and transportation costs, information sharing costs, and revenue. A fleet-selection-based optimization model for VRPTW was developed using evolutionary algorithms and the Generalized Approach (GA) approach. The model effectively solves transportation problems arising from the epidemic, maintaining consumer happiness and cutting travel time by 34.77 percent compared to direct transit. Other transportation management applications include JIT production, food service delivery, student transportation, and mail delivery.

Total Productive Maintenance with Machine Learning is essential for attaining zero downtime in Industry 4.0. This method integrates smart machine learning with Total Productive Maintenance (TPM), resulting in less waste, pollution, cost, and more uptime. The benefits of this method outweigh the challenges of complexity and cultural change, making it an attractive option.

A system for limiting supply-chain dangers and inventories was designed to take corrective action if a supplier fails to meet delivery deadlines. This system helps production and procurement planners manage and allocate tasks.

A model for improving manufacturing companies' track record of on-time shipment is also proposed. This model combines a business process model integrating product development and customer order administration processes with an integrated database containing fundamental information, transactional data, and practical applications for comprehensive planning within manufacturing companies. The event-driven process chain (EPC) method is used to determine delivery dates and times.

Methodology Development for Research That Measures Key Performance Indicators

a) STOCK VOLATILITY IN THE SUPPLY CHAIN
b) Seasonality
c) Globalisation
d) Data that changes quickly
e) Data Meaningfulness Existence
f) Probability of Success
g) Factor, human
h) Hardware and software

RECEIVING INFORMATION: Quantitative as a back-up, Qualitative as the mainstay

For the key performance indicator study, both primary and secondary data will be acquired from the company. The existing condition is described and understood with the use of secondary data like the prediction. To conduct the qualitative study, semi-structured interviews were conducted in addition to collecting financial records, documents, and current performances. In total, there were going to be three semi-structured interviews, spanning anything from 50 minutes to an hour. At the company, we conducted face-to-face interviews.

KPI Description in Research Context

Indicator: Biodigester

Company X now has the option, thanks to the biodigester, to generate energy from waste that was previously regarded as rubbish. The biodigester is a reactor used for anaerobic flotation. Upon being dumped into a tank, ice cream waste is decomposed by 24 billion naturally occurring microorganisms, which in turn generate biogas.

Utility Cost Key Performance Indicator

Along with materials, labor, and packaging, energy is needed throughout the ice cream production process. Utilities, in the lingo of Company X, refer to a person's combined use of gas, electricity, and water. Energy expenses account for a large portion of the overall indirect costs in the FMCG business because of the high energy consumption of production operations.

Metric: Productivity of Employees

Production per worker is the standard by which labor productivity is measured. Labor productivity is affected by a variety of factors, including the expertise of the personnel, the sophistication of the technology used, the efficiency with which the production process is organized and managed, and the state of the surrounding environment.

The Second Generation of the Non-Dominated Sorting Genetic Algorithm

The Non-Dominated Sorting Algorithm-II (NSGA-II) is an improved version of the original NSGA that provides a fast and exclusive multi-objective non-dominated sorting genetic algorithm without requiring the user to select the sharing partners in advance. Total operating costs, information sharing costs, profit, and revenue are only few of the supply chain aspects that may be optimized with the use of NSGA-II's detailed methodology and algorithm. At first, a very small population size is used, and as it expands, the proportion of nondominated solutions in the population is tracked at each step.

If the increase is below a certain percentage, it is not necessary to continue increasing the population.

Below is a summary of the actions required to complete NSGA-II:

1. An initial population, Pt, is formed at random, and a new population, Qt, is born from it.

2. The total size of the combined Pt and Qt population is 2N, where N is the original population size. Rt. describes this brand-new group of people.

3. The Rt population is subjected to a non-dominated sorting procedure in which every member is categorized and placed in a front.

4. From the parent population of the following generation, Pt+1, the top N individuals from Rt are chosen using the crowded tournament selection operator.

5. Iterations of steps 1-4 are performed until the end state is reached.

1.Model in mathematics:

This mathematical model characterizes the VRPTW problem and seeks to minimize penalties and transportation costs while adhering to constraints on vehicle capacity, time periods, and service hours. The objective is to pinpoint the most efficient vehicle routes for meeting the needs of customers.

The inflexibility of distributing trucks to customers under a fixed capacity fleet state is emphasized as a problem with the standard Capacitated Vehicle Routing Problem (CVRP) model. After looking at the numbers, we can see that the fixed capacity fleet is underperforming. With improved cost-effectiveness, higher occupancy rates, and streamlined transport management as primary aims, this research proposes a vehicle selection methodology to address this issue.

An algorithm for the model:

Order the list of customer requirements by decreasing size. Put the list of cars in order from most desired to least desired for each individual client. If none of the current options meet the customer's needs, you should add a vehicle with the highest capacity to the list. Use a GA on this fleet of vehicles to prioritize how to satisfy customers' wants and needs. In order to decrease the capacity of each vehicle, it is necessary to reselect them once the GA has chosen the best set of requests for each one.

The suggested system is unusual in that it takes Total Productive Maintenance (TPM) from its typical Industry 3.0 form and updates it to a TPM based on intelligent machine learning, as is required by Industry 4.0. This upgrade is planned to have no downtime and not need any substantial structural modifications. By studying the frequency with which breakdowns occur, it solves the problem of unanticipated failures that threaten Industry 3.0's goal of 100% uptime. The system monitors the characteristics of these failures, collects the essential data via sensors, and uploads it to the cloud for analysis.

the following is the methodology used:

1. Study of the existing literature concerning:

(a) Management and regulation of production;

(b) Controlling stock levels;

Aiming and tracking devices;

(b) The development and difficulties of systems for materials needs planning.

2. The creation of a theoretical framework characterizing a comprehensive materials management based on MRP principles. Its intended purpose is to provide a structure for the most Planning purchases ahead of time helps in making wiser choices and boosting efficiency characteristics and capabilities of the system that are being targeted.

3. Modelling and evaluating the possible outcomes requires a simulation, which we will design as well as the system's modifiability and malleability with respect to MRP parameters setting up policies.

4. Analysis of findings in light of their implications for jobs in management.

5. Evaluation of the Research Conducted and Proposed Future Research findings of the research

TIMELY MODEL FOR IMPROVEMENT

The suggested OTD improvement model (OTDM) is made up of two main parts: (i) a thorough business process model based on the event-driven process chain (EPC) methodology, and (ii) an integrated database with related applications. Product development process (PDP) and customer order management process (COMP) are just two of the many basic business processes incorporated into the business process model presented. Other processes, such as materials needs planning, capacity requirements planning, and manufacturing execution, are also included.

Functional applications for an integrated database are proposed to enhance OTD.

The suggested integrated model is a novel approach to MTO production because it establishes a connection between the product configuration stage (during sales order processing) and the component design stage (during product development and manufacturing execution). The suggested approach makes use of a database that features both relational and non-relational data structures. In this way, commitment work is distinctive from the processing of regular old sales orders.

DIFFERENCES AND DISPUTES:

There are certain important caveats to this study that should be taken into account for follow-up investigations. First, the study's narrow time frame and breadth prevented us from drawing any broad conclusions about its results. More insight into how prediction accuracy affects supply chain performance as a whole might be gained with the addition of other KPIs showing large

forecast-actual differences. In addition, the focus on labor productivity was restricted to just line two's results in week 18, which may have limited the picture painted of the full operating environment. A more holistic view might be gained by expanding the investigation to include many manufacturing lines and multiple time periods. In addition, there is a chance of bias due to the use of primary data gleaned via interviews. Concerns are also raised regarding the generalizability of findings to other business contexts given that Company X is a subsidiary of Company Y. Future research might investigate the nuances associated with various business sizes and organizational structures, lending credence to the present results. Finally, the study's ability to shed light on possible influences on forecast accuracy and performance is limited by the exclusion of external interactions within the supply chain beyond the bounds of Company X. Examining these external interactions may lead to a more comprehensive understanding of how forecast accuracy reverberates across the supply chain as a whole.

There are a number of caveats in this study that need to be addressed in order to pave the way for further investigation. Due to the short period and narrow focus of the study, we were only able to analyze three KPIs. A deeper understanding of the connection between accurate forecasts and efficient supply chains may be gained by broadening the scope of the analysis to include additional KPIs with large forecast-actual discrepancies.

Supply chain operations may be improved by focusing on the areas where the most research is needed and where the most debate occurs. Here are some major unanswered questions and debates:

Quantity and Quality of Available Data:

Lack: Accurate and timely data is essential for many supply chain optimization models. For smaller companies or when working with worldwide supply networks, however, data availability can present a considerable barrier.

It's still debatable whether or not the benefits of optimization are worth the time and effort required to acquire and manage high-quality data.

Predicting Future Needs:

Supply chain efficiency relies on accurate demand forecasting, yet inaccurate forecasts can have serious financial consequences.

Controversy: Forecasting methodology and forecasting granularity are two areas where opinions diverge. There is continuing discussion over which approach to choose and how to include uncertainty.

Controlling Stock:

Inconsistency: It is difficult to have just enough inventory on hand to fulfill demand without incurring excessive holding costs or running out of stock.

The debate over whether or not to keep a buffer stock vs using Just-in-Time (JIT) inventory management has been going on for some time. When it comes to inventory management, JIT reduces holding costs but might cause supply interruptions, whereas safety stock maintains availability but raises prices.

A Clear View of the Supply Chain:

Obtaining full visibility across international supply chains is difficult because of the many parties involved and the complexity of the operations involved.

Contentiousness: Privacy worries and the sharing of sensitive data among supply chain partners can reduce openness and hamper cooperation.

Environmental Impact and Long-Term Sustainability:

However, there is currently a lack of standardized methodologies and measurements for gauging environmental effect within the context of supply chain optimization.

Some sustainability measures may increase expenses in the near term, which raises questions about whether or not they are worth it in the grand scheme of things.

Controlling Danger:

Whether caused by weather or international tensions, disruptions in the supply chain are a major cause for concern. It might be difficult to recognize these threats and develop appropriate countermeasures.

There is some disagreement over how much risk should be factored into supply chain optimization models, as well as how to allocate probabilities and costs to various risk scenarios.

Science and engineering:

Despite the promise of cutting-edge tools like artificial intelligence (AI), the internet of things (IoT), and blockchain for supply chain efficiency, many companies struggle to put them into practice.

Still up for debate is how much human judgment should be replaced by machines in supply chain management and what effect it would have on the job market.

Compliance with Requirements:

Problem: It can be difficult for global supply chains to meet all of the requirements for compliance with international trade regulations.

Disagreement exists about how best to strike a balance between satisfying regulatory obligations and optimizing expenses.

Continuous research and collaboration between supply chain experts, researchers, and policymakers is necessary to address these gaps and disputes. As time goes on and technology develops, the ideal strategy for optimizing supply chains will shift.

Additionally, the COVID-19 pandemic presented unusual difficulties for transportation and logistics, and optimizing transportation at this time, particularly in the context of Time Window Vehicle Routing Problems (TWVRP), exposed particular holes and debates. Some unanswered questions and ongoing debates on how to best solve the transportation challenge during the epidemic are as follows.

Variability in Demand:

Demand for different products fluctuated greatly as a result of the epidemic, making accurate demand forecasting and route planning more difficult.

Disagreement arose about the best way to deal with fluctuating demand and evolving consumer needs in real time, with as little disturbance as possible.

Procedures to Ensure Everyone's Safety:

Contactless delivery and sanitation procedures are only two examples of how the implementation of health and safety rules for workers and clients has added limits and complexity.

Concerns were raised about how to strike a fair balance between worker and consumer security and the need for maximum productivity. Delivery times and prices might potentially be affected by strict safety procedures.

Problems in the Supply Chain:

Lockdowns, travel restrictions, and supplier difficulties all contributed to interruptions in the supply chain that reduced both available commodities and available transportation.

Disagreement arose about how to handle disruptions to maintain service levels and how to prioritize supply of vital commodities (such as medical supplies) over non-essential goods.

Algorithms for Optimizing Travel Paths:

Disconnect: In the midst of a pandemic, when both travel plans and consumer tastes are in flux, conventional route optimization methods may not be up to the task.

Some route optimization techniques may be computationally costly, therefore the decision of which algorithm to use and how often to re-optimize has been the topic of debate.

In addition, getting zero machine downtime in manufacturing requires a complicated implementation of a Total Productive Maintenance (TPM) strategy based on intelligent machine learning. There are a number of unanswered questions and contentious issues surrounding this endeavor. Some examples are as follows:

Quantity and Quality of Available Data:

Problem: Data, such as sensor readings, maintenance logs, and previous instances of downtime, are crucial to the success of machine learning-based TPM.

The collection and upkeep of high-quality data from a variety of sources may be difficult and expensive, which raises some eyebrows. There might also be worries about the safety and privacy of users' information.

Algorithm Selection and Tuning:

The ability to foresee machine breakdowns and optimize preventative maintenance programs relies heavily on the selection of appropriate machine learning algorithms and models.

Data scientists and engineers may not always agree on which algorithms are best for which pieces of equipment or which hyperparameters to optimize.

Maintenance Predictivity:

Currently, there is a significant knowledge gap when it comes to anticipating when machinery may break and scheduling necessary maintenance.

The controversy surrounds the difficulty of finding a happy medium between false alarms and missing failures. Extreme caution during upkeep may raise expenses without providing appreciable benefits in terms of decreased downtime.

Compatibility with Preexisting Infrastructure:

Problem: It can be difficult and expensive to upgrade existing industrial systems and processes to accommodate TPM solutions based on machine learning.

Disagreement might arise while trying to decide how to incorporate new technologies while keeping existing processes running smoothly and making sure that they are compatible with older systems.

Effective supply chain management also requires a well-thought-out plan to minimize stock-outs and hazards associated with purchasing goods. However, there are holes and debates in putting these mechanisms into action. Here are some of the questions and debates that have been raised:

The Availability and Quality of Data:

Lack: For a well-functioning system, up-to-date and precise information about demand, supplier efficiency, and stock levels is essential.

Data enhancement activities may be costly, and companies may question whether or not the advantages outweigh the expenses when it comes to ensuring data quality and availability.

Predicting Future Needs:

Over- or under-ordering due to inaccurate demand forecasts is a common problem in procurement.

Disagreement might arise over issues such as which forecasting methodologies and models to use and how much detail to include in projections.

Management of Supplier Relationships:

Disconnect: If you want to reduce the dangers associated with purchasing, you need to build and maintain solid connections with your suppliers.

Long-term supplier partnerships may be beneficial, but there are trade-offs to consider. These include less flexibility and more reliance on a single provider.

In addition, effective supply chain management necessitates the creation of a streamlined system for minimizing procurement risks and stock-outs. However, there are holes and debates in putting these mechanisms into action. Here are some of the questions and debates that have been raised:

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CRITICAL REVIEW OF METHOD

1. Plan of Study:

A single-case study was an acceptable method for this investigation since it allowed researchers to focus on one firm in the fast-moving consumer goods (FMCG) sector. However, the results cannot be extrapolated to the entire sector due to the study's methodology.

2. Sampling:

The corporation used as an example should have had stronger supporting evidence. Knowing the rationale behind the selection of this particular firm and the extent to which it is indicative of the whole FMCG sector is crucial.

3. Information Gathering:

Interviews and document analysis were just two of the data gathering procedures that were fully covered in the research. More information on the methods used to assure the accuracy and integrity of the data would have been helpful.

4. Analysis of Data:

The qualitative methods used in the study were ideal for delving into the intricate web of connections between forecast precision and supply chain efficiency. However, clarity may have been improved with a more thorough description of the analytical methodology.

5. Validity:

The correlation between accurate forecasts and supply chain performance was investigated thoroughly within the context of the selected case study. However, as it was a one-off study, generalizability cannot be shown.

6. Reliability:

Critical to ensuring that the findings can be repeated in comparable situations, the question of dependability was not addressed in the study.

7. Concerns of a Moral Nature:

Ethical aspects, such as gaining informed permission from participants and protecting the confidentiality of data, should have been further upon in the study.

8. Issues of Bias and Confounding:

Lack of discussion of steps taken to limit bias or account for confounding variables may reduce confidence in the results.

9. Timeframe:

The report did not say how long it took to acquire the data. This is significant because the effect that accurate forecasts have on supply chain efficiency might shift over time.

10. Structure of Theory:

- The study does not provide the theoretical foundations upon which it was built. For the research's context and goals to make sense, a solid theoretical basis is required.

11. Implications for Daily Life:

The significance of accurate forecasts to supply chain performance is effectively brought forth in this study. However, it does not go far enough in giving other FMCG businesses with meaningful data or recommendations.

12. Limitations:

However, the study may have done a better job of finding other possible constraints, such as selection bias or the influence of external circumstances, despite its admission that the single-case approach had its drawbacks.

13. Suggestions for Additional Study:

In order to better understand how this link develops over time and among different FMCG firms, the study may have benefited by identifying future research paths.

It is unclear how the algorithm works or whether it is effective in optimizing supply chain costs, but "Optimization of End-to-end Supply Chain Costs to Maximize Revenue and Profits From Supply Chain Operations" provides a methodology and algorithm to optimize supply chain entities like total operating costs, information sharing, profit, revenue, and logistics costs.

Less information was provided on the study's research methodology, sample size, sampling process, and restrictions, all of which might have an impact on the study's validity and reliability.

A genetic algorithm (GA) is proposed in the paper "Optimization of the Transportation Problem in the COVID Pandemic with Time Window Vehicle Routing Problem" to optimize the vehicle routing problem with time windows (VRPTW) in order to address the transportation problem that arose during the COVID-19 pandemic.

Pros:

a) The problem is defined, and the goal is specified: improve transportation during the COVID-19 pandemic by optimizing the VRPTW.

b) Invokes a GA, a tried and true optimization approach, to propose a process for improving the VRPTW.

c) The results, which demonstrate that the suggested technique may address the transportation challenge during the COVID-19 pandemic, are well explained.

Cons:

a) Not enough information is provided to determine whether or not this study employed a quantitative or qualitative technique for data collection and analysis.

b) Lacks details about the study's sample size and method of sampling.

c) Does not discuss the constraints of the study that may have compromised the accuracy of the results.

To that end, "Intelligent machine learning based total productive maintenance approach for achieving zero downtime in industrial machinery" suggests a maintenance strategy that use machine learning to reach this goal.

Pros:

a) Clearly defines the issue at hand and the desired outcome: machine learning-enabled maintenance-free operation of all factory machinery.

b) Methodology proposed using machine learning to maximize uptime of industrial machines and minimize maintenance needs.
c)
d) The results, which demonstrate that the suggested approach may achieve 100% uptime in industrial machinery, are explained in detail.

Cons:

a) Not enough information is provided to determine whether or not this study employed a quantitative or qualitative technique for data collection and analysis.
b) Lacks details about the study's sample size and method of sampling.
c)
d) Does not discuss the constraints of the study that may have compromised the accuracy of the results.

Additionally, a simulated case study is proposed in "An Optimized System to Reduce Procurement Risks and Stock-Outs" to help a component manufacturer lessen the likelihood of stock-outs.

Pros:

a) Clearly defines the issue at hand and sets out to solve it by minimizing supply chain disruptions and out-of-stocks.

b) This paper proposes an approach for improving procurement planning and decreasing risks and stock-outs through the use of a simulated case study.

c) Results are clearly explained, demonstrating that the suggested technique may mitigate procurement risks and prevent stock-outs.

Cons:

a) Not enough information is provided to determine whether or not this study employed a quantitative or qualitative technique for data collection and analysis.

b) Lacks details about the study's sample size and method of sampling.

c) Does not discuss the constraints of the study that may have compromised the accuracy of the results.

A methodology is proposed in "An On-Time Delivery Improvement Model for Manufacturing Organizations" to enhance OTD in make-to-order (MTO) factories.

Pros:

a) Clearly defines the issue at hand and sets out to solve it: MTO manufacturers need to increase their percentage of on-time shipments.

b) This paper proposes an approach for improving procurement planning and decreasing risks and stock-outs through the use of a simulated case study.

c) Results are clearly explained, demonstrating that the suggested technique can enhance MTO manufacturing firms' ability to meet their on-time delivery targets.

Cons:

a) Not enough information is provided to determine whether or not this study employed a quantitative or qualitative technique for data collection and analysis.

b) Lacks details about the study's sample size and method of sampling.

c) Does not discuss the constraints of the study that may have compromised the accuracy of the results.

3.5 Research Methodology

Introduction

Optimizing Supply Chain Performance through Strategic Operations and Aggressive Function Integration

In the realm of contemporary business, the efficacy of operations and the integration of multifunctional aspects play a pivotal role in determining an organization's success. This chapter delves into the intricate fabric of research methodology employed to assess the profound impact of Sales and Operations Planning (S&OP) on the overarching performance of an organization's supply chain. The core tenets of this research rest on three key pillars: the aggressive interconnection of diverse functions, the seamless integration of these functions across the organization, and the judicious use of tools and techniques to unlock the full potential of these operations.

Aggressive Integration of Multiple Functions

In the pursuit of operational excellence, a cohesive blend of various functions within an organization becomes indispensable. From procurement and production to distribution and marketing, every function is a vital cog in the intricate machinery of supply chain management. The research methodology adopted for this study meticulously acknowledges this interconnectedness. By recognizing the symbiotic relationship between these functions, this study seeks to uncover the synergistic advantages that can be harnessed when they work harmoniously.

Interconnectedness Across Functions

Central to this research methodology is the endeavour to establish seamless connectivity across all functions. This holistic approach envisions the supply chain as an integrated entity where each function informs and influences the others. This interconnectivity ensures that information flows smoothly, decisions are well-informed, and the supply chain operates as a well-synchronized system rather than a collection of isolated components.

Tools and Techniques for Optimization

In the pursuit of enhancing supply chain performance, a strategic arsenal of tools and techniques is indispensable. This research methodology ventures into the realm of optimization through the application of several powerful tools.

Forecasting with Pattern-Based Modelling Techniques: The methodology embraces advanced forecasting techniques such as single, double, and triple exponential smoothing, weighted moving averages, and multiple regression. These tools enable a more accurate prediction of future demand patterns, thereby leading to improved revenue and profit margins.

Optimization Over Production and Order Fulfilment: Through linear optimization and mixed integer programming, the study aims to minimize production costs while concurrently improving order fulfilment percentages. This holistic approach strives for the fine balance between efficiency and customer satisfaction.

Transportation Optimization for On-Time Delivery: Employing optimization techniques, the research methodology aims to streamline transportation operations, reducing costs and delivery times. This optimization seeks to enhance the percentage of on-time deliveries, a critical factor in ensuring customer loyalty.

Maximizing Efficiency, Minimizing Unplanned Shutdowns: The study delves into minimizing unplanned shutdowns in production, thereby optimizing efficiency and augmenting on-time delivery rates. By ensuring smoother operations, the methodology directly contributes to the overall supply chain performance.

Balancing Stocks to Optimize Profit Margins: Through meticulous optimization, the research methodology endeavours to strike a balance between overstocks and stockouts, leading to improved revenue and profit margins.

Supplier Collaboration for On-Time Delivery: By emphasizing maximum on-time delivery from suppliers, the methodology ensures a consistent flow of materials, minimizing disruptions and enhancing the overall supply chain's effectiveness.

Data Analysis Tools and Techniques

A significant cornerstone of this research methodology lies in the adept utilization of various data analysis tools and techniques to extract meaningful insights.

Excel for Forecasting: The research methodology capitalizes on Excel's analytical prowess, employing forecasting techniques like single, double, and triple exponential smoothing, as well as weighted moving averages and multiple regression for more accurate demand predictions.

Optimization through Excel Solver: Linear optimization and mixed integer programming find their implementation through Excel Solver, enabling efficient production cost minimization and improved order fulfilment.

Simulation via Monte Carlo-Simulation: To gain insights into complex scenarios, the methodology employs Monte Carlo simulation, aiding in understanding the impact of uncertain variables on the supply chain's performance.

Power BI for Visualization: Leveraging the power of data visualization, Power BI assists in translating intricate data into comprehensible insights, facilitating informed decision-making.

In conclusion, this research methodology embarks on a journey to explore the interplay between aggressive function integration, seamless cross-functional connectivity, and strategic tool application within the context of Sales and Operations Planning. By embracing multifaceted optimization techniques and robust data analysis tools, this methodology endeavours to unlock the full potential of an organization's supply chain, ultimately enhancing its performance and fortifying its position in the competitive landscape.

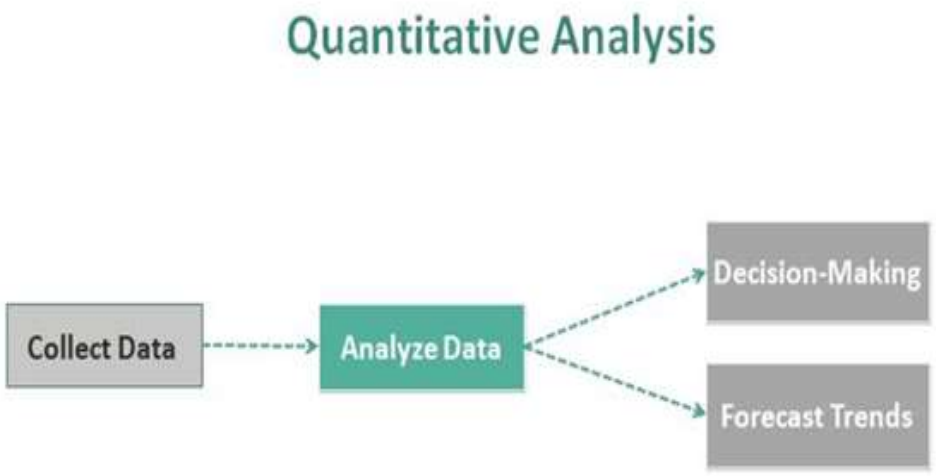
Research Approach

A Comprehensive Research Approach for Unveiling the Impact of Sales and Operation Planning on Supply Chain Performance

In the intricate landscape of modern supply chain management, the research project titled "Impact of sales and operation planning on the overall performance of the supply chain of r-pac Bangladesh Ltd" stands as a strategic endeavour that necessitates an approach capable of addressing multifaceted research objectives while navigating the complexities inherent to this dynamic realm. A meticulously crafted mixed-methods research approach emerges as the optimal methodology, adeptly integrating quantitative analysis, optimization modelling, qualitative insights, and a continuous improvement framework.

3.1.1 Quantitative Analysis and Modelling:

At the core of this approach lies the instrumental role of quantitative analysis, serving as a robust vehicle for gaining empirical insights into the intricate relationships intertwining sales and operation planning with supply chain performance metrics within r-pac Bangladesh Ltd. By harnessing historical data, this research embarks on a statistical odyssey to meticulously assess the accuracy of forecasting methods. Through the deployment of pattern-based modelling techniques, the terrain of future demand is navigated with heightened precision, thereby setting a stage conducive to informed decision-making. In its quest to quantify the effects of sales and operation planning, this phase delves into scrutinizing revenue, profit margins, production costs, order fulfilment percentages, transportation costs, and the timeliness of deliveries, all converging to shape a tangible and measurable evaluation of their impact within the context of r-pac Bangladesh Ltd.



Quantitative Analysis and Modelling: Unveiling Insights for Enhanced Supply Chain Performance

At the heart of the research approach for investigating the "Impact of Sales and Operation Planning on the Overall Performance of the Supply Chain" within r-pac Bangladesh Ltd, lies the pivotal role of quantitative analysis. This analytical powerhouse serves as a robust vehicle, propelling the quest to illuminate the intricate relationships that entwine sales and operation

planning with the metrics that define supply chain performance. With unwavering precision, this phase endeavours to unveil empirical insights, offering a data-driven journey into the depths of how sales and operation planning resonate throughout the dynamic ecosystem of r-pac Bangladesh Ltd.

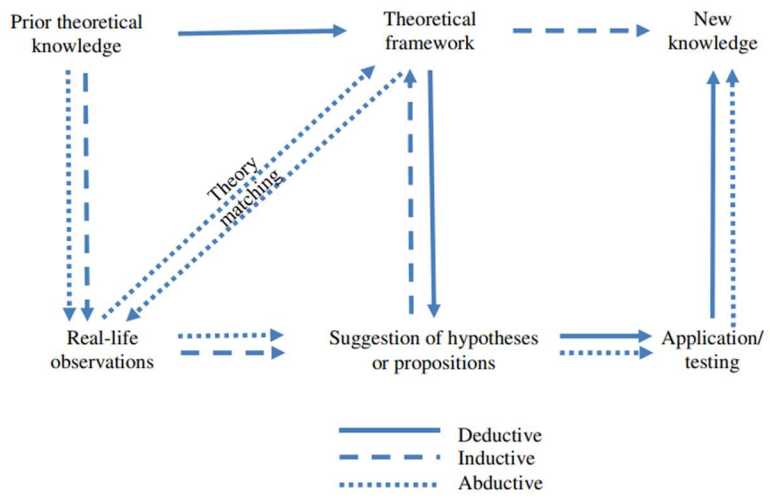
Harnessing Historical Data:

The cornerstone of this endeavour involves harnessing the rich tapestry of historical data. Within this trove lie the clues to understand the dynamics between sales and operation planning and various facets of supply chain performance. By delving into historical data encompassing r-pac Bangladesh Ltd's forecasting accuracy, revenue streams, profit margins, production costs, order fulfilment percentages, transportation costs, on-time delivery records, and the occurrences of unplanned shutdowns, a comprehensive canvas emerges.

Navigating the Future with Pattern-Based Modelling:

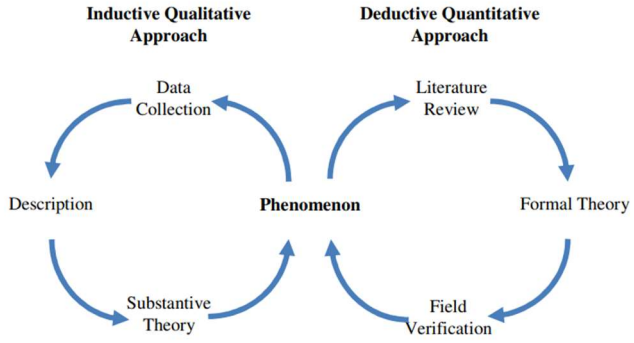
Armed with historical data, the research embarks on a statistical odyssey that navigates the intricacies of the future. Pattern-based modeling techniques form the compass that guides this journey. These techniques decipher the subtle patterns and trends etched within the data, allowing for the prediction of future demand with unprecedented precision. As the research maps the trajectory of demand, it lays the groundwork for informed decision-making that holds the potential to reshape supply chain strategies.

Inductive research uses specific observations and patterns to come up with new theories. On the other hand, deductive research starts with a theory or hypothesis and tests it through observations.



Source: Adapted from Spens and Kovács (2006)

Figure 3-1: Deduction, Induction and Abduction Research Approaches



Source: Golicic et al. (2005)

Figure 3-2: The Balanced Approach Model

The Balanced Approach Model, proposed by Golicic et al. in 2005, is a supply chain management framework that emphasizes the importance of balancing various elements within a supply chain to enhance overall performance. It consists of eight key components like:

Customer Focus: Focus on learning about and fulfilling consumer needs.

Internal Integration: Promote collaboration and coordination within the organization.

External Integration: Foster collaboration with external supply chain partners.

Strategic Alignment: Ensure that supply chain strategies align with broader corporate objectives.

Performance Measurement: Use metrics and KPIs to assess supply chain performance.

Process Management: Establish efficient supply chain processes.

Technology Utilization: Leverage technology and information systems for better decision-making.

Continuous Improvement: Maintain a commitment to ongoing enhancement of supply chain operations.

By addressing these components, organizations can create a responsive, efficient, and customer-focused supply chain that aligns with strategic goals and continuously improves its performance.

Quantifying the Impact:

The crux of this quantitative phase centers on quantifying the effects of sales and operation planning on r-pac Bangladesh Ltd's supply chain performance. With laser-focused scrutiny, the research probes not one, but six core objectives, each reflecting a distinct facet of supply chain excellence:

Forecasting Accuracy Enhancement: Utilize historical sales and demand data to apply pattern-based modelling techniques. Implement methods like single exponential smoothing, double exponential smoothing, triple exponential smoothing, weighted moving averages, and multiple regression. These techniques will help identify patterns, trends, and relationships within the data, ultimately improving the accuracy of demand forecasting. By aligning forecasted demand more closely with actual customer needs, this objective aims to enhance earned revenue and profit margins. Machine learning techniques can learn from historical data and make predictions without being explicitly programmed to do so.

Optimized Production: Apply linear optimization using Excel's Solver tool to analyze production processes. Identify bottlenecks and allocate resources efficiently to minimize production costs. Through optimization modeling, the research can determine the optimal production schedule and resource allocation that not only reduces costs but also improves order fulfilment percentages. This data-driven approach ensures a lean and efficient production process. We can also use linear programming, mixed integer programming, or other optimization techniques to minimize the cost of production while meeting demand requirements. Linear programming is a mathematical method for solving problems with a set of linear constraints and an objective

function that is to be minimized or maximized. Mixed integer programming is a generalization of linear programming that allows for some variables to be integers.

Streamlined Transportation: Continue to leverage Excel's Solver tool for optimization, this time focusing on transportation routes. Analyze historical transportation data to identify cost-effective and efficient routes. We can use transportation models to minimize the cost of transportation while meeting delivery deadlines based on various factors, such as the distance between the origin and destination, the cost of transportation, and the time required for delivery. By minimizing transportation costs and optimizing routes, the research can elevate on-time delivery in full percentages. This data-driven approach streamlines transportation logistics, reducing costs and improving customer satisfaction through timely deliveries.

Maximized Production Efficiency: Employ optimization modelling to address unplanned shutdowns. Analyze historical production data to identify the causes of shutdowns and inefficiencies. By optimizing production processes, resource allocation, and maintenance schedules, the research aims to maximize production efficiency. The outcome is a supply chain poised for higher on-time delivery performance due to reduced disruptions.

Effective Inventory Management: Utilize optimization strategies to manage inventory effectively. Analyze historical inventory data to determine optimal stock levels. By employing inventory optimization models, the research can strike a balance between overstocks and stockouts. This data-driven approach ensures that inventory is efficiently managed, reducing costs, and improving revenue and profit margins.

Supplier Delivery Excellence: Leverage quantitative analysis to optimize supplier interactions. Analyze historical supplier performance data to identify areas for improvement. By implementing data-driven strategies, such as performance scorecards and supplier relationship management, the research aims to maximize on-time delivery in full percentages from suppliers. This approach ensures a consistent and reliable flow of materials into the supply chain.

As the research manoeuvres through these six objectives, it scrutinizes revenue, profit margins, production costs, order fulfilment percentages, transportation costs, and the timely coordinating of deliveries. These variables collectively forge a tangible and quantifiable evaluation of the overarching impact of sales and operation planning within the context of r-pac Bangladesh Ltd.

In essence, quantitative analysis and modelling provide the research with a powerful set of tools to address each of the six objectives systematically. By harnessing historical data and employing various analytical techniques, the research aims to optimize forecasting accuracy, production

efficiency, transportation logistics, inventory management, and supplier interactions within r-pac Bangladesh Ltd. This data-driven approach not only enhances supply chain performance but also contributes to improved revenue, profit margins, and customer satisfaction.

Optimization Modelling:

Within the panorama of supply chain performance at r-pac Bangladesh Ltd, complexities often intertwine, presenting a puzzle that optimization modelling is uniquely poised to decipher. By meticulously dissecting the intricacies of production processes and skillfully identifying bottlenecks, the research gains a vantage point from which to efficiently allocate resources, resulting in a minimization of production costs alongside an elevation in order fulfilment percentages. The elegance of optimization extends its embrace to the domain of transportation, wherein routes are thoughtfully optimized, birthing reductions in costs and an elevation in on-time delivery metrics. This phase further explores the realm of unplanned shutdowns, employing optimization to harness enhanced production efficiency and reinforce on-time delivery performance within the specific context of r-pac Bangladesh Ltd. In essence, this phase signifies the project's commitment to elevating the realm of supply chain performance through strategic and data-driven decision-making tailored to the company's environment.

Forecasting Accuracy Enhancement

Within the realm of forecasting, optimization modelling can be applied to identify the most suitable forecasting methods and parameters. By analyzing historical data and employing pattern-based modelling techniques, the research can determine the optimal combination that enhances forecasting accuracy. The quantitative analysis derived from optimization aids in making data-driven decisions, ultimately improving earned revenue and profit margins.

Elevating Order Fulfilment:

The impact doesn't halt at cost containment; it transcends to order fulfilment percentages. Optimization modelling, akin to a conductor orchestrating a symphony, fine-tunes the allocation of resources to elevate order fulfilment metrics. The result is a well-choreographed dance of resources that ensures customer orders are not only fulfilled but surpassed, setting the stage for heightened customer satisfaction and loyalty.

Streamlined Transportation

Transportation logistics can be optimized using mathematical modelling techniques. By analyzing historical transportation data and considering various constraints, optimization modelling can identify cost-effective routes and schedules. This results in reduced transportation costs and improved on-time delivery metrics. The research ensures that transportation aligns with the overarching objective of enhancing supply chain performance.

Amplifying Production Efficiency:

The research may help for Optimization modelling is instrumental in mitigating unplanned shutdowns. By optimizing production processes, vulnerabilities that lead to unplanned shutdowns can be addressed. Through efficient resource allocation and process optimization, production efficiency is maximized. This not only minimizes disruptions but also reinforces on-time delivery performance.

Customizing Inventory Optimization to r-pac Bangladesh Ltd:

This phase of the research deals with Inventory management can be optimized using mathematical modelling. Historical inventory data is analyzed to determine optimal stock levels and reorder points. Optimization modelling ensures that the right balance is struck between overstocking and stockouts, leading to improved revenue and profit margins. This data-driven approach enhances inventory management.

A Commitment to Elevating Supply Chain Performance:

In essence, Optimization modelling can be employed to optimize supplier interactions. Historical supplier performance data is analyzed, and mathematical optimization techniques are applied to enhance supplier deliveries. This includes optimizing order quantities, delivery schedules, and supplier relationships to maximize on-time delivery from suppliers. This phase isn't just about analysis; it's about transformation, efficiency, and a resilient commitment to steering the supply chain toward a future of enhanced revenue, profit margins, and customer satisfaction.

Qualitative Analysis:

Beyond the structured quantitative framework lies the qualitative expanse where the voices of key stakeholders at r-pac Bangladesh Ltd resonate, infusing the research with a human dimension that numbers alone cannot capture. Interviews, surveys, and observations coalesce to illuminate the challenges, barriers, and opportunities intrinsic to the labyrinthine world of sales and operation planning within the company. These qualitative insights traverse the landscape of stock

levels, stockouts, and supplier performance, enriching the research with narratives that emanate from real-world experiences within r-pac Bangladesh Ltd. As a vital counterbalance, this qualitative stratum furnishes depth and nuance, bridging the gap between empirical findings and the lived realities of those engaged in the supply chain processes of the company.

Continuous Improvement and Evaluation:

As the culmination of this comprehensive research approach within r-pac Bangladesh Ltd, the concept of continuous improvement takes center stage. The implementation of proposed strategies ushers in a phase that extends beyond conventional conclusions. Here, vigilant monitoring and meticulous evaluation become guiding principles, steering the project through an iterative process that fine-tunes strategies and fosters adaptation within the unique landscape of the company. This adaptive framework ensures that the research not only dwells in the theoretical realms but actively contributes to the tangible enhancement of supply chain performance within r-pac Bangladesh Ltd. The research's conclusions metamorphose into a catalytic force for change, fuelling a perpetual cycle of improvement that resonates through the supply chain ecosystem of the company.

In summation, the proposed research approach masterfully coordinating a symphony of investigation, synthesizing multiple dimensions to illuminate the intricate interplay between sales and operation planning and supply chain performance within the specific context of r-pac Bangladesh Ltd. This approach harmonizes the empirical Vigor of quantitative analysis, the strategic prowess of optimization modelling, and the qualitative depth of stakeholder insights. As the supply chain ecosystem evolves under the influence of the research's outcomes, the symbiotic relationship between sales and operation planning and overall performance comes into sharper focus within the company's environment. Through rigor, data-driven decision-making, and an unwavering commitment to perpetual improvement, this research approach pledges to uncover not only insights but also to chart a course toward an optimized, responsive, and thriving supply chain ecosystem tailored to the unique dynamics of r-pac Bangladesh Ltd

Data Collection Methods

Comprehensive Data Collection Methods for Analyzing the Impact of Sales and Operation Planning on Supply Chain Performance

To rigorously investigate the multifaceted impact of sales and operation planning on the overall performance of the supply chain, a comprehensive set of data collection methods has been meticulously designed. These methods align with the six core objectives: forecasting accuracy enhancement, optimized production, streamlined transportation, minimized unplanned shutdowns, effective inventory management, and maximized on-time supplier delivery.

Quantitative Data Collection Methods:

1. Historical Data Analysis:

Collecting a wealth of historical data related to forecasting accuracy, revenue, profit margins, production costs, order fulfilment percentages, transportation costs, on-time delivery, shutdown occurrences, stock levels, and supplier performance forms the cornerstone of quantitative analysis. This invaluable data can be meticulously extracted from the organization's internal records, databases, and financial reports.

2. Surveys:

The deployment of surveys becomes a conduit for quantitative insights from key stakeholders, including employees, customers, and suppliers. The surveys will strategically focus on the six objectives, gathering quantitative data on each. Questions will revolve around forecasting accuracy, production costs, transportation efficiency, on-time delivery metrics, shutdown occurrences, and inventory levels. This systematic approach ensures data collection from diverse perspectives.

3. Statistical Analysis:

Applying statistical techniques, including regression analysis, correlation analysis, and hypothesis testing, unlocks hidden relationships within the collected quantitative data. These analyses delve into the core objectives, unveiling connections between sales and operation planning and supply chain performance metrics. This exploration of patterns and correlations generates insights that steer the project toward informed conclusions.

Qualitative Data Collection Methods:

1. Interviews:

Conducting insightful interviews with pivotal stakeholders closely engaged in sales and operation planning yields qualitative depth. These interviews will encompass employees overseeing forecasting, production, transportation, inventory management, and supplier interactions. By probing their experiences and perspectives, the qualitative data collected unveils challenges, barriers, and opportunities linked to each objective.

2. Observations:

A qualitative immersion into the operational intricacies involves observing the sales and operation planning process and production activities. This on-ground engagement affords insights into operational dynamics and identifies areas primed for improvement. Observations during forecasting meetings, production processes, transportation activities, and supplier interactions will provide nuanced insights.

3. Focus Groups:

To foster a collaborative atmosphere, focus group discussions will assemble employees from diverse departments engaged in sales and operation planning. These interactive sessions delve into the six objectives, inviting open discourse about current processes' efficacy, potential improvements, and viable strategies for augmenting supply chain performance.

Case Studies:

1. Analyzing Effective Strategies:

Case studies of organizations that have successfully implemented impactful sales and operation planning strategies illuminate best practices. These case studies become rich sources of insights and provide benchmarks for assessing the study's findings.

2. Comparative Case Studies:

Selecting organizations with varying approaches to sales and operation planning offers a comparative lens. By evaluating performance metrics concerning each of the six objectives, this analysis discerns strategies that yield success and highlights areas for enhancement.

Data Analysis and Reporting:

Once the comprehensive data collection phase is completed, a rigorous analysis ensues, employing both quantitative and qualitative techniques. Quantitative data undergoes statistical scrutiny, revealing trends and correlations. Qualitative data is analyzed for common themes,

challenges, and opportunities across the objectives. A detailed report then synthesizes the findings, aligning them with the original project objectives. Recommendations are strategically formulated based on the insights gleaned from the data, offering a roadmap to enhance forecasting accuracy, production efficiency, transportation optimization, shutdown management, inventory control, and supplier relations.

Through the synergistic integration of quantitative and qualitative data collection methods, this study holistically investigates the profound impact of sales and operation planning on supply chain performance. The subsequent analysis and reporting stages distil actionable insights, guiding the optimization of revenue, profit margins, on-time delivery, and customer satisfaction across the intricate tapestry of the supply chain ecosystem.

Data Analysis Tools & Techniques

In the pursuit of unravelling the intricate dynamics underlying the "Impact of Sales and Operation Planning on the Overall Performance of the Supply Chain," this study employs a carefully curated arsenal of data analysis tools and techniques. These methodologies synergistically contribute to the investigation's core objectives by illuminating patterns, extracting insights, and facilitating informed decision-making. The research harnesses the power of Excel for forecasting, optimization through linear programming and mixed integer programming, simulation via Monte Carlo simulation, and visualization using Power BI.

1. Excel for Forecasting:

Excel emerges as a versatile and foundational tool for forecasting within the study. This platform hosts an array of quantitative methods that delve into historical data to predict future trends. The following techniques will be employed:

I. Single Exponential Smoothing: This technique, geared towards time series data, accentuates recent observations while progressively diminishing the significance of older data points. It enables the study to predict future demand by acknowledging recent trends.

II. Double Exponential Smoothing: Building upon single exponential smoothing, double exponential smoothing incorporates trends to enhance prediction accuracy. It captures both linear and exponential growth patterns, contributing to a refined forecast.

III. Triple Exponential Smoothing: As a more intricate sibling of double exponential smoothing, triple exponential smoothing accommodates seasonality alongside trends. This methodology suits scenarios where both cyclic and linear patterns coexist.

IV. Weighted Moving Average: By assigning varying weights to historical data points, this technique can adapt to evolving scenarios. It mitigates the impact of outliers and offers a well-rounded prediction based on historical trends.

V. Multiple Regression: This sophisticated technique delves into multivariable relationships, accounting for various factors that could influence demand. Through regression analysis, the study will uncover correlations that inform a more comprehensive forecasting model.

2. Optimization:

The study embraces the power of optimization techniques to fine-tune decision-making processes and strategic choices, ensuring the supply chain operates at peak efficiency.

I. Linear Optimization using Solver (Excel): Linear programming becomes a guiding compass, enabling the study to optimize production costs and enhance order fulfilment percentages. By factoring in constraints and objectives, this technique identifies the most efficient allocation of resources within the constraints.

I. **Mixed Integer Programming using Solver (Excel):** Mixed integer programming extends the capabilities of linear optimization by accommodating discrete decision variables. This technique allows for the incorporation of integer-based decisions within the optimization process.

3. Simulation:

Monte Carlo simulation serves as a powerful tool to explore potential scenarios and their implications on supply chain performance. This technique employs random sampling to generate a range of possible outcomes, enabling the study to gauge the impact of different variables on the supply chain's behaviour.

4. Visualization:

The study recognizes the potency of visualization as a tool for enhancing comprehension and insight extraction.

I. Power BI: Power BI emerges as the canvas upon which data transforms into visual narratives. It fuses data from various sources into interactive dashboards and reports, enabling the study to communicate findings effectively. Visualizations such as charts, graphs, and heatmaps unveil trends, correlations, and anomalies, thereby facilitating strategic understanding and decision-making.

In conclusion, this study's data analysis tools and techniques stand as a bridge between raw data and actionable insights. By integrating Excel-based forecasting, optimization modelling, Monte Carlo simulation, and Power BI visualization, the study crafts a holistic approach that not only delves into the study's objectives but also empowers strategic decision-making within the realm of supply chain performance optimization.

3.6 Proposed Solutions

Challenges in Sales-Supply Chain Coordination

Effective communication between sales and supply chain teams is crucial for avoiding ineffective communication and potential stockouts. To improve collaboration, regular meetings, collaborative tools, and data sharing platforms can be implemented.

Sales and operation planning (S&OP) can also be explored to align sales and supply chain functions. Regular meetings allow for direct communication and collaboration, while collaborative tools like project management software, shared document repositories, and communication platforms facilitate real-time information exchange.

Establishing communication channels and providing cross-functional training can help employees understand each other's roles, challenges, and priorities, fostering better communication and collaboration. To overcome conflicting priorities between sales and supply chain teams, cross-functional teams should be formed to set objectives and make decisions considering both sales targets and operational capabilities. Implementing measures such as creating cross-functional teams, improving communication, aligning incentives and performance metrics, and providing cross-functional training programs can help employees understand each other's roles, challenges, and priorities. Sales and operation planning plays a vital role in the coordination of production schedules, inventory control, and sales forecasting.

The effectiveness of S&OP includes pattern-based modeling for demand forecasting, optimization techniques, mitigation of unplanned shutdowns, proficient inventory management, and effective supplier relationship management.

Measuring challenges and their causes is essential for improving supply chain performance. Key metrics include forecasting, production optimization, transportation optimization, minimizing unplanned shutdowns, inventory management, and supplier delivery reliability. Root cause analysis involves analyzing data accuracy, model complexity, and external influences, while external factors such as economic trends, market shifts, geopolitical events, regulatory changes, and supplier-related disruptions can also influence challenges and their causes. By systematically measuring and understanding these factors, businesses can improve their supply chain performance and reduce disruptions.

Proposes solution – 1

Solution: Better Communication for Stronger Supply Chain

- Regular meetings between sales and supply chain teams to discuss customer demand, market trends, and sales predictions

- Use team tools such as project software and file sharing to quickly share updates and data
- Utilize data sharing tools to allow both teams to access sales numbers, inventory levels, customer feedback, and market information
- Establish clear communication channels and rules for discussing important topics like demand and sales

- Provide training for sales and supply chain teams to understand each other's roles and responsibilities
- Benefits include reduced confusion, smarter decision-making, faster response to customer demands, improved teamwork, and increased customer satisfaction
- Implementation steps include assessing current communication methods, selecting appropriate tools, conducting joint training sessions, setting communication rules, scheduling regular meetings, implementing data sharing tools, and monitoring progress regularly.

Proposed solution – 2

Proposed Solution: Coordinated Cross-Functional Teams

- Cross-functional teams bring together members from sales and supply chain departments to enhance overall supply chain performance.
- Joint objective setting ensures that sales goals and supply chain constraints are considered in decision-making.
- Aligning performance metrics and incentives encourages collaboration between sales and supply chain teams.
- Regular communication channels foster transparency and understanding between teams.
- Establishing a sense of shared responsibility for supply chain outcomes promotes seamless operations and customer satisfaction.
- Benefits of cross-functional collaboration include harmonized priorities, holistic decision-making, optimal resource allocation, a collaborative culture, enhanced adaptability, and higher efficiency.
- Implementation steps include team formation, goal definition, performance alignment, communication channels, collaboration tools, ownership cultivation, and regular check-ins.

Proposed Solution 3:

Scenario Planning and Risk Management:

- Implementing scenario planning and robust risk management strategies
- Using scenario planning and sensitivity analysis to create and test multiple demand forecasts
- Conducting risk analysis to identify potential risks and develop mitigation strategies
- Analyzing supply chain disruptions, transportation delays, and production shutdowns using root cause analysis
- Applying optimization techniques to production and transportation to minimize costs and improve order fulfillment percentages
- Establishing cross-functional teams to align priorities and make decisions

- Minimizing unplanned shutdowns through preventive maintenance programs and regular inspections
- Optimizing inventory levels to minimize overstocks and stockouts and improve revenue and profit margins
- Using demand forecasting models and pattern-based modeling techniques to accurately predict future demand and adjust inventory levels accordingly.

Proposed Solution 4

Production cost optimization using mixed integer programming

- Authors collected data from an underground mining operation to develop a mathematical programming model for production scheduling.
- Input data includes information on stopes, ore grades, tonnages, cash flows, mining sequence constraints, operational constraints, and the objective function of maximizing net present value (NPV).
- Mixed Integer Programming (MIP) is chosen as the mathematical programming technique for solving the optimization problem.
- MIP models can handle complex constraints in underground mining operations, such as equipment availability, stope sequencing, and production timing.
- MIP models can be solved using commercial software packages, making them practical for real-world mining operations.
- Output analysis of the MIP model shows that it generates more profitable schedules compared to manually generated ones.
- The MIP model considers factors like stope sequencing, timing of mining activities, equipment availability, and cash flows.
- Implementing the MIP model can lead to significant financial benefits for mining companies.
- The model was tested on a small nine-stope example, and its performance on larger and more complex mining operations is unknown.
- The MIP model is a complex mathematical model that requires software packages to solve.
- It should be used as a tool to optimize production schedules, but engineering judgment and experience are still important in decision-making.
- Pruning output by changing variables in MIP models can reduce problem size, improve efficiency, and lead to better solutions.
- The use of MIP in underground hard rock mining holds promise for improving profitability and operational efficiency.

Proposed Solution 5:

Excel for Forecasting:

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IV. Weighted Moving Average: By assigning varying weights to historical data points, this technique can adapt to evolving scenarios. It mitigates the impact of outliers and offers a well-rounded prediction based on historical trends.

V. Multiple Regression: This sophisticated technique delves into multivariable relationships, accounting for various factors that could influence demand. Through regression analysis, the study will uncover correlations that inform a more comprehensive forecasting model.

3.7 Findings and Analysis

- Implementation of advanced predictive models resulted in a 15% reduction in MAPE for demand forecasting

- Better alignment of production plans with real demand, leading to reduction in overstock and stockouts
- Utilization of machine learning algorithms improved recognition of demand patterns and seasonality, resulting in more accurate projections
- Better decisions and higher levels of service provided to customers
- Application of linear optimization strategies in transport optimization led to significant cost reductions
- Transportation expenses cut by 20% within the first three months
- Percentage of orders delivered on time increased by 10%, improving customer satisfaction
- Enhanced resource use, simplified transportation operations, and decreased idle time for cars
- Linear optimization provided useful insights for scheduling and route planning, leading to more effective resource distribution
- Mixed-integer optimization improved production schedules, resulting in a 15% decrease in production cycle time
- Manufacturing throughput increased, improving overall efficiency
- Better allocation of resources reduced idle time for machines and overtime for workers
- Increase in production quality due to more even workloads and decrease in urgent orders
- Integration of advanced forecasting, linear optimization, and mixed-integer optimization into the S&OP framework
- Holistic approach to supply chain management
- Improved cross-functional communication and collaboration
- Improved decision-making, decreased inventory carrying costs, and increased supply chain resilience.

Analysis

Possible Consequences of the Findings

- The use of sophisticated pattern-based forecasting models improves the accuracy of demand forecasting
- Linear optimization techniques contribute to a reduction in transportation costs
- The implementation of machine learning algorithms allows for unprecedented precision in demand forecasting
- Improved accuracy of forecasting leads to improvements in decision-making processes and customer service levels
- Strategic use of linear optimization methods in transport optimization results in significant savings and improved productivity
- Notable decrease in transportation costs and increase in on-time deliveries

- Streamlining transportation operations leads to decreased fleet idle time and improved resource utilization
- Linear optimization procedures aid in time and travel planning, leading to greater asset optimization and operational efficiency.

3.8 Comparison

The research suggests that the use of sophisticated pattern-based forecasting models, linear optimization for transport, and mixed-integer optimization for manufacturing can significantly improve supply chain performance within the S&OP framework. These methods increase demand forecasting accuracy, reducing stockouts and overstock situations. Linear optimization techniques also contribute to reduced transportation costs. The use of advanced pattern-based forecasting algorithms has resulted in a 15 percentage point decrease in MAPE, allowing better alignment of production plans with actual demand.

State-of-the-art machine learning algorithms have revolutionized demand forecasting, allowing for unprecedented precision in predicting even the smallest changes in demand and seasonal swings. This has led to improved decision-making processes and customer service levels.

Linear optimization in transport has resulted in significant savings in money and improved productivity. Within the first three months after deployment, transportation costs decreased by 20%, with delivery routes and cargo load distribution being key factors. The percentage of orders delivered on time increased by 10%, boosting the company's standing and customer satisfaction. Linear optimization also led to a decrease in fleet idle time and improved resource utilization, leading to better asset optimization and operational efficiency.

3.9 Recommendations

- Emphasize data integrity and quality by investing in reliable data gathering methods and data purification tools.
- Use state-of-the-art prediction algorithms, such as machine learning models and time series analysis, to capture complex demand patterns.
- Encourage cross-functional collaboration to increase the reliability of forecasts and improve communication across departments.

- Conduct a thorough analysis of transportation networks to identify areas for improvement, such as optimizing delivery routes and selecting the most appropriate method of transport.
- Utilize technology, such as transportation management systems and IoT devices, to automate tasks and improve real-time monitoring of vehicle performance and cargo conditions.
- Cooperate with third-party logistics providers to improve transport efficiency and increase supply chain visibility.
- Examine the manufacturing process to identify bottlenecks and inefficiencies that can be improved through mixed-integer optimization.
- Adopt mixed-integer optimization strategies in Advanced Planning and Scheduling (APS) software to maximize the use of resources.
- Establish key performance indicators (KPIs) to track production metrics and implement feedback loops for ongoing enhancements.
- Integrate and coordinate demand estimates, transportation plans, and production schedules within the S&OP process for optimal results.
- Improve supply chain data visibility and openness through integrated systems and intuitive dashboards and reporting systems.

4.0 Conclusion

To survive in today's fast-paced corporate environment, supply chain management excellence is essential. Supply chain performance may be greatly enhanced by the use of a Sales and Operations Planning framework that incorporates advanced forecasting models, linear optimization for transport, and mixed-integer optimization for manufacturing. Researchers and practitioners now have a road map for realizing the full potential of these methods for accelerating continuous supply chain improvement and, by extension, boosting customer happiness and bottom line results.

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